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Industries:

A JOURNAL OF ENGINEERING, ELECTRICITY, & CHEMISTRY

FOR THE

Mechanical and Manufacturing Trades.

VOL. IV.—JANUARY TO JUNE, 1888.

Offices:

LONDON: 22, WELLINGTON STREET, STRAND, W.C. MANCHESTER: 70, MARKET STREET.

GLASGOW: 62, ST. VINCENT STREET.

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FRIDAY, 6TH JANUARY, 1888. VOL. IV.

Industries.

INDUSTRIES AND COMMERCE DURING 1887.

FOLLOWING out the arrangement we adopted at the beginning of last year we intend in this and following issues to place before our readers a review of the trade and industrial progress of the past year. We shall first review in a general way our industrial and commercial position as regards 1887, and afterwards consider separately the technical progress made during the past year in the three main subjects taken up by *Industries*, viz., Engineering, Electricity, and Chemistry. The circumstances of trade and commerce during 1887 have been decidedly mixed and variable. In the early part of the year hopes ran high, and there was every prospect of a substantial revival of business. Values appreciated generally, the volume of trade increased, there was a more active demand all round, and the outlook as a whole was such as to inspire confidence and buoyancy of feeling. But this condition of things did not long continue. The remarkable prosperity of the United States was not reflected to the same extent as it has been in previous years in the recuperation of British industry. The Colonial demands were not appreciably greater than usual. The new countries in Africa and our own territorial acquisitions in Burmah did not quite answer expectations, and have indeed scarcely had time as yet to develop. China, which for a time showed a strong disposition to come into the field with large demands for railway materials, has actually limited those demands to a beggarly 30,000 or 40,000 tons. The political horizon became unsettled in Europe, if, indeed, it had ever been anything else; and rumours of wars did not tend to increase the hopes that the future had really better times in store. The adoption by the Canadian Parliament of a new scale of Customs duties that were less favourable than before to certain leading descriptions of iron and steel, excited fears that our Colonial markets were by no means so secure and so capable of indefinite expansion as had been imagined. Agriculture continued depressed, and in regard to several leading products prices actually suffered a further fall. The labour market became more and more glutted, as a consequence of the migration of agricultural labourers into the cities and towns; and this fact, while it had the effect of keeping down the wages of those who were employed in industrial occupations, created a considerable amount of distress. All this tended to depress the markets, and to prevent prices from improving during the greater part of the year. But in the last quarter of 1887 there were again unmistakable signs and tokens of a revival, although the immediate occasion was far from manifest. Copper was one of the first materials to exhibit the change, and for a time prices in the copper market underwent violent fluctuations, until the price settled down at about double that of the same time in 1886. Iron and steel followed suit, but not to anything like the same extent. Textiles have been comparatively unaffected, and agricultural produce has not reflected the improvement as might have been anticipated. But in regard to a number of minor industries, there has been a real appreciation of prices and of demand. The political outlook is, however, still far from satisfactory. All the capitals of Europe are more or less in a condition of ferment, if not of panic. The rumours as to the intentions and policies of the several great Powers are as contradictory and unreliable as such rumours usually are; and all that can safely be predicted is that until political apprehensions are more or less abated, business is not likely to flow in its natural channels.

AGRICULTURE.

We must seek for a true index to the condition of agriculture in two paramount sources of information—the agricultural returns issued by the Privy Council, and the import and export returns issued by the Board of Trade. The former show that there has actually been an increase of 24,000 acres in the area of land under cultivation in Great Britain in 1887 as compared with 1886, and that there has been a decrease of 114,200 acres in the area of corn crops under cultivation. In Ireland, however, there has been a decrease of 82,000 acres in the area under cultivation. The decrease of cultivated area in the United Kingdom has not been so considerable as was generally expected. The common impression has been that in most of the purely agricultural counties many farms were unlet, and that the land had been allowed to go out of cultivation because it did not repay the cost of farming it. The official returns, happily, do not lend much countenance to this view. They show, however, an increasing tendency to substitute grass and clover for cereal crops, which means, of course, that less labour is employed upon the land, and that we must become increasingly dependent upon other countries for our breadstuffs. There has also, during 1887, been an increase in the area of land under flax, which is a hopeful sign. We are now importing more than a million and a half hundred-weights of flax from foreign countries, chiefly from Russia. During 1887 this supply was imported at a lower price than in either of the several preceding years, the average having been £1. 14s. 6d. per cwt. in 1887, and £1. 17s. 6d. in 1886. It is to be presumed, therefore, that the flax growers in Great Britain and Ireland did not obtain very satisfactory prices during 1887. But it has been proved that a large area of the land of this country is suitable for flax cultivation, and there appears to be a disposition in certain quarters to make a fuller trial in this direction.

Regarding the extent and character of foreign competition in agricultural produce during 1887, we find that the imports of the leading descriptions of agricultural produce during that year have been as follows:—

	Imports during the first eleven months of 1887.		1886.		Increase in 1887.		Decrease in 1887.
	1=1000cwt.				1=1000cwt.		
Wheat	50,775	...	44,052	.....	6723	...	—
Wheat meal and flour	16,442	...	13,465	.....	2977	...	—
Barley	11,603	...	11,869	.....	—	...	266
Oats	12,825	...	12,467	.....	358	...	—
Indian corn	29,054	...	29,364	.....	—	...	310
Fresh beef	604	...	755	.....	—	...	151
Fresh mutton	703	...	584	.....	119	...	—
Butter	1406	...	1436	.....	—	...	30
Cheese	1721	...	1630	.....	91	...	—
Potatoes	2648	...	2595	.....	53	...	—

When we take into account the fact that the population of this country is increasing at the rate of about 400,000 per annum, the above figures do not indicate an excess of imports that would seem to be out of proportion to the natural growth of the population, taking one product with another. Prices have again ruled very low. This is sufficiently evidenced by the fact that the total imports of food during the first eleven months of 1887 were officially valued at 105 millions sterling, as compared with 100½ millions in 1886, and 114 millions in 1885. The average recorded value of the imported wheat during 1887 has been rather over that of 1886, but under that of any previous year, the figures being—

	s.	
1887	7·7	per cwt.
1886	7·5	„
1885	7·8	„
1884	8·4	„
1883	9·8	„

For a part of 1887, the price of wheat was under 29s. per quarter, but towards the close of the year it slightly improved. With hardly any better prices for their own produce than in the previous year, it almost goes without saying that agriculturists have not been able to render that help to industries and to trade generally that would have come with better times.

THE COAL INDUSTRY.

There has seldom, if ever, within recent years, at all events, been a period of such entire and unmitigated depression as the coal trade has witnessed during 1887. This has more especially been the case with steam coal. The range of prices in every branch of the trade has been exceptionally low, and it appears probable that they will continue so. The redeeming feature in the trade is the increase in the quantities of coal exported and shipped for the use of steamers engaged in the foreign trade. These have compared for the first eleven months of each of the last two years as under:—

	1887. Tons.		1886. Tons.		Increase in 1887. Tons.
Exported	22,362,768	...	21,540,241	...	822,527
Foreign trade steamers	6,285,039	...	6,142,367	...	142,669
Totals	28,647,807	...	27,682,608	...	965,196
Add probable exports, &c., in December	2,446,291	...	2,300,690*	...	145,601
Totals	31,094,098	...	29,983,298	...	1,110,800

* Actual quantity.

According to this estimation, the consumption of coal from these two sources is likely to exceed by about a million tons the consumption for 1886. But this increase has been accompanied by a decrease in price, so that coal owners have not gained much advantage by the larger demand; and where pits have been working, as many of them are now doing, at an absolute loss, the improvement does not afford much cause for satisfaction. The average price of the coal shipped for export in 1887 has only been 8·3s. per ton, as compared with 8·4s. per ton in 1886, and 8·9s. per ton in 1885. The decrease of price on 1886 has certainly not been large; but the trade is now worked on such an extremely narrow margin, that even a very small difference in price has an appreciable influence on the business of many large firms.

It is too early as yet to make any estimate of a reliable character as to the total coal output of 1887. The increased activity in iron, steel, and other works in which coal is largely consumed, coupled with the increase in the quantities exported and used for shipping purposes, and the continually increasing domestic consumption, would justify the expectation that the output was greater than in 1886. The general feeling appears to be that coal has been too actively produced, and that as long as production is so far ahead of consumption as it now is, there is little likelihood of any material rise in prices. For this reason the miners of some leading districts have been taking steps to bring about a reduction of output. There has not, however, been sufficient cohesion and unanimity among themselves to carry this object generally into effect. The movement in question might create a revival in the coal trade, so long as it was general; but if it was only partially adopted, it is manifest that its only influence, so long as it lasted—which could not, in that case, be very long—would be to benefit particular districts at the cost of others. Nor should it be forgotten that, while the very low prices recently current have been extremely unsatisfactory to the coal trade, as a trade, they have been of great advantage to other industries, and to the general community. A large increase of price is certainly not desirable. The coal miners already show a disposition to "take time by the forelock," and with the first faint streaks of dawn in the commercial horizon, they have been putting forward demands and claims which would be likely to deprive the owners largely, if not wholly, of any possible improvement. In one district, indeed—that of Monmouth—the men have been agitating for "eight hours per day, five days per week, a week's holiday early in the New Year, and a 10 per cent. advance." This is a fairly "large order" for a district in which the owners have for a year or two found it most difficult to earn a 2½ per cent. dividend.

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The fact has probably not yet been sufficiently appreciated that the range of prices during 1886 was lower than it has ever been in the history of the coal trade, so far as reliable statistics are at command. The official value of the 157½ millions of tons of coal raised in that year is £38,145,000, being an average of only 4·8s. per ton, as compared with 5·1s. in 1885, and 5·4s. in 1884. There has thus been an estimated fall of ·6s., or rather over 6d. per ton, in the interval, whilst during 1887, the condition of the market has certainly not improved. It needs not much argument or evidence to show that this is an average price at which the profits must almost entirely disappear, especially as it is coincident with legislation that is calculated to increase, in however small a degree, the cost of production. The process of "natural selection" has now been going on in the coal trade for some years. During the past year some of the weaker firms and the worst collieries have gone to the wall. The number of collieries in operation has been further reduced, and the efforts of coal owners have been directed to obtaining the largest possible output against the more or less invariable standing charges. The miners have also, in general, been working very steadily, so that there has been very little interruption to work.

THE IRON AND STEEL INDUSTRIES.

The year 1887 has been a much better year for the iron trade, as a whole, than either of the two previous years. Prices have not picked up, as it was confidently expected they would do from the appearances of the early part of the year; but the volume of production has considerably exceeded that of 1886. The exports of most varieties of iron and steel show that there has been a substantial improvement in the foreign trade. This is especially noticeable in railroad iron and tin plates. Stocks have decreased appreciably in the Cleveland district and in one or two others. The range of prices remained low until the closing months of the year, when pig iron, plates and angles, and some minor descriptions improved. Scotch warrants rose during the last days of November and early in December by 2s. to 3s. per ton, and Cleveland iron followed, in sympathy with this movement. But there is a widespread impression that this is not altogether due to increased demand, since it followed upon the close of the navigation season instead of preceding that event. Whether speculative operations have really been at the bottom of the spurt time will show. The fact, however, remains that rails and plates have been in much better demand. The demand from the United States has been larger than in either of the two preceding years, and so with our Indian and Colonial requirements, one order of 40,000 tons of rails for Australia and another of 30,000 tons for South America having been placed a few weeks ago. Shipbuilding iron and steel are also much more inquired after. There is, indeed, a tolerably widespread idea that we are on the eve of a substantial revival of the shipbuilding trade, in which, of course, makers of plates and angles will at once participate. Steel is now all but universally used in shipbuilding, and hence the principal firms that formerly produced iron plates and angles have now, for the most part, laid down steel plant. There is, however, reason to believe that the steel making plant already laid down to supply shipbuilding requirements is quite equal to the productive resources formerly available in iron. The basic Bessemer process has made less progress during the past year than the basic open hearth process. There are several firms going into the latter trade, which is likely by this time next year to be of considerable extent. Finished iron, nevertheless, continues to live; the trade dies hard in Staffordshire, although it may be regarded as all but extinct in the North of England and Wales, which formerly produced well on to a million tons a year.

The increase in the value of our exports of iron and steel for the eleven months ended 30th November has been 2¾ millions sterling over the year 1886. But this increase is much more considerable than it really appears from this figure, for the downward tendency in the prices of some leading commodities has been considerable, although in other cases there has been a real improvement of prices. It may therefore be taken that there has been a much greater increase of volume than of values. This is specially noticeable in some leading articles, such, for example, as tin plates, of which the value of the 247,042 tons exported to America in 1887 is returned at £3,274,485, as compared with £3,383,200, the declared value of the 242,130 tons exported to the same country in 1886. In this case the average value in 1886 was £14 per ton, whereas in 1887 it was only £13·2 per ton. Pig iron, on the contrary, shows a slight increase of value, the figures having been for the eleven months ending 30th November:—

Year.	Quantity. Tons.	Value. £	Average per ton to nearest decimal. £
1887	1,062,637	2,528,626	2·4
1886	988,354	2,128,470	2·2
Increase in 1887	74,283	400,156	

Coming now to railroad iron of various descriptions, we find that there has been a decrease of value in 1887 as compared with 1886, the figures for the eleven months comparing as under:—

Year.	Quantity. Tons.	Value. £	Average per ton to nearest decimal. £
1887	914,840	4,161,486	4·5
1886	688,635	3,463,533	5·0
Increase in 1887	226,205	697,953	

Of other descriptions of iron and steel exported, the values, as compared with quantities, were as under, for the eleven months ended 30th November:—

Year.	Quantities. Tons.	Values. £	Average value per ton to nearest decimal. £
1887	1,819,188	16,118,679	8·8
1886	1,446,275	14,506,965	10·0
Increase in 1887	372,913	1,611,714	

The first impression likely to be conveyed by these figures is that the iron and steel works have been working for lower prices, and presumably also for lower profits, in 1887 than in 1886. This is, indeed, likely to have been the case, but it need not necessarily be so. Everything depends upon the proportions of the different descriptions of iron exported. If the exports for 1886 embraced a considerably larger proportion of iron or steel that cost a high price to produce, and if those for 1887 included a larger proportion of cheaply produced iron, the result might be a larger profit in 1887, concurrently with a lower average realised value. It is here that the Board of Trade returns are defective in the information they supply. But they do show, unmistakeably, that the money received for our iron and steel exports, relatively to quantity, fell considerably short in 1887 of what was similarly received in 1886. It is said that threatened men live long. This aphorism is peculiarly applicable to the case of the tin plate industry, for notwithstanding all the efforts of the United States and Germany to oust our tin plate makers, they have sent abroad in 1887 a larger tonnage than in any previous year, although at unprecedentedly low prices.

LEAD, TIN, COPPER, AND OTHER METALS.

The improvement which has been noted in some other branches of the mineral and metal trades, has extended in a minor degree to lead, the imports of which for the first eleven months of the current year were nearly 8000 tons in excess of those of the corresponding period of 1886. There has also been an increase of nearly 2400 tons in the exports. The output of metallic lead in the United Kingdom during 1887 is not yet ascertainable; but for the year 1886 it amounted to 39,482 tons, being an increase of nearly 2000 tons on the production of the previous year. The tendency is to become more and more dependent upon foreign sources of supply, and this tendency appears to have been quite accentuated during the past year. Prices over the year have not varied greatly from those of 1886. The average import price for 1887 was £12·5 per ton, as compared with £12·7 in 1886, and £11·2 in each of the two preceding years. The prices of 1884-85 were, however, the lowest in the history of the trade. Indeed, the average price over the seven years ending with and including 1878 was more than £20 per ton, or about double the average of recent years. This enormous difference has, of course, been chiefly due to the opening up of foreign sources of supply, which have had the effect of practically shutting up a number of English mines, and on which we must apparently more largely depend in the future.

As measured by volume, the tin trade has not been so active during 1887 as in the immediately preceding years. The imports for the first eleven months of the year amounted to 442,155cwt., as compared with 445,220cwt. in 1886, and 480,525cwt. for 1885, in the corresponding periods. Leaving the recent sudden rise of the market out of account, prices of imported tin have been higher in 1887, averaging £5·3 per cwt., as against £4·81 in 1886, and £4·28 in 1885. The tin trade, like those of lead and copper, has become mainly dependent on foreign supplies. In 1878 the production of tin in the United Kingdom amounted to 10,106 tons, and the imports were 16,644 tons. In 1886, however, the home production was only 9312 tons, while the imports were 24,026 tons. The effect of the higher price of imported tin in 1887 has, of course, been unfavourable to the tin plate industry, the more so as the prices of tin plates have been lower than in the two preceding years, when tin was cheaper. There has, however, been a larger export of unwrought tin in 1887 than in either of the two previous years. The average price of the exported tin in 1887 was £5·0 in 1886, and £4·4 in 1885. The fact that England is so largely dependent upon foreign tin supplies alters our relative position as a tin-plate producing country, and it is used by Americans as an argument for renewed efforts to establish in the United States a tin-plate industry, in order to become independent of English supplies of that material. The prices of imported tin do not, however, diminish. They are, on the contrary, considerably higher than they were a few years ago.

There has been a good deal more fluctuation in the copper trade during 1887 than in any of the other metals. The imports of copper ore have been rather larger than in 1886, but about 12,000 tons less than in 1885. Of regulus and precipitate, the same story is to be told, the imports having been 69,399 tons for the first eleven months of 1887, as against 65,166 tons in the same period of 1886, and 79,617 tons in the first eleven months of 1885. There has, however, been a remarkable decline in the imports of worked and unworked copper, which were 27,040 tons in 1887, 40,692 tons in 1886, and 39,317 tons in 1885. The average price of copper was, during the first eleven months of 1887, £42·2, as compared with £42·3 in 1886, and £46·9 in 1885. In all three years, however, prices have been, on the average, abnormally low. Up to 1883, the price of copper never fell below £60 per ton; and in 1872, it was as high as £92. It has within the last four years fallen to less than one-half its former average price. It has been the same with copper ores, the imports of which averaged £6·7 per ton in 1887, as compared with £6·85 in 1886, and £11·10 in 1884, while between 1872 and 1876 the price varied from £17·2 to £12·4 per ton. The export trade in copper has been better in 1887 than in either of the two previous years; but not so with mixed or yellow metals. India continues to be the best market for our copper products, and France has largely increased her consumption in 1887. The total value of our exports of copper in the first eleven months of 1887 was £2,404,000, as compared with £2,366,000 in 1886, and £2,815,000 in 1885. The output of fine copper from British ores is rapidly falling. It was over 5000 tons a year until 1873; but since that time it has gradually diminished, until in 1887 it was only 1471 tons, valued at £65,463. Copper is, in this respect, following the same course as lead and zinc, the production of the latter from British ores having fallen from its maximum yield of 16,130 tons in 1882, valued at over £286,000, to 8989 tons, valued at only £141,000, in 1886. The prices of zinc, have thus also suffered serious reduction. Between 1872 and 1877 crude zinc varied from £20 to £23 per ton. Over the last four years, it has fluctuated between £14 and £15. The imports of crude zinc in 1887 were larger than in any previous year except 1885, when they were over 60,000 tons.

The following is a statement of prices in December of each of the last three years:—

	1887. Per ton.	1886. Per ton.	1885. Per ton.
Copper, Chili bars	£ 80 10 to —	£ 38 to 39 0	£ 40 0 to 41 0
Tin, English ingots	153 0 „ —	155 „ —	97 0 „ —
Lead, English pig	15 0 „ 15 10	12 „ 13 0	12 10 „ 12 15
Spelter, Silesian	19 0 „ 20 0	14 „ 14 10	14 10 „ 15 0
Antimony, regulus	45 0 „ 46 0	28 „ 30 0	34 0 „ 35 0

(To be continued.)

IMPORTS INTO SICILY.

Owing to the loss of a copy of the report of the British Consul at Palermo in the post, the statistics of the trade of Sicily for last year have only just been published by the Foreign Office. The principal imports from England were coal, iron, water pipes, tin plates, leather and raw hides, carpets, chemical products, machinery, linseed oil, copper, lead, zinc, coffee, biscuits, woollen, cotton, and jute goods, colours and varnishes, earthenware, and glass goods. There was a decrease in the importation of coal during the year of 16,312 tons, representing on arrival a value of £23,208, as compared with 1885; but the imports of iron and iron goods, metals, and machinery were greater. Iron and iron goods show an increase of 41,068 tons, of a value of £28,777. The greater part of the imports of iron came from Liverpool, and of water pipes from Glasgow. The British percentage is, however, falling off, owing to Belgian competition. The imports of machinery, which largely consist of sewing machines, have slightly increased. The chemical products imported consist chiefly of sulphate of quinine from England and France; citrate of magnesia, mainly from Milan; sulphuric, nitric, citric, and other acids, chiefly from Newcastle; soda, in iron drums, potash, sal-ammoniac, sulphate of copper, and chloride of lime. Germany is a strong competitor in this branch of business. Out of chemical imports of the value of £16,868, products to the value of £6,097 were derived from England. As regards tissues of all kinds, with the exception of silk goods, there was a slight general decrease, and English manufactures specially show a falling off, though they once had a monopoly of the market. The Consul states that the competition of Italian and German goods is driving English textiles out of the market, and that the hardware trade has passed entirely into German hands.

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IRRIGATING MACHINERY ON THE PACIFIC COAST.*

In offering the present paper to the Institution of Mechanical Engineers the author does so with a tolerably complete knowledge of the very advanced practice in England in this class of machinery; and his purpose is mainly to explain the differences that have been called for by local circumstances in California.

Character of the Country.—The western or Pacific slope of the Sierra Nevada or coast range of mountains in California is very abrupt, the crests of the range being so near that the snow is visible from the coast during the whole year. Hundreds of streams cross this narrow country, falling either direct into the Pacific Ocean or into the great basin formed by the Sacramento and San Joaquin rivers. These two rivers, the largest in California, run in opposite directions, nearly parallel with the coast, and meet at the Bay of San Francisco, forming a continuous valley 400 miles long and from 50 to 100 miles wide. The small streams for the most part are fed by melting snow in the summer; and every gulch or cañon has its rivulet or brook. They increase in volume until they pass into or through the hills at the foot of the mountain range; and there, unless of considerable size, they may wholly disappear in summer by percolation through the silt or by evaporation. Streams exposed to the torrid air which in summer sweeps across the sand deserts of southern California are dried up with wonderful rapidity. The evaporation from Salt Lake, exposed to the same dry wind, is sometimes equal to half an inch per day, or 64 million tons of water. Notwithstanding this great loss by evaporation, the quantity of water falling into the ocean on the coast of California has been estimated at 100 million cubic feet or 2¾ million tons per minute, enough if distributed properly to irrigate 25,000 square miles. The Pacific coast in California may be said to consist of a mountain slope, fissured everywhere by water; and of alluvial plains formed by the sediment deposited from the water, which varies from coarse gravel and sand to fine silt, as the velocity and volume of the water courses have determined. Nearly the whole country is therefore underlaid with strata of sand and gravel, which afford water everywhere at various depths.

The need of irrigation arises from three causes: the lack of rain, which in summer ceases wholly along the coast; the want of surface water; and the free percolation into the sand beneath. The area requiring irrigation comprises most of the land in the country, except the lowlying sedimentary plains near the mouths of the rivers, and around the Bay of San Francisco, where water reaches the surface by capillary saturation.

Water Training.—In the days of placer gold mining, a large part of the running water in the mountains and foot hills was collected in extensive ditches, flumes, and iron pipes; the water was as important as the gold, which could not be washed out without it. Placer mining is gone; but the ditches remain, most of the water now being required for the more permanent business of fruit growing and other kinds of agriculture. Perhaps no part of the world equally rugged and difficult of access has been so thoroughly explored and mapped as this. From the tops of the mountain ridge to the depths of the cañons there is scarcely an acre that has escaped the search for gold and silver. The information thus acquired respecting the surface of the country was made use of as soon as agriculture began to receive attention; and the result is that nearly all land is now occupied upon which water can be led, not only by training small mountain streams, but also by leading long canals, or ditches as they are called, from the rivers; until at the present time, or when works now in hand are completed, the only remaining resource for getting water will be by lifting it from the rivers or the gravel strata by machinery.

Character of the Machinery required.—The standard methods of raising water for irrigation and drainage, commonly adopted in the Netherlands and elsewhere, would not apply on the Pacific coast. Permanent foundations are wanting; a number of small separate pumping stations, widely distributed, are required, instead of a few large establishments centrally situated; and a high efficiency is essential in the machinery employed, because of the high cost of fuel, coals of indifferent quality being worth from 30s. to 40s. a ton. For raising 420,000 gallons per hour from 6ft. to 10ft. high the cost of the machinery is from £500 to £600. For raising 1,000,000 gallons per hour from 10ft. to 14ft. high the cost is from £800 to £1,000, including engines, boilers, pipes, and framing. This must account for the light sections and other scant proportions that will be observed in the drawings; material enhanced in value 40 to 50 per cent. by tariff taxes is of course used sparingly. An efficiency of 65 to 70 per cent. is attained in most cases when the head or lift is between 8ft. and 16ft. For pumping from deeper wells the machinery is much more expensive, in proportion to the quantity of water raised, both because of the greater length of the driving connections to the pumps, which are placed in the bottom of pits in order to be within suction distance of the water, and also because of the greater strength required in all parts to stand the speed and pressure.

Fruit farms, on account of the labour and attention they require, are limited in size; and irrigating machinery must come within moderate limits of cost. Where the water is drawn from the gravel, concentration of pumping is out of the question. Percolation is not free enough to admit of large quantities being raised at one point and distributed; and even if this were possible, adjacent wells would be robbed, and litigation might ensue. In some experiments at San José, California, during the year 1885, it was found that, in drawing 15,000 gallons per hour from two artesian wells of 10in. diam. and 200ft. depth, neighbouring wells of distances of from two to six hundred yards were lowered. In this instance the water rose naturally to 2½ft. above the surface of the ground at the wells, and was lowered only 6ft. by drawing 15,000 gallons per hour. The wells here referred to, and indeed nearly all wells in irrigated districts, are tubes of sheet iron from 6in. to 14in. diam., sunk by forcing, the earth being removed through the interior of the tubes. In the broad alluvial plains along the Sacramento river, and especially in places near to its banks, percolation is so rapid that some attempt has been made at concentration of pumping plants. One well of 40ft. diam. and 16ft. depth, having an infiltrating surface of 1000 sq. ft. to 1200 sq. ft., yields 180,000 gallons per hour; and others of smaller infiltrating area yield a proportionate quantity. But these are in places where the water bearing strata are much thicker than usual, the gravel coarse, and the saturation greater than in most other parts of the country.

Early Irrigating Machinery.—One of the earliest appliances for raising water in California was the Chinese pump, illustrated in Fig. 1, which consists of an endless band travelling round pulleys at top and bottom of a moderate slope, and carrying a series of wooden floats or cross bars fixed on its outer face; the under span ascending through an open trough carries up water from a ditch or pit and delivers it into a launder or flume at top. The endless bands are sometimes made of india-rubber or cotton canvas; but more commonly consist of a pair of ropes, upon which the cross bars, having their ends split, are clamped at regular intervals by means of screws. It is a very cheap contrivance, and for low lifts is still employed to a considerable extent by the Chinese and Italians; it was doubtless introduced into California by the Chinese in imitation of similar pumps extensively used in China for raising water from the canals, where the lift is only a few feet. For slopes not steeper than 20 degrees, and lifts of only from 3ft. to 6ft., it is found to be very economical in cost of working, and is said to be capable of high duty when the wooden floats or cross bars are so arranged and proportioned as to render the rising span nearly buoyant in the water, and especially when the inside of the trough is lined with metal to diminish the friction. For irrigation these pumps are commonly driven by horses, and for other purposes are employed only temporarily; and so far as the writer knows, no experiments have been made to determine their real efficiency. For lifts exceeding 10ft. and slopes steeper than 30 degrees, the friction and leakage render them unsuitable; and their use is being abandoned as better methods are introduced.

Tube Well Pumps.—These pumps, or the method of constructing them, grew out of the oil well experience in the Atlantic States. The tubes or barrels, which constitute both well and uptake, are made of galvanised iron, from No. 18 to No. 14 B.W.G., or 0·050in. to 0·085in. thick, with the longitudinal seams riveted and soldered together throughout. They are made from 6in. to 14in. in diameter, and are sunk to depths varying from 100ft. to 200ft., sometimes more when pure water is wanted. The water rises in the wells to heights varying with different seasons, and in some cases overflows at the surface, as in the well at San José already mentioned. The pumps are placed at different depths accordingly. For irrigation the wells are generally arranged in a quadrangle. These crude looking pumps are much more effective and economical in their working than would be supposed. The pump rods are of wood, their section being equal to half the area of the working barrel; consequently in both the up and down stroke the delivery is equal to half the capacity of the barrel. In effect therefore the pumps are double acting, with only one set of valves, and the load is in a measure equalised between the up and down strokes; they correspond with the ordinary bucket and plunger arrangement common in mining districts. The working barrel is either a brass casting bored out, or made of drawn brass tube. The foot valve at bottom is inserted from the top, and can be drawn out and replaced without trouble, after the pump rod and bucket valve have been removed. The two tube wells of 10in. diam. at San José, already mentioned, were put down by contract at 5s. per foot for the first 100ft., including everything. For a second 100ft. the cost per foot would be something more, not exceeding 50 per cent. extra, and generally less, according to the nature of the ground to be sunk through. Wells from 7in. to 8in. diam., and not exceeding 150ft. deep, cost from 4s. to 6s. per foot, including galvanised tubing inserted ready for use. Much depends of course on the nature of the ground, and if boulders are met with the whole work may be lost. It is not easy to withdraw the tubes, and in case of obstruction they are generally abandoned. A serious impediment to the use of these pumps is the wear of their valves or leathers, which are soon destroyed by sand and gravel. To renew them, the pump rods of 50ft. to 100ft. length have first to be removed by drawing them up and disconnecting the sections one at a time. As the rods are long, heavy, and inconvenient to handle, half a day's time of two men may be required to replace a leather which will not last twenty-four hours after it is inserted. Accordingly for pumping from the sand and gravel strata the author is of opinion that no machinery which involves close fitting pistons or sliding joints of any kind exposed to the water can ever succeed in California.

Centrifugal Pumps.—The destruction of pistons by the sand and gravel has led to the adoption of centrifugal pumps. In these, with their constant and rapid flow, the sound of the gravel striking against the elbows and sides of the pipes can be heard distinctly. A pile of gravel and coarse sand soon accumulates wherever the speed of the discharged water is slow enough to allow of precipitation; and the wonder is what supplies the displacement thus caused at the bottom of the wells. Elsewhere it has not been common to recommend centrifugal pumps for high lifts, and they have been considered less economical than piston pumps; but the opinions hitherto entertained regarding them have been much modified by the experience of their working in California. A head of 100ft. however, for a centrifugal pump to work against, is a very different thing from a head of only 10ft. When the head exceeds 40ft., efficiency declines rapidly, but not to such an extent as to outweigh the great economic advantages of centrifugal pumps for heads up to 100ft. or even more. For lifting water from the gravel strata in California, four kinds of centrifugal pumps have been employed, viz.: firstly, the common make, with open vanes revolving in a plain volute casing; secondly, wheels with shielded or encased vanes, the water being drawn in at the centre and discharged from the circumference; thirdly, compound pumps with two or more wheels acting in succession upon the water during its passage through the pump; and fourthly, balanced pumps receiving the water at one side, whence it is deflected in an easy curve to the circumference by a conical disc on which are formed the vanes. These various forms of the centrifugal pump may be regarded as phases of development, adapted in some cases for particular objects, but generally reverting from enclosed discs, compound or double wheels, and other features, back to the original simple form of the first pumps in use prior to 1820. The wheels with encased vanes, for example, have been a feature of first practice with most prominent makers. These wheels were made in America as early as 1831, mainly with the object of partly avoiding side thrust when a single inlet was employed.

Centrifugal Pumps with Open Vanes.—These are employed for lifts up to 30ft., and are usually arranged, as shown in Fig. 2, at the bottom of rectangular pits sunk to the depth required for bringing the pumps within suction distance of the water. The pits have often to be sunk 50ft. or more below the surface, and are usually 10ft. to 12ft. long, and 4ft. to 6ft. wide. The sides are lined with planks of redwood (*sequoia*), which is very durable under exposure in such situations. Two or more tube wells T are sunk from 50ft. to 150ft. below the bottom of the pit, and in them are placed suction pipes S, connected by bends at top to the upper side of the horizontal pump casing, as shown in the illustration. This mode of connection is adopted simply for convenience in the present case, in which there is no upward thrust; but for a different and more important purpose in other cases to be described presently. The pump P is driven by a vertical shaft, which is mounted in pivoted bearings B, each having a supporting collar for carrying the weight of the shaft and pump wheel. The compression couplings C, for connecting the several lengths of which the shaft is made up, are so constructed as to be almost instantly loosened or removed. These couplings were introduced in England a short time ago by the writer, and have given evidence of superiority over the more intricate modifications that have preceded them. The uptake or rising main U from the pump is of galvanised iron, and preferably two to three times as large in area as the delivery nozzle on the pump. The pumps are charged in several ways, always from the top of the pit. In Fig. 2 is shown a steam ejector at E, with a small pipe running down to the pump. Air pumps are sometimes used. Charging with water is out of the question, because foot valves are no longer employed; it was found that the rapidly entering water, loaded with sand and gravel, cut away the valves like the sand blast process; and there is no room in the well, as there is above, for making flap valves that swing clear of the current. Single acting engines have been found most suitable for driving these pumps, and are now extensively adopted for the purpose, being connected with the top of the vertical pump shaft by a band, as shown in Fig. 2. For some of the earliest pumps horizontal driving shafts were employed, with bands extending down the pit from a shaft at the top to the pump at the bottom; but the weight of the bands, the danger to anyone descending the pit, and the delay caused by breaking, rendered the plan undesirable, and it has given way to vertical driving shafts. One of the first experiments in deep pumping with a centrifugal pump was made in a case where the water stood at 70ft. below the surface; and when it had become lowered by pumping, the lift was 74ft. The pump was a compound one, driven at 900 revolutions a minute, raising 10,000 gallons an hour. The pit was only 3½ft. square, and the pump was fixed at 60ft. below the surface. A band passing down the pit was employed for driving; but the difficulties attending its use were such as to direct attention to other and safer methods of transmitting power in deep pits.

Centrifugal Pumps with Shrouded or Enclosed Vanes.—Nearly all makers of centrifugal pumps in California and elsewhere have at first followed Sir Henry Bessemer's plan of more than thirty years ago, employing shrouded wheels, in which the sides of the vanes are attached to two enclosing discs that revolve with them. The difference is very great between a wheel or runner constructed in this manner, with closed sides, and an open wheel without enclosing discs attached to the vanes. With the shrouded wheel a water tight joint must be maintained all round the inlet orifice; otherwise the water would only circulate through the pump, passing from the circumference back to the inlet. Such leakage is increased by the pressure, which at all points on the sides of the wheels is the same as in the discharge pipe or at the discharge orifices of the wheels. The skin friction of the water seems to be less with a shrouded wheel; the water instead of being driven round in contact with the sides of the stationary casing, flows through the wheels as it does through the pipes, without any greater skin friction in passing through the wheel than for an equal distance in the pipes. On the other hand, however, there is the skin friction of the outside of the wheel itself, and this has been found to be diminished by having a considerable thickness of water intervening between the outside of the revolving wheel and the inside of the stationary casing. In the pump shown in Fig. 3, there is only a very narrow clearance space at the sides of the wheel; but here unusual care has been taken in construction, the wheel being turned and made perfectly true after being keyed on the spindle. The resistance greatly increases if the wheels are not perfectly true, but up to the present time the data respecting friction in such cases are meagre. Experiments now being made in the University of California it is hoped will before long afford useful facts respecting the friction of submerged bodies revolving at high speed. As the water enters through one side only of the wheel, it causes a thrust in that direction, which is equivalent not to the force of suction only, as is generally supposed, but to the whole duty performed, including both suction and delivery. The pump being inverted, with the suction inlet at the top, the entering water flows downwards, and the reactive force is consequently upwards. The upward thrust, which, in most cases, would be objectionable, is here turned to practical account for supporting the weight of the vertical driving shaft and the pump wheel. The plan of inverting the pump so that the suction enters at the top was introduced in California by the writer in the latter part of 1883, and he believes it will be of great importance in future, because of the difficulty of supporting the vertical driving shafts by other means in the deeper pits. In the case of one pump, completed a short time ago, the weight of the shaft and its attachments was nearly 2000lb. The shaft was of steel, 2¼in. diam., and ran at 600 revolutions a minute. The upward thrust was sufficient to carry this shaft, together with some additional weight which was found necessary. The lift was 90ft., inlet of pump 10in. diam., throat of discharge 5in. diam., uptake pipe 10in. diam. This problem of thrust upon enclosed wheels taking water at one side is an intricate one. If the rear side of the wheel is exposed, as is common, to a pressure

* A paper read before the Institution of Mechanical Engineers on the 30th September, 1887, by Mr. John Richards, of San Francisco. The discussion on the paper was held over till a subsequent meeting.

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IRRIGATING MACHINERY ON THE PACIFIC COAST.

Fig. 1.

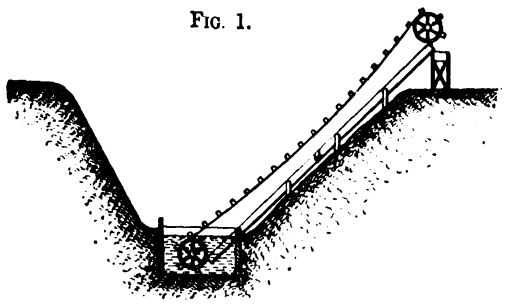


Fig. 2.

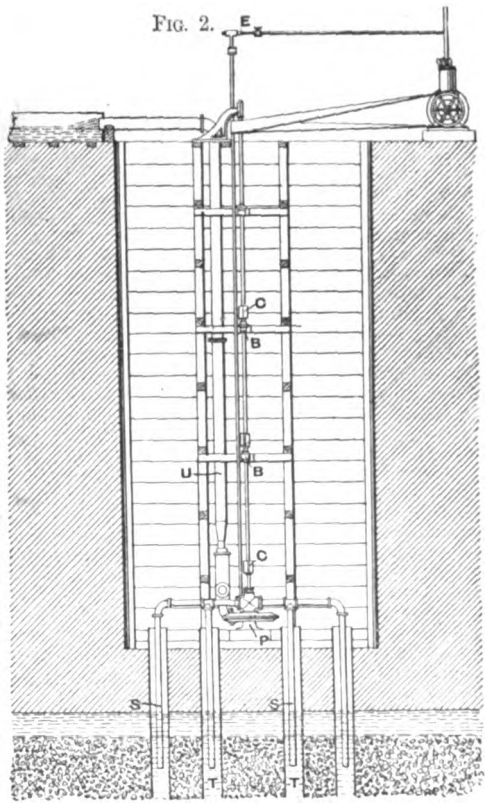


Fig. 3

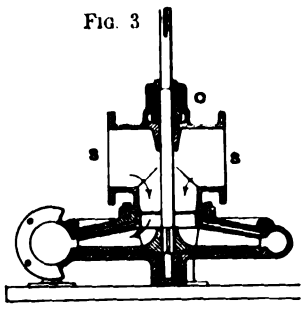


Fig. 4.

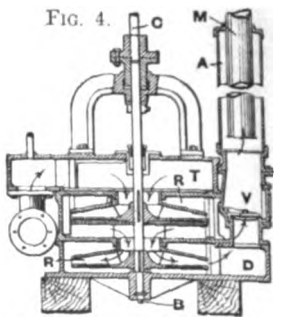


Fig 5.

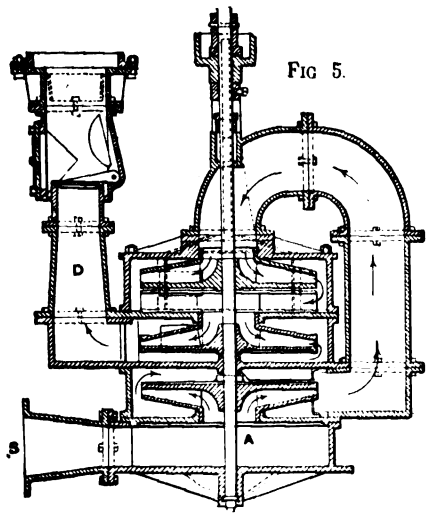


Fig 6.

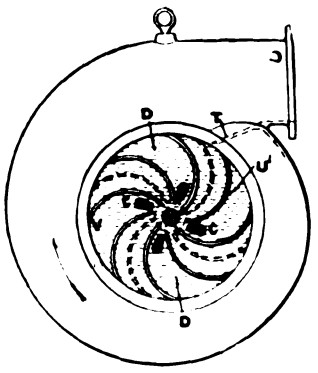
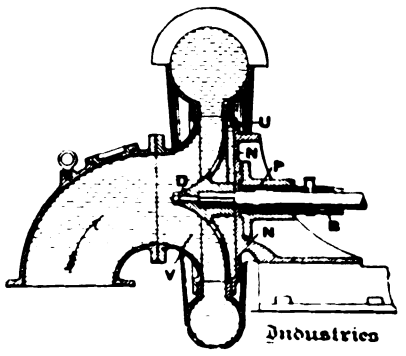


Fig. 7.



equal to the discharge, the thrust is the inlet area multiplied by the discharge pressure. If the wheel is shrouded on one side only, the thrust will be equal to the whole area of the wheel multiplied by the discharge pressure. At starting there is of course no upward thrust until the pump is charged. Provision is therefore made at C for carrying the shaft on collars, which are already required for steadying the revolving wheel laterally in the pump casing, and are so arranged as to support the shaft vertically for a short time, unassisted by the water thrust. The collars are screwed upon the shaft, and several thin washers of steel are inserted between them and the seat which carries them. They run in a pool of oil, or rather oil and water, because there is generally a small pipe leading a little water back from the discharge pipe to the thrust box C. The joint thus formed seals the pump, taking the place of a packing gland. It was with some misgivings that the writer first ventured to substitute this contrivance for a packing gland on the suction side of a pump; but thus far it seems quite as reliable, and requires no care or adjustment. The suction pipes S S are shown as commonly arranged, for branches leading in from right and left; their area is equal to that of a number of branch pipes.

Compound Centrifugal Pumps.—Two of the main problems to be dealt with in applying centrifugal pumps to high lifts are how far the impact or mechanical push of the vanes may be disregarded as a factor in the pump's duty, and how the bearings and driving gearing may be maintained in proper order at the high speed required. Practically the speed at which the pump should be driven increases as the square of the height of lift. As the pits are too narrow to admit pumps with volute casing and with a single wheel large enough to attain the required speed, the pumps have to be compounded, as shown in Fig. 4, so as to reduce the speed of rotation and diminish the size of the wheels and casing. In the compound pump here shown with two revolving wheels R, the main casing is made in five parts, consisting of three hoops or rings and two intervening diaphragm plates, all secured together by external bolts. The driving shaft from the top of the pit is coupled to the pump spindle at C. A charging pipe is carried down from the top of the pit. The foot of the delivery main M is surrounded by an annular air vessel A. The water is drawn by suction into the top chamber T, whence it passes downwards through the two wheels or runners R, and out through the discharge chamber D, the delivery valve V, and the rising main M. The two shrouded wheels have each five curved vanes. Curved throat pieces and tangential tips to the vanes are found in such cases to be of practical value so far only as they tend to obviate friction and consequent slight loss of power. The diaphragm above the upper runner is a plain flat plate; but the intermediate diaphragm between the two runners is made with fixed guide blades on its upper side, for leading the water back from the circumference of the upper wheel to the central inlet into the lower. The delivery valve V is arranged to swing clear of the ascending column of water; the area of passage is here contracted, and determines the pump's capacity. In all other parts the area of passage is made much larger. The seat of the delivery valve V is raised so as to leave an annular space all round it, for catching any gravel deposited in the valve chamber; this space is commonly made much larger than shown in the illustration. The bottom bearing of the pump spindle at B, Fig. 4, is simply a hole bored in the base plate. There is no strain upon it when the wheels are carefully balanced. It is of course exposed to sand and gravel, but these do not seem to have much effect upon bearings of steel running in cast iron; either the sand is at once pulverised and washed out, or in some other way attrition is prevented. Similarly the throats of the inlet orifices in the revolving wheels do not seem to wear after they have ground themselves out of contact.

Triple Centrifugal Pump.—In Fig. 5 is shown a vertical section of a triple pump designed for the permanent duty of raising 3,000,000 gallons of water per day through a lift of 70ft. for a town supply in California. The suction pipe S is here connected with the bottom of the pump casing, and the water entering at A ascends through an inlet orifice in the under side of the bottom runner, from which it is delivered to the top of the pump, and thence passes downwards through the two upper runners, and from the lower of them to the delivery pipe D. Two of the three wheels balance each other in vertical thrust, and the upward thrust of the third will be sufficient to support the steel driving shaft of 2½in. diam., together with all its mountings, the whole weighing 1800lb. to 2000lb. In one instance the working of a compound centrifugal pump has been interfered with by the liberation of carbonic acid gas in the suction pipe, owing to the vacuum of 6lb. or 8lb. per square inch below the atmosphere. The difficulty is easily overcome by providing vent for the gas at the highest point in the discharge chambers.

Balanced Pump with Single Lateral Inlet.—In Figs. 6 and 7 is shown the construction adopted by the author for pumps with a single inlet at one side, a form most suitable for the requirements of the Pacific coast, and essential in many cases. The drawing shows a pump of 12in. bore arranged for a head of 30ft. The wheel consists of a curved disc D, shaped so as to deflect the water gradually from the centre to the circumference. On the face of the disc are formed the vanes U and V of unequal area, On the back of the disc are also vanes N. Holes C are made through the disc, so that any water passing around the circumference may circulate in this way. An equal or nearly equal centrifugal action is thus set up on each side of the disc, and there is no axial thrust, the pump being balanced in the same way as though there were double inlets, one at each side. In this arrangement the suction pipe is easily removed, and can be hoisted vertically clear of the pump. The water passages are also more free, and of large area until the disc is reached. In order to guard the spindle bearings from sand and grit, the packing is placed at P inside the main bearings B, which act also as glands for compressing the packing. This arrangement is now employed in all the various modifications of centrifugal pumps from the author's designs, and in working permits no leak of either air or water; and the packing seldom needs renewal. The pumps are characterised by great steadiness of running, and an absence of the pulsation or jar common with free or open vanes or with enclosed discs. Such jar is often caused by an obtuse or imperfectly formed throat piece at T, especially with enclosed discs, the radial flow being interrupted at that point.

(To be continued.)

LOGGING IN CANADA.

I.

In England, where the trade in native timber is so limited as to be hardly worth consideration, it is difficult to realise the wholesale manner in which the felling of trees and subsequent handling of logs is carried on in the great continent of North America. Compared with this industry, whether in Canada or the United States, the timber business in what we are in the habit of calling "timber growing" countries in Europe is quite insignificant. The great centre of the logging industry is the country surrounding the lakes Huron and Superior, which form part of the boundary line between Canada and the United States. On the Canadian side is situated the province of Ontario, and on the opposite side is the state of Michigan. The system of "logging," being the name by which the trade is generally known, is much the same in both countries. The statistics and details, however, given in these articles will mostly relate to Canada, though in cases of special interest reference will also be made to the United States.

It is stated that the exports of timber produce from Canada alone average an annual value of £6,000,000, by far the greater proportion of which represents pine. This sum, however, only represents about three-fifths of the total output of the forests, as the remaining two-fifths are required for home use. The demand is still on the increase, especially for the latter purpose, as the population of Canada is rapidly multiplying, both from immigration and natural causes. The supply of timber is, however, equally rapidly decreasing; so much so, that it is considered by many that within a few years these pine forests, which until recently were looked upon as inexhaustible, will be entirely obliterated. Opinions differ very much as to what quantity of pine still remains, and as it is most difficult to assess standing timber correctly, this difference of opinion is easily accounted for. We give herewith the estimates of two authorities on this subject. At the Forestry Convention in Montreal, in 1882, Mr. Little stated that in the whole of Canada there remained ten thousand million feet of pine, and that felling was going on at the rate of one thousand million feet annually. From these figures it would appear that there was enough at that time to last ten years, leaving now only a five years' supply. Professor Macoum, botanist to the Canadian Government, however, looks on the matter in a very different light, giving us to understand that the supply is not so limited, and that, even if the "white" pine does fail, there are other qualities of pine sufficiently good to replace it in the European market. We extract the following from his speech at the Conference on Colonial Timber which took place in London last year: "Many of our men say that the white pine, known as the yellow pine here, is getting scarce; but we think the Douglas pine, which is not confined to British Columbia, will take its place. It is found all through the Rocky and Selkirk mountains right down to the Pacific coast, and I know that it grows five degrees to the north, as I myself found it from latitude 49 to latitude 55, so that you see the supply is not limited; and when our yellow pine gets so scarce that it becomes dear you will have to take this in its place. The trees will produce a great quantity of timber, and one tree that was cut down was 90ft. long, the large end being just 13in. across and the small 7in., so that in ninety feet the taper was precisely six inches. . . . When we Canadians talk about supplying woods, we are prepared to supply any quantity—not for a few years only, but for years and years."

One thing, however, is very certain, and that is no matter when the date may be that these forests will cease to exist, it must come sooner or later, unless prompt and

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systematic re-planting is at once undertaken; and the various governments of the provinces, urged by practical men, are now awakening to that fact, and are in many cases offering great facilities for its accomplishment. The disappearance of the forests would not only be an immense loss to the Dominion on account of the value of the timber, but also on account of the lamentable effect that such a state of things would necessarily have on the climate, and consequently on both health and agriculture. For statistics clearly show that the wholesale destruction of trees has the effect of producing both drought and floods, with their attendant evils.

Although the lumberman and the agricultural settler are responsible to a great extent for the thinning of the forests, the principal element of destruction has hitherto been fire. Terrible conflagrations have from time to time played enormous havoc with vast tracts of valuable timber, destroying everything in their path, and leaving behind them a wilderness of charred débris; so scorching up all vegetable life, and the soil itself, as to make it impossible for anything to grow there for years to come. Mr. Thistle, a lumberman and surveyor of great experience, gave it as his opinion that ten times as many trees had been destroyed by fire as by the axe; and this can be readily understood when it is pointed out that fires extending over some hundreds of square miles were at one time of no unusual occurrence. The largest fire that has ever been known in Canada, and probably in the world, took place in October, 1825, in the neighbourhood of the Miramichi River, in the province of New Brunswick, and extended over a total length of 220 to 230 miles, and a vast breadth, destroying not only the forests and many hundreds of lives, but also several towns, including Douglastown and Newcastle, and leaving 2000 people absolutely destitute. From the above it will be seen that precautions against fire are at least as important as the re-planting of trees, and it is a satisfaction to know that stringent regulations are now in force in most of the provinces, and that special watchers are appointed to see to the proper carrying out of them.

A reckless waste of wood characterised the work of the early lumberman, and it is estimated that he has been in the habit of leaving behind him as much serviceable wood as he has taken away, using only such parts of the tree as could be got at with the least work. This is not only wasteful, but also a source of danger, as the vast amount of dry chips, branches, and the rejected timber afford excellent food for the flames if a fire should break out in the locality. Another source of waste and danger, not so prevalent nowadays, was the amount of timber felled by the road makers, and left to rot.

As before stated, the province of Ontario is the principal lumber district of Canada; in fact, it is estimated that it contains more than one-third of the "white" pine in the Dominion. It covers an area of 200,000 square miles, being more than half as much again as the whole of the British Isles. Its climate is very healthy, though the thermometer varies to a great extent, viz., from many degrees below zero to upwards of 90°F. It is difficult to strike a mean temperature which will give a correct idea of the whole province, as the temperature varies greatly with locality; but the official reading for the last forty-four years is 44°18F. Within the memory of living man the whole of Ontario was one vast virgin forest; but it is doubtful whether one-third of the area is under timber at the present day. Until recently lumbering was its principal industry; but now, although this trade is increasing, agriculture has surpassed it, progressing in a greater degree owing to the continuing influx of immigrants, and the favourable properties of the land for farming. The lumber trade in this province is estimated to provide employment for a population numbering 100,000, directly and indirectly, about 20,000 of whom represent the men actually employed in the forest. The revenue from this industry amounts to an annual sum of nearly half a million dollars, and is derived in the following manner: The Government allots the forest land, sometimes by private sale, but more often by auction, and the purchaser of the tract or "limit," as it is usually called, has the right of felling the timber upon it, paying a further tax of so much per thousand feet of wood when the trees have been converted into logs, in addition to a ground rent of $2 per square mile during his occupancy, the Government retaining the ownership of the land, so that in reality the so-called "purchaser" is, more properly speaking, merely the licensee.

Logging begins when the saw mills close—that is to say, towards the end of September the various gangs find their way into the forests to the scene of their respective labours. The number of hands in a gang varies very much; but as a rule they consist of from thirty to sixty or seventy men. Having reached the "limit," the foreman selects a suitable spot for the camp, and all hands proceed to clear it and erect the necessary buildings. These shanties are seldom used for more than one season, as the gangs work further into the forest each year, and consequently the buildings, though substantial, are of the rudest construction. Each camp is

LOGGING IN CANADA.



FIG. 1.—A LOGGING SHANTY IN WINTER.

composed of four or five different buildings, viz., dwelling hut, stables, blacksmith's shop, granary, and shed for sleighs, which latter must be kept under cover as much as possible, on account of the heavy snowfall, which in this district averages as much as 70in. in the year, the snow commencing to fall early in October and not disappearing for six months. Strange as it may appear at first sight to Englishmen, who look on snow as a serious impediment to traffic and business generally, in Canada its appearance is looked forward to by all, whether by the pleasure seeker of the city, to whom it means an incessant round of gaiety, or by the lumberman, who regards it as the highway by which his supplies for the forthcoming season are to be conveyed the first step on their journey. Indeed, were it not for the smooth surface afforded by the frozen snow, often 3ft. deep, it would be well nigh impracticable to convey the rough logs to the river down which they are to be floated. Fig. 1, above, represents a logging shanty in winter. The buildings, as is natural, are constructed entirely of logs, even to the roofs. The dwelling hut is rectangular, and consists of one compartment, round which the sleeping bunks of the men are ranged, a box being placed at the foot of each, containing the effects of the occupant. A huge log fire burns day and night in the centre of the room, not only serving to heat it and cook the victuals, but also affording the only light to the interior, there being no windows whatever. The smoke escapes through a conical chimney in the roof. As will be readily understood, the supply of provisions, though plentiful, is anything but varied, consisting usually of salt pork or beef, flour, and tea, no intoxicants whatever being allowed. The supplies are brought in as often as practicable on sleighs from the nearest station. The men employed are mostly French Canadians, who, though without remarkable physique, are tough and wiry. They by no means strike the observer as possessing a vast amount of intelligence, with the exception of the leading men, who, holding a responsible position, must be capable of using their heads as well as their hands. A logging gang is generally made up somewhat on the following lines: One foreman, who has entire control of the work and camp; one "culler" appointed by the Government, whose duty it is to measure every log cut, and who is bound by oath to render a correct account of it to the authorities, for the assessment of the timber dues (it is he who inspects and passes the good timber, rejecting the unsound by marking it with a "cull," or red cross, on the butt end of the log); eight or ten log makers, who fell the trees, cross cut them to the standard lengths, and "butt" or trim the ends; half a dozen or so teamsters for conveying the logs along the side tracks in the forest to the main road leading to the river; a certain number of chainers, who, with the aid of horses and tackle, drag the logs from where they are felled to the sleighs; a corresponding number of sloop loaders; a blacksmith; and a cook, who is assisted by a "chore boy," whose duty it is also to collect fire wood and make himself generally useful about the shanty. For conveying the logs down the main road to the river (often a considerable distance) another gang of teamsters is frequently employed, working by contract, independent of the logging gang, and occupying a separate shanty.

The wages paid to the various workers in a logging gang may be rated as follows: Foreman, $1,000 per annum; log makers, from $20 to $23 per month; teamsters, from $18 to $20 per month; general workers, $16 to $22 per month; blacksmith, $26 per month; and cook, $30 to $35 per month. None of the men are paid anything until the end of the season, as, food and lodging being found for them during the time they are in the forest, they have no opportunity of spending money. It will be seen that the cook, on whom the camp depends to a great degree for creature comforts, receives a wage somewhat in excess of what might be expected; but in spite of the fact that the meals are of the simplest description, and each one is an exact repetition of the former, his position is by no means a sinecure, cooking and baking, as he does, three meals a day for two or three score hungry men. The consumption of provisions in a shanty of fifty men, exclusive of the cost of conveying, may be valued at about $1,000 per month. The life of the logger while in the forest is almost devoid of recreation, as the nature of his work renders him disinclined for anything but repose at the end of the day. Sunday is kept by him as a day of rest in the most literal sense of the word, and Saturday night is the only time when any attempt is made to depart from the regular routine of work, food, and sleep. It is then that the more energetic indulge in a few songs and "breakdowns," to the accompaniment of a more or less melodious violin, if the camp can boast such a luxury, which is usually the case. It is interesting to note that although these men live together practically shut out from the world for about half the year, there are but few serious disagreements between them, law and order prevailing in the forest to perhaps a greater extent than in any densely populated city.

(To be continued.)

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 3RD JANUARY, 1888.

THE IRON MARKET.—A feeling of relief pervades the iron market. With the last week of the old year the depressing influences under which we have so long suffered passed away, and we find ourselves at the commencement of 1888 amid circumstances favourable to a speedy return to prosperity. There is, perhaps, some exaggeration in the tone of hopefulness and confidence which now prevails; but a great improvement has certainly taken place, and there is abundant evidence of a tendency to further progress. A steady revival of business throughout the country, combined with the influence of a powerfal combination on the part of the manufacturers, has compelled the merchants of Paris to change their attitude, and there is no longer cause to complain of an undercutting trade. There is a manifest desire to acknowledge a community of interests, and manufacturers and merchants are now acting in concert. An agreement was come to a few days ago to advance prices 4s. a ton, making bars £5. 12s. and joists £5. 4s. In spite of the large business of the last three months, stocks in Paris are still heavy. The amount on hand is estimated at 70,000 tons, of which 67,000 tons are held by the merchants. Old rails sell well at 64s. The reality of the revival is shown by the activity which has for some weeks past characterised the crude iron trade of the Meurthe-et-Moselle. At this time last year there were stocks on hand amounting to 100,000 tons. Now there is not a ton remaining, and the demand exceeds the production. Prices of pig iron are consequently rising, and as coke has this week further advanced, the upward movement will be accentuated. The latest reports from the chief centres of industry are very encouraging. The present week will be a dull one on account of the New Year holidays and stocktaking, but these ended, we may hope to witness a rapid expansion of trade.

THE METAL MARKET.—Some of the parties whom I mentioned last week as members of the syndicate formed to keep up the price of copper have publicly denied their participation in that compact; but it is worthy of note that the denial was not given till a general shout of indignation was uttered by the Press, and angry demands were made for legal action against the offenders, who, it seems, are amenable to the law for "rigs" of this sort. This week the price of copper has further advanced to £85. 10s. Business in tin has been very quiet, but prices remain firm. Lead has given way slightly, the latest quotations being £16 a ton. Spelter continues to rise slowly in price, and is likely to go considerably higher, the demand for galvanising purposes being very strong and stocks low.

THE FOREIGN TRADE OF FRANCE.—The foreign trade for the later months of 1887 compares unfavourably with that of 1886. The value of the imports in November amounted to 376,423 million francs against 363,423 millions in the same month of last year, the increase being chiefly in food stuffs. The exports, which have fallen off considerably in manufactured goods, are valued at 302,253 millions against 328,002 millions in November of 1886. For the trade of the eleven months ending with November the value of the imports is 3,805,560 million francs against 3,766,392 millions in the corresponding period of 1886. The value of the exports for the same period is 2,980,096 millions against 2,934,002 millions last year.

A SCHOOL OF BREWING.—The project to establish a school of brewing at Paris is to be carried into effect. The Minister of Agriculture, by a decree dated the 24th December, has ordained the immediate creation of "Laboratory Schools of Brewing, Distilling, and Sugar Making," for which suitable buildings are to be erected on lands adjacent to the National Agronomic Institute, in the Rue Arbalès and the Rue Claude-Bernard.

THE EXHIBITION OF 1889.—Rumours are current here that notwithstanding official announcements, it is possible that the date of the opening of the International Exhibition will be postponed till 1890, in order to avoid the political complexion which it would have if it were to be held next year.

BERLIN, 2ND JANUARY, 1888.

THE IRON MARKET.—Owing to the holidays there has been some temporary dulness in most branches of the iron trade during the past week, but in fine sheets business has been fairly brisk. Heavy sheets, with the exception of boiler plates, have for some weeks been in but slight demand. Some good orders were secured for the home market before the holidays by steel makers, but there are not many orders for export on hand. The recent revival in prices is shown by the figures quoted at the end of last month for railway material required by the Magdeburg railway administration. The following were the successful contractors: Carl Delius, of Magdeburg, for 700 tons of bar iron at 140s. per ton. This corresponds to about 126s. per ton at the works in Westphalia. The ruling price at the same time last year was 91s., thus showing an enormous improvement in the market. A. Druckenmüller, of Berlin, obtained the contract for 59 tons of rivet iron at 150s. per ton, which price is low in comparison with that of bar iron. A rolling mill in Upper Silesia obtained the contract for heavy sheets at 142s., whilst the contract for fine sheets was secured by Messrs. Grillo, Funke, & Co., at 156s. per ton. The Cologne railway administration have ordered a batch of railway waggons. Amongst these are some goods waggons with Carpenter brakes, quoted at £382 each, and some smaller waggons with hand brakes, quoted at £295 each, by the Düsseldorf Railway Supply Company. Harkort, of Duisburg, has secured an order for fifty coal waggons, made entirely of iron, at £87 each. The Frankfort railway administration have ordered a parcel of steel rails from the Hörde Company at 125s., and some steel sleepers from the Aix-la-Chapelle Company at 135s. per ton.

TEXTILES.—Satisfactory reports are to hand regarding the worsted and stocking trades of Saxony, where manufacturers have sufficient orders on hand to keep their works going full time, and at fairly remunerative prices. Tricots are in strong request in the south of Germany for export to North and South America, and several works have ordered a considerable number of new looms, In gloves the trade is also reviving. Dr. Lahmann's "reform cotton goods" are beginning to be well appreciated, and a brisk trade is being done in this kind of article.

ELECTRIC LIGHTING.—The experiment recently made in Berlin of joining the underground mains of two central stations has proved completely successful. Hitherto the network belonging to each station has been kept distinct from neighbouring mains, but as such a sub-division entailed greater administrative expenses and a greater outlay for reserve machinery, the Allgemeine Elektricitats Gesellschaft resolved to join their two stations, one in the Markgrafenstrasse and the other in the Mauerstrasse, so that during the day time and late at night only one of these stations need be kept at work. I have during the holidays visited various Continental towns with the object, amongst others, of ascertaining what progress has been made in electric lighting. The following is a short account of my experience: The railway stations at Bonn and Mayence, and a portion of the goods yard in the former, are now lighted electrically, whilst the work of installation at the Frankfort-on-the-Maine central railway station is rapidly progressing. In Darmstadt the railway station buildings and the goods yard have also been electrically lighted; and a central station for the public supply of electricity in this town will be taken in hand as soon as the frost permits of building operations, whilst the installation at the Court Theatre is already finished. The railway station at Carlsruhe is lighted throughout by electricity, and glow lamps are also installed in a covered arcade in the town containing shops. The electric light installation in the Strasburg railway station, which was put up some time ago, continues to give great satisfaction. A project is on foot in Basle for utilising the water power of the new Rhine canal for lighting the town, but the concession will not be given to a private contractor, since the town authorities wish to keep the business in their own hands. In Zürich the railway station and some neighbouring restaurants are electrically lighted. The central electric light station at Lucerne is now supplying about 4000 glow lamps, but further extensions are in progress. As your readers probably know, alternating currents are used in this instance. The machines were made by Messrs. Ganz and Co., of Buda-Pesth, and are installed about four miles from the town, where water power is available. The current is conveyed to Lucerne by overhead conductors, and Zipernowsky transformers are used. A good deal of activity in electric lighting, and especially in utilising water power for this purpose, is now being developed in Switzerland.

VIENNA, 2ND JANUARY, 1888.

THE IRON MARKET.—It has now been officially announced that the syndicate of iron masters has been established up to the end of 1890. The delay to which I alluded last week arose from the difficulty of conciliating the claims of different works in the distribution of the permissible output for each. Bohemian iron works have obtained some concession in the schedule of distribution which will allow them to turn out about 5000 tons more than during the past year, and the Ternitz works are permitted to increase their output by 800 tons. On the other hand, the Witkowitz works sacrifice about 1200 tons, and the rest is divided between other Austrian and Hungarian works. Otherwise no important alterations have been made in the constitution of the previous syndicate, which was formed on the 1st May, 1886, and the main objects of the new syndicate are also identical, viz., to do away with over production, to obtain a uniform classification of the products, and to regulate prices and customs in the trade. The announcement that the syndicate has been definitely established has not had any influence on the condition of the iron market, as at no time was the success of the movement seriously doubted. The market remains exceedingly dull, which is partly due to the holiday season, but mainly to rumours of war. Bohemian engineering shops are an exception to the general depressed condition of the market, and are fairly busy with agricultural machinery, boilers, and apparatus for sugar works. On the whole, the position of the iron and steel trades during the year which has just passed has been better than in the two or three previous years. The demand for rails during 1887 was by 20,000 tons greater than in 1886, and the quantities sold of building iron castings and other finished goods were greater than in the previous year. The same was the case with machinery, boilers, and railway material. There was also, on the whole, a slight improvement in the prices of crude and finished iron, and this was especially noticeable as regards sheets, nails, and wire. The Hungarian Government have definitely decided to discontinue the management of the State iron works from the 1st instant, and these works will therefore be offered for private management. The more important of these works are the following: In Transylvania, Vajda Hunyad, and Gyalar; in Hungary, Gömor, Sohl, Marmaros, and Szolnok-Doboka.

MINING.—In estimating the possible prosperity of the above works when under an energetic and intelligent management, some account should be taken of the mineral resources of the district, and in this connection the following details may perhaps be of interest to your readers. Transylvania and Hungary are exceedingly rich in iron ores. In the former district the largest deposit is that of Gyalar, where the ironstone contains 40 per cent. of iron, and under the present Government administration the cost of mining it amounts to about 2s. 6d. per ton at the mine, and including freight and other charges 3s. 2d. delivered at the furnace of the nearest iron works. The deposit extends over an area of 7 miles by 3 miles, and is of considerable depth, and rough estimates put the quantity which can be extracted by open work at 32 million tons. In Hungary proper there are three principal deposits of ironstone now worked under State management. The ore also contains about 40 per cent. of iron, and in some places considerable quantities of manganese. These deposits are not continuous, but are separated by private mines, the right of way, however, being secured by Government. The ores are magnetite, limonite containing oxides of manganese, and oligonite, and they are specially suited for the production of ferro-manganese. There are other smaller mines also offered for private exploitation, and the total quantity of ores which might be extracted is estimated at 40 million tons. The total value of the mines and iron works which have hitherto been under the management of the Hungarian Government is estimated at about £7,000,000. The Government has stipulated that whatever party may take over these works must agree to develop the industries which were begun under Government administration, amongst which are those of the manufacture of steel in various forms, enamelled iron ware, and cast iron pipes.

THE PETROLEUM INDUSTRY IN GALICIA.—The owners of petroleum wells in Galicia have during the year which has just passed not found this industry a very profitable one. Although the area over which petroleum occurs is very considerable, amounting to about 1500 English square miles, the local yield is small, in many cases not exceeding 1½ barrels per day per bore hole, whilst the price of Galician petroleum has ruled very low, varying from 4s. to 5s. 6d. per ton. Russian oils can be delivered here for 7s. per ton. The cost of sinking bore holes in the eastern portion of Galicia amounts to about 75s. per yard, whilst in the western portion the cost is only 20s. per yard. During the last six years there were sunk 280 bore holes averaging in depth from 200 to 400 yards. There are about 50 boring engines at work, besides a considerable number of hand drills, and quite recently diamond drills have been introduced so as to accelerate the work.

BRUSSELS, 3RD JANUARY, 1888.

THE COAL MARKET.—The situation in the iron trade is affecting the other markets, and coke is very scarce, as well as small coking coal. Some makers propose to charge 12s. per ton for coke, and speak of still higher rates for future delivery. This rise will harm a number of furnaces which have sold their production at low rates. It is evident that under the circumstances blast furnace owners will have to raise the price for pig. The rates for other kinds of coal continue the same as reported in my last letter. Owing to cold weather having set in, there is a better demand for household coal.

THE METAL MARKET.—Although at this time of the year the demand is usually small, rolling mills have difficulty in fulfilling the orders which flow in. Prices of finished iron have risen 4s. per ton, and if this condition of affairs is maintained until spring, a good business year will follow. Engineering works have difficulty in obtaining prices corresponding to the rise in raw materials, the rate for ingot copper being £82 per ton, for tin £164, for zinc £20. 16s. to £20. 12s., and regulus of antimony £50 to £52. There is plenty of work in girders, special sections, and sheets. Pig iron is scarce. The management of the economic railways are going to order a hundred carriages. For the State railways a number of luxurious international cars will be required. There will also be ordered from home makers three hundred trucks and one hundred locomotives. The outlook is therefore very good in this branch of business. Steel works have not much in the way of rails in hand, but further work is in course of negotiation, and orders have been received for metal sleepers, axle boxes, and other railway material. Makers of springs and buffers are busy.

FLAX AND YARN MARKETS.—The Belgian market for home-grown flax exhibits no new features. Generally the amount of business transacted is less than it was a few weeks ago, and prices show a weakening tendency. Probably this state of things is in part attributable to the season. A commonly held opinion is that the demand will strengthen after the middle of this month. At Bruges the market is dull, but flax of good quality finds a ready sale at firm prices. At Courtrai business has shrunk within narrow limits, but there, too, a good demand is reported for the higher qualities. At Ghent there has been more flax on offer this week, and prices are weaker. A considerable amount of buying has taken place in Russian.

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Linen yarns move heavily in the market, and what little demand there is, is for tow yarns. Cotton yarns are not much sought after, business being delayed on the part of consumers in the hope of easier prices.

Railways, Posts, and Telegraphs.—A report has been issued on the operations of the State railways, posts, and telegraphs during the last official year, from which it appears that three new types of locomotives have been adopted for light traffic, fourteen new carriages have been ordered, and 150 carriages have been altered so as to have a central gangway. At present one hundred carriages for train-tramways are being built. Oil, gas, and electric lighting have been extended. The receipts show a diminution compared with the previous year. The number of accidents has been steadily decreasing since 1880, and only 113 cases of collision or derailment are cited in the present report. There were 3 railway passengers killed, 27 wounded, and 13 received contusions. Among railway servants 56 were killed, 241 wounded, and 56 received contusions.—In the posts and telegraphs section, there has been a falling off in the letter traffic, but the number of telegrams has slightly increased. Three new telephone systems have been established, having as their centres Ostend, La Louvière, and Ieseghem. An increase has taken place in the receipts of the mail steamers between Ostend and Dover.

DÜSSELDORF, 2nd January, 1888.

State and Prospects of the Iron Market.—As there is nothing to record of the iron markets this week but the fact that business has, as usual, been brought practically to a standstill by the Christmas and New Year holidays, I will set out for review the salient features of the situation, and try to forecast the near future of the trade. Not the least suggestive, perhaps, of the events which have marked the course of the year now ended is the unusual heartiness with which the Christmas festivities have been indulged in. Clearly the pinch of adversity is no longer felt. The contrast between 1887 and 1886 in this respect is very striking, The revival dates back to the beginning of last year. Consumption of iron has steadily grown down to the present time, bringing a constantly increasing demand. The improvement was not confined to the home markets. The foreign demand kept pace with the home requirements, and helped materially to swell the total volume of trade. A remarkable feature of the revival has been its persistence. There has been no interruption of its progress. At first, competition being exceedingly keen, prices showed but little tendency to follow the movement in volume. To remedy this, the syndicate system was adopted, and the results arrived at have far exceeded the hopes of the most sanguine. Under this system, a rapid and great advance in prices has taken place, changing the situation for the manufacturers from one of profitless production to one of very remunerative work. The demand has continued unchecked by these enhanced prices, and is now, with a much larger make of pig iron and increased imports of foreign pig, well ahead of production. What the course of the trade will be in the first half of the year on which we have entered it is not hard to predict, for it is already marked out. Blast furnace owners have sold the whole of their make of iron in the first three months, and orders are being rapidly booked for delivery in the second quarter. Makers of finished iron and steel are not dealing speculatively in thus buying far forward, for they, too, have their order books filled for four, five, and, in some instances, six months to come, and business continues to flow in. In these circumstances, with the whole trade controlled by syndicates, it is certain, leaving war only out of account, that the present situation is assured for at least six months to come, and that the second half of the year is likely to show the same features which will distinguish the first. Thus we enter upon 1888 with prospects that justify the tone of confidence now prevailing, and strengthen the hope of a long-to-be-continued prosperity.

The Wages of Iron Workers.—The annual balance sheets of the great iron works' companies, recently issued, show an improvement in the rate of wages paid in the business year 1886-87 relatively to 1885-86. Thus the accounts of the Dortmund "Union" gave an average annual rate of £47. 2s. 3d. per head against £46. 19s. 2d. Again, those of the Bochum "Verein" gave an average of £48. 19s, 10d., against £47. 3s., or leaving out all hands under twenty years of age, £51. 18s. 5d., against £49. 13s. 2d. Those of the Wesphalian "Union" at Hamm give a general average of £41. 8s. 3d., against £39. 14s. 5d.

The Zinc Market.—The demand for zinc steadily increases and prices as steadily tend upward. This market contrasts favourably with that of copper, which is entirely in the hands of speculators. The prevailing activity is due to a larger consumption of the metal, and the advancing rates are fully justified by the state of trade. Prices had reached a very low level, stocks are practically exhausted, and the requirements of consumption are in excess of production. The average price of Silesian spelter fell from £16. 6s. a ton in 1882 to £14. 10s. in 1883, to £14. 0s. 10d. in 1884, and to £13. 10s. in 1885, at which price it remained stationary throughout 1886. From the middle of June to the beginning of December, 1887, the prices increased £3 a ton, and between that date and the end of the month it rose to £18. 6s. The production of Silesian spelter in the above mentioned years amounted to 69,846 tons, 71,466 tons, 77,278 tons, 80,838 tons, and 82,730 tons, respectively.

LILLE, 3rd January, 1888.

Textile Manufactures.—The trade in textile goods continues to make steady progress towards recovery, and the markets are evidently tending towards greater activity. The linen goods trade has become fairly animated. Buyers from the wholesale houses of the Eastern districts have operated largely within the last few days, but manufacturers complain of low prices. At Rouen business in cotton goods increases, but is not yet sufficient to impart a cheerful tone to the markets. At Roubaix the recent advance in combed wool has been partly lost. There is, however, buoyancy in the markets, which will doubtless make itself felt after the holidays. Spinners are asking higher prices for yarns, a good indication of the tendency of business. There is some animation in the business in woollen stuff goods, but the demand is for the moment confined chiefly to novelties. The export trade is wanting in animation. The values of the woven goods exported in the first eleven months of 1887 are as follows, the figures within brackets representing the values for the corresponding period of 1886: Woollen goods, £12,714,480 (£13,726,000); cotton goods, £4,162,600 (£3,952,000); linen and hempen goods, £282,240 (£509,240); jute goods, £115,920 (£73,600); and silk goods, £7,977,960 (£9,514,240).

Flax and Yarn Markets.—The demand for home grown flax is strong, and prices move in favour of sellers. Walloons from Douai and Bergues are much sought after. The activity which I reported last week in Russian "futures" continues unabated. As a consequence prices are hardening. There is a strong current of business in yarns of all classes. For the fine and medium numbers spinners are asking higher prices. Some important sales of Riga tows have been effected this week on foreign account. Jute yarns are still in strong demand at steadily rising prices.

The Iron Market.—The higher rates for iron are now readily paid, and the only matter about which there is dispute is the time of delivery. The merchants, in anticipation of further advances, seek to contract at present rates for delivery in the second quarter of the year, but manufacturers generally refuse to bind themselves beyond the end of March. The market is animated, the demand being brisk for nearly all classes of iron. The Algerian syndicate is now complete, and came into force on the 1st instant.

The Sugar Crop.—The latest estimates of the sugar production of Europe, founded upon the results already arrived at, are as follow: Germany 900,000 tons, France 425,000 tons, Austria-Hungary 420,000 tons, Russia 400,000 tons, Belgium 95,000 tons, and Holland 50,000 tons; total 2,200,000 tons against 2,630,000 tons last year.

WINTERTHUR, 2nd January, 1888.

Railways.—The management of the St. Gothard railway have decided to commence doubling the track shortly. The second track on the section Faido-Airolo is to be in working order by 1890, that on the section Faido-Biasca by 1892, and that on the section Göschenen-Erstfeld by 1896. The estimated cost of doubling the line is £520,000. A one-metre gauge line is projected in the Engelbergerthal to feed the Brünig railway; it will run from Hergiswyl through Stans, Büren, Wolfenschiessen, and Grafenort. The estimated cost of construction is £3,600 per mile.

Arms.—There will be plenty of work for our arms factories this year, as the Landwehr artillery is to be equipped with fifty-six new cannon, at a cost of £14,400. The Vetterli repeating rifle, which up to the present has given excellent results, will also soon have to be changed for a type with a smaller bore, preliminary trials with which have already proved eminently satisfactory. The Budget for this year contains an item of £20,000 for the Gothard fortifications.

The Paris Exhibition.—On the whole there is not much anxiety shown in Switzerland to take part in this Exhibition, and machinery makers and others, who would be put to great expense in being represented, are holding back. Watch makers, on the contrary, who can make a valuable display in a small space, are more disposed to patronise the Exhibition. Lace makers also feel it necessary not to let Saxony have the field to herself. In order to reduce expenses, an effort is being made to get intending exhibitors to act in concert, instead of independently. Switzerland has now decided to take part in the Exhibition officially, and the Commercial Department has appointed Colonel Vögeli-Bodmer as a commissioner.

MADRID, 2nd January, 1888.

Telephony.—The contract to establish a telephone station at Cadiz is offered for public tender under payment to the Government of 10 per cent. of the gross receipts. The system, if limited to the town itself, would be of but little importance; but if Jerez, Port St. Mary, and other small places surrounding Cadiz were included, the business would pay. The Madrid Telephone Company is doing very well; their charge is £12 a year, but a reduction would greatly increase the number of subscribers.

Railways.—A line of railway, owned by a number of Oporto capitalists, has been opened for traffic from Salamanca to the Portuguese frontier. There have been some engineering difficulties to overcome, and though the length of the line is only about fifty miles, twenty tunnels had to be bored. A Bill is being prepared which will give an impulse to the construction of economic railways, a large number of concessions will be made, and probably the line from Calatayud to Teruel, which has been repeatedly offered as a broad gauge line, will now be submitted as a narrow gauge line. It is reported that a syndicate is being formed by M. Anspach, the Belgian financier, to take over all the central lines. English capitalists might do well to turn their attention to railways here, which, if the cost of construction be kept within reasonable limits, should pay from 7 to 9 per cent.

ST. PETERSBURG, 31st December, 1887.

Railways.—A new route has been projected by Mr. Protzenko for the Siberian railway, which differs considerably from other schemes. He proposes to commence the line at Zlataousk, and to pass through the thickly populated districts of Tchelahou and Kourghan, along the southern confines of the Ishimsky district to Omsk. The road next proceeds in a straight line to Tomsk and Krasnoyarsk, crossing the rivers Irtish, Ohi, and Yenisei to Irkutsk, and then to the northern end of Lake Baika, where there are several large iron works. It then turns north-east, crossing the rivers Vitim and East Olekmon, by which it is connected with the Yakutsk gold fields. It would next cross either the Stanovoi or Jablonoi mountains, and run along the river Oura to the Amoor, and past Khabarodka to Vladivostock. As this port is closed for two months each winter, an alternative route, provided the consent of Corea were obtained, would be along the coast of the sea of Japan to port Lazaret, which is open all the year round. The total length of the line would be 3978 miles, the estimated cost being about £40,000,000. Surveys have already been begun for a line between Tomsk and Irkutsk, and the municipality of the former town have granted 270 acres of townland for railway works and stations. Traffic has now been opened on a new line of railway between Valka and Dorpat, in the government of Livonia.

Harbour Works.—The port of Mariopot, on the Sea of Azov, will, when finished, be one of the finest in Russia. The new works were commenced last year, and are to be completed in 1893, the estimated cost being four and a half million roubles. The contract is in the hands of the firm which constructed the St. Petersburg Canal.

NEW YORK, 24th December, 1887.

Cotton.—Statistics have been published in reference to the statement that the yield of cotton per acre tends to decrease with the extension of the area under cotton in the United States. The figures, which deal with the period between 1879 and 1887, show that though there has been some recovery in the last two years, the general tendency has been downwards, and this is attributed partly to the exhaustion of old lands, to the increase in acreage being mainly in poorer tracts, to the tendency to sell the seed for manufacturing purposes instead of using it on the land as formerly, and to the indiscriminate use of artificial fertilisers.

Iron Production.—Estimates of the production of iron during the present year place the quantity at about 6,300,000 tons, an increase of over 10 per cent. as compared with last year, and over 50 per cent. as compared with 1885. It is calculated that about 13,000,000 tons of iron ore have been consumed during the year.

Oil Works.—The Standard Oil Company has bought up the Toledo Oil Company of Ohio, which refines coal oil, for £20,000.

Cable Traction.—The Rapid Transit Cable Company has been incorporated, with a capital of £20,000. Its object is to introduce an improved cable motor gripper and curve devices for drawing heavy rolling stock on elevated and other railways. The new system bears a similarity to that employed on the Brooklyn Bridge.

Automatic Coupler Tests.—A committee was instituted some time ago with a view to bring about the adoption of a uniform draw bar and coupler for freight trains. Tests were made under the superintendence of the committee with four link and pin and seven vertical couplers, but it was decided that further trials should be made. According to the report of the committee, which has just been issued, these trials took place in the yard of the West Shore Railroad at Weehawken. The first service test was made, on October 14th, with five cars equipped with the Janney freight coupler, and five cars equipped with the Dowling automatic coupler. It was found that cars having each type of coupler could readily be coupled together, and that the Dowling and Janney coupled with each other and uncoupled without difficulty on straight and curved tracks. The hook of one coupler, which was coupled to an ordinary draw bar with a link, broke, the fracture showing that the material was not properly applicable to that purpose. The trial of coupling the Dowling and Janney couplers on a curve of 31½° proved that while each coupler would couple with that of its own class, it would not couple readily with the other on the curve. Physical tests were made with four couplers during the second week in October by Captain Michaelis at the Troy Iron and Steel Company's works, and according to the report presented by him to the committee, the results obtained were not satisfactory, since the couplers broke under the tests. The conclusion arrived at by the committee is that none of the couplers presented fulfil the conditions requisite in a coupler before it can be generally adopted, and they recommend that competitors should not prepare for further tests until they have made such modifications as are necessary to fully meet the requirements of the committee.

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HARGREAVES' THERMO-MOTOR.

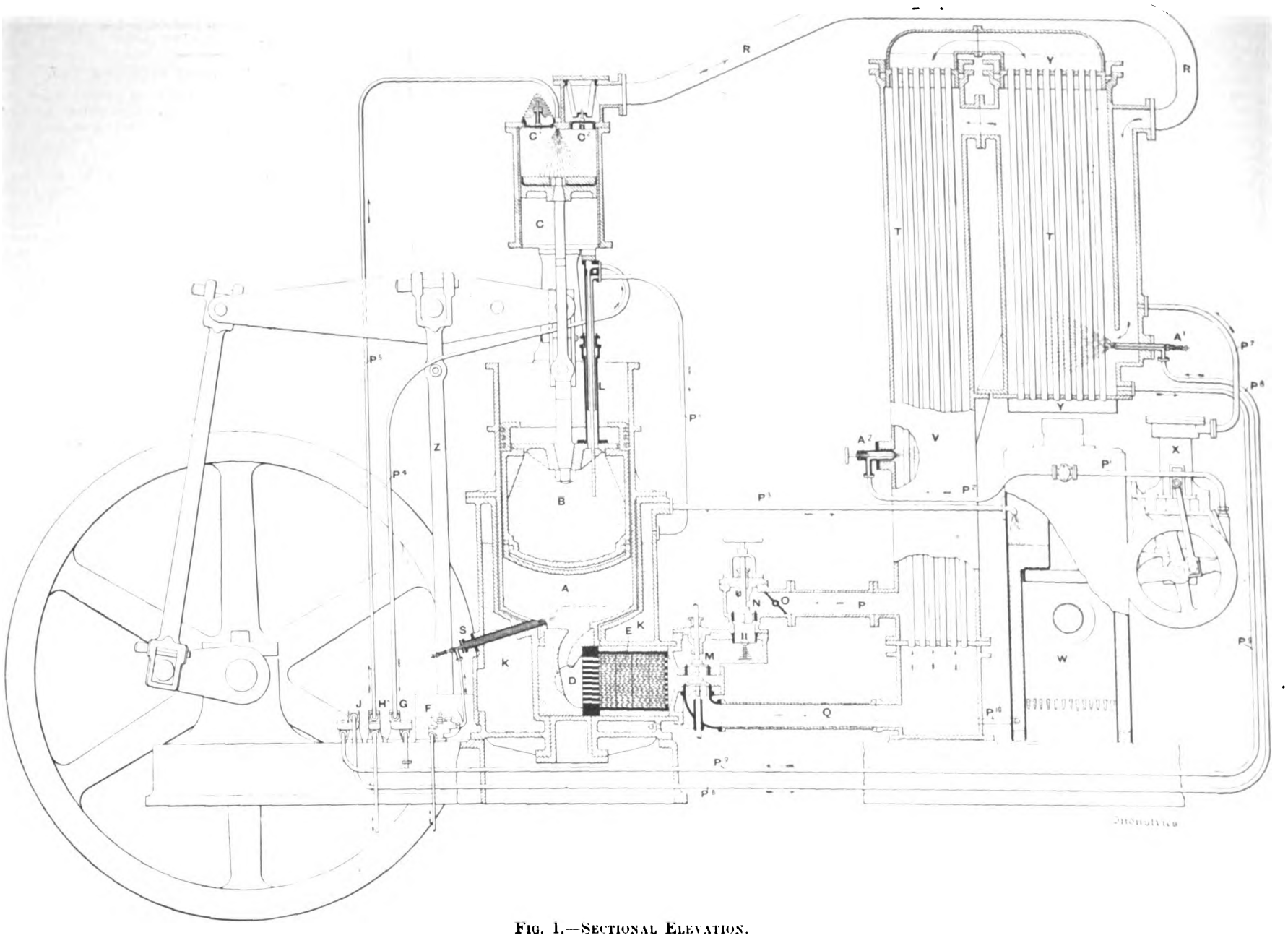


FIG. 1.—SECTIONAL ELEVATION.

HARGREAVES' THERMO-MOTOR.

FROM the researches and investigations of Carnot, Joule, Rankine, Clausius, and Sir William Thompson, the science of thermo-dynamics has not only been brought into existence, but fully matured. We learn from it, that whereas, in the steam engine, on account of the limited range of temperature in the working cylinder, and the rapid conduction of steam during condensation, no combination of cylinders can materially affect its present efficiency; internally fired engines, such as gas and caloric engines—being, as it were, less fettered—can have their already high efficiency increased by simply overcoming mechanical difficulties. To this fact is no doubt due the recent remarkable development of gas and caloric engines. The first caloric, or hot air engine, was invented by Sir George Cayley in 1807, and in 1827 Dr. Robert Stirling, a Scotch minister, took out his first patent for a hot air engine, which was the foundation of many subsequent machines, and by the invention of the regenerator he converted what was practically a scientific toy into an efficient machine.

One of the most ardent workers in this field at the present time is Mr. James Hargreaves, of Widnes, who, with a thorough theoretical knowledge of the subject, has, after many years of patient perseverance, overcome many of the mechanical difficulties, and designed the engine of which the above is an illustration.

The sectional elevation, shown in Fig. 1, is an expanded view of the machine, shown thus to enable the action of the machine to be more clearly understood; the relative position of the different parts, as actually made, is shown in the side elevation (Fig. 4). The principal working parts of the machine are the combustion chamber D, which is of the form shown, lined with fire brick, and having an entrance, with the door screwed down like a manhole lid; the working cylinder A, surrounded by the water casing K; the piston B, with a water lining, and coupled to the end of the working beam by a parallel motion, the beam being supported by two rocking columns Z, as in engines of the "grasshopper" type; the air compressor C, coupled directly to the piston of the working cylinder; the injection pump F, for supplying the fuel—creosote or coal tar—to the combustion chamber; the regenerator E; the receiver and separator V Y; the feed and exhaust valves M.

The action of the machine is as follows: Assuming the engine to be in condition for starting, the sides of the combustion chamber D are red hot, the chamber charged



FIG. 2.

with air, and the spray of creosote, injected by the pump F, is ignited; the expansion of the gases produced by the combustion acts upon the bottom of the piston B, forcing it to the top of the cylinder, and thus, by intermediate mechanism, causing the crank shaft to revolve. By the same stroke a charge of air is forced by the compressor C into the receiver through the pipe R. The cylinder is, of course, single acting, and on the down stroke of the piston B—which falls by its own weight and the momentum of the fly wheel—the exhaust gases are forced through the regenerator E, which absorbs most of their heat; they then pass through the exhaust valve, placed immediately under the feed valve M, along the pipe Q, up through the pipes T fitted into the receiver V, down the pipes T fitted into the saturator Y, and out of the funnel fixed to the bottom of Y.

The charge of air for supplying the combustion chamber is forced by the compressor C through the pipe R, *outside* the tubes T in the chambers V and Y, along the pipe P, through the feed valve M and the regenerator E into the combustion chamber. In its passage from the compressor, it first picks up the residual heat of the exhaust gases in the tubes T, and finally the heat absorbed by the regenerator E, thus entering the combustion chamber in a highly heated state. Having described generally the passage of the air from the compressor to the working cylinder, and back again to the funnel, we will now describe the details. The working cylinder A is fitted into the casting which forms the water casing K, a space being left between the bottom of the cylinder and the casing, which is filled with a non-conducting mixture of asbestos to protect it from the heat of combustion; the bottom of the piston B has a similar protection, and the regenerator has a lining of the same mixture, to prevent any heat from escaping through the casting which holds it. The water in the casing K and in the piston B is supplied by a small pump G, which forces the water through the pipe P_4 into the telescopic pipe L, either into the piston B or through the pipe P_6 into the casing K—the bottom of the casing being connected by the pipe P_{10} with the auxiliary boiler W. The steam generated in the casing K is carried to the boiler W by the pipe P_3, and from the boiler it passes along the pipe P_2, through the valve A_2, into the chamber V, thus giving up its heat to the incoming air, with which it mixes. The vapour gradually condenses at the bottom of the vessel Y, and the water so formed is drawn by the pump J along the suction pipe P_9, and forced through the pipe P_5, back to the chamber Y through the valve A_1, and in the form of spray plays on the tubes T, and absorbing any residual heat. The heat generated by compression in the cylinder C is absorbed

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by a spray of water from the pump H, the vapour being carried along with the air through the pipe R to the chamber Y, where it is separated, and falling to the bottom is circulated, as just described, by the pump J.

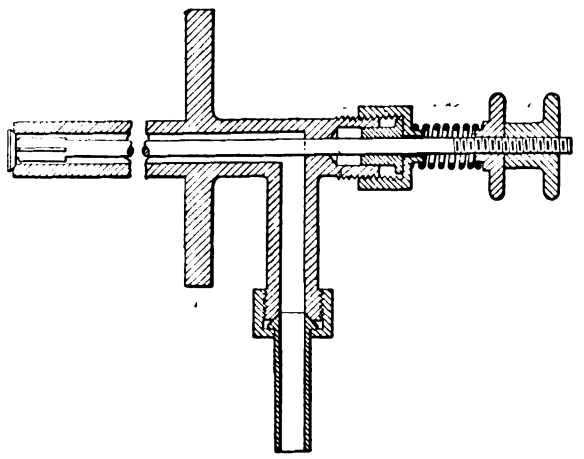


FIG. 3.

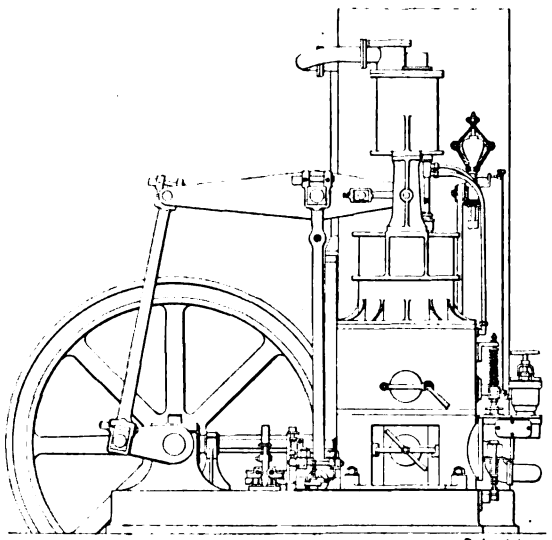


FIG. 4.

X is a small auxiliary air compressor, to obtain the necessary compression to start the engine, and is worked from the boiler W. In future engines this compressor will be superseded by a specially designed injector, which will produce the necessary pressure at a considerable reduction in cost. When once the engine is started, the fire of the auxiliary boiler can, of course, be drawn, as the main engine afterwards makes its own steam. The regenerator E has circular ends of fire clay perforated, the body being filled with fire clay spirals of the shape clearly shown in elevation in Fig. 2. The injector valve for the creosote is shown to a larger scale in Fig. 3; this valve has, however, been since considerably modified and improved. The feed and exhaust valves M are actuated by cams keyed to a counter shaft driven by bevel wheels from the main shaft. The creosote pump F is also worked by a cam on the same shaft, but the pumps G H J are worked by eccentrics. A stop valve N is fixed to the supply pipe P, under which is placed a back pressure valve to retain the pressure in the combustion chamber. The engine is regulated by an ordinary Porter governor actuating the throttle valve O. An engine, as described, has been constructed by Messrs. Adair & Co., engineers, Waterloo Road, Liverpool, and has been running most satisfactorily for several weeks, the results being clearly shown by the indicator diagrams (Figs. 5 and 6). The results obtained by this motor are very remarkable, and are a long way in advance of any previous performance, as only a little over ½lb. of fuel is used per i.h.p. per hour. It may be mentioned that the temperature of the combustion chamber is calculated to be about 2500°F., and that of the exhaust gases does not exceed 180°F.

DIAGRAMS FROM CYLINDER AND AIR PUMP.

NET INDICATED HORSE POWER, 40.
REVOLUTIONS PER MINUTE, 100.
COAL TAR CONSUMED PER HOUR, 20·5 LB.
COAL TAR PER I.H.P. PER HOUR, ·512 LB.

Diagram from cylinder—25in. diam., 18in. stroke. i.h.p., 63.
Scale, 1/10in. Mean pressure, 28·21b.

FIG. 5.

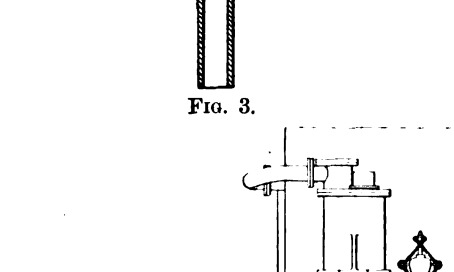


Diagram from Air Pump—15in. diam., 18in. stroke. i.h.p., 23.
Scale, 1/10in. Mean pressure, 28·5lb.

FIG. 6.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Saturday, 7th January, 3 p.m. Lecture on "Astronomy," by Sir Robert S. Ball LL.D., F.R.S.

NEXT WEEK.

SOCIETY OF ARCHITECTS.—Tuesday, 10th January, 7 p.m. Ordinary meeting.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 10th January, 8 p.m. Ordinary meeting. Paper to be read on "The Use and Testing of Open Hearth Steel for Boiler Making." By the late Hamilton Goodall, Assoc.M.Inst.C.E.—Friday, 13th January, 7-30 p.m. Students' meeting. Paper to be read on "Railway Engineering in British North America," by Robert J. Money, Stud.Inst.C.E.

SOCIETY OF ARTS.—Wednesday, 11th January, 7 p.m. Juvenile lecture on "The Application of Electricity to Lighting and Working," by Mr. W. H. Preece, F.R.S.

PRICES CURRENT, 5TH JANUARY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		33/6	Cash
Scotch Warrants, m/n		43/1	"
Hematite Warrants, m/n		45/7	"
Stocks in Stores. Scotch	942,840—Inc. for week,	—	Tons
Middlesbro'	341,013—Inc. "	3796	"
Hematite	211,005—Inc. "	1341	"

Exclusive of stocks in makers' yards.
Market quiet, but steady.
Scotch shipments 6714 tons, against 6332 tons for same week last year.

	No. 1.	No. 3.	
Coltness	52/9	44/9	f.o.b. Glasgow.
Gartsherrie	48/–	44/9	" "
Dalmellington	44/6	42/6	" Ardrossan
Eglinton	44/–	41/9	" "
Glengarnock	48/–	43/–	" "
*Derbyshire	—	38/–	f.o.t. Works.
*Lincolnshire	—	35/–	" "
*Lancashire	—	38/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 15 0	5 5 0	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 2 6	5 12 6	Manc'hr.
" Angles	5 12 6	6 2 6	"
Crown Sheets	6 12 6	7 2 6	"
" Hoops	5 17 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		8 5 0	"
" Ship and Girder		8 0 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/–
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/–
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/–

METALS.

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—The market continues firm at about £85 per ton for Chili bars. It is said that the speculators in Paris, who act by a syndicate, so as to control the market quite artificially, are now endeavouring to keep the present price of copper steady, so as to unload their stocks, and realise the large profits which at present exist only on paper. They have probably been led to this course by the attention their proceedings have received of late from the Paris press, and the threat of Government interference. It is clear that the metal trade has been seriously hampered by their proceedings, and the best course is evidently to steady prices without forcing them further until they would become impracticable. The present price of manufactured copper, £90 per ton for "strong," is based upon a much lower price than that current for Chili bars, viz., on about £78 per ton for raw copper, as compared with £85 for Chili bars. It is thus a favourable price for the consumer, and should encourage exporters to place orders for early shipment, as the stocks abroad are now very low.

TIN remains firm, being strongly held; but a belief gains ground that the price cannot be maintained much longer at its present high figure. Straits tin may be quoted £167, whilst English tin is from £148 to £150. There was a remarkable note in the *Times'* money article of Tuesday from importers of Straits tin, stating that the cost price was only £78 per ton, equal to London delivery, and that the output was being greatly increased, the Chinese miners working day and night, so that stocks were beginning to accumulate. The present price is very much higher than it ought to be, and there is good prospect of an early reduction on account of increased supplies.

LEAD remains at about last week's prices, £15. 10s. to £16 per ton.

SPELTER continues firm at advancing prices. Spot parcels are scarce, and many of the largest works in Silesia and Belgium have sold their whole production for many months to come, so that forward quotations have advanced greatly. The English smelters are also sold a long way ahead. This metal will be likely to continue dear, as the demand has quite overtaken the production, and the advance has been caused by natural and not by speculative influences.

Spelter:	Ordinary	£21	15	0	to	£22	0	0
Copper:	British Cakes and Ingots	85	0	0	"			
"	Chili Bars	85	0	0	"	85	10	0
"	Manufactured (strong)	90	0	0	"			
Lead:	Common Pig	15	15	0	"	16	0	0
"	English Sheet	16	10	0	"	16	15	0
Tin:	Straits	167	0	0	"			
"	Australian	168	0	0	"			
"	English Ingots	149	0	0	"	150	0	0

OILS.

		£	s.	d.
Cocoanut:	Cochin per tun	29	0	0
"	Ceylon "	23	15	0
Cottonseed	"	19	10	0
Cod	"	20	0	0
Lard	"	43	0	0
Linseed	"	19	5	0
Palm, Lagos	"	21	10	0
Rapeseed:	English "	26	0	0
Seal:	Pale "	23	10	0
"	Brown "	18	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	0	0	6
Petroleum	(Refined) "	0	0	6½
"	Spirit "	0	0	7½

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals lb.	0	1	2	to	0	1	3
"	" Liquid gal.	0	1	2	—	0	1	6
"	Citric lb.	0	1	8	—	0	1	9
"	Oxalic "	0	0	4	—	0	0	4½
"	Sulphuric ton	1	5	0	—	1	10	0
"	Tartaric lb.	0	1	6¾	—	0	1	7
Alum:	Lump (powder 10/- ex.) ton	4	15	0	—	4	17	6
Ammonia:	Carbonate lb.	0	0	3½	—			
"	Muriate (Grey) ton	23	0	0	—			
"	" (White) "	26	0	0	—			
"	Sulphate "	12	0	0	—	12	5	0
"	Liquor lb.	0	0	3½	—			
Bleaching Powder	ton	7	10	0	—	7	12	6
Bisulphide of Carbon	"	13	0	0	—			
Borax	"	28	0	0	—			
Benzole	(90%) gal.	0	3	6	—			
"	(50 90%) "	0	2	9	—			
Copper Sulphate	ton	22	0	0	—	24	0	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—			
Lead:	Nitrate "	24	0	0	—	25	0	0
"	White Sugar "	27	0	0	—	29	0	0
"	Brown " "	19	10	0	—	20	10	0
Potash:	Bichromate lb.	0	0	4½	—			
"	Caustic ton	22	0	0	—			
"	Carbonate "	17	15	0	—			
"	Chlorate lb.	0	0	6½	—			
"	Prussiate (Yellow) "	0	0	7⅝	—			
"	Sulphate (Basis 90%) ton	9	0	0	—	9	10	0
Precipitate:	Red lb.	0	3	1	—	0	3	2
"	White "	0	3	0	—	0	3	1
Salts: Epsom	Bags ton	2	10	0	—	2	12	6
	Casks "	3	5	0	—	3	10	0
"	Glauber "	1	10	0	—	1	15	0
Sulphur:	Sublimed Flowers "	9	0	0	—	9	10	0
"	Recovered "	4	10	0	—	4	12	6
Soda:	Ash deg.	0	0	1	—	0	0	1½
"	Caustic (White, 70%) ton	7	5	0	—	7	10	0
"	" (" 60%) "	6	5	0	—	6	10	0
"	" (Cream, 60%) "	6	2	6	—	6	5	0
"	Crystals "	2	10	0	—			
"	Bicarbonate "	5	10	0	—			
"	Hyposulphite "	6	5	0	—			
Solvent Naphtha	gal.	0	1	3	—	0	1	6
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

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HOME INDUSTRIES.

MANCHESTER, 5TH JANUARY, 1888.

THE COTTON TRADE.—The New Year has opened with promise of better trade for spinners, and although business has scarcely recovered from the effect of the holidays, there is still sufficient being done to afford some indication of the probable tendency. Many spinners sold freely just before the close of the year and are well under contract, while those who are not in that position are content to wait rather than sell unless they can get some advance on recent prices. Some kinds of yarns are sold a long way forward, and bundles especially are very scarce. During the past few weeks free buying of cotton has taken place, and the stocks in the hands of spinners must be very much increased. On the other hand, the supply of yarn is not any larger than is required by the demand, and consequently spinners are enabled to adhere firmly to their quotations. Owing to the difficulty which manufacturers experience in getting corresponding advances for cloth, they are indisposed to pay higher rates to the spinners, and in the home trade it is somewhat difficult to arrange business. The cloth market is in anything but a good state at present, the difficulty being mainly one of prices, which tend to become lower for several reasons. The large increase in the manufacturing power, to which we have before alluded, is now beginning to have its natural influence, and is rendering the competition for orders keener. On the other hand, the augmented use of yarn so created has made that commodity much dearer, a development which is aided by the increasing price of cotton. Thus, the manufacturer has to pay more for his materials, has a wider circle of competitors to meet, and finds an increasing difficulty in obtaining a corresponding advance of rates from his customers. Fortunately many makers are well sold, and can afford to wait before accepting low offers. It is stated that a new company has been floated at Rochdale to build, equip, and work a weaving shed, which is to contain 1350 looms.

THE SHIP CANAL.—Since we last referred to this enterprise considerable progress has been made. Mr. Walker has brought into operation a large quantity of plant, and work is now going on at four points. A novelty in the way of a land dredger, which is made by a German firm, is about to be brought into operation, and is expected to give good results. The quotations of both the ordinary and preference shares have advanced, and after the payment of the next call on the former, which is due on the 16th inst., are likely to become still higher. Since the acquisition of the Bridgewater Navigation Company's canals by the Ship Canal Company, the traffic on them has largely increased, and this route is now becoming a favourite one with shippers.

THE IRON TRADE.—There is an unmistakeable movement in this trade towards higher prices. Whether the advance in pig iron is speculative or not, it has been productive of some free buying, and all round the tone is very firm. Hematites especially are being sold at better prices, and appear likely to advance further. The movement has extended to finished iron, which is now very firmly quoted at a basis of £5 per ton for common bars; but sellers are very indisposed to do much even at that price. In the minor branches of this industry there is a fair trade doing, hoops, for instance, selling freely.

NEW STOP VALVE.—A stop valve is about to be put on the market here, a distinguishing feature of which is that it is seatless. The valve consists of a hollow spindle with its lower end blank, but drilled round its circumference with such a number of holes that their combined area is rather in excess of that of the bore of the spindle. The holes referred to are, when the valve is shut, raised into asbestos packing suitably placed, and when the valve is open are pushed into a steam space. In this way the steam is admitted into a steam chamber, to which the exit pipe is affixed. The amount of steam passed can be regulated by the number of holes uncovered, and the valve has the advantage that leakage can at all times be prevented.

LONDON, 5TH JANUARY, 1888.

THE MONEY MARKET.—After a week of some little stir the money market has become very easy again. The first week of the year always throws a deal of loanable capital on the market, and in view of this there were speculations in the early days of the week as to the likelihood of the Bank directors reducing their rate of discount in keeping with the general tone. Gold still continues to be in demand for Berlin, a fact which is adverse to a reduction; but, on the other hand, considerable sums have just been placed in the Bank, and more is in sight. Another broken week has made the stock markets of less interest, and the ruling tendencies are much as they have been for some time back. Copper still keeps up, and several new mining properties will shortly be brought into the market upon the strength of the present boom. Several hopeful home industrial investments may also be looked for as soon as the holiday influence has passed away. The striking feature of the past month, and indeed of the past year, was the demand for substantial home securities in the form of railway debenture and preference stocks. The number of investments which are absolutely safe does not increase in proportion to the wants of the investing public, hence the enhanced prices of such stocks, which are now almost prohibitive.

COMPANIES.—There were registered during the month of December 203 companies, with an aggregate capital of £21,100,000. Since our last report, the following new companies have been registered: New Minerva Mining Company, Limited, with a capital of £30,000; the Llwydarth Iron, Steel, and Tin Plate Company, Limited, with a capital of £75,000; The Clamond (Continental) Incandescent Gas Light Company, Limited, with a capital of £200,000; the Lawrence Automatic Gas Company, Limited, with a capital of £310,000; and Lockwood's Patent Horse Feeder Company, Limited, with a capital of £3000.

COPPER.—According to Messrs. H. R. Merton & Co.'s report, the stocks of copper in England and France on the 31st December amounted to 34,451 tons, as compared with 54,890 tons, 46,116 tons, and 37,770 tons at the same date in 1886, 1885, and 1884 respectively. Adding the copper advised from Chili and Australia, the amounts are 42,301 tons on 31st December, 1887, 63,290 tons in 1886, 58,170 tons in 1885, and 49,543 tons in 1884. The price per ton for Chili bars was £85, £38. 10s., £41, and £47. 5s. at these dates respectively.

SHIPPING.—With reference to the great increase in ship building which is now taking place, Messrs. Angier Brothers report that freights during the past year were poor and unprofitable for the first six months, followed by a solid progressive improvement during the second half of the year, at least as far as regards the shorter trades. In the long trades there is less encouragement, the improvement being as yet but little felt. They are of opinion that one important fact has been demonstrated, viz., that the present supply of tonnage is not too great for the demand, and that any increase in the general trade of the world would at once lift freights; but this favourable position is likely to be spoiled by the too eager haste of owners to increase their fleets. Second hand tonnage has been largely dealt in during the year, and after touching the lowest price on record has now risen considerably, the number on offer being small.

COAL.—The imports of coal into London during the month of December amounted to 1,211,140 tons, and the quantity conveyed beyond the limits of the coal duty districts to 276,338 tons, as compared with 1,100,856 tons and 272,085 tons in December, 1886. The total imports last year amounted to 12,054,048 tons, as compared with 11,800,507 tons in 1886; and the total exports to 2,997,246 tons, as compared with 2,984,628 tons in 1886. The total net increase in consumption is thus nearly a quarter of a million tons.

SUGAR.—The price of sugar is advancing. Though stocks in the United Kingdom show an increase, it is expected that the visible supplies during the year will decrease, in view of the deficiency in the production of beet and of greater consumption.

THE DRAUGHTSMAN'S PROVIDENT SOCIETY.—This society is to be formally established on the 9th inst. Membership is open to draughtsmen who are in the employ of architects, engineers, or surveyors. Besides the usual death insurance and sick pay allowances, there is also a provision made for advancing loans to members who are in distress. By contributing one shilling a quarter, a member is entitled to borrow a sum not exceeding £10 for a period of six months.

PATENTS.—The applications for patents during 1887 were higher than in any preceding year, the number amounting to 18,029, as against 17,162 in 1886, 16,101 in 1885, and 17,110 in 1884, the first year after the passing of the Act reducing the preliminary fees.

RAILWAYS.—The gross receipts of the twenty-two principal railways in the United Kingdom for the week ending 25th December amounted to £1,258,734 on 15,502½ miles, as compared with £1,155,311 in the corresponding period of 1886, when the mileage was 15,394¾ miles. An increase is thus shown in the mileage of 107¾ miles or 0·6 per cent., and in the receipts of 8·9 per cent.

THE NEW RIFLE.—It is announced that the Small Arms Committee have decided on the new magazine rifle for the infantry, and that one of the new weapons is now finished. It has a bore of rather over 0·3, and is rifled on the Metford principle. The magazine can be detached, and the rifle used as a single shot weapon.

GLASGOW, 5TH JANUARY, 1888.

PROSPECTS FOR THE NEW YEAR.—There can be no doubt that trade this winter has been brisker in Glasgow than for some years past. Ship builders and engineers have fairly well filled order books, and some are even withdrawing estimates, the acceptance of which had been delayed. The briskness in these departments and the considerable gains in iron and ore on the Stock Exchange have infused in commercial circles a feeling of liveliness to which the city has been a stranger for some time. In Greenock, also, the simultaneous rise in sugar and in freights has enabled some houses, who had lost heavily in the bad years, to recoup their losses, in some cases to a large extent. Retail trade has felt the improvement also, and the numbers of unemployed, as compared with those of previous years, would appear to be very much reduced, though on this point the absence of accurate statistics renders it hazardous to draw conclusions. In the flour trade there has been considerable briskness for some months, and the close of the year found stocks unusually low, while imports have been exceptionally heavy. Freights for steamships have been advancing during the last three or four months; but sailing freights have not yet manifested any material improvement. The price of iron touched an extremely low point on November 3rd, when it was quoted at 38s. 5½d.; but the last weeks of the year showed a great rebound, and though some of the advantages have, as usual, been lost, there seems reason to believe that for the present a firm advance has been made.

SHIPBUILDING.—An order has been placed with Messrs. Denny Brothers, Dumbarton, by the Compania Trans-Atlantica of Spain for a steel screw steamship of 5000 tons gross for Atlantic service. Messrs. A. Macmillan and Son, Dumbarton, have booked an order for a screw steamer for a French company. The Preston Town Council have ordered from Messrs. Fleming & Ferguson, Paisley, a dredger capable of dredging 800 tons per hour from a depth of 35ft.

PROPOSED ELEVATED FERRY STEAMERS.—A proposal has been made to construct some elevated ferry steamers for the cross river traffic. At present the traffic is conducted by small steamers, two plying at each ferry. The construction of more commodious vessels to meet the very great traffic is only a question of time. The matter has been remitted to the engineers to examine and report.

CLYDE TRUST.—The quarterly report of the engineer to the Clyde Trust, just issued, shows that the quantity of material dredged from the bed of the Clyde by the dredgers of the Trust, and deposited in Loch Long, is rapidly increasing. The total quantity dredged during the quarter was 354,144 cubic yards, and the quantity deposited in Loch Long alone was 331,640 yards. The new works at Cessnock Dock are being carried on steadily. The west wall of the entrance to the dock is now ready for the granite cope, and the ferry stair in the wall is completed. The Winne cylinders of the east wall of the entrance are being sunk. These Winne cylinders are sunk to a depth of 55ft. below the level of the cope. The new cattle loading bank at Shieldhall, Govan, has been finished during the quarter.

LARGE CORLISS ENGINE.—There is now being shipped at Glasgow, per "Clan Cameron," a very large Corliss engine for a cotton mill in Bombay. The low pressure cylinder is 70in. in diameter, and weighs 27½ tons; the high pressure cylinder is 40in. in diameter, and each has a stroke of 72in. The fly wheel, which is 30ft. in diameter, weighs 110 tons. It is 8ft. 6in. in width, and is grooved for 38 ropes. The crank shaft is made of Whitworth's fluid compressed steel, and is 25in. in diameter. The engine will work up to 2500 h.p. The number of revolutions per minute will be sixty, and the working pressure 100lb. per square inch. The engine has been constructed by Messrs. Douglas & Grant, Kirkcaldy.

LLOYD'S REGISTER AND BASIC STEEL.—The Committee of Lloyd's Register have just issued circulars stating that they now sanction the use of basic steel of ⅝in. in thickness and under, for shipbuilding and boiler making purposes carried out under their supervision, provided that the works supplying such material first satisfy them that they are producing it in accordance with their tests, and of uniform quality. The Glasgow Iron Company, of Wishaw, near Glasgow, are now supplying steel under these conditions.

LIVERPOOL, 4TH JANUARY, 1888.

(From our own Correspondents.)

OPENING OF THE WEST WIRRAL RAILWAY EXTENSION.—An official inspection of the extension of the Mersey Railway to Birkenhead Park, Wallasey, and Hoylake was made last Wednesday by Major-General Hutchinson, who, after a very careful examination, expressed the utmost satisfaction, and unhesitatingly gave his consent for the opening of the lines for passenger traffic on January 2nd. The lines were accordingly opened on that date, but without any ceremony beyond the conveyance of the leading officials along the whole length of the extensions. It is expected that the extensions to West Kirby and to New Brighton will be ready for traffic at Easter. One portion of the railway between the Mersey Tunnel and Birkenhead Park has been constructed under very great difficulties on account of the many quicksands encountered. The company have had to pay heavy compensation to the property owners in Beckwith-street for damage done to the buildings in consequence of the subsidence of the ground. Sir James Brunlees and Sir Douglas Fox were the engineers for the work, Messrs. J. Waddell & Son, of Edinburgh, being the contractors for the Birkenhead Park Extension, and Messrs. Meakin & Dean, of Birkenhead, for the Wirral Railway works.

PRESCOT WATCH MAKING INDUSTRY.—For many years this industry has been in a most depressed state, and a movement has now been set on foot by the Vicar, with the support of the Earl of Derby and other influential men, to build a factory for the manufacturing of watches by machinery to compete with the large American firms. The capital of the company is to be £100,000, in £1 shares. The movement has the entire sympathy of all who know the present suffering of the villagers.

THE LIVERPOOL WATER SUPPLY.—A report embodying several important alterations in the charges for water supplied outside the city has been prepared for the Water Committee and submitted to the Council. The recommendations are as follows: (1) The water supplied by meter outside of the city to be charged 50 per cent. more than that for the supply within; (2) the charge for water supplied by meter to supplement supplies from private wells or canals to be increased; (3) to discontinue the inspection of private hydrants, and to make an annual

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charge for connecting the same to the mains. The estimated annual increase in the receipts by the adoption of the above recommendation is £3,588.

SHEFFIELD, 4TH JANUARY, 1888.

A RETROSPECT.—One of the most significant evidences of improving trade is the increasing business with the United States. The bulk of trade done by Sheffield in 1886 with America, chiefly in steel and cutlery, was £701,545, whereas, in 1887, the total exports amounted to £1,063,356. In December alone steel to the amount of £27,170 was exported to the United States, and this was a considerable increase on the exports of the two previous months. Other branches of local trade show a decided improvement, and there is everywhere proof of reviving markets, less difficulty in obtaining orders, and more work for skilled artisans.

IRON AND STEEL.—Prices are still firm, and Bessemer billets are selling at higher quotations than those given in this report last week. Makers are sanguine, in fact, that there will be a considerable rise in price before the first quarter of 1888 closes. As an indication of growing business, it may be stated that several Sheffield houses, doing largely in the steel trade, were obliged to curtail the Christmas holidays owing to the pressure of orders. All descriptions of railway material are in steady demand at higher prices, and shipbuilding material is selling well. Corrugated flues, for marine boiler furnaces, are becoming a profitable specialty; and a very large trade is being done in crucible steel castings. There is undoubtedly a reviving shipping trade. Heavy marine castings are more extensively on order; and Messrs. William Jessop and Sons, who have been actively engaged for some months on engine bed plates, rudders, rams, and so on, have their books satisfactorily filled with new orders. There is on every side the admission that competition was never keener; but best quality material is telling in the commercial struggle, and Sheffield firms, now thoroughly roused, are putting down the newest plant, and straining every nerve, to uphold their reputation for good work, and at prices that would, ten years ago, have been considered preposterous. Railway springs are obtainable at £9 per ton; tyres £6, or a little over; axles from £6. 5s. to £6. 10s. per ton. In heavy machinery and other engineering work there is more activity, and employment is easier to get both at the rolling mills and foundries. Indeed, the heavy branches of Sheffield trade have not had a brighter prospect for the past ten years than at the present time. Messrs. John Brown & Co., Limited, have one or two orders on their books, but are waiting for specifications; and Messrs. Charles Cammell & Co. have also a few orders for steel faced plates. Messrs. John Brown & Co., Messrs. Charles Cammell & Co., Messrs. Firth & Sons, and Messrs. Vickers and Co., have now completed and put down enormous plant for the production of heavy ordnance. It is anticipated that the Government, during the next few days, will send very extensive orders to Sheffield.

CUTLERY, &C.—In cutlery, edge tools, silver and electroplate, and skates particularly, the demand is extensive, and orders are coming in daily.

THE MANUFACTURE OF STEEL WHEELS.—Messrs. Hansell & Co., of this town, have arranged to undertake the sole manufacture of the "National" interchangeable steel tramway wheels and axles. The tyre is rolled from cast steel, and the centre is cast in one piece of mild Swedish crucible steel. Each spoke is partly divided towards its end by an oval-shaped opening, and steel bolts pass through holes formed in the sides of these openings in a direction at right angles to the axle, and having a broad spring washer threaded on between the sides. The centre is then placed inside the tyre, and each spoke opening is gradually tightened up, causing each spoke to expand slightly.

NORTH STAFFORDSHIRE, 4TH JANUARY, 1888.

THE IRON TRADE.—Last week a general holiday prevailed throughout the district; and most of the mills and forges only started work again on Monday, orders not being plentiful enough to warrant makers curtailing the usual holiday. The product of the blast furnaces has mostly been put into stock, for which some firms, whose stocks have been decreasing, are not unthankful, in anticipation of an improvement in demand and in prices after quarter day. Consumers are fully bought for the next two and three months at late low rates; and it remains to be seen whether prices will hold out until they are again in the market. Finished iron must see an advance before producers can afford to pay more for the crude metal.

THE COAL TRADE.—The seasonable weather of the last two or three weeks has put the resources of local collieries to the severest test, and where men could be got to work, the pits have been kept going uninterruptedly, even during Christmas week. The holiday in the pottery trade curtailed the demand for that class of fuel, and deliveries of forge coal also fell off. Prices of all coals are low for the time of year, and afford little, if any, margin for profit.

ENGINEERING.—There has not been much work for local founders of late, and prices of all descriptions of castings are unremunerative. The wish is repeatedly expressed that foundry pig iron would go up to 60s. per ton, as under such a condition engineers could do satisfactory work.

COLLIERY EXPLOSION.—Early on Monday morning an explosion of gas occurred at No. 2 pit of the Diglake Colliery, Audley, belonging to the Audley Coal and Iron Company. A fire had broken out in a gob, and although every precaution had been taken to put it out by building stoppings, it got to some gas, and an explosion resulted. Fortunately, owing to the precautionary measures taken, no loss of life occurred. It was afterwards found necessary to fill up No. 2 shaft bottom.

BARROW-IN-FURNESS, 4TH JANUARY, 1888.

SHIPBUILDING AND ENGINEERING.—In connection with the business of shipbuilding and engineering which is being taken over from the Barrow Shipbuilding Company by a new company, of which Mr. Bryce-Douglas is the managing director, it is worthy of remark that one of the features of the new concern is to be a gun factory, which will be under the guidance of Mr. Nordenfelt.

IRON AND STEEL.—The Christmas holidays have attracted attention from business, but it is noticeable that in the iron and steel trades makers have been very well employed, and have been also in receipt of numerous inquiries both for prompt and forward delivery. A firm tone prevails in the market, and there are indications of a brisk trade. Prices are steady at 47s. for mixed numbers of Bessemer iron net at maker's works or f.o.b., and 46s. 3d. to 46s. 6d. forge and foundry samples. Stocks have been somewhat reduced. Steel makers are busy all round, and steel rails and plates are in exceptional demand, the former at £4. 2s. 6d. for heavy sections, and £4. 7s. 6d. for lighter sorts; and the latter at £7. 5s. per ton net f.o.b. Iron ore is exceptionally firm and brisk, and prices range from 9s. 6d. to 13s. 6d., according to quality net at mines.

MIDDLESBROUGH, 4TH JANUARY, 1888.

PIG IRON.—The holidays are hardly over yet, so the pig iron market may be said to be nominal. The tone is firm, however, and prices are unchanged, No. 3 G.M.B running from 33s. to 33s. 3d. per ton for prompt delivery. Warrants are 33s. 6d. per ton cash for Connal's No. 3 G.M.B., and 45s. to 45s. 6d. for Connal's hematite mixed numbers. There has been an increase during the month of December in Connal's store of 12,969 tons. On the 31st December the stock stood at 340,133 tons.

SHIPMENTS OF PIG IRON.—The shipments of pig iron for the month of December amounted to 66,173 tons, as compared with 64,488 tons in November, and 63,777 tons in the month of December, 1886. The shipments for the entire year of 1887 amounted to 814,294 tons, as compared with 783,555 tons in the year 1886. Of the 814,294 tons 444,951 tons went coastwise, and 369,343 tons foreign. Rather more has been shipped to Belgium and Germany, and slightly less to Holland in 1887 than 1886. America has taken 54,080 tons, as against 19,083 tons. Upon the whole the shipments for the past year may be looked upon as very fair, and full of hope for the year now begun.

MANUFACTURED IRON AND STEEL.—The works are still busy, except for the usual lull during the holidays. At the Eston Steel Works there has been a partial stoppage in one department in consequence of the alleged forgery of Lloyds' stamp upon a steel angle iron; but the firm are confident of a satisfactory explanation of the difference between them and Lloyd's inspector being given by the gentleman appointed to arbitrate, and this is asserted after the examination has been passed. The shipments of manufactured steel have increased during the month of December by 5428 tons over those of December in the previous year. In the shipments of manufactured iron and steel India figures largely, having taken 13,224 tons more this December than the previous one.

SUNDERLAND, 4TH JANUARY, 1888.

SHIPBUILDING.—All the shipbuilding firms on the Wear are commencing the year with better prospects than in any of the three previous years. The most recently reported orders are for two steel steamers to be built by the Strand Shipping and Shipbuilding Company, Limited.

MARINE ENGINEERING.—The large marine engineering concerns are now in every case actively employed, and in each the machinery will be worked night and day after the holidays. Ironfounders are also consequently obtaining increased employment.

SHIPPING.—The trade of the port during the last month of the old year has been well maintained, 338,778 tons of coals being shipped, as against 308,751 tons in December, 1886, an increase of 30,027 tons. Shipments of coke and patent fuel were also larger, 5873 tons of the former and 4760 tons of the latter being shipped last month, as compared with 1610 tons and 980 tons in December, 1886. A similar increase is to be noted in the shipment of bottles. Freights continue to be somewhat easier, and it is feared that when the vessels recently ordered are launched, the slight improvement in shipping investments may disappear. More especially is this true of trades in which vessels of 3000 tons and upwards are available, as the great bulk of the cargo carrying steamers now building are of large carrying capacity. In the meantime the outlook is more cheerful, as it is anticipated that there will be a brisk demand for tonnage in the freight market as soon as business gets into its ordinary groove after the holidays.

NEWCASTLE, 4TH JANUARY, 1888.

IRON.—The leading iron manufacturers in the district have taken the opportunity, afforded by the observance of the New Year holidays, to effect a thorough repair of furnaces, &c. The inadequacy of the steel supply for ship building purposes has caused a larger inquiry to arise for angle bars &c., manufactured from the older material; and there is little reason to doubt that the works will be kept more constantly employed during the present year than they have been since 1884. The establishments which are specially devoted to the manufacture of merchant iron are generally so well supplied with forward orders, that no prolonged periods of stoppage are expected to occur for at least the first six months of the year.

STEEL.—The newly erected steel works belonging to the Consett Iron and Steel Company have not yet been put in operation, chiefly on account of the unfavourable weather. At the Jarrow Steel Works the pressure of orders is far beyond the existing capabilities of production, but the proprietors are actively carrying out measures to meet the greatly increased demand for such specialties as steel plates, angles, &c. The Redheugh Iron and Steel Sheet Manufactory has been kept going during the whole of the holiday period, the unprecedentedly heavy strain upon the resources of the establishment rendering this course absolutely necessary. The proprietors have recently made some large contracts with London tank makers for the supply of steel and iron sheets over the first half of the year. The prices obtained under these contracts are, as compared with the prices of two months ago, 20s. per ton higher on steel sheets, and from 10s. to 15s. per ton on iron sheets. Those establishments where steel castings are produced are also in full activity, and in some instances arrangements for increasing the output are in progress, or are contemplated.

THE COAL TRADE.—Though the shipments of coal from the Tyne for the week ending December 31st show a large decrease as compared with the shipments in the concluding week of 1886, the year opens with greatly improved prospects for the industry, as the demand for all descriptions of coal produced in the district has been greatly stimulated lately, and many important contracts for forward supply have been secured, thus insuring steady work for months to come at several colleries. The demand for coke, both for home use and exportation, has also largely increased, and the shipments of this commodity have been more than doubled lately, as compared with those of a year ago.

PETROLEUM OIL.—The tank steamer "Petrolea" arrived in the Tyne yesterday, from Libau, with 280,000 gallons refined Russian petroleum. This cargo is from Messrs. Nobel's refineries, Baku, the "region of eternal fire." The Droojba Fountain sends up a column of oil 200 to 300 feet high 18in. in diameter, and forces the oil out of the earth at the rate of 2,400,000 gallons every 24 hours, being nearly equal to the output of all the 20,000 wells in the oil fields of the United States.

DUNDEE, 4TH JANUARY, 1888.

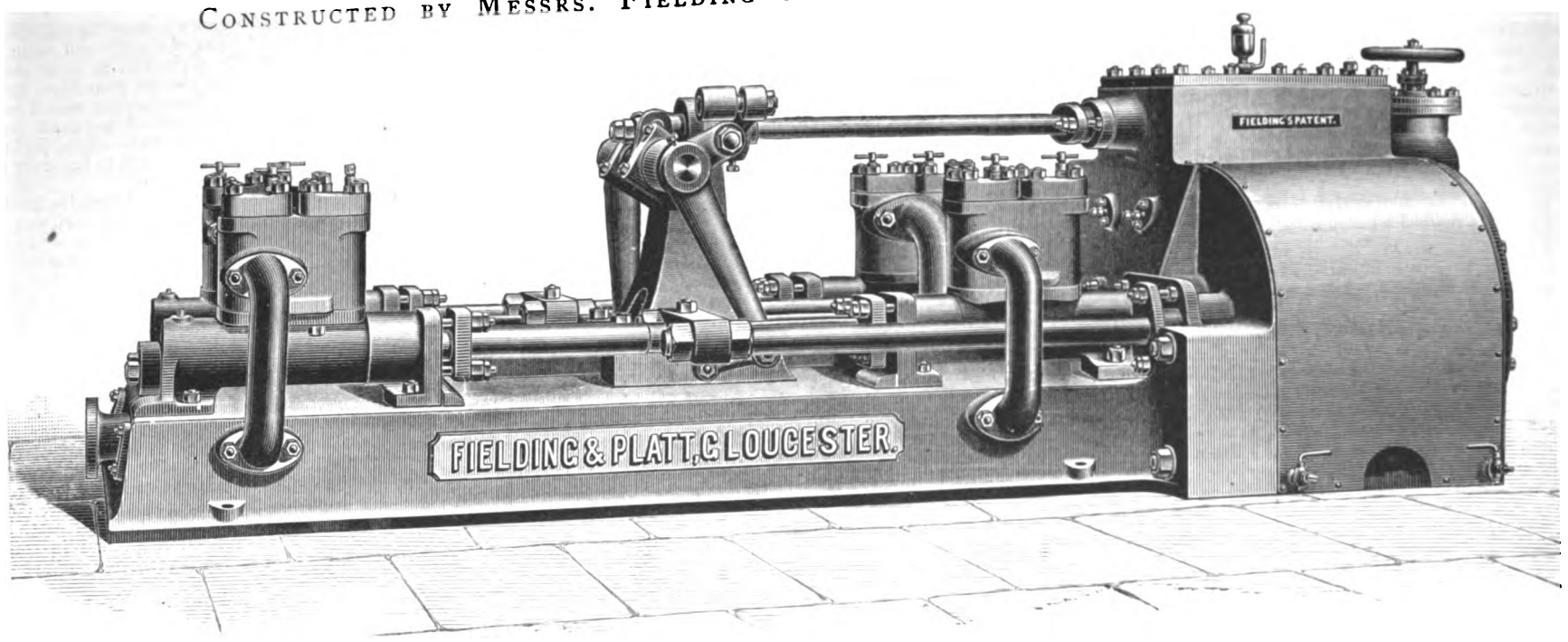
FLAX AND JUTE TRADES.—Owing to the holidays there has been little doing in the local market during the past fortnight. The year opens hopefully, however, and the prospects are better than they usually are at this season. It is calculated that the import of jute during the past year has been 173,346 tons. The trade employed 79 vessels of an aggregate tonnage of 137,000. There has not been so extensive an importation since 1883, when 114 vessels of 162,210 aggregate tonnage arrived. The increasing employment of steamers has been a feature of the trade during the year. At present there are some twenty jute laden sailing vessels bound for Dundee from India. Manufacturers are more and more learning the expediency of cultivating specialties instead of relying on ordinary coarse goods. Carpets, rugs, and checks are now quite common articles of manufacture. The market generally has been favourable to a productive output during the twelve months. The limitation of production at Calcutta has enabled makers to dispose of the stocks that hung on their hands, and business now seems in a healthy condition. In the linen trade signs of of improvement are noticeable in the finer branches, but the market for coarser goods has not been buoyant. Local spinners have felt the competition of French and Belgium yarns. There appears for the moment an increased disposition to invest money in local undertakings. Several important works are likely to be begun this year. Among them are the circular district railway, the Dundee and Highland district line, new water works, and a marine embankment. One of the railway companies is making preparations for building an extensive new station. The value of new property erected within the borough last year was over £100,000.

TIMBER TRADE.—Considerable activity has prevailed in this trade during the year. Eighty-one cargoes arrived, and the number of loads imported was 47,896. In this, as in other trades, the importation is being taken up by steamers. The classes of timber imported were: Yellow pine, 3351 loads; pitch pine, 2885 loads; firewood, 1073 loads; spars, 1232 loads; lathwood, 1473 loads; birch, 218 loads; elm, 152 loads; ash, 88 loads; poplar, 62 loads; and oak, 42 loads. Most of the wood comes from Scandinavian ports, but Cronstadt sent more than any other single place of export, 7181 loads; whilst Quebec sent 4056 loads.

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DUPLEX PUMPING ENGINE.

Constructed by Messrs. Fielding & Platt, Engineers, Gloucester.



COLLIERY WARNINGS.

Those who are in the habit of accepting without question statements made with some appearance of authority, are likely to become confused in their opinions if they give heed to all that is written concerning the causes of accidents in mines. The Government Inspectors of mines ascribe, in their last annual report, the gradually diminishing proportion of deaths by accident solely to the system which they administer. The error of this partial view we recently felt ourselves compelled to expose. More extended knowledge, discoveries in science, improved mechanical appliances, and better education count for something in this matter. Now a fresh claimant to the sole honour and rewards of lessening the dangers that beset the occupation of a collier has appeared. For some years past the Press Association has monopolised the services of a prophet whose particular function it is to discern coming events in the domain of coal mining. At least he is expected to foretell the issue of fire damp in increased quantity. The method of procedure is this: The seer having observed from the daily report of the Meteorological Office that the barometer is likely, in the course of the next twenty-four hours, to fall rapidly, writes a paragraph of warning to colliery managers, which the Press Association forthwith sends to the daily newspapers published in the districts affected. The Association has just issued a report in which it claims to have brought about by this means the notable reduction in the number of deaths by explosion per one thousand hands employed which appears in the statistics of the last ten years as compared with the preceding decade; and *The Times* newspaper lends the weight of its authority in support of the contention. We must once more protest against an assumption of this sweeping character. If that of the Government Inspectors was groundless, this is absurd. It is well known that colliery managers give no heed to these warnings, which the Royal Commission on Accidents in Mines condemned as rather pernicious than useful. All such warnings must come too late. The indications of the barometer at the mine demand the prompt and careful attention of the manager, affording as they do trustworthy evidence of the movements of gas. But their whole value lies in the possibility of their being promptly acted upon. To take the warning from the newspaper of the next day is to lock the stable door after the steed has been stolen. So far, therefore, from having alone brought about the improved state of things, it may reasonably be doubted whether this system of colliery warnings has contributed anything to that result. The mischief of making these groundless claims lies, first, in diverting attention from the true causes at work, and, next, in bringing discredit upon a system in itself good and capable, when properly applied, of serving a useful purpose. Whatever is done in weather warnings for colliery managers must be the work of the Meteorological Office, and the warning must be conveyed by telegraph direct to the mines.

AN IMPROVED RATCHET BRACE.

The accompanying illustrations are taken from the *American Machinist*, and show some new forms of ratchet braces, as manufactured by the Lowell Wrench Company, Worcester, Massachusetts. Figs. 1, 3, and 4 represent the tool in different forms. Fig. 1 shows a square ratchet wrench, while Fig. 3 illustrates the same tool changed into a ratchet brace. In Fig. 2 the cap is removed, showing the internal construction. There are two pawls, the lower one of which is engaged with the ratchet, while the other pawl is pressed back into a recess in the casing head

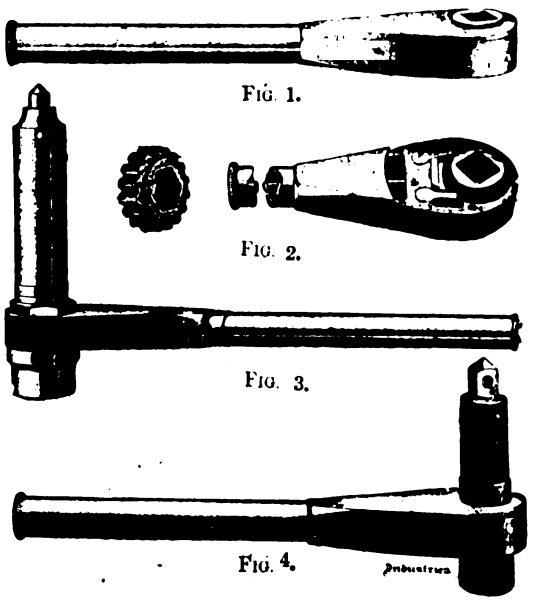


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

by a narrow metal bar capable of sliding to and fro in a transverse groove. This sliding bar is provided with a vertical slot, in which a crank pin slides. This pin is connected to one end of a rod passing through the centre of the handle, while the other end carries a milled button. The pawls are pressed into gear by spiral springs. By turning the milled button, and thereby moving the crank pin either to an extreme left or right position, the sliding bar throws the corresponding pawl out of gear, while the spring pushes the other one into gear. The length of the vertical slot in the sliding bar is so adjusted as to allow the crank pin to go slightly beyond the centre, in which position the pressure of the pawl spring locks the crank. The wrench wheel, one of which is shown at the left of Fig. 2, is made in various shapes and sizes within the limit of the wrench, and can easily be changed by removing the cap. In the same manner the wrench wheel may be removed, and the drill socket substituted, thereby making a complete ratchet brace, as shown in Fig. 3. The possibility of causing a change from right to left hand motion from the end of the handle gives the invention an additional advantage, apart from making the tool look neat and handy. It is sometimes desirable to produce certain motions in places where the hand of the operator could not reach the head of the wrench. This new design allows the reciprocating motion of the handle to be changed to either right or left hand rotation without displacing the wrench. Fig. 4 shows the same principle applied to a tool solely intended for use as a ratchet brace. The comparatively small size of the ratchet wheel and its casing renders this tool extremely useful in places where but a limited space is available for working.

DUPLEX PUMPING ENGINE.

The above illustration shows a new form of duplex engine and pump now working in a satisfactory manner at the Atlas Iron Works of Messrs. Fielding & Platt, engineers, Gloucester. It supplies an accumulator loaded to 1500lb. per square inch. By means of an automatic arrangement the pump is stopped as soon as the accumulator reaches the top, and started again when it begins to descend. There are no chains and balance weights, the only connection between the pump and accumulator being a small delivery pipe. This duplex pumping engine is the patent of Mr. Fielding, and it is manufactured solely by Messrs. Fielding & Platt. We may mention that two sets of compound engines have been working for a considerable period at the shipbuilding yards of Messrs. J. L. Thompson & Sons, Sunderland, and at the works of Messrs. John Readhead & Sons, South Shields. The engines supplied to Messrs. Thompson & Sons have 12in. high pressure and 20in. low pressure cylinders, 12in. stroke, and are pumping water against a pressure of 1500lb., for working Tweddell's hydraulic riveters and winches. It is claimed for this duplex pumping engine, that it is the only non-rotative pumping engine which has positive valve gear. Silence and smoothness of working have thus been completely secured, and efficiency, reliability, and durability have been maintained. The change of design embodied in this valve gear is important, when it is recalled that duplex pumping engines have hitherto mostly consisted of two entirely distinct and complete engines placed side by side, the slide valve of each being operated by the cross head of the other. The distinctive feature, then, of the Fielding engine is that instead of each cylinder being fitted with its own slide valve a single valve serves both cylinders, an arrangement which causes a reduction in the number of parts subject to wear and requiring attention. As each pump plunger begins its stroke the other comes to rest, and in this way the flow of water in the suction and delivery pipes is steadily maintained with little or no pulsation, whilst a pause is made by each plunger at the end of the stroke, enabling the chamber to be completely charged—the valves closing by their own weight alone, thereby insuring small and even wear.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, *Wellington-street, Strand, London, W.C.*
70, *Market-street, Manchester.*
62, *St. Vincent-street, Glasgow.*

Advertisements:
London: 62, *Ludgate Hill, E.C.* (*Watkins & Osmond.*)
Manchester: 70, *Market-street.*
Glasgow: 96, *Buchanan-street.*

Telegraphic address: "INDUS, MANCHESTER."
„ „ "INDUS, LONDON."
„ „ "JOURNAL, GLASGOW."
Telephone number: 684, MANCHESTER.
„ „ 2785, LONDON.

Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," *either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.*

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 6TH JANUARY, 1888.

A RETROSPECT AND A FORECAST.

IT is an excellent practice, and one that can never fail to be profitable in its ultimate results, to take stock at the commencement of a new year, with a view to ascertaining how far we have progressed or receded in the period that has just passed. A retrospect for the year 1887 is necessarily one of mixed colours, but it is not quite so unrelieved in its sombre tints as that which we had to draw at this time last year. The outlook is decidedly brighter. The amount of business actually done during the year has been greater almost than during the previous year in almost every department of industry; but whilst the volume of trade has thus been enlarged the range of prices, with all the improvement of demand, and increase of confidence, continues to be almost unprecedentedly low.

Owing to the interdependence between agriculture and manufactures, there is some reason to believe that the depressed condition of manufacturing industry is largely bound up with the misfortunes that have overtaken the farming community. The farmers of Great Britain are estimated to have lost some 200 millions, or about one-half of their entire working capital, during the last ten years. This, again, signifies that they have not had the means with which to purchase agricultural implements, domestic requisites, and many other items which they could afford when their trade was prosperous. The future of the agricultural interest is far from hopeful. It could be materially improved by higher prices for produce; but these higher prices do not appear to be probable in face of the increasing competition between our own Colonies, India, and America for British markets. Some optimistic and speculative minds have been seeking to solace themselves with the belief that, by-and-by, the United States and India will themselves consume all the food that they can raise; and others are content with the more proximate satisfaction that this year's harvest will not allow of the same surplus for export in the chief wheat growing countries of the world.

The future of prices is necessarily determined by two leading considerations: the first, that of how cheap raw materials can be bought; the second, that of how economically we can produce. There is a third element that has always a great deal to do with the question, viz., that of the character and extent of the competition that our manufacturers have to meet, both at home and abroad. There does not appear to be any solid reason to anticipate that we shall have a materially higher price to pay for the raw materials of our manufactures. The area of supply for the majority of materials is continually widening, and this alone is a sufficient guarantee that prices will not be greatly advanced, except under very exceptional circumstances. Our manufacturers, however, are evidently increasingly subject to a keen competition on the part of other nations in manufactured commodities. Our imports of manufactured goods during 1887—including metals, which are more or less manufactured—amounted to about seventy millions sterling, being nearly 20 per cent. of our total imports of all kinds in that year. This is, no doubt, good for the general consumer; but it is far from satisfactory to the manufacturer, who, under a free, fighting trade, finds it more and more difficult to keep his head above water, and for whom the only possible hope of salvation seems to lie in the utmost economy in every direction.

There is one remarkable feature of the depression from which we are now beginning to emerge, and that is that it has been literally world-wide. England has only been an exceptional sufferer in so far as her commerce and manufactures are on a larger scale than those of other countries. With hardly a single exception, the export and import returns of all other countries show a shrinkage as well as our own, and even our Colonies are not exempt. In most of the Colonies, the trade done during the last two or three years has been considerably under that of some previous years. Continental agriculture has suffered like our own, but not with equal reason, seeing that the majority of European nations levy tariff duties on imported bread stuffs, while ours are absolutely free. Other nations have, in isolated cases, made remarkable strides in particular industries; but this has been so rare an event as to have provoked a greater amount of observation than it could fairly claim. England still continues to produce the cheapest manufactured commodities in all the leading industries of the world. We produce the cheapest coal, the cheapest iron ore, the cheapest iron and steel, the cheapest machinery, and the cheapest cotton, quality for quality. If we continue to do this—and there is no reason to apprehend that we shall fail—we are sure to hold our own in the home market, and in the markets of the world.

The auguries for the future are, however, by no means so harmonious as we should wish them to be. There are still very grave apprehensions that we are on the eve of a huge and desolating European war. Why there should be such a war is a problem that no one seems to think it necessary to solve. The armaments that are now maintained at enormous cost by all the leading nations of continental Europe are in themselves a standing menace to the peace of the world. With all respect to the ancient aphorism that the best way to preserve peace is to be prepared for war, it is not justified by results; and there is a growing disposition to believe that the people who are taxed for the maintenance of the enormous standing armies of the Continent will not be satisfied to keep up this taxation unless they see some fruits accruing therefrom. In the case of France, retaliation on Germany is perhaps a sufficient object; whilst in Germany there is profound belief that it is necessary to keep up armaments that will be more than a match for those of France. Austria-Hungary and Italy have each their own theories as to their dangers and necessities, and the "Colossus of the North" has, by repeated aggressions, and by the discordant character of the elements that compose the Russian Empire of to-day, become so much of a menace to Europe, and so liable to internal troubles, that it is probable that disarmament would involve dismemberment, if not more serious disaster. It is regarded in some quarters as probable, for these and other reasons, that a European war is an event of the near future. It is owing to this feeling of uneasiness that the revival of trade, which has undoubtedly commenced, will probably not attain the large proportions usual after a prolonged period of depression. Thus we enter upon 1888 with better hopes than could be entertained in the beginning of 1887, but hardly with a greater feeling of confidence in the stability of the situation.

Political considerations are, however, at the present moment not the only disturbing factors in the prosperity of English industry and commerce. Internal

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difficulties regarding the relative positions of employers and employed are unfortunately an ever present danger to the prosperity of our great manufacturing community. Of late there has been a good deal of dissatisfaction on the part of large employers of labour with the current rates of wages, which seem out of proportion to the interest realised by capital on manufacturing operations. So far as capital is concerned, there has been a tendency for a number of years towards a lower level of safe interest. The price of Consols, and the high premiums at which the shares of our leading railway companies are quoted, would appear to prove that secure investments paying more than 3 per cent. are becoming increasingly scarce in this country. In the case of a successful business enterprise, the earning power of capital, with some amount of superintendence added, may occasionally rise as high as 10 per cent.; but that is now the exception where it formerly was the rule. The capitalist naturally regards this state of things as unsatisfactory, and is apt to regard a reduction of wages as a fair and proper remedy. This view is strengthened by the fact that wages have generally been increased concurrently with a remarkable reduction in the value of commodities over the last thirty years.

The President of the Institution of Civil Engineers, in his address, referred to the rise of wages paid to engine fitters as a proof that during the last fifty years their position has greatly improved. According to Mr. Bruce, the wage per hour has in that interval increased by about 26 per cent. At the same time, many commodities have fallen by 20 or 25 per cent., so that skilled artisans are now very much better off than formerly, whatever may be the position of the unskilled labourers. At the same time, the return to capital has been reduced from 10 or 12 to 3 or 5 per cent., and in this discrepancy between the rewards falling to the two wealth-producing factors lies the danger. As wages cannot be reduced without impairing the quality of the manufactured articles, and thus injuring the trade generally, to say nothing of the personal hardship inflicted on the artisan, capital will seek for fields where it can obtain a larger return—in other words, it will be gradually withdrawn from such British industry as fails to reward it adequately, and transplanted to foreign countries. This movement has to a certain extent already taken place during the past year, and there are indications to show that it will go on during the present year to even a larger extent.

THE COMMERCIAL DEVELOPMENT OF SHIPPING AND SHIPBUILDING.

I.

THERE is nothing in the history of industry that is invested with a greater degree of interest to a maritime nation like our own, than the development of shipbuilding and its consequent effect on the commercial position and prospects of different nations. To Great Britain, as the shipbuilder of the world, this record is, and must always be, peculiarly interesting. We have achieved a position in the carrying trade of the world that has never been attained by any other nation. Our shipbuilding interest is thereby placed in the very front rank. We produce a greater tonnage of new shipping every year than all the other nations of the world put together. This is an economic problem of very great importance, and it naturally divides itself into the two considerations, viz.: (1) How has England come to occupy its unique position as a shipping and shipbuilding nation? and (2) Is it probable that that position will be maintained in the future?

The shipping and transport trade of the world has from time to time been subject to great changes and vicissitudes. These are naturally so much a part of the domain of ancient history, that we cannot give much attention to them here. In the seventeenth century the carrying trade of the world appears to have been divided between Holland, Spain, and England. During the war between Holland and Spain, the latter country lost the greater part of her naval power. Between the years 1643—when the treaty of Munster was concluded between these two continental powers—to 1698 the commerce of Holland is estimated by De Witt to have increased by about one-half, and Spain was at that time forced to hire Dutch ships to sail to her American possessions. Holland had then, according to Sir William Petty, about 900,000 tons of shipping, or about one-half the total tonnage of Europe. The Dutch almost monopolised the shipping trade for nearly a century afterwards, not as a result of any artificial monopoly, but by reason of the greater number of their ships, and their superior skill and economy in navigation. In 1701, when Holland was at the zenith of her naval power, inquiries were addressed by the Commissioners of Customs to the officers at the different ports, which showed that the whole mercantile navy of England amounted at that time to no more than 261,222 tons, carrying only 27,196 men and boys.

The remarkable feature in the shipping and shipbuilding supremacy of Holland during a great part of the seventeenth and eighteenth centuries was that that country had no conspicuous natural advantages for the prosecution of either industry. The Dutch had, indeed, scarcely a piece of timber fit for shipbuilding purposes, and they had no native produce to export worth speaking of. The principal centre of the Dutch shipbuilding trade was Swaardam, a place that has since been of very little account. It was by the force of industry, the close cultivation of colonial resources, and the economy and skill with which all operations of a commercial and industrial character were carried on, that Holland so far "breasted the blows of circumstance" as to secure the position that Great Britain subsequently wrested from her. The same readiness to grapple with natural obstacles has been apparent in more recent times. Even now, although Holland produces neither iron nor timber, a considerable shipbuilding industry is carried on at the principal Dutch ports. The merchant navy of Holland, on the other hand, is now not more than one-half, as measured by tonnage, that it was in the seventeenth century. This decay has been attributed to the natural development of commerce in other countries, and to the pressure of taxation at home.

The expansion of English shipping and shipbuilding has been dated, by some writers, from the adoption, in 1651, of the famous Act of Navigation. That of France has been attributed by others to the promulgation of the tariff of 1664 by M. Colbert. The effect of these measures, however, cannot have been very immediate, since Sir William Petty gave the tonnage of English shipping in 1690 at less than half a million of tons, and that of France at only 100,000 tons. These, and all other returns up to within the last half century, are, however, very conjectural. The truth of the matter is, that although the Custom House authorities professed to keep returns of the mercantile marine, they were vitiated by the fact that the law did not compel these vessels to be registered that plied only within the limits of a port. The inaccurate and imperfect character of the official returns caused the committee appointed by Parliament in 1839 to investigate the causes of accidents on steamships, and institute a special inquiry into the extent of the then shipping industry, and they found that there were 760 steam vessels in Great Britain and Ireland having a registered tonnage of 78,884 tons, and 56,490 h.p. Of these, 256 were under 50 tons burthen, 145 were between 50 and 100 tons, 84 were between 100 and 150 tons, 76 were from 200 to 300 tons, and 41 were between 300 and 400 tons. Only twelve vessels in all were over 400 tons burthen.

The effect of the introduction of iron in the place of timber has been to shift the *venue* of the shipbuilding trade in this country, and to give it a special stimulus in localities where iron was cheap and plentiful. In the days of "wooden walls," vessels were largely built in the South of England—at Woolwich, Gravesend, Dartmouth, Portsmouth, and Southampton. The Clyde, the Tyne, the Wear, and the Tees—the modern centres of the trade—were then almost of no account. But these northern rivers took the lead when iron became the dominant material, and they have kept it ever since. This is especially true of the Clyde. Commencing with the construction of the "Comet," constructed by Henry Bell, in 1812, for the transport of passengers between Glasgow and Greenock, the Clyde has ever since kept to the front in marine architecture. In 1864, indeed, there were 178,000 tons of new shipping constructed on that river, out of a total of 461,000 tons launched in the United Kingdom as a whole. But even these figures do not adequately show the relative superiority of the northern river, for most probably at least three-fourths of the tonnage launched in that year on the Clyde would be iron steamships; and as the total tonnage of steamers built in the United Kingdom in that year was only 186,000 tons, the Clyde manifestly did by far the lion's share of this kind of work. Taking an average of the last twenty years, the Clyde has contributed nearly one-half of all the shipbuilding of the country. In some years, as in 1881, when the proportion falling to the Clyde was 327,000 tons, out of a total of 608,000 tons built in the country as a whole, the shipbuilders of that river have contributed more than one-half of the whole.

It goes without saying, that during those earlier days of the iron shipbuilding trade the business was fairly prosperous. This fact called into existence a great expansion of the trade, chiefly on the Tyne, Wear, and Tees; but also, to a less extent, at Dundee, at Leith, at Grangemouth, and at Belfast. Other localities of minor importance came into the field; and by the year 1880 there were upwards of thirty distinct ports or localities in the United Kingdom at which ships were being built of iron or steel. The main difference between one port and another, in an economic aspect, was that involved in questions of transport. Obviously, all other conditions being equal, the Tyne, Tees, and Clyde, which are in the neighbourhood of great iron works, providing the materials used at the cheapest possible rate, should have advantages over districts that had to import their materials over longer distances. But this, after all, cannot be the sole determinant of success, otherwise the iron shipbuilding trade at Southampton and Belfast would be brought to a standstill, whereas it has for years past been in a very flourishing condition. The most flourishing and progressing centres of the shipbuilding industry at present appear to be the Tyne and the Tees. A few years ago, those rivers came very far behind the Clyde in their united production. Now, however, they unitedly produce about as great a tonnage as the more northern river.

In a survey of the general economic progress of shipbuilding, it is necessary that we should direct our attention to other countries than our own. In so doing, our first glance will be cast at the United States, which have had a remarkable record. About 1861 the total tonnage of the shipping of the world was, according to a high authority, thus distributed:—

Belonging to the United States.....	5,539,000	tons.
" the United Kingdom	5,895,000	"
" all other countries	5,800,000	"

The tonnage of shipbuilding turned out of the United States ports at this time often exceeded that produced in the United Kingdom. The material employed was, of course, chiefly timber, and the class of vessels built, the famous clipper ships of that day. America could keep her own so long as timber-built vessels were the order of the day. When iron took the place of wood the condition of things were changed. The tariff of the United States did not allow of iron being imported, except on the payment of almost prohibitory duties, and with labour very much more costly, the shipbuilding trade of the American Continent rapidly decreased. This movement was greatly accelerated by the events of the civil war, which, for a time, almost stopped the production of American-built vessels, and caused the trade to be transferred to England. The American shipbuilders now turn out, on an average, about one-third the tonnage annually built in Great Britain. They chiefly, however, build wooden vessels. The tonnage built in iron has never in any one year exceeded 40,000 tons, being approximately about one-sixth of the whole production, whereas in the United Kingdom the new work turned out is almost exclusively in iron or steel. Many attempts have been made to revive the shipbuilding industry of the United States. Remissions of tariff duties have been made on iron imported for shipbuilding purposes. Bounties have been proposed. Foreign vessels have been entirely excluded from the internal commerce of the country. But these, and other devices of the same kind and tendency, have alike failed to restore the American shipbuilding trade to its former prosperity, and for many years past the Americans have had the mortification of seeing about 90 per cent. of their over-sea trade carried in British-built and British-owned bottoms.

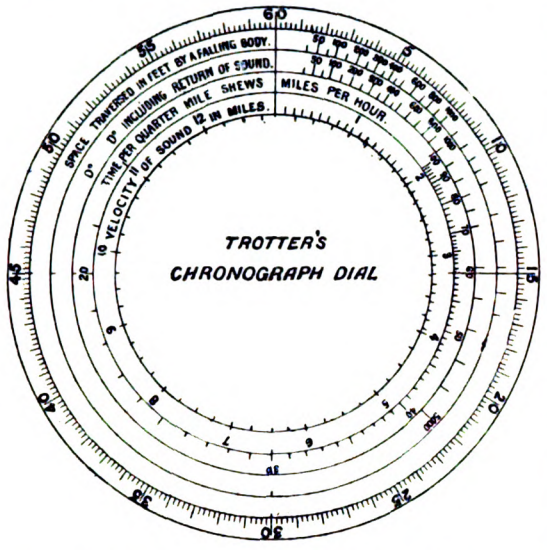
The case of Continental countries has not been much more satisfactory to themselves than that which we have just cited. From time to time we have been accustomed to hear it said that the shipbuilding supremacy of our own country was in serious danger. We have no wish to be unduly optimistic, but the figures show that if our shipbuilding industry is not unassailable, it has not so far been successfully assailed. The tonnage of vessels launched in France has not, in any year since 1873, exceeded 60,000 tons, and if we except the years 1882 and 1884, it has never exceeded 40,000 tons. In Germany the trade has made somewhat more progress, but even there the greatest tonnage launched in any one year has been under 85,000 tons, or less than one-fifth our own average over the last ten years. Italy, the only other shipbuilding country of any note, has never been able to supply her own requirements, small as they are.

The causes of the supremacy of British shipbuilders are not far to seek. They are to be found in a plentiful supply of cheap raw materials, including in that term iron or steel and timber; in the superior efficiency and industry of British labour, in our splendid seaboard, with its admirable harbours, and every facility both for building and launching ships; in the superior scientific knowledge of our naval architects, and in our unquestionable prestige and repute as a shipbuilding nation. Whether these advantages will ultimately be wrested from us, or shared in a material degree by other nations, we do not venture to say. Hitherto, at all events, they have been retained almost exclusively.

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TROTTER'S CHRONOGRAPH DIAL.

THE annexed sketch illustrates an ingenious dial, devised by Mr. A. P. Trotter, for use in stop watches. By the addition of this dial to an ordinary stop watch, the latter can be employed for determining the distance traversed by a falling body, by observing the time occupied between the moment of release and the moment it strikes the ground, or with an appropriate allowance for the speed at which sound travels, by observing the time from the moment the object is released until it is heard to strike the ground. The distances can be read off on the second and third circles of the dial respectively. The first or



outermost circle gives seconds, as in the usual chronograph dial. The second and third circles are only marked up to the depth a freely falling body would reach in eight or nine seconds, because for greater distances the velocity acquired by a falling body becomes so great that the air resistance sensibly affects the time occupied in falling a certain distance; and as the air resistance depends on the size, shape, and weight of the body, it is impossible to make a general allowance for this disturbing effect. The dial has therefore been marked only so far as 1000ft., which limit will probably suffice for all practical purposes. The fourth circle shows miles per hour when the second hand is started when entering upon and stopped when completing a quarter of a mile. The fifth or innermost circle shows the distance in miles corresponding to the interval which elapses between the flash of a gun and the arrival of the sound. Mr. Trotter's ingenious and inexpensive addition to chronographs and stop watches should prove of great value to engineers.

SHIPBUILDING NOTES.

Messrs. Pearce Brothers, Dundee, launched this week for a Japanese syndicate in this country, the first of a fleet of passenger screw steamers for traffic on the Japanese coast. She is expected to run at a speed of 14 knots an hour. The steamer was named the "Anshin-Maru."

The s.s. "Karagda," built for the British India Steam Navigation Company by Messrs. A. & J. Inglis, underwent steam trials on the Clyde a few days ago. The "Karagda" is a vessel of about 1170 tons. The speed obtained was 13·85 knots on extended trials.

The s.s. "Damascus," built by Messrs. R. Napier & Sons, Glasgow, for Messrs. George Thompson & Co., of Aberdeen, underwent a trial last week. The "Damascus" is a vessel of 3800 tons gross, and is fitted with triple expansion engines of 3000 h.p. The mean speed attained on the measured mile was 14½ knots. The "Damascus" is intended to be used in the Australian and China trade of Messrs. Thompson.

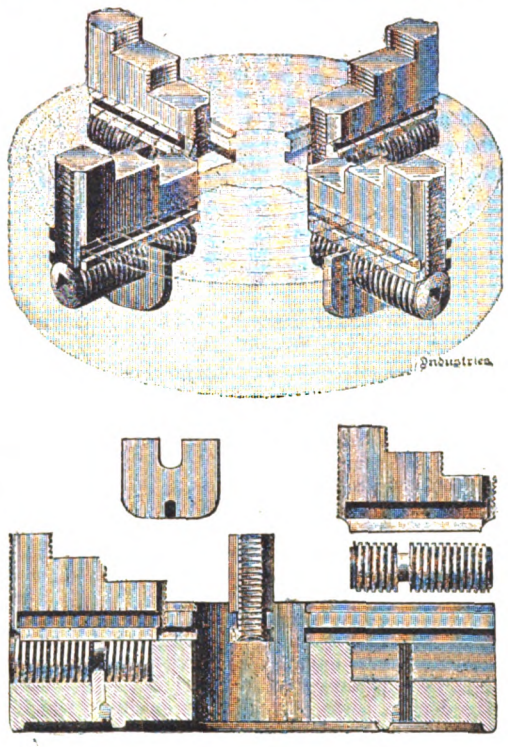
On December 29th, 1887, there was launched from the yard of Messrs. Jos. L. Thompson & Sons, Sunderland, the steel steamer "Cabo San Antonio," built to the order of Messrs. Ybarra & Co., Seville. The vessel is of the following dimensions: Length, 260ft.; breadth, 36ft.; depth, 23ft. 6in.; and it has been constructed on the longitudinal or cellular bottom system, under special survey of the highest classification. The principal saloon will be handsomely furnished, the floor being laid with encaustic tiles. The "Cabo San Antonio" is being fitted with triple expansion engines of 700 i.h.p. by Messrs. Blair & Co., Limited, of Stockton-on-Tees.

Messrs. Short Brothers, Pallion, have apparently determined to have as favourable a return for tonnage built in 1888 as possible, as they began the year with launching, at 4-0 a.m. on the 2nd inst., the steel steamer "Scottish Prince," built to the order of Messrs. Knott Partners, Newcastle-on-Tyne. The "Scottish Prince" is a vessel of 1954 tons gross register, length 290ft., breadth 38ft. 9in., depth moulded 20ft., and is to be fitted with a set of triple expansion engines of 180 n.h.p., by Mr. John Dickinson, of Palmer's Hill Works. The boilers are of steel, 150lb. working pressure. This is the seventh vessel built for the same owners by Messrs. Short Brothers during the last three years.

A handsome iron sailing ship, the "Afghanistan," was launched last Thursday for the British and Eastern Shipping Company, Limited, of Liverpool, from the yard of Messrs. Richardson, Duck, & Co., of South Stockton. The following are the principal dimensions: Length, 305ft.; breadth, 42ft.; depth of hold, 24·7ft.; registered tonnage, about 2200 tons. She is rigged as a four-masted barque, with full poop aft, with saloon and accommodation for captain and officers. This is the sixth ship built for the company.

REVERSIBLE JAW CHUCK.

WE are indebted to our contemporary, the *American Machinist*, for the accompanying illustrations showing a new independent reversible jaw chuck invented by Mr. D. E. Whiton, and manufactured by the D. E. Whiton Machine Company, New London, Connecticut. The chief part of the chuck consists of a casting fitted with radial slots open on both ends, beneath which the screws for working the jaws are fitted. The screws are provided with a groove near the middle, into which a U shaped plate of



hardened steel fits, and which is inserted through a groove at the back of the chuck after the screws are in position. This steel plate takes the horizontal thrust of the screw. The advantages claimed for this chuck are: Work of larger diameter than the chuck can be held, as the thread of the screw extends to the outside of the chuck; the thrust in the screw is entirely taken by a hardened steel plate, thereby reducing the wear; the screws may be easily removed or replaced, but are safely held in their places while the chuck is working; the screws and jaws are made of bar steel, and the jaws are hardened and easily reversible.

Books Received.

Practical Treatise on Bridge Construction. By T. CLAXTON. FIDLER, M.Inst.C.E. London: Chas. Griffin & Co.

Technical Education and Foreign Competition. By SWIRE SMITH. Reprinted from the *Westminster Review.*

American Chemical Journal. Vol. IX., No. 3. Baltimore: Ira Remsen.

Proceedings of the Institution of Engineers and Shipbuilders in Scotland. Meeting, October 25th, 1887.

Proceedings of the Cleveland Institution of Engineers. Meetings, April 4th and May 16th.

On a Form of Apparatus for the Rapid Determination of Specific Gravities of Bodies. By M. WALTON BROWN

A System of Practical Arithmetic. By SAMUEL YOUNG. Manchester and London: John Heywood.

Proceedings of the Philosophical Society of Glasgow, 1886-7. Vol. XVIII. Glasgow, 1887.

The Sugar Bounties: The Case for and Against Government Interference. By WILLIAM SMART, M.A. Edinburgh and London: Wm. Blackwood & Sons. 1887.

Electrical Distribution by Alternating Currents and Transformers. By RANKIN KENNEDY. London: H. Alabaster, Gatehouse, & Co.

Tafel der Viertel-Quadrate aller ganzen Zahlen von 1 bis 200,000. Von JOSEPH BLATER. Vienna: Alfred Hölder.

Kalender für Elektrotechniker, 1888, mit Beilage. Herausgegeben von F. UPPENBORN. Munich and Leipsic: R. Oldenbourg.

The Elements of Chemistry: A Text Book for Beginners. By IRA REMSEN. London and New York: Macmillan and Co.

Lockwood's Dictionary of Terms used in the Practice of Mechanical Engineering, edited by "A Foreman Pattern Maker." London: Crosby Lockwood & Son.

Marine Engineering of the Victorian Era. London: *Shipping World* office.

Reports from the Consuls of the United States. 3 Vols. Washington Government Printing Office.

Annual Report for 1886 of the Secretary for Mines and Water Supply. To the Hon. Duncan Gillies, M.P., Secretary for Mines for Victoria.

Reviews.

SCHOOLS OF FORESTRY IN GERMANY. By J. C. Brown, LL.D. Edinburgh: OLIVER & BOYD. London: SIMPKIN, MARSHALL, & Co. 1887.

Forestry as a branch of industry has not received the same attention in this country as it has on the Continent, where for many years there have been fully equipped schools for the training of men who were intended to take charge of the plantations belonging to their respective Governments or to private individuals. Until a few years ago those intended for the forest service in India were sent to Spain, France, or Germany for their training, while those in charge of the forests of this country or the Colonies picked up their knowledge in the same haphazard manner as apprentices in other businesses usually do. Considering the importance of the subject, this is very much to be deplored, for not only is timber absolutely necessary in every description of architecture and rural occupation, but trees in a living state have a very important effect on the climate, by yielding shelter to lands exposed to rough winds, and shading those subject to burning sunshine. Attention has now, however, been directed to the matter, and a Select Committee of the House of Commons, which was appointed to consider whether by the establishment of a Forest School or otherwise our woodlands could be rendered more productive, has recently issued its report. Notwithstanding this, the book which has been written by Dr. Brown is likely to be useful, for the author has had a very large and varied experience in different parts of the world, and has recorded his experience in a long series of works. Four years ago, at a public meeting held in Edinburgh and presided over by the present Secretary of State for Scotland, it was resolved that it was expedient in the interests of forestry to promote a movement for the establishment of a National School of Forestry in Scotland, with a view to furthering and stimulating the scientific management of woods in Scotland and the sister countries. As a result of such movement it was decided that an International Exhibition of forest products and other objects of interest connected with forestry should be held in Edinburgh. The exhibition proved a great success, but as yet no definite steps have been taken for the establishment of the school; in fact, with the exception of a few classes in the Indian Engineering College, no instruction is given on the subject in Britain. Dr. Brown points out how some of our existing institutions might be so modified as to admit of forestry being taken up in them, and that at a comparatively small outlay, and his book is intended to give an idea of the nature of the instruction which ought to be afforded. It begins by giving a short outline of the history of what may be called scientific forestry, and then enters into descriptions of the more important schools of forestry in Germany, such as the Royal Saxon Forest Academy in Tharand, the Royal Prussian Forest Academy at Neustadt-Eberswalde, the Royal Hanoverian Forest Academy in Munden, and others, as well as an account of the courses of instruction in forestry in various polytechnic schools; and the concluding chapter is taken up with an account of the relation of the schools of forestry to the national system of education in Germany, and with some of the financial questions connected therewith,

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while an appendix gives a considerable amount of information and a number of suggestions which would be useful in organising a British National School of Forestry. We trust that Dr. Brown's book will advance the object he has in view, and we recommend it to those of our readers who are interested in forestry.

THE ENGINE, BOILER, AND EMPLOYERS' LIABILITY INSURANCE COMPANY, LIMITED — CHIEF ENGINEER'S REPORT FOR 1886.

The report of Mr. Michael Longridge for the year 1886 practically forms a short treatise on the safe and economical working of steam engines and boilers, apart from its value as a record of useful inspectional work, which just now has an important bearing on past and prospective legislation. In the report is a summary of defects which have been discovered during the year in engines and boilers coming under his company's inspection, whilst a large space is devoted to an analysis of the Board of Trade Reports on boiler explosions. It also contains some interesting remarks on the proposed boiler legislation. The total number of accidents of all kinds to engines is rather below the average for the previous seven years; but the insurance of engines is a matter in which, even with careful and periodical inspection, there will always of necessity remain a large element of risk. It is interesting to note that whilst 37 per cent. of the accidents to engines were due to causes purely accidental or unascertained, 30 per cent. were ascribed to weakness and faulty design, though Mr. Longridge remarks that "as regards the latter class it is but fair to say that in many cases the fault lies not with the designer and builder, but with the owner, who, to avoid expense, persists in using pressures and speeds which the engine was never designed to bear."

There is the usual lists of defects in boilers which have been discovered by inspection, under the head of corrosion, fractures, &c., and mountings either out of order or altogether inoperative; but it is gratifying to learn that during the year there has been no explosion of a certified boiler. A boiler, however, which was insured by the company but not certified, ruptured in the fire box, which was much weakened by corrosion. With regard to this, it is explained that "as the boiler, notwithstanding repeated applications on the part of the company, had never been prepared for thorough examination or certified, the company does not consider itself in any way, except pecuniarily, responsible for the damage." During the year the Board of Trade have investigated and reported on fifty-five explosions of boilers and other vessels working under steam pressure, causing the death of thirty-two persons, and injury to sixty-one others. The chief feature of Mr. Longridge's report, and that which will have an especial interest for the steam user, is the chapter on "Boiler Legislation." After specifying the object of the draft Bill which it is proposed to submit during the next session of Parliament, the writer proceeds to examine each of its provisions, and to point out the consequences they appear to involve. He then goes on to consider whether the interests of the public demand such a stringent measure, and whether, if carried out, it is likely to be successful in its operations. He calls attention to the fact that most of the proposals contained in the Bill are embodied in the boiler laws of France and Germany, and yet the rate of explosions in these countries is higher than in England, and generally concludes that except in making the existing Boiler Explosions Act of 1882, more effective, and in that way bring reckless and wilfully negligent boiler owners under full legal control, no further legislation is required. Altogether Mr. Longridge's report is, as usual, well worth the close attention and careful study of all interested in steam power.

EXPANSION OF STRUCTURES BY HEAT. By John Keily, C.E. London: CROSBY LOCKWOOD & Co.

In his preface Mr. Keily says: "A bare record of experiments and observed facts would be but of little use to a student, or an engineer, who might not have time to study them and to frame a theory from them. To be useful, it is necessary to connect the facts together, and to show how far they are applicable to ordinary engineering practice." A well meant attempt to do this, "simply and comprehensively, by means of ordinary geometry," is contained in the subsequent pages, and from the author's point of view the attempt is fairly successful. But in a book of this kind something more than success in this narrow sense is expected, for there is little in it which an engineer or a student with elementary attainments in science could not work out for himself with a little trouble, and the principal use of such a book is to save that trouble by placing the facts and propositions in connected sequences, as Mr. Keily says; but also to state both the facts and the theories with perfect lucidity, and to work out the proofs with unquestionable and complete reasoning. In these latter respects the book before us is so deficient, that we fear that many would-be readers will find it easier and more satisfactory to work out their own conclusions than to seek help in its ambiguous and apparently illogical language. As the author appears to be master of his subject, we conclude that he is quite inexperienced in imparting his knowledge, which inexperience, combined with an over anxiety for conciseness, will explain most of the faults of his work, which, for the most part, reads like a student's note book, intended to be intelligible only to the particular student who compiled the notes. After a short preliminary section, the subject matter of the book is defined as the second of the two classes of changes caused in metallic bodies by changes of temperature, viz.: "The changes which take place in the position of the body." It is not apparent why "position" is used instead of "dimensions." The expansion of single bars leads to that of simple frames, and that to the expansion of complex frames and plates. Section V., dealing with "Thermal conductivity," has some unsatisfactory passages; for instance, "When a metallic bar . . . is exposed to the direct action of the sun's rays" it "becomes heated more rapidly than the surrounding atmosphere, because it is a better conductor of heat than the atmosphere." Sections VI. and VII. treat of elasticity, tensile strength, force of expansion, effect of heat on strength, set, flow of metals, and work of expansion and contraction; and the last section is given to suspension bridges. Section II. has articles on surveying chains and india-rubber; the last page is headed "Breech loaders in the Soudan," and immediately preceding it is a note of some observations on sea water. The omission of these subjects would not injure the book. As a general view of the effects upon structures of changes of temperature, the book may certainly be found useful by many students and practitioners of civil engineering, and we shall be glad if a demand for a second edition gives the author an opportunity of making it acceptable to a much larger number, by amplifying many passages and proofs, by distinguishing more clearly between assertions based on experiments and deductions therefrom, by the correction of such expressions as "the temperature of heat," "the principle of the centre of gravity," &c., and by the expunging of irrelevant matter.

STUDIES IN MACHINE DESIGN. By C. F. Archer. London: GRIFFITH, FARREN, OKEDEN, & WELSH.

These "studies" consist of twelve sheets of machine drawings intended for re-drawing to a different scale, in order to give students facility in drawing and familiarity with the general construction of the parts of a steam engine. There are two series of six drawings each, corresponding, we presume, with the requirements of the Science and Art Department examinations in the elementary and advanced stages respectively. The "elementary" series includes drawings of general engine details, such as bolts and nuts, couplings, joints, and valves, while the "advanced" series comprises a complete set of drawings relating to a launch engine. The drawings are well adapted to give a clear understanding of the principles underlying steam engine design, without confusing the student by unnecessary complexity; but as regards some of the details, there is a want of exactness which, unfortunately, may be frequently noticed in this class of drawings.

MINUTES OF PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS. Vols. LXXXIX. and XC.

Volume LXXXIX., like most of its predecessors, contains much matter of interest, not merely in the papers read with a view to discussion, but also in the "other selected papers." The first paper in this volume is that by Mr. J. J. Webster, on "Dredging Operations and Appliances." The author gives a concise account of the various systems followed and appliances used in dredging, supplemented by particulars, collected from various sources, and partly based on his own experience, of the cost of dredging operations under various conditions, and also of the power required. With the help of a large number of indicator diagrams from engines working dredges, he establishes a simple formula for ascertaining approximately the indicated h.p. required for dredging different kinds of material under varying conditions of lift. This formula takes the shape of $i.h.p. = C.W\sqrt{H}$ where H is the height of the top tumbler shaft from the surface of the ground to be dredged, and W the number of tons per hour to be removed; C is a constant depending on the nature of the ground.

Next in order is a paper by Colonel E. Maitland, R.A., on "The Treatment of Gun Steel," which for various reasons excited considerable interest, and gave rise to an animated discussion. The latter was by general consent not limited to steel as applied to guns only, and many of the speakers handled the subject from a more general point of view. An abstract of this paper was given in our issue of the 18th March last (see *Industries*, Vol. II., page 269), so that we need not do more now than refer to that notice for details of the paper.

A very considerable portion of the discussion appears to have been devoted to the two questions of whether the ultimate strength or the elastic limit should form the basis for determining the admissible stress, and whether oil hardening be beneficial and necessary or otherwise. Major Mackinlay opened the debate, and after criticising the somewhat loose manner in which the author had employed the terms strain and stress, proceeded to explain briefly the principles involved in the building up of a gun. As we have recently had occasion to quote Major Mackinlay's own work on this subject, we shall not now again refer to the matter. Sir Frederick Bramwell supported the author's views as to the value of the elastic limit; "it was commonly said that if the elastic limit were passed the material was being destroyed;" "but as far as he (Sir Frederick Bramwell) was concerned, he did not know what the elastic limit was," as the so-called elastic limit could be raised, as stated by the author, by successive applications of stress. Sir Frederick remarked that, "if the ordinarily received views about the elastic limit were correct, then wire guns . . . must, as regarded the essential material of which they were made, viz., the wire, be every one ruined before they were made." He proceeded to explain his meaning by pointing out that wire or ribbon was manufactured by means of the draw bench, and that it "was so much strained in the act of drawing that permanent set was put into it, and it came off in the circular hank, the recognised trade form of wire;" this must mean that its power of recovery had been destroyed because the elastic limit had been passed, and it remained in a circular hank. This alone, the speaker contends, ought, according to the views of the mathematician, to ruin it, apart from the subsequent treatment it might receive in the process of application to gun construction. Professor Unwin replied very effectively, and, as we think, conclusively, to the contentions of the author and Sir Frederick Bramwell on the subject of the elastic limit. The matter is so important that we may be excused for quoting somewhat liberally from Professor Unwin's remarks. The author in the course of his paper had taken the case of two guns, one of which was constructed of a material with an elastic limit reached at 12 tons powder presssure per square inch, and the other of a material with an elastic limit attained at 20 tons. He supposed that under the action of a series of charges the elastic limit of the 12-ton gun was raised to 20 tons, and he stated that the two guns would then be in exactly the same condition—that the gun with the originally low elastic limit would be as good as the gun which had the higher elastic limit. Professor Unwin "wished to recall the fact that up to the elastic limit of the steel the whole extension of the material did not amount to more than about $\frac{1}{1000}$th of its length. The moment the elastic limit was passed, with an increase of stress of say ¼ ton, the material stretched $\frac{1}{100}$nd of its length, and in order that it might have its elastic limit raised, say from 16 tons to 20 tons, it must be stretched $\frac{2}{100}$th of its length. Take the case of the barrel of a 13½in. gun: supposing the gun had in the bore initially a material the elastic limit of which was exceeded by the circumferential and radial stresses induced by the action of powder, then before the elastic limit of that material could be raised at all the bore of the gun must stretch $\frac{1}{50}$nd of its length; before it could be raised to 20 tons it must be stretched by $\frac{1}{25}$th of its length; in other words, the 13½in. gun must become more than a 14in. gun. He imagined that guns did not expand as much as that, and if they did not he wanted to know whether it was possible that the elastic limit after all was raised. It was not by the mere loading of a material that its elastic limit was raised, but by the stretching which followed the loading in ordinary cases. If a material were in a position in which stretching was impossible there was not a particle of evidence that its elastic limit would be raised." Apart from the question of guns it may be said that no one with any knowledge of the subject will contend that a material is necessarily ruined by being strained to a certain extent beyond the elastic limit once, or even half a dozen times, and in many processes of manufacture this must occur. The point, however, of primary importance, as has been fully proved, is that the stress in excess of that at which the elastic limit is reached should not be too often repeated. It is quite obvious, to begin with, that the stress must not be carried as far as the breaking down point, and to insure security against a practically unlimited number of repetitions of stress the latter must be kept very much below that point. Recent experiments tend to prove that the raising of the elastic limit by repetitions of stress in one sense is a somewhat unstable phenomenon, and that a blow with a hammer, or a single application of stress in the opposite sense, will suffice to reduce the elastic limit to its original condition. If such a result can be brought about by the blow of a hammer on a test piece, it seems very probable that the shock of explosion in a gun would produce a similar effect on the materials of which it is constructed, and that the improvement, if any, effected by one discharge might be neutralised by the next. As

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one of the speakers at the Institution pointed out, in ordinary engineering structures, and in machinery, the necessity for keeping the stresses well within the elastic limit is dictated by the purely practical consideration that anything in the nature of permanent set is quite inadmissible as a general rule. On the question of oil hardening, another of the chief points in debate, opinions were pretty fairly divided. The author himself appears to doubt the advisability of oil hardening, and holds the opinion, shared by many of those who took part in the discussion, that it tends to set up internal strains. Among those inclined to this view were Sir Frederick Bramwell, Mr. Daniel Adamson, Mr. Riley, and Mr. B. Baker, while on the other side were to be found Major Mackinlay, Mr. Nordenfeldt, Mr. Head, Mr. Longridge, and Mr. Maxim. Those practically acquainted with the behaviour of steel can, we think, have little doubt that internal strains must be produced by oil hardening under ordinary circumstances, and the larger the masses of metal dealt with, the greater the risk from the above cause. The suggestion put forward during the discussion, that large steel guns should be cast in one piece, is a proposal on which we think few, if any, private steel makers would be prepared to act on their own responsibility. One of the strongest arguments in favour of built-up guns, is the fact that the quality and condition of the metal used are under much better control than where very large masses are manipulated.

Want of space prevents us from doing more than mention a few of the remaining papers, all of which contain matter of interest. The last paper read and discussed which appears in this volume of the "Minutes," is on printing machinery by Mr. Edward Arnott Clowes. It contains a good account of the advances made in this department from its commencement up to the present date. Among the "other selected papers" are the following: "Gas Power Compared with Steam Power," by Mr. J. E. Dowson; "Setting out the Curves of Wheel Teeth," by Mr. W. I. Last; "Further Investigations Regarding Wire Gun Construction," by Mr. J. A. Longridge; and "Recent Researches in Friction," by Mr. John Goodman, Wh. Sc. and Stud. Inst. C.E. The latter contains an account of experiments carried out in the laboratory of University College, to ascertain, among other matters, the relation existing between the total frictional resistance of a brass and the chord of its arc in contact with the journal. It forms a continuation of a paper previously read at a students' meeting by the same author, to which was awarded the Miller Scholarship.

The succeeding volume contains an unusually large number of comparatively short papers, many of which, however, bear upon the same or kindred subjects. It is an admirable feature in the arrangement and editing of the papers read before and published by the Institution, that those relating to similar matters are kept as much as possible in juxtaposition with each other, in order to facilitate comparison and reference. The first four papers, on "Chalk Springs in the London Basin," "Borings in the Chalk at Bushey, Herts," "On a Bore Hole in Leicestershire," and "The Wells and Borings of the Southampton Water Works," respectively by Messrs. J. W. Grover, W. Fox, T. S. Stooke, and W. Matthews, were read and discussed together. For the population of this country in general, and more especially of the large towns and manufacturing districts, it is impossible to overrate the importance of the subject; it is brought very forcibly home to our minds by the fact that Manchester—a town situated in a county and district abounding in streams, and blessed by nature, as a rule, with an almost too abundant supply of fluid from the clouds—has to bring the water necessary for its requirements a distance of between eighty and ninety miles as the crow flies. Mr. Grover's paper refers to the water works of Newbury, Wokingham, Leatherhead, and Rickmansworth, all drawing their supply from the chalk springs in the London basin. The difficulties connected with the water problem as affecting the population in and around the Metropolis are in many respects of a different character to those occurring in Manchester and other manufacturing districts. In both cases there is a large and increasing population; but while in the latter the natural water supply would probably be amply sufficient if not contaminated, in the former this is not the case, the district around London having comparatively few rivers, and those, with one exception, insignificant, while the rainfall is much less than in the northern counties. Mr. Grover states that in July, 1885, no less than 96,000,000 gallons were drawn from the Thames daily, being more than one-third of the entire volume of the river then flowing over Teddington weir. He looks to the chalk as the proper prospective supplemental source of supply for London. With reference to this point, the following remarks of Dr. Evans during the discussion are worth quoting: "In the case of a chalk country the whole of the water abstracted by pumping was so much abstracted from the streams, which would otherwise flow through the country. Of course, the question would arise as to the water supply, not only of the Metropolis, but of the towns around the Metropolis, and in every case where there was chalk, ... they might get an admirable supply of chalk water for the towns and villages. That water, after being used, was returned to the rivers, and practically the rivers did not suffer. But if London were to obtain the whole of its supply from the wells sunk around London in the chalk, taking Mr. Grover's figures of 160,000 gallons daily as the produce of four inches of rain on a square mile of country, London would require, instead of that, 160,000,000 gallons; and the whole of the water of the streams on 1000 square miles of country—an area considerably larger than a great many English counties—would be consumed for drinking water, and for other purposes, in the Metropolis. But he was wrong in speaking of it as drinking water. There was not the slightest necessity for any such large supply of drinking water being brought into London. There was, for ordinary purposes, any amount of water in the shape of Thames water. At present there was brought into London more than enough spring water to supply all the necessities of the Metropolis; and if he were to make a suggestion to the Institution of Civil Engineers, it would be—why not try whether some system of double service could not be adopted, rather than attempt to rob the whole neighbourhood around London of its natural water supply, and be at an enormous expense to bring pure water into the Metropolis, to flush the sewers and water the roads?"

The next paper in order is that on "The Conversion of Timber by Circular Saws and by Band Saws in the Pine Growing Districts of the United States of America," by Mr. L. H. Ransome, a student of the Institution. The paper relates chiefly to the practice in the State of Michigan, of which the Saginaw Valley district turns out, according to the author's statement, more lumber than any timber producing district of like extent in the world. The largest quantity of wood ever cut in one season was in 1882, when the total reached 1,011,274,905ft. (square feet one inch thick). In the course of the paper, a very ingenious machine, called a "steam nigger," for placing the logs on the travelling carriage of the sawing machine and holding them in position while being fixed, is described; when properly manipulated, it will roll into position and fix on the travelling carriage ready for sawing a log of 16ft. long by 2ft. diam. in from three to four seconds.

As regards the speed of circular saws, it is generally considered in America that the circumferential speed should be about 7540ft. per minute, with a saw 8ft. diam. With respect to the comparative merits of circular and band saws, the circular has the advantage in rapidity of production, turning out 50,000ft. of lumber in ten hours, as against 35,000ft. for the band saw. The quality of the work produced by the latter is, however, superior and the waste less, while having been only recently introduced for this purpose it is capable of further improvement, whereas the circular saw has probably reached the utmost limits of production.

Sir Lowthian Bell's paper on the "Manufacture of Salt near Middlesbrough," describes what appears to be in that district a comparatively new industry. In 1859, Messrs. Bolckow & Vaughan commenced the sinking of a bore hole, with the object of eventually sinking a deep well to obtain water for steam and other purposes; but instead of finding what they required, came at a depth of 1200ft. upon a bed of rock salt 100ft. in thickness. After an attempt, frustrated by the large influx of water, to sink a pit and work the mineral by a regular system of mining, the undertaking was abandoned for many years, but eventually taken up again by Messrs. Bell Brothers. The salt is raised in brine, and for the evaporation of the latter the waste gases from the blast furnaces, which are in excess of what is required for heating the air and raising steam, are employed. By means of the waste heat thus utilised, from two hundred to three hundred tons per week of salt is obtained. In connection with this salt industry, the manufacture of soda by an ammonia process invented by Mr. Schloesing, of Paris, has been established.

Sir Frederick Abel contributed a very interesting paper on "Accidents in Mines." In it the various causes of accident are enumerated, statistics of casualties given, and the various means and apparatus devised for their prevention described. In regard to the detection of fire damp in mines, Sir Frederick Abel states the qualities which must be demanded of a really useful fire damp indicator, viz., simplicity of construction, facility of use by persons of average intelligence, quickness of action, non-liability to derangement, and capacity to detect less than 1 per cent. of fire damp in the air of the mine. The instrument which has hitherto most nearly approached the fulfilment of these essential conditions is the fire damp indicator of Mr. E. H. T. Liveing, in which he uses photometrically the rise of temperature produced in a platinum wire when this is heated in a mixture of fire damp and air.

Among the subjects of the "other selected papers"—all well selected—are: "Water Supply in the Cape Colony," by Mr. J. G. Gamble; "The Yanegase Yama Tunnel on the Tsuruga-Nagahama Railway, Japan," by Mr. Kinske Hasegawa; "Flour Mills and their Machinery," by Mr. Alfred Chatterton; and "The Strength of Iron and Steel in Shear and Torsion," by Messrs. Platt and Hayward.

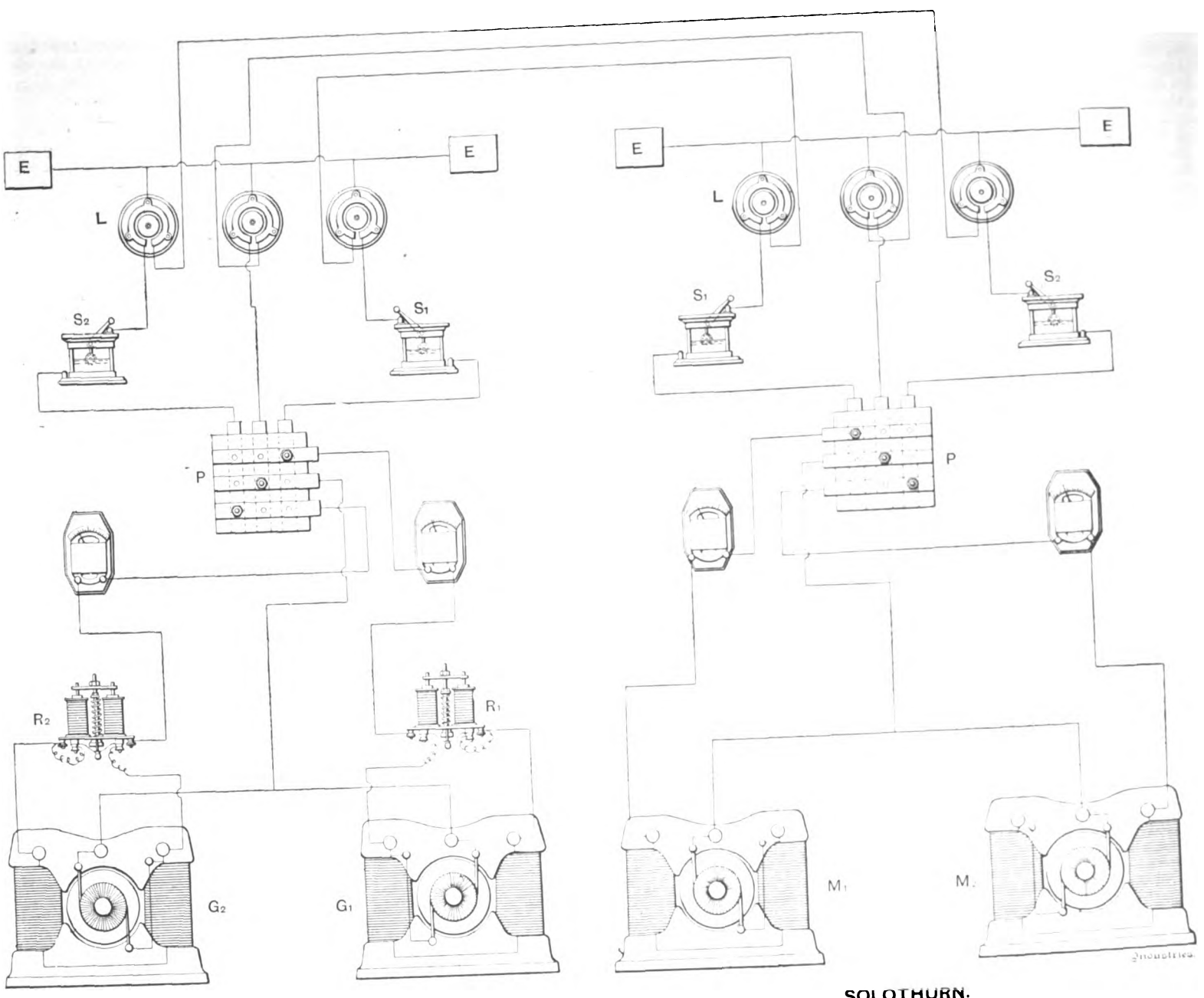
We note that an increasing number of the papers published are by students of the Institution. The foreign abstracts are chosen with the usual good judgment and discrimination, and contain much matter of interest to all classes of engineers.

Every Man His Own Art Critic at Manchester Exhibition, 1887. By Patrick Geddes. Manchester: John Heywood.

There are some minds so singularly fertile in suggestion upon all sorts of topics that one loses in time any sense of surprise at finding them commenting with their old vigour in some new field. Yesterday they out-rhymed the laureates, to-day they re-organise a science, to-morrow they may revise the constitutions of all previous Solons. They have the true secret of versatility, which is for the most part the application of the same unvarying form or set of forms to varying matter. To those who have followed Mr. Geddes' work at all closely there will be little astonishment at finding him writing upon art and art criticism. A scientist of well earned reputation, a suggestive writer on economics and on social and industrial topics, a practical organiser of philanthropic work upon æsthetic lines, it was quite in the range of his many-sided interest to apply to art the powers of analysis and synthesis which he has so successfully employed elsewhere. The mould was already there, the fusion of the new material for pouring into it was comparatively easy. The superb collection of pictures at Manchester afforded the opportunity for the subjection of art products to the crucible of the scientific mind, and the result is an exceedingly useful primer of modern pictorial art. Of the need for such a work there can be no question. The growing desire to learn the lesson of the arts and to enter into the House Beautiful has had as yet no commensurate results. The power which should be expended in progressing along the path to it is lost in the endeavour to find the way. People exhaust themselves in fictitious enthusiasms. A smattering of knowledge about details of design and colour represents the highest level of ordinary artistic culture, just as a smattering about books passes for profound literary knowledge. Not one man in a hundred has sought to get at the centre, to start with a method which shall give stability and value to his criticisms, and which shall correspondingly increase pleasurable emotions by giving them direction and concentration. To all seeking more earnestly to get out of art its best and all its best, the brochure of Mr. Geddes will be of the greatest value. It may not be always novel; it may sometimes claim for science the discovery of truths discovered when science was still dividing its attention between casting horoscopes and concocting elixirs; it may occasionally read as though "Every man his own art critic" meant "Every man for himself, but, more particularly, Mr. Geddes for us all;" but these are small detractions from the genuine educational value of the treatise. To all intents and purposes Mr. Geddes places himself before a picture and interrogates himself audibly, for the benefit of those around him. "In the first place, then, let us take a simple interest in what and how much these painters' eyes have seen, and add this to our own experience of life and nature, to our power of intelligent vision henceforward. Secondly, we have to make out something of how they have expressed and re-arranged the impressions they took in—how they have made their colour photographs of the world into these works of art; for only when these two things are done, and we understand our painters as observers and workmen, shall we be in a fair way to understand them in their third capacity, *i.e.*, in so far as they are poets and philosophers, humorists or satirists, optimists or pessimists." The questions are familiar enough, but then the majority of men are not given to put any questions at all to themselves; still less are they given thus methodically to exhaust a subject by continuous questioning. If Mr. Geddes had done no more than enforce this habit, he would have done excellent work; but he has given the answers as they appealed to him in the cases of a considerable number of pictures, and so far furnished valuable illustrative aid to those who shall follow his example of orderly interrogation. It is needless to say that in these answers a personal note is struck, with which the opinions of other critics will not always be in harmony. Such a result was inevitable, since even in the individual the solution of to-day will scarcely be the solution of to-morrow. But the answers, whether in themselves acceptable or otherwise, are happily and strikingly conceived, and have often wider issues than concern the special matter of the moment. To men of general culture no less than to those straining after it, to art critics as well as to those fraudulently asserting themselves to be critics, the pamphlet may be heartily commended.

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ELECTRIC TRANSMISSION OF ENERGY.



KRIEGSTETTEN. SOLOTHURN.

ELECTRIC TRANSMISSION OF ENERGY.

In our issue of the 8th of April, 1887, we gave an account of experiments carried out at the Oerlikon Engineering Works with a plant of two dynamos and two motors intended for the transmission of energy from Kriegstetten to Solothurn. These experiments were made by a committee of engineers and scientific men, with a view to ascertain the total commercial efficiency of the transmission plant; but as the machines were in this case placed side by side, the results could only be taken as approximately correct. It is evident that, in such an arrangement of machines and resistances erected within the limits of a covered workshop, the insulation of the circuits presents no difficulty whatever, whereas in the actual installation, when many miles of overhead wires must be used, the insulation becomes a matter of some difficulty, and atmospheric influences may also have some effect upon the performance of the plant. These considerations induced the makers to arrange for some further trials with the plant as actually installed. A committee was appointed, under the presidency of Professor Amsler, of Schaffhausen, the well known inventor of the planimeter, and the following gentlemen were members: Professor Weber, of the Zürich Polytechnic School, and his two assistants; Professor Hagenbach Bischoff, of Basle; Professor Veith, who occupies the chair of machine construction at the Zürich Polytechnic School; Herr Keller, engineer to Messrs. Escherwyss, of Zürich; Herr Lang, a manufacturer of Derendingen; and Herr E. Bürgin, of Basle, the inventor of the Bürgin dynamo. This committee have just issued their official report on the trials made on the 11th and 12th of October last with the plant as actually installed. Before quoting the results of these trials, it will be well to briefly refer to the general arrangement of this installation. At Kriegstetten there is a water power available, representing about forty actual horse power, and the problem was to carry as much of this power as possible to a mill in Solothurn, the distance being $4\frac{3}{4}$ miles as the crow flies; but, allowing for deviations, the length of each circuit may be taken as about five miles. There are at Kriegstetten two generating dynamos, and at Solothurn two motors, coupled up on the three-wire system, as shown in the above illustration. A perspective view of the dynamo was given on page 358, Vol. II. Each dynamo weighs 3 tons 12cwt., and has a Gramme armature 20in. diam. and 14in. long, the normal speed being 700 revolutions per minute. Referring to the diagram of connections, G^1 and G^2 are the generators at Kriegstetten, and M^1 and M^2 are the motors at Solothurn. R^1 and R^2 are electromagnetic switches which automatically come into action and short circuit the exciting coils in case of the current rising beyond a certain limit. This provision was introduced in order to guard against the destruction of the generator in case a short circuit should take place somewhere in the line. The current from each of the generators passes through an ammeter and then to a plug board, to which is also connected the balancing wire joining the negative brush of G^2 with the positive brush of G^1. The balancing wire is then carried direct to the middle one of the three lightning arresters L, and then to the middle wire of the line, whilst each of the outside wires is led through a liquid switch S^1 S^2, then to a lightning arrester, and to the line. Each lightning arrester consists of a circular metal disc, the edge of which is provided with projecting teeth, and situated in a concentric metal ring, the internal circumference of which is also provided with teeth, but not touching the teeth of the disc. All the discs are connected with a common earth wire and two earth plates E E. Should a flash of lightning strike the line, the current will leap across the intervening space between the teeth of the ring and those of the disc, and will thus be led to earth without passing through the machinery. The same provision against lightning is made at the motor station. The switches S^1 S^2 are of peculiar construction, and consist of a vessel containing a conducting liquid and a perforated metal ball dipping into it. When the current is to be switched off, the handle is turned so as to raise the ball out of the liquid; but the circuit is not immediately interrupted, since the liquid within the balls issues in fine streams out of the perforations, and so maintains the connection for a short time after switching off. As the liquid in the ball gets exhausted, and the streams become thinner, the resistance of the liquid connection is gradually increased to infinity, and thus causes the current to gradually diminish to zero. The line wires are supported on Johnson & Philips' patent fluid insulators, and the average span is about 1:30ft. Two sets of experiments were made. On the 11th October only one generator and one motor were tested, whilst on the 12th October both generators and both motors were tested. In the latter test the balancing wire was cut out of circuit as of no importance when, as in these experiments, it was quite easy to regulate the load of each motor so as to fairly divide the work between them.

Electrical measuring instruments were fitted up at both stations in rooms sufficiently distant from the machinery, so as not to be influenced by stray magnetism. The current was measured by large tangent galvanometers, and Thomson mirror galvanometers, standard cells, and potentiometers were used to measure the pressure. The object in measuring the current at both ends of the line was to ascertain whether any appreciable leak took place. In addition to these purely electrical measurements, obser-

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vations were made at the generator station regarding the water level in the head and tail race of the turbine, the position of the regulator on the latter, and the speed of the dynamos and turbine. After the transmission trial on the 11th October was completed, the armature of the dynamo was taken out and replaced by a plain spindle provided at the end with a brake. The turbine was then started again under exactly the same conditions as were noted at the previous trial, and the power absorbed by the brake was measured. The comparison between the power thus measured and the electrical energy given out by the generator is evidently the commercial efficiency of the latter. On the following day both generators and both motors were tested in the same condition as prevails in actual practice, with the only exception that, as already mentioned, the balancing wire was cut out of circuit. This alteration, which could obviously not increase the efficiency of the whole system, was made to simplify the measurements. The power absorbed by the generators was computed on the basis of the previous day's trial from the observed conditions under which the turbine worked, whilst the power developed by the motors was on both days directly ascertained by means of a friction brake fitted to a first motion shaft common to both motors. A small correction was made for the power absorbed by this shaft when running idle. The following tables give the results as published by the committee:—

I.—Electrical Measurements.

Time of trial.	Electromotive force.		Terminal pressure.		Current measured at	
	Generators.	Motors.	Generators.	Motors.	Generators.	Motors.
11th Oct.	1231·6	988·6	1177·7	1041·2	14·20	14·17
„ „	1237·0	1016·8	1186·8	1066·1	13·24	13·28
12th „	1836·5	1575·4	1753·3	1656·1	11·48	11·42
„ „	2129·0	1896 2	2058·0	1965·2	9·78	9·79

II.—Resistances and Loss of Pressure.

Time of trial.	Resistance of machines.		Line resistance.	Pressure lost in line.		Temperature of air. Centigrade.
	Generators.	Motors.		Calculated	Measured.	
11th Oct.	3·741	3·716	9·228	130 9	136·5	+7·5
„ „	3·741	3·710	9·228	122·3	120·7	+7·5
12th „	7·251	7·060	9·044	103·7	97·2	+3·2
„ „	7·240	7·042	9·040	88·4	92·8	+3·2

III.—Determination of Energy.

Time of trial.	Internal electrical horse power.		Terminal electrical horse power.		Actual horse power	
	Generators.	Motors.	Generators.	Motors.	Supplied to generators.	Obtained from motors.
11th Oct.	23·76	19·03	22·72	20·02	26·15	17·85
„ „	22·27	18·34	21·35	19·23	24·54	16·74
12th „	28·64	24·46	27·34	25·71	30·87	23·21
„ „	28·29	25·21	27·37	26·13	30·87	23·05

IV.—Percentage of Efficiencies.

Time of trial.	Electrical efficiency.		Commercial efficiency.		Total efficiency of transmission.	Remarks.
	Generators.	Motors.	Generators.	Motors.		
11th Oct.	90·8	93·7	86 8	89·1	68·3	One generator and one motor.
„ „	90·6	91·3	86·9	87·1	68·2	
12th „	92·8	94·8	88·5	90·3	75·2	Both generators and both motors.
„ „	91·6	91·4	88·7	88·2	74·6	

An inspection of these figures will show that there is practically no loss of current by leakage on the line. In some cases the current measured at the motor station is slightly below that measured at the generator station; but the discrepancy is exceedingly small, and evidently due to personal or instrument errors, since in some other cases the current received by the motors appears to be even slightly larger than that sent out by the generators, which is obviously impossible. The second table also shows the influence of the air temperature upon the total resistance. The third table gives the power, and the fourth the efficiencies in percentages. It will be noticed that when one generator and one motor only were used, the commercial efficiency was slightly over 68 per cent.; but when both generators and both motors were used, this efficiency rose to about 75 per cent., which is clearly due to the higher voltage employed. On the whole, the result of these trials must be considered highly satisfactory, and Mr. C. E. L. Brown can be congratulated upon having succeeded in transmitting power over a distance of five miles with a loss not exceeding 25 per cent. It is needless to say that so high an efficiency could not possibly have been attained with any purely mechanical system of transmission.

Notes.

THE PROPELLING OF STEAM VESSELS.

The *Liverpool Journal of Commerce* states that one of the most startling and important inventions of the day with regard to the propelling of steam vessels is now under consideration. Should it prove successful and meet the expectations of the inventors, it will entirely revolutionise the whole of the steam service of this country; and it is stated further that one eminent firm of engineers has offered £100,000 for the patent.

SULPHUR MINES IN SICILY.

The low prices obtainable for sulphur are causing great anxiety to the owners of sulphur mines in Sicily, there having been a steady decrease for the last five years. The British Consul at Palermo states that dealers there have now to be content with a tenth of their former profits, owing to excessive production, the annual output at present being 60,000 to 70,000 tons above the ordinary consumption. The result is that enormous stocks are accumulating, and though the formation of a syndicate of mine owners for the purpose of restricting the production would probably bring about a better state of affairs, Sicilians are not inclined in favour of such a course of action.

ARTIFICIAL ILLUMINATION.

During the discussion of two papers dealing with artificial lighting, read at the recent meeting of the American Gas Light Association, Dr. Morton, the well known physicist, drew attention to a point apt to be overlooked in these days of electric and incandescent gas lighting, viz., the importance of a thoroughly diffused light, if injury to the eye is to be avoided. He said that diffused lighting, emanating from not too brilliant sources, is better in every way than that which, though equal in absolute quantity, proceeds from intensely bright points; and he referred to the paralysing effect and ultimate injury to the eye produced by frequent exhibitions of powerful naked lights of any kind. All lights of great brilliancy should be placed above the ordinary line of vision, and suitably shaded.

SUMACH.

One of the chief products of Sicily, according to a report by the British Consul at Palermo, is sumach, which appears in the English and American markets in the form of a powder packed in bags, and produced by drying and grinding the twigs and leaves of the plant. The powder serves both as a dye and as a mordant to fix other dyes, and is used also for tanning. The sumach powder produced in Sicily is of two sorts. The best is of a rich green colour and carefully sifted, is soft to the touch, smells rather pleasantly, and has a strong astringent taste. The second has these qualities in an inferior degree, while its colour degenerates and takes a reddish hue. The sumach grown in Continental Italy is much inferior to the Sicilian, and has a yellowish colour tending both to green and red. None of the inferior sorts are prepared with such care as the best Sicilian, and are known by the prevalence of unground fibres and minute chips, indicative of less pains taken in sifting. Various adulterations are practised in preparing sumach for the market—the most obvious, that of mixing it with mineral dust, can be discerned by steeping the suspected powder in water, when the mineral portions will fall to the bottom. When vegetable substances, however, are used, chemical analysis must be resorted to.

A GIGANTIC INDUSTRIAL AND COMMERCIAL CONCERN.

The tendency of the present day in industrial and commercial concerns is towards concentration of the means of production in few hands, and the abolition of middlemen in distribution. It is rumoured that a very remarkable development is about to take place, and in which a number of American and British capitalists are interested. According to current reports, the promoters intend to erect granaries, stores, pork curing establishments, and cheese and butter factories, on sites convenient to the line of the Minnesota North-Western Railway, and that all kinds of American produce, such as flour, fruit, ham, bacon, cheese, and butter, as well as live cattle, are to be run along this line to Chicago, thence by the Baltimore and Ohio Railway to New York, and a bridge is to be built connecting the mainland with Staten Island, where large docks will be constructed. From this port the products of the United States will be carried by steamers specially built for the company, and landed at Barrow-in-Furness. Here it is proposed to build alongside the docks abattoirs for slaughtering the cattle immediately after landing, tanneries for preparing the hides, and factories for making margarine out of the tallow. Large warehouses will also be erected, and from these the products will be distributed throughout Great Britain by means of retail stores, which will be opened in all the large towns, in order to supply consumers direct. It must be confessed that in these days of syndicates and corporations it is very difficult to see how in many departments of industry the single handed manufacturer is going to survive.

THE GERMAN CORN LAWS.

The German Reichstag has, after a long and extremely animated discussion, in which the Free Trade party made its influence strongly felt, raised the import duty on cereals, in response, partly to the clamour of the agriculturists for further protection, and partly in satisfaction of a revengeful feeling evoked by the fiscal policy of Russia towards Germany. The annual consumption for the whole of the German Empire has now reached, in round numbers, 400,000,000cwt. Down to the year 1866, the home production exceeded the requirements, but since that date an important import trade has sprung up, and has grown so rapidly that German agriculturists, like our own, have been driven into adverse circumstances. In the period between the years 1881 and 1884, inclusively, the imports of cereals, about one-half of which were derived from Russia, increased, on an average, by 40,000,000cwt. annually, or about one-tenth of the total consumption. As the tendency of this foreign trade manifestly was to grow at a still more rapid rate, the agricultural party became alarmed at the prospect, and raised an outcry against the insufficiency of the existing tariff laws. Pressure was brought to bear upon the Government to raise the duty on wheat to 3s. per cwt. The result is not quite up to this high level; but the compromise that has been effected between the extreme and the moderate parties fixes the duty henceforward at 2s. 6d. Under these amended laws, Germany has the highest import duties for cereals of any country in Europe. The following is a comparative table of the rates now in force per cwt.:—

	Wheat.	Rye.	Barley.	Oats.
	s. d.	s. d.	s. d.	s. d.
Germany	2 6	..... 2 6	..... 1 1·5	..... 2 0
France	2 0	..... 0 7·3	..... 0 7·3	..... 1 2·6
Spain	1 9	..... 1 3·5	..... 1 3·5	..... 1 3·5
Austria.....	1 6	..... 1 6	..... 0 9	..... 0 9
Italy	1 2·6	..... 1 2·6	..... 0 5·6	..... 0 9·7

HARBOUR WORKS AT BORDEAUX.

Although there has been some improvement shown recently in expediting the publication of British consular reports, a good deal of the information obtainable from these sources is out of date. Mr. W. Ward, our consul at Bordeaux, is, however, alive to the importance of supplying early information, and we quote the following extract from a report made by him: "Although no official notice to such effect has been published here, I am enabled to state, upon the strength of trustworthy information, that the contracts for the execution of the improvements in the basin and quays of Bordeaux will be put up to public competition at Bordeaux, to all probability in March or April next, and that after publication thereof about one month will be allowed to intending contractors for sending in tenders. The works projected consist of about 1600 metres (5250ft.) of stone embankment on the left bank of the river at Bordeaux, and of 500 metres (1640ft.) of iron piles and jetties on the right side of the river, and of various improvements in the existing wet dock basin. These latter will include new iron palisading, hydraulic winches, a second hydraulic machine for opening the dock, strengthening of sifting sluices, new works for emptying locks, a new floating gate, boring of another artesian well, construction of a short aqueduct, and ballasting of quay platforms. Although British firms desirous of competing for the contracts for the various kinds of work required must not be disappointed if they should fail in obtaining the same, in view of the strong feeling at this port against awarding contracts of the nature in question to foreigners, it may, in view of the importance of the works projected at Bordeaux, be well for them to be prepared in due time, and to make themselves acquainted with the precise nature of the work required here."

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

23rd December, 1887.

17659. Cooke, J. ..... Furnaces.
17661. Glover & Whalley..... Stop motions for winding frames.
17663. Matthews & Johnston Governor.
17673. Allen, W. H..... Shaping metals.
17686. Bickerton, H. N..... Gas engines.
17689. Clark & Clark ..... Steam engines.
17697. Hanrez, P..... Steam boilers.
17702. Nordenfelt, T. ..... Turret mountings for guns.

24th December, 1887.

17708. Boulton, I. W..... Traction engines.
17716. Roberts, W..... Boiler furnaces.
17717. Buckland, H. B. ..... Steam boilers.
17718. Bailey, W. H. ..... Wool combing machines.
17721. Smith, R. B. ..... Hydraulic riveting machines.
17738. Weatherhogg, G. W... Petroleum engines.
17739. Mondini, L. ..... Double ash pit for furnaces.
17744. Hogg, T. C. ..... Petroleum engines.
17747. Saunders, S..... Tubular boilers.
17752. Davies, E..... Compound engines.
17758. Longridge, J. A..... Ordnance and cartridges.

27th December, 1887.

17782. Hodgson, G. H. ..... Looms.
17790. Reed, J..... Marine boilers.
17792. Boult, A. J. ..... Breech loading fire arms (*Hampton*).
17795. Proctor & McPherson Spinning machinery.
17798. Lake, H. H. ..... Grinding mills (*Coles*).
17806. Gubbins, R. R..... Rolling mills.
17808. Stratton, E. P. ..... Steam separators.

28th December, 1887.

17822. Nasmith, J. W..... Carding engines.
17823. Carter & Haley..... Apparatus for sawing metals.
17824. Chandler, N. ..... Centrifugal fans.
17828. McLaine, L..... Machinery for spinning flax.
17835. Bridgman & Hodges ... Box nailing machines.
17841. Taverdon & Taverdon Rotary engines.
17843. Galley, J. G. ..... Furnaces.
17847. Newton, P. A. ..... Propelling and steering vessels (*Chesebrough*).
17857. Haddan, R. ..... Machines for cutting bricks and tiles (*Burr & Stipes*).
17858. Loudon, G. S. ..... Utilising waste steam.
17860. Gilmour, J. ..... Fresh water apparatus for steamships.

29th December, 1887.

17861. Hargreaves & Hargreaves ..... Printing.
17870. Orr, R. ..... Steam boilers.
17872. Burgess, W..... Alarm guns.
17874. Armitage & Sons ..... Looms.
17876. Kershaw & Bennett... Type writing machines.
17878. Thompson, W. P..... Apparatus for dyeing textile fabrics (*Hampe*).
17879. Hancock, J., & others... Traversed warp machine.
17887. Negri, C. de..... Knitting machines.
17888. Smith, G. A..... Marine governors.
17891. Jarman, H. ..... Multiple cylinder engines.
17895. Jörg, J..... Spinning machines.
17896. Abel, C. D..... Gas engines (*Gas Motoren-Fabrik Deutz*).
17899. Willcox, B. ..... Furnaces (*Perret*).
17903. Kirkaldy, J..... .. Obtaining fresh water on board ships.

ELECTRICITY.

23rd December, 1887.

17655. Mills, R. H. D..... Incandescent lamps.
17669. Smith & Sinclair ..... Telephonic apparatus.
17682. Cheesman, T. ..... Telephones.
17704. Herts, A. C..... Telephones.

24th December, 1887.

17722. Gisborne, J. S..... Telegraphic apparatus.
17726. Statter, J. C. ..... Electromotors.
17757. McMullin, M..... Incandescent lamps.
17762. Sellner, L. ..... Electric signalling apparatus.

27th December, 1887.

17807. Rawson, F. L. (Woodhouse & Rawson)..... Rheostats (*Wirt*).
17812. Zipernowsky, C..... Alternating electric currents.

28th December, 1887.

17837. Justice, J. M. ..... Generating electricity from heat (*Acheson*).
17840. Barker & Hills ..... Electric indicator.
17846. Anders, G. A., & others Telephonic apparatus.

29th December, 1887.

17863. Haswell, R..... Producing electrical energy.
17902. Pitt, S. ..... Telephone exchanges (*Scribner*).

CHEMISTRY.

23rd December, 1887.

17657. Staveley, W. W..... Alkaline carbonates.
17676. Lawrence, R. S. ..... Carburetters.
17696. Bailey & Greaves ..... Improved saccharum.

24th December, 1887.

17754. Westgarth & Charnock ..... Coating metals with alloys.

27th December, 1887.

17772. Plummer, J..... Hydrochloric acid.
17809. Rigaud, F..... Smelting zinc ores.
17811. Imray, O. ..... Colouring matters (*Farbwerke vormals Meister, Lucius and Brüning*).

29th December, 1887.

17898. Redfern, G. F..... Heat generating apparatus for use as a blow pipe (*Jolicard*).
17905. Gassner, C..... Manufacture of galvanic dry elements.

MISCELLANEOUS.

23rd December, 1887.

17653. Vine, J. W., & others ... Rag tearing machines.
17658. Radcliffe, J. ..... Safety lamps.
17664. Nelson, J..... Economising fuel.
17666. Hartung, H..... Fire bars.
17667. Bevan, J. ..... Apparatus for paring silk or felt hats.
17670. Rowbotham, T..... Machine for ironing hat brims.
17672. Barthel, A. E..... Manufacturing articles from sheet metal lattice work.
17675. Townsend, T. G..... Gates.
17677. Griffiths, W. J..... Twist drills.
17683. Harper, T. ..... Needles.
17687. Maier, S. ..... Binders for letters (*F. Soenneckens Verlag*).
17688. Burns & Dumbell ..... Locks.
17690. Beard, J..... Ironing stoves.
17692. Newton, H. E..... Anchors (*Starr*).
17694. Dehany, G. E. ..... Extinguisher for lamps.
17701. Vero, C..... Manufacture of felt hats.
17705. Snelgrove, W..... Machinery for weighing.

24th December, 1887.

17707. Pike, W. H. ..... Gas stoves.
17710. Maxim, H. S..... Self locking sight for guns.
17712. Sawrey & Colley ..... Separating liquids from solid matters.
17713. Doyle, D. ..... An improved "graph."
17714. Deakin, W. ..... Card shooting machines.
17715. Atkins, F. G..... Funnels.
17720. Holmes, J. H..... Valve gear.
17723. Sewell, S. J..... Type writer.
17724. Fevez, V. P. ..... Velocipedes.
17725. Nicholas & Fanshawe. Shot and shell.
17731. Perry & Perry ..... Laundry trucks.
17736. Horn & Robson ..... Jointing building blocks.
17737. Bosch, J. A. ..... Car coupling.
17741. Wilmott, F. A..... Wire netting machines.
17746. Guérin, J. B..... Apparatus for preserving milk.
17753. Johnson & Wickens .... Tricycles.
17755. Barber & Peach..... Trucks.
17756. Williams & Puplett... Refrigerator.
17760. Clark, A. M..... Compressing air (*Honigmann*).
17761. Jaeggli, J..... Brakes.
17763. Leak, E..... Apparatus for supporting pottery in kilns.
17764. Lockwood, W..... Packing rings of pistons.
17765. Miller, H. P. ..... Heating apparatus.
17766. Ribault, G. E..... Apparatus for coupling rolling stock.
17767. Archer, J. A. ..... Material for roofing.
17768. Smith, W. S..... Apparatus for insulating wire.
17770. Lysaght, J..... Apparatus for coating metal plates.

27th December, 1887.

17773. Bingham, C. H..... Clocks.
17775. Bird, W. H. ..... Locks.
17777. Otley, G. ..... Prevention of fouling of chimneys.
17778. Fuller, S. C. L. ..... Improved shaft fulcrum.
17780. Howes & Howes ..... Driving gear for bicycles.
17783. Loesewitz & Maass..... Lubricators for railway cars.
17786. Brooksbank, R. ..... Washing machines.
17787. Hedderly, C. H., and others..... Oil feeder.
17788. Cockburn, D., & others. Wheelbarrows.
17789. Bell, J. B..... Gas stoves.
17791. Allison, H. J. ..... Cord fastener (*Warner*).
17793. Thompson, W. P..... Apparatus for extracting the juice from cane (*Man*).
17794. Thompson, W. P..... Hinges (*Strachan*).
17796. Roberts, L., & others... Machines for armoring hose.
17797. Roberts, L., & others... Spiral springs.
17799. Hutchinson, H. ..... Generating gas.
17800. Cole & Cole..... Apparatus for branding packing cases.
17802. Samson, A..... An improved hay rack.
17803. Baylis & Howarth..... Railway fish plate.
17804. Wicken, W. B..... Incandescent gas lighting.
17810. Manton & Newton..... Sights for fire arms.
17814. Quarante & d'Escalonne..... Process for preserving wood.

28th December, 1887.

17818. Bradshaw, A. ..... Return steam traps.
17819. Barker, J., & others ... Safety appliances for the doors of hoist wells.
17820. Henderson, J..... Feathering gear of paddle wheel floats.
17825. Wilson, A..... Apparatus for veneering felt hats.
17827. Bradshaw, A. ..... Back pressure valves.
17829. Rogers, C. D..... Method of screw threading the points of wood screws.
17830. Rogers, C. D..... Device for holding and guiding screw blanks.
17831. Rogers, C. D..... Self adjusting die for screw making machines.
17832. Sayer, R. C. ..... Water taps.
17833. Sherwood & Sherwood Paraffin lamps.
17836. Johnson, J. Y..... Permanent way for railways (*Moncharmont*).
17838. Sprange, A. H..... The traverse calculator (*Mountfort & Mountfort*).
17839. Johnson, J. Y..... Improvements in flexible supports carrying buckets (*Damey*).
17844. Scott, J. S..... Solid letterpress printing plate.
17845. Murphy, P. E. ..... Snow destructor.
17848. Keats, C. H..... Machinery for lasting boots and shoes.
17852. Thompson, W. P..... Ventilation (*Oehlmann*).
17853. Upsdale, J. ..... Manufacture of gloves.
17854. Wacks, L..... Trigger action for opening doors.

29th December, 1887.

17864. Fenney, T. F. ..... Pipe joint cutting.
17866. Macandrew, A..... Improvements in lug sails.
17875. Bertram, A..... Preventing overwinding.
17877. Thompson, W. P..... Gas lamps (*Deimel*).
17880. Newlands & Alliott... Separation of solid matter from water.
17881. Andrews, W..... Velocipedes.
17882. Osborne, H..... Means of attaching india-rubber tyres to metal wheels.
17884. Anderson, A. ..... Sewing machine shuttles (*Singer Manufacturing Co.*).
17886. Field, E., & others ..... Lock nuts.
17889. Eli, A. J. ..... Supplying petroleum to wick burners.
17890. Dick, W..... Securing cast metal plate work.
17901. Wenster, C. J..... Apparatus for gilding the backs of books.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

28th December, 1887.

401c. Fryer, R. McC..... Bearings for propeller shafts. (Originally included in No. 401, 1887, takes, under Patents Rule 23, that date.)
834. Larrabee, C. S..... Machinery for polishing the heels of boots.
2243. Singleton, T. ..... Looms.
2354. Boult, A. J..... Apparatus for bleaching wool (*De Pawlowski*).
2755. Boult, A. J..... Apparatus for loading cartridge shells (*Hazard*).
2840. Russell, D..... Furnace bars.
2942. Smith, D. P..... Machines for finishing woven fabrics.
2967. Batley, J. A..... Steam boilers.
2968. Newton, A. V..... Cutters for paring the soles and heels of boots and shoes (*Keats and Keats*).
2970. Stone & Burnett..... Looms.
2978. Stoner, J. B..... Elevating grain.
3010. Earnshaw, E., others... Furnaces.
3011. Wrigley & Patterson.. Carding engines.
3013. Keith, J..... Boilers.
3041. Oliver, M. J..... Harvesting machinery.
3340. Wicksteed, J. H..... Machines for cutting hot blooms, &c.
3900. Simmons, T. J..... Compound steam engines.
16144. Williams, H..... Gas motor engines.
16161. Hampson & Marshall.. Machinery for raising nap upon textile fabrics.
16290. Craven, W. ..... Machine tools for cutting and shaping metals.

31st December, 1887.

17121. Burton, B..... Magazine fire arms.
193. Wallace, J. O..... Apparatus for breaking, scutching, and cleaning flax.
336. Holt, J..... Expansion rollers for levelling yarn on beams.
2227. Shepherd, J. W..... Collapsible ship boats.
2449. Birch, H..... Sewing machines.
2684. Denison & Ward..... Improvements in wheels, pulleys, and bearings.
2744. Shaw & Chittick..... Machinery for punching holes in metal plates.
2747. Gray, J..... Machines for separating fluids.
3112. Brown, A. B..... Hydraulic cranes for ships.
3853. Corden, H..... Boilers.
6955. Butler & Howarth.... Machinery employed in spinning cotton.
11277. Winby & Winby..... Cable tramways.
16295. Richards, N. H..... Brake gear of cable tram cars.
16345. Robertson, J. B..... Sewing machines.
16363. Evans, W. W..... Type writing machines.
16426. Thompson, W. P..... Joint for crossing parts of corrugated metal (*Hodges*).
16492. Lami, J..... Braiding machines.

ELECTRICITY.

28th December, 1887.

17120. Crompton & Swinburne Dynamo machinery.
3998. Chary, F. J..... Electric light.

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31st December, 1887.

15344. Clark, A. M..... Automatic governor for electric lighting (*Electrotechnische Fabrik Cannstatt*).
16865. Davies & Shearer..... Coupling up batteries.
15099. Foster & Steljes..... Type printing telegraphs.
16406. Delany, P. B..... Telegraphic transmission.
16424. Thompson, W. P..... Telegraphic instruments (*Burke*).

CHEMISTRY.

28th December, 1887.

12295. Atkins, G. J..... Separation of gold.
1132. Windham, F..... Manufacture of gas.
2983. Marshall, G. F..... Carbon for filtering purposes.
2999. Brode, L. A..... Preparing ironstone waste for smelting.

31st December, 1887.

6022. Johnson, J. H..... Explosives (*Engel*).

MISCELLANEOUS.

28th December, 1887.

16979. MacIlwaine, A. W..... Apparatus for extracting oils.
1057. Hunt & Wilson..... Treatment of cotton seed.
1647. Holmes, C., & others ... Bearings for washing machines.
1910. Colby, J..... Railway chairs.
2214. Mackay & Christiansen Refrigerator.
2489. Bown, W..... Improvements in rims of wheels.
2490. Bown, W..... Improvements in the spokes of wheels.
2700. Pipe, H..... Velocipedes.
2911. Morgan, W..... Machines for finishing felt hats.
2912. Barber, J..... Stove grates.
2944. Read, A..... Lids for sheet metal kegs.
2952. Woodward, J..... Lock.
2990. Statter, J. G..... Apparatus for enabling speeds to be ascertained at a distance.
3004. Bradley & Whalley.... Washing machines.
3026. Bowman & Bowman..... Lanterns.
3043. Sutton, J. B..... Elevator buckets.
3067. Fenby, J. B..... Appliances for supplying hydrocarbon oils to burners.
3103. Laws, R..... Washing machines.
3254. Booth, J..... Metal cup with porcelain lining.
8894. Cox & Cox..... Anchors.
11410. Reid, J. C..... Rendering doors draught proof.
11533. Palmer & Stock..... Fastenings for boxes.
11664. Munier & Salvaire..... Process of staining wood.
13313. Boorman, J. A..... Apparatus for ascertaining the angles of bevel and mitre wheels.
13688. Gross, H..... Bricks.
14887. Campbell, D..... Improvements in ships' yards.
15756. Furnival, T., & others.. Machines for cutting cardboard boxes.
16150. Thompson, W. P..... Lamp burners (*Deimel & Von Bühler*).
16181. Norris & Simmons..... Sewing machines.
16201. Lendrum & Mitchell.. Stockinette frames.
16225. Iliffe, G. Y..... Improvements in castors.
16245. Baillie, R..... Corrugated plates.
16246. Brüggemann, F. A..... Vacuum brakes.
16286. Hornsteiner, R..... Apparatus for guiding driving bands.

31st December, 1887.

16940. Fraser, W..... Lubricators.
75. Patterson & Strype... Lamps for burning paraffin.
99. Lamont, S..... Packing for stuffing boxes.
592. Stubbs & Thornton.... Steam traps.
1024. Illidge, A..... Fastenings for doors.
1399. Grace, T..... Apparatus for coupling the rolling stock of railways.
2176. Dowd, T. C..... Padlocks.
2833. Fricker, H..... Lamps for heating purposes (*Wanzer*).
3045. Belling, G. F..... High pressure tap.
3063. Keith, J..... Heating coils or radiators.
3064. Graham, D..... Pneumatic apparatus for signalling.
3075. Read. A..... Sheet metal kegs.
3409. Schweiger & Mühlmann..... Casting of metals and alloys.
3843. Downing, G..... Refrigerating materials (*Baeschlin*).
4021. Thompson, W. P..... Apparatus for heating air (*Smead*)
4749. Clark, A. M..... Preventing the emission of flame and smoke from chimneys (*Oriolle*).
5379. Alsing, J. R..... Construction of triturating cylinders.
9749A. Hartmann, W..... Knife sharpener. (Originally included in No. 9749, dated 12th July, 1887, takes, under Patents Rule 23, that date.)
10018. Vincent, C..... Boiler tube stopper.
10943. Cornes, H..... Apparatus for heating railway carriages.
12317. Redman, T..... Velocipedes.
14775. Luhmann & Rommenhöller..... Apparatus for withdrawing gases from liquids.
15575. Vautin, C. T. J..... Apparatus for the separation of metallic salts from pulverised material.
16064. Lightfoot, F..... Railway rails.
16349. Spiess, A..... Blocks and other mouldings.
16383. Johnson, J. Y..... Argand lamps (*Upton*).
16384. Johnson, J. Y..... Graphophones (*Volta Graphophone Co.*).
16388. Groom, T..... Improvements in wheels.
16433. Freeman, M. P..... Water meters.
16476. Bayliss & Jones..... Manufacture of telegraph and telephone poles.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 24th September, 1887, inclusive.)

Year 1883.

4449. Watt, J..... Kilns for drying oats, &c.
4451. Schuman, S..... Boiler furnaces.
4452. Macdonald, D..... Excavating machines.
4454. Haddan, H. J..... Wrenches (*Blomquist & others*).
4456. Durnford, C. D..... Rifles.
4459. Thompson, W. P..... Stuffs made in long pieces (*Desbruères*).
4460. Boult, A. J..... Electric cables (*Hyde*).
4464. Newton, H. E..... Mills (*International Fibre and Juice Extracting Co.*).
4465. Sheldrake, J. H..... Fittings for electric lighting.
4467. Lake, W. R..... Solutions used in galvanic batteries (*Peckham*).
4470. Stevens, F. M..... Valve gear.
4475. Collins, J. W..... Floating anchor.
4476. Collins, J. W..... Fog horn.
4480. Clapp, W. J..... Ships.
4486. Lake, W. R..... Locomotive engines (*Weisz*).
4491. Urquhart, R. L..... Tramways, &c.
4495. Hughes, E. T..... Rock boring (*Heshuysen*).
4498. Haddan, H. J..... Liquid and gas pumps (*Maltby and another*).
4502. Bolton, R. P., & ano.... Compressing air.
4504. Newton, G. A..... Removing dirt, &c., from tramway rails.
4507. Hudson, R., & others.... Davits.
4508. Nawrocki, G. W. von... Treating hides, &c. (*Spitta*).
4510. Henderson, A. C..... Raising sunken vessels (*Picot*).
4525. Heap, J..... Screwing apparatus.
4528. Holden, J..... Wheels of railway rolling stock.
4529. Jackson, J. ..... Hand tools.
4533. Wesselmann, B..... Locks.
4544. Smith, S. W..... Permanent way of railways.
4550. Schwab, M..... Illuminating gas (*Overhoff*).
4560. Lake, W. R..... Breaking pig iron (*Blake*).

Year 1882.

4464. Wrightson, T., & ano... Driving screw piles.
4487. Imray, J..... Treatment of phosphorites (*Daudenart*).
4504. Beeman, J. S., & others. Measuring electric force.
4511. Andrews, J. D. F..... Storing, &c., electricity.
4527. Carter, B. J..... Electromagnetic engraving machine (*Guerrant*).
4530. Reddie, A. W. L..... Coupling apparatus for railway carriages (*Compagnie de Appareils Automatiques pour Accrocher et Décrocher les Wagons des Chemins de Fer*).
4545. Coley-Bromfield, J., and another..... Gas.

Year 1881.

4083. Richards, W. ..... Measuring water.
4086. Atkinson, J..... Gas engines.
4092. Howard, J., & another. Cutting and binding corn crops.

Year 1880.

3784. Droste, G. J. ..... Electric type printing telegraph apparatus.
3803. Lake, W. R. ..... Operating, &c., railway switches (*Williams*).
3809. Rogers, J. B..... Dividing the electric currents.
3812. Birkbeck, J. A. ..... Cooling and breaking up blast furnace slag.
3822. Clapp, W. J..... Iron and steel.
3827. Justice, P. S..... Iron and steel (*Dupuy*).
3834. Williams, J..... Quarrying and dressing stone.
3851. Justice, P. M. ..... Combined ploughs and pulverising apparatus (*Sackett*).
3856. Henderson, J..... Steam boiler and furnace for paddy husks (*Russell*).
3860. Whittingham, J..... Steering and driving arrangements.
3865. Weston, F..... Increasing illuminating power of coal gas.
3867. Hofmann, B..... Oleine, &c.

Year 1879.

3740. Brown, J., & another... Coupling, &c., railway vehicles.

Year 1878.

3742. Edmonds, E..... Mowers (*McCormick*).

Year 1877.

3530. Michele, V. D. de ..... Preparing slip for cement.
3574. Hamilton, F., & another Reflectors of daylight.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Steam Boilers.—*W. Waller, Hasland, near Chesterfield.*—The inventor proposes to introduce four improvements into the construction of an ordinary steam boiler. In order to secure the freer expansion of parts of the fabric of the boiler without occasioning strain in other parts, he substitutes for the solid screwed stays in the fire box a conical or hollow vessel, which is screwed into the inner wall of the fire box and secured to the outer wall by a screw formed on the stay. He provides for the better circulation of the water by conducting it in pipes externally to the boiler, from the part of the boiler where the sediment has been deposited to the furnace end of the boiler. In order to obtain as much heat as possible from the gases as they pass along the boiler tubes, the inventor places within those tubes other tubes containing part of the water of the boiler. The boiler plates are to be made with alternate projections and recesses, in order to give additional strength to the plates, and to increase the area of the heating surface. There are four claims.—No. 811. January 19th, 1887. 11*d.*

Extraction of Saccharine Matter from the Cane.—*M. A. Perret, Paris.*—The apparatus which is hereby patented is designed for treating sugar cane out of contact with the air, and for kneading, macerating, and pressing the cane by a continuous action. The apparatus is constructed of three principal parts, viz.: the disintegrator which is shown in general view in Fig. 1, and part of it to a larger scale in Fig. 2, a diffusing and pressing apparatus, and a conical pressing apparatus. The cut cane is

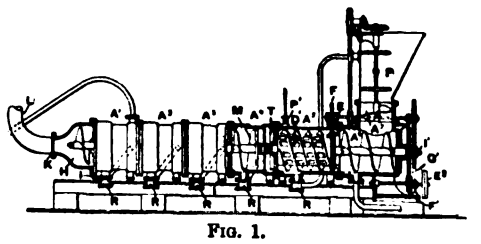


Fig. 1.

delivered from the hopper P into the revolving feeding screw A^7. Whilst it passes through A^6 it is saturated with steam. The screw in A^6 feeds the mass into the disintegrator A^5, which is shown in Fig. 2. A cone B with a helical blade C pushes the charge against the drum B^1, which also has an external blade C^1, and holes on which are placed cutters D^1. The cone and drum rotate in opposite directions. The cane arrives in a disintegrated condition in the annular space E^2, and is pushed out of the annular opening F^2 into the diffusing and pressing compartments A^4, A_2, A_3, A_1. All parts of the machine are supplied with liquid, which is also provided with an escape pipe. After

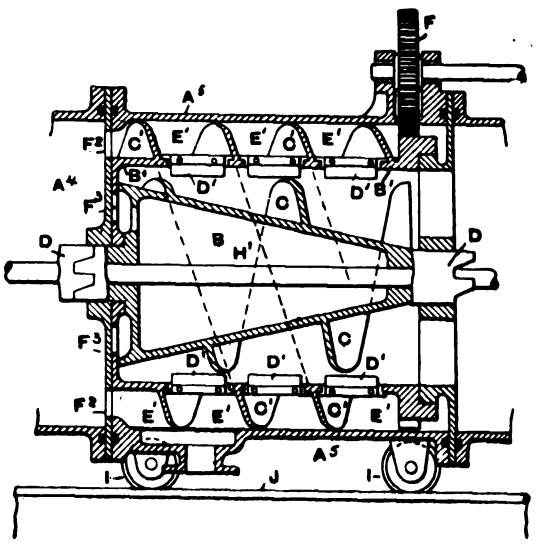


Fig. 2.

the mass has been treated in this process it is forced by the screw H up the pipe at the end, and into another machine, where it experiences a similar treatment. After the fibrous mass has been thus exhausted of its saccharine matter it passes into a cone. Here it is pushed by blades into a conical press, which is provided with two screw blades, and the fibre is thereby pressed through an opening, while the liquid runs back through a pipe at the bottom of the cone. There are seven claims for the various parts of this apparatus.—No. 1931. February 7th, 1887. 1*s.* 3*d.*

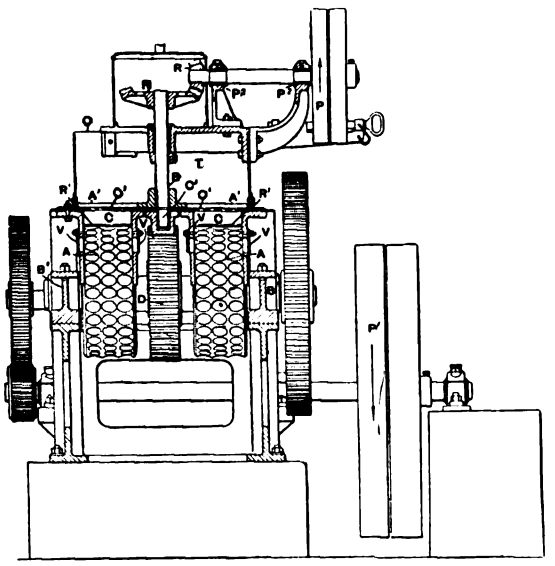
Paper Cutting Machines.—*H. P. Trueman & J. G. New, Birmingham.*—This invention relates to the guillotine paper cutting machine, and has for its object certain improvements and novel arrangements of the various parts. A bracket for carrying the worm and worm wheel is fixed in front of one of the upright members of the frame, instead of at the end of the frame as heretofore; and the space vacated by the worm and wheel is now occupied by the fly wheel and crank. Also the connecting rods from the worm wheel to the knife bar are placed immediately behind the worm wheel and in front of the knife bar. The clamping and releasing of the material operated on is effected by placing a sliding nut on the frame work of the machine; and the said nut is pressed down by a spring, which is compressed by the knife bar on its upward stroke. Means are also supplied for arresting the automatic action, thus converting the machine into an ordinary hand cutter. An improvement in the moving and holding of the fence or gauge is introduced by discarding the usual slot in the table for a guide for the nut, and by carrying the usual screw for operating the gauge completely across the cutting machine from end to end, where it runs in bearings. The nut working on this screw is provided with a vertical extension, which passes through the slot and is fixed to the gauge; and there is also a horizontal prolongation which extends a long distance down the screw shaft, and there embraces the same. By this means is insured a bearing as long as the gauge itself, thus reducing the error caused by the wearing of the parts. There are five claims made, one for each of the improvements described above.—No. 15302. Nov. 24th, 1886. 8*d.*

Carding Engines.—*J. Elce & T. S. Whitworth, Manchester.*—To improve the method of adjusting the flats relatively to the main cylinder, the inventors attach to a flange on the engine

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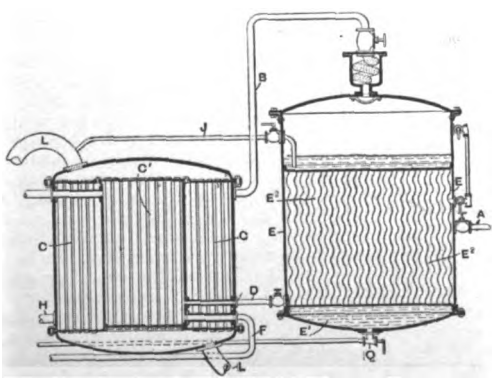
bend a disc or plate provided with slots, one for each flat supporting bracket. The upper end of each bracket is shaped to the segment of a circle concentric with the cylinder. A second disc or plate is mounted on a flange on the face of the first. Each bracket carries a stud or projection which fits into a helical groove on the inner face of the second plate. The flats are adjusted relatively to the cylinder by rotating this plate by means of warm gearing. Both discs are revolved together when it is desired to grind the flats. To allow of adjustment, the bearings of the cylinder are fitted so as to slide vertically in the pedestal. Beneath each bearing is an eccentric shaft or bolt, which is rotated by means of a worm and worm wheel. As the eccentric bolt is turned the bearing is either raised or lowered. The inventors make six claims for the improvements described. —No. 1427. January 29th, 1887. 8*d*.

Apparatus for Moulding Blocks of Artificial Fuel.—*J. Y. Johnson, London.* (*G. Mülheims & R. Zimmermann, Neuf-les-Mines.*)—The object of this apparatus is to mould artificial fuel in blocks of an ovoid shape. There is no necessity for breaking up blocks of this shape before putting them on the fire, and there is little stoking required, because the blocks will of themselves assume a proper position; also the currents of air can easily find access through the intermediate spaces between the blocks. The figure shows an elevation of a press used in this process. The rotary cylinders A fit with similar cylinders, which are placed behind and parallel to them, and are provided with mould forms recessed into them as shown. A hopper T consists



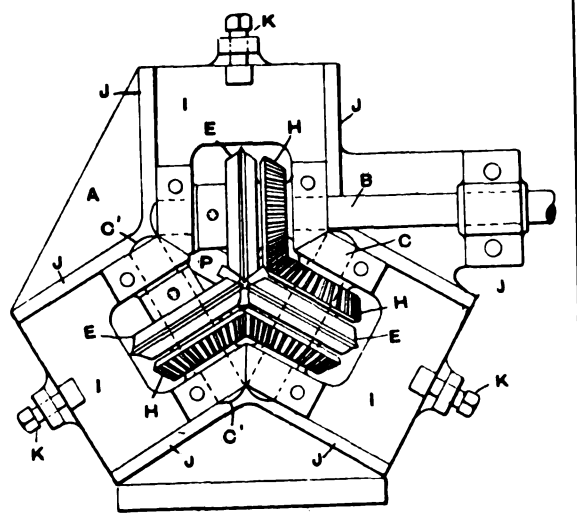
of a box which contains the material to be operated on. A distributing arm A^1 has a horizontal rotary motion given to it by the shaft B, and works along the bottom of the hopper, moving the material through the shoot C, whence it drops H between the two cylinders that carry the moulds, and is compressed into shape. The balls are discharged automatically from the moulding recesses, simply falling out owing to the shallowness of the said recesses. The inventors make three claims: (1) For the apparatus for producing ovoid blocks; (2) for the combination of arm and hopper with the compressing cylinders; (3) for the method of construction of the compressing cylinders.—No. 14531. October 25th, 1887. 8*d*.

Apparatus for Obtaining Fresh Water from the Sea.—*W. F. Pamphlett, Portsea, Hampshire.*—This invention relates to an improved method for obtaining fresh water for drinking purposes, or for feeding the ships' boilers. In the Figure, E shows the evaporator and C the condenser. The evaporator consists of a vessel made of any suitable material according to the pressure of the steam. The corrugated tubes E^2 are of brass or steel, and connect the upper and lower parts of the vessel E. The water to be evaporated is led into E through the pipe J and fills the space E^1 and the tubes. The steam from the boiler enters through A and fills the spaces between the tubes, passing out through the pipe D. The evaporated steam is



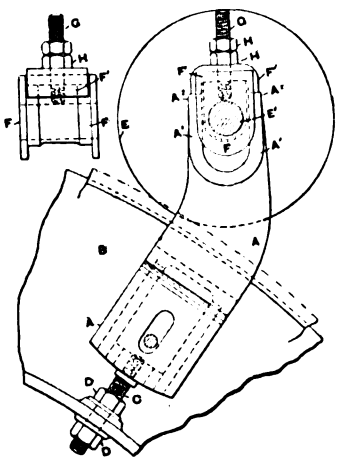
conducted to the condenser through the pipe B. The condenser is made in the same way as the evaporator, but consists of two separate concentric chambers C and C^1. The evaporated steam enters C, where it is condensed by circulating cold water, and is afterwards drawn off by the pipes L. The steam from the boiler passing through D into C^1 is also condensed by the cold water, and is drawn off through the pipe F. The sediment and saline matter deposited in E^1 is blown off through the pipe Q. There are four claims.—No. 14228. October 19th, 1887. 8*d*.

Longitudinally Grooved Wire.—*H. H. Lake.* (*P. Clifford and J. Coupal, Quincy, Massachusetts, & J. E. Bertrand, Boston, Massachusetts, U.S.A.*)—This invention has for its object the provision of improved means for longitudinally grooving wire by a rolling process, and also consists in the article produced. The wire is adapted for use in the boot and shoe sole nailing machines as the material for sole fastenings. The figure shows a front elevation of the machine which embodies this invention. J represents the stand or frame, having bearings in which are journalled the shafts B, C, C^1. To these shafts are fixed the grooving rolls E. The bevel wheels H are fixed to the shafts



and cause the rolls to act simultaneously on the wire. The shaft B is driven by any suitable motor, and motion is communicated from it to the shafts C, C^1, the series of rolls being thus positively rotated and caused to simultaneously feed and groove the wire. Behind are placed some guides which lead the wire into a suitable position for entering the space between the three rolls. The bearings of the shafts are made adjustable by means of the slides I and the screws K. The wire thus has three longitudinal ribs impressed upon it, and is also compacted by the pressure to which it is subjected. There are five claims for the various combinations.—No. 13837. October 12th, 1887. 8*d*.

Carding Engines.—*W. Taylor, Oldham.*—This invention relates to the brackets for carrying the grinding roller and stripping brush of a carding machine. The improvement consists in combining the two separate adjustments for these parts. The figure shows a side elevation of part of the engine bend, with one of the brackets and the stripping brush in position thereon. The bracket A is supported and free to slide as usual on the engine bend B, and is furnished with an adjusting screw C and lock nuts D, by which it is adjusted and secured in position. The circle E represents the outline of the stripping brush, and E^1 is the spindle supported in the bearing F, which is fitted into slide ways A^1. A cap F^1 is connected to the step F by a screw G, which passes through the cap and screws into the step. The step F enters the neck of the bracket A, while the cap F^1 rests on



the upper surface A^2 of the slide ways A^1; so that by operating the nuts H the step carrying the brush may be lowered or raised to or from the wire of the cylinder. The grinding roller is supported by a plain step, which rests in the bottom of the neck A^1; so that the adjustment of the bracket with the grinding roller is effected directly by the screw C. The object of this arrangement is that, when the stripping brush is required, the grinding roller can be removed and the brush substituted without interfering with the adjustment of the bracket. There are two claims: (1) For the combination of parts for the separate adjustments mounted on one bracket; (2) for the general arrangement of parts.—No. 14406. October 24th, 1887. 6*d*.

Forging or Shaping Machine.—*T. Allen, Reading, Berkshire.* —The improved machine is adapted to form irregularly shaped articles that are round in transverse section. Upon a suitable bed plate are two bearings carrying a hollow spindle, through which is passed a second solid one. The two spindles are caused to rotate in opposite directions by means of a bevel wheel being attached to one end of each shaft, the driving bevel pinion being inserted between and gearing with them both. Attached to the free end of the hollow shaft is a hollow chuck, inside which a wheel is mounted on the solid spindle. The periphery of the wheel and the inner surface of the hollow chuck carry the dies for forming and shaping the metal. Two claims are made for the forging or shaping machine described.—No. 298. January 8th, 1887. 8*d*.

Steam Boilers.—*O. D. Orvis, London.*—In a boiler fitted with these improvements series of tubes are arranged in the flues in the boiler setting for the purposes of superheating the steam and insuring a thorough circulation of the water. At the point where the blow off cock is usually situated the boiler is connected to a box or header, which is connected by a series of tubes to a drum extending across the flue. The drum is at a slightly lower level than the box or header, and the feed water si introduced into it instead of direct into the boiler. Another series of tubes extend from the drum to the back of the boiler, and are connected to the steam space. In the side flues in the boiler setting are other series of pipes connected at one end to the drum under the boiler and at the other to the steam space. The drum is provided with a blow off cock to discharge any mud or sediment. All the tubes are provided with plugs at the end, which may be removed for cleaning purposes. Three claims are made for the arrangement of tubes as described.—No. 14703. October 28th, 1887. 8*d*.

Steam Generators.—*W. Land, Grantham.*—These improvements relate to vertical steam boilers, and their objects are to simplify the construction and to increase the efficiency and economy of working. Referring to the drawings, Fig. 1 is a central vertical section, and Fig. 2 is a horizontal section through the fire tubes. A is the fire box furnished with a slightly curved top A^1, from which a short tube B leads to a combustion and tube chamber C, the products of combustion passing among the tubes D and escaping through a passage E to the smoke box F and shaft G. There is a water space I between the

FIG. 1.

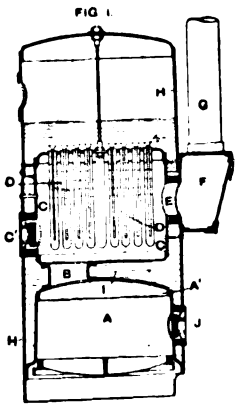
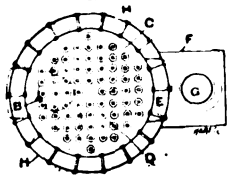
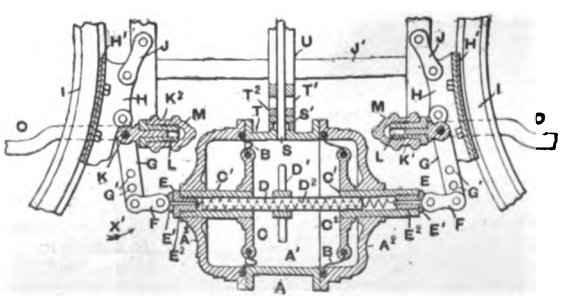


FIG. 2.



bottom of the combustion chamber C and the top of the fire box. The tubes D are closed at one end. They are fixed vertically in the crown of the combustion chamber and extend to within a short distance of the bottom. The boiler is preferably domed or egg-ended, and is stayed either to the sides of the shell H or to the top of the combustion chamber C. J is the furnace door, and C^1 is a door for cleaning out the combustion chamber. Two claims are made for the improved construction and combination of parts of a boiler.—No. 994. January 21st, 1887. 8*d*.

Vacuum Brakes.—*L. P. Lawrence, Passaic, New Jersey, U.S.A.* —The object of this invention is to arrange the parts of a brake so that they may easily "give" according to the movements of a car or locomotive to which the appliance is attached. A brake saddle is placed on each side of each wheel, and on all the four wheels of a double driving locomotive. The figure shows a longitudinal sectional view of the actuating cylinder, and the links and rods operating on the brake shoes. The tube U communicates with an ordinary air ejector at one end, and at the other with the cylinder A through the opening S. The cylinder



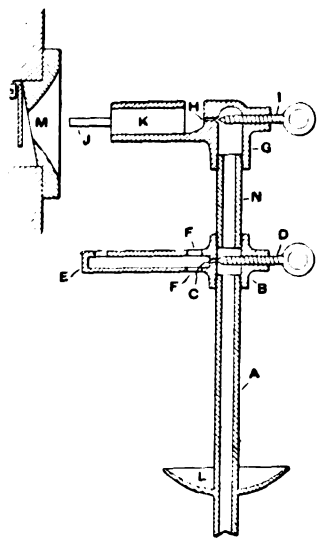
A consists of three parts A^1 A^2 A^3. The pistons C C^2 are fixed to the hollow piston rods C^1, which pass out through the ends of the cylinder and slide on the guiding tube D. This guiding tube is held in position by a cross piece D^1, and through it passes a spiral spring D^2. An annular ring of rubber B is clamped to the outer edge of each of the pistons, and also to the inner wall of the cylinder. The links and levers connecting the piston rods with the brake saddles H on the inner side of the wheels are seen clearly on the diagram. The tubular screw L is screwed into a threaded aperture of a box M, and the fork K, pivoted to the lever G, is formed on the end of a pin K^1, which passes into the bore of the tubular piece L. At the rear of the box M is a mechanism not shown in the

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diagram. A recess is formed in M, through which passes the threaded end of the connecting rod O. This rod O actuates similar mechanism at the outer side of the wheel, and presses the brake block on the wheel simultaneously with the parts which are shown. When the brakes are not in action, the pistons are held in the position C^2 by the spring D^2. Directly the vacuum is formed by the air ejector the pistons assume the position indicated by C; the links move in the direction of the arrow, and press blocks against the wheels. The joints at E and M allow for the adjustment of the various parts, and prevent any straining whilst the locomotive is in action. The inventor makes sixteen claims, for a brake saddle on each side of each wheel, levers for operating the saddles, a cylinder, piston, and piston rods for operating the levers, as described, and also for the various combinations of the parts.—No. 14155. October 18th, 1887. 8*d*.

Hydrocarbon Engines.—*W. D. Priestman & S. Priestman, Hull.*—This invention refers to an improvement in the system of working an engine which was described in Patent No. 1394 of 1886. Instead of mixing the hydrocarburetted air with the additional quantity of air previous to admission to the motor cylinder, these charges are to be conveyed separately to the cylinder. The inventors make four claims for the improvements.—No. 1454. January 9th, 1887. 6*d*.

Hydrocarbon Engines.—*C. E. Hearson, London.*—This invention relates to certain improvements in the arrangements for utilising the vapour of liquid hydrocarbons for actuating gas engines. The objects of the improvements are chiefly to vaporise the liquid by means of the waste heat from the engine, to cause the vapour to pass into the cylinder by the action of the engine alone, and to fire the explosive mixture by means of the flame of a vapour burner. The vaporisation of the liquid is effected by leading into the reservoir of liquid a pipe through which passes steam coming from the jacket of the cylinder, or from the exhaust pipe. In order to fire the explosive mixture, some of the liquid hydrocarbon is delivered under pressure into



an apparatus, a vertical section of which is shown in the accompanying figure. The liquid is supplied under pressure through a tube fixed to the lower end of the chamber A, and is evaporated by the burning of some hydrocarbon placed in the cup L. The vapour passes through the outlets C H, the sizes of which are regulated by the needle valves D I. Air enters through the holes F in the lower burner, and the mixture of air and vapour burns at E and at the end of K. The two burners E and K are so placed that the flame at K shall be opposite the firing port M of the engine, and that when the explosion extinguishes it, the flame issuing from E shall re-light it. The inventor makes five claims.—No. 15955. December 6th, 1886. 8*d*.

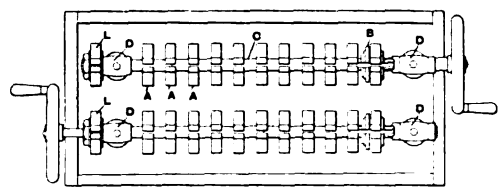
ELECTRICITY.

Dynamos.—*R. C. Jackson, London.*—The inventor proposes to substitute an aluminium and iron alloy for the iron hitherto used in the construction of electro magnets and dynamos. A suitable proportion for the alloy is one part of aluminium to ninety-nine of iron. The advantage of this alteration is an increased electrical effect, as the alloy is very uniform, and has a higher point of saturation or magnetic capacity than the best iron. An incidental advantage is that this alloy is readily cast into clean sharp castings. There is one claim for this improvement.—No. 1390. January 28th, 1887. 4*d*.

Dynamos.—*D. Halpin & I. A. Timmis, London.*—In order to obviate the frictional grooving of the contact surfaces of the brushes and commutator, the inventors propose to impart to the commutator brushes a slight lateral to and fro motion in the direction of the axis of the commutator. A uniform frictional action over the whole surface of contact is thus insured. This motion may be obtained by fixing to the commutator shaft a worm wheel gearing with a worm whose spindle has crank pins on its ends connected by links to the brush holders. The supports of these holders are arranged so as to rock a slide laterally to a small extent. There is one claim for this improvement.—No. 1331. January 27th, 1887. 8*d*.

Underground Telegraph Wires.—*T. O. Callender, London.*—The object of this invention is to reduce the inductive capacity of any underground conductor in an economical manner. The proposed method of laying and insulating the wires is carried into effect in the following way: Cases or troughs of a rectangular shape are made of bitumen concrete, and formed in the required lengths. These lengths are jointed together *in situ*, so as to form a continuous receptacle for the conductors. The wires are cased with the bituminous material described in Callender's patent No. 4409 of 1881, and are protected as usual by tape braiding. They are then laid in the trough, and spaced apart by bridges. Afterwards the vacant spaces are filled up with molten bitumen. The inventor makes one claim for the method above described.—No. 1499. January 31st, 1887. 6*d*.

Distribution of Currents.—*R. E. B. Crompton & J. H. F. Soll, Chelmsford.*—This invention relates more particularly to multiple or regulating switches or commutating apparatus, such as are used for switching the current on to a series of terminal blocks in order. The contact blocks are to be placed in line, and to be made in ring form, and the connection to these rings is made by forcing through them in turn an elastic copper disc. The disc is mounted on a spindle whose axis coincides with that of the disc. The annexed figure represents a plan of one form

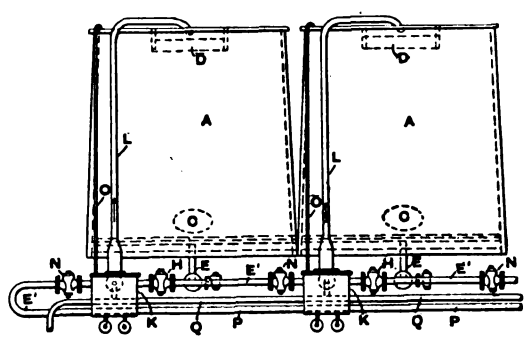


of this apparatus. A A A are the ring-shaped contact blocks and B is the elastic disc, which is forced through them by means of the screwed spindle C. The contact rings A are split at the upper side so as to insure a good contact on to the circular disc. In order to convey the current to or from the screwed spindles, a circular revolving contact is preferably employed, and is placed at L as shown in the diagram. The inventors claim: (1) The arrangement of forcing circular discs through ring-shaped contacts; (2) the split ring-formed contacts; (3) the use of rows of contact rings side by side with operating mechanism to regulate an accumulator or other electric batteries; (4) the combination of parts for operating several circuits of different e.m.f.—No. 275. January 7th, 1887. 8*d*.

CHEMISTRY.

Colouring Matters.—*O. Imray, London.* (*Farbwerke vormals Lucius & Brünig, Höchst-am-Main.*)—This invention consists in the manufacture of blue or violet colouring matters by the action of paranitroso-derivatives of secondary amines on phenols and oxycarbonic acids. One of the examples mentioned in the specification runs as follows: To five parts of chlorohydrate of paranitrosodiphenylamine and eight parts of gallic acid are added fifty parts of acetic acid. This mixture is heated on the water bath until it assumes a blue colour, the product is then poured into cold water and the blue colouring matter is precipitated. The claim made by the inventor is substantially embodied in the first sentence of this abstract.—No. 737. January 17th, 1887. 6*d*.

Saccharification of Starchy Materials.—*V. C. A. M. Bondonneau, Paris, and A. J. M. G. Fosèt, Chalon-sur-Saône.*—This invention relates to a process and apparatus whereby acid saccharification can be effected in such a manner as to convert all the starchy ingredients and produce a pulp equivalent to that which is obtained by the malt process. Each diffuser-saccharifier consists of a vessel A of wood, copper, or enamelled iron, provided with a double bottom B of perforated wood or metal covered with wire gauze. C is a man hole for emptying the pulp, and D is a box for breaking the flow of liquid. The heater elevator consists of a cylinder K, containing



a conical bell within which is a steam coil for heating the liquid. The process operates in the following manner: The saccharifier A is charged with the vegetable matter and water acidulated with any suitable acid, and is placed in communication with the heated elevator K by means of the pipe E and the cock H. Steam is introduced into the steam coil, so that the liquid flowing round the same is heated to boiling point, and by its expansion is forced up the pipe L into the box D. Thus a circulation of liquid is set up, and the boiling liquid is made to flow slowly through the whole mass of matter in A, heating it and converting it into saccharine matter. The syrup is then allowed to run off through the cock F, and a corresponding amount of water is allowed to enter K through another cock. The process thus continues until the whole of the saccharine matter is drawn off. There are two claims for the process above described.—No. 986. January 21st, 1887. 8*d*.

Manufacture of Aluminium Alloys.—*E. Cleaver, Stockwell, Surrey.*—This operation consists of extracting aluminium from its oxide, and alloying it with iron. Alumina is dissolved in sulphuric acid, and the sulphate of alumina so obtained is absorbed into finely powdered carbon. The salt is then reduced by heating the mixture out of contact with air, and the material thus obtained is mixed with cast iron filings and raised to a temperature sufficient to melt the metal. An alloy of iron and aluminium is the result. Other salts, such as the ferrocyanide, may be used instead of the sulphate. There are four claims for the branches of this process.—No. 1276. January 26th, 1887. 6*d*.

Peroxide of Lead.—*D. G. Fitz-Gerald, London.*—The inventor prepares peroxide of lead for use in voltaic batteries by mixing monoxide of lead with an insoluble salt of lead, such as the sulphate, together with a certain quantity of water. This mass is then placed in moulds of the required forms, where it gradually sets into a porous and coherent shape. An addition to the above mixture of a small proportion of peroxide of lead promotes its setting and augments its conductivity. Three claims are made.—No. 16608. December 17th, 1886. 6*d*.

MISCELLANEOUS.

Illuminated Fountains.—*C. J. Galloway & J. H. Beckwith, Manchester.*—This invention relates to certain arrangements by means of which the control of the fountain jets and of the coloured slides may be in the hands of one or two operators, who occupy a commanding position. The main supply pipe is provided with as many valves and branch pipes as there are minor fountain jets. Each valve is worked by a suitable lever connected to it by a set of rods or counterweighted chains, and all the levers are arranged in a row so that they shall be under the control of one man. In a similar way another set of levers operate on the coloured slides. When the extent over which the slides are disposed is considerable, each of the rods or

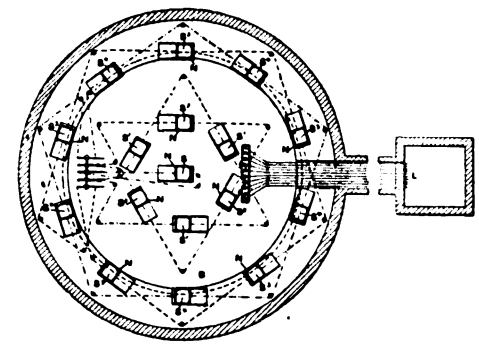


Fig. 1.

chains is preferably attached to the piston of a hydraulic or pneumatic cylinder, and then the attendant, by opening a cock or valve, can transmit pressure to work the set of slides. In the accompanying diagrams, which represent a plan and vertical section, B is the basin of the fountain, and underneath are arranged the main water pipe M and the branch pipes. The valves V of the branch pipes arranged over the main

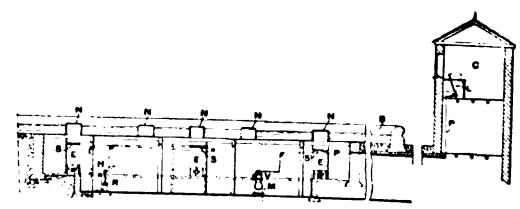


Fig. 2.

pipe, and the levers connected with the valves, are operated by chains and levers L in the cabin. Under each of the glazed hatchways N are placed a series of electric lights E. The sliding screens S, glazed with coloured glass, are fitted underneath each of the hatchways, and are connected by means of cords and pulleys with the levers H. The screens are preferably grouped in sets, so that one of the levers H works all of one set. Thus, as indicated in the plan, the middle lever H works the central screen S, the levers H^1 and H^2 respectively the three screens S^1, and the three screens S^2, and so on. Each screen may have many successive coloured glasses. The levers H may be worked by hand, or by pneumatic or hydraulic power. Claim: The arrangement under the basin of a set of valves and a set of coloured screens to be worked by levers in a cabin commanding a view of the fountain.—No. 1460. January 29th, 1887. 8*d*.

Underground Conduits.—*A. J. Boult, London.* (*E. E. Ries, Baltimore, U.S.A.*)—This invention relates to underground conduits for electrical conductors for railway or telephonic, &c., purposes, for cables for a cable railway, and for pneumatic or hydraulic tubes. A suitable trench is excavated along the line of way, and suitable brackets or ties are placed across it and supported on a foundation of asphaltum or similar material. The brackets consist of a perforated iron plate, provided with flanges, on which rest the track rails, and the rails forming the slot for the cable gripper or current collector. The perforations in the ties receive tubes for containing the telephonic, &c., conductors, or for conveying air and water. Suitable recesses are cut in the flanges of the ties to form a firm seat for the slot rails. Along the edges of the slot in the brackets are projecting lips or flanges which deflect any water or foreign matter away from the conductors. Twenty-three claims are made.—No. 12752. September 20th, 1887. 8*d*.

Obtaining Fresh Water for Ships' Use.—*Hamilton Dansey, London.* (*L. C. Auldjo, Sydney, N.S.W.*)—This invention is an apparatus for obtaining fresh water for ships' use, in which the waste gases escaping from the boiler furnace are utilised to effect the evaporation of sea or other water while in a partial vacuum. A vertical tube is fitted in the smoke box, uptake, or funnel of the ship's boiler. Its lower end is led into a tank open to the atmosphere, partially filled with the water to be evaporated. The upper end is connected with a pipe which is in

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communication with a surface condenser. When the necessary cocks of the tubes have been opened, the water in the tank will rise by reason of the vacuum of the condenser, and will become heated and evaporated by the heat from the waste gases in the funnel or uptake. Being in a partial vacuum, evaporation takes place at a low temperature and rapid rate. The steam thus generated passes into the condenser and is condensed. The height of the vertical tube is required to be about forty feet. The inventor makes two claims, one for the principle involved and one for the mechanism employed.—No. 1089. January 24th, 1887. 8*d*.

Harvesters.—*A. J. Boult, London.* (*Milwaukee Harvester Company.*)—This invention relates to a grain saving apparatus which is to be affixed to the harvester, in order to catch the grain which is thrashed out in the reaping and binding process. An inclined deck and a rearwardly extending receptacle at the lower edge of the deck are arranged in combination with the frame of the harvester. The deck is corrugated or ribbed, and provided with fingers at its lower edge in order to guide the grain into the receptacle, whilst the bundles are delivered from the deck. There are four claims made.—No. 14853. November 1st, 1887. 6*d*.

Weaving Figured Fabrics. — *C. Brazil & J. E. Johnson Ferguson, Bolton.*—This invention consists of the production of a new toilet quilt or cover, having a weft twill or satin raised figure upon a seed ground. The cloth is woven with three ends or warp threads to every dent of the reed. The weft is thrown in two picks of coarse weft and two picks of fine weft alternately, and the whole pattern of ground and figure is completed in eight picks. A weaver's diagram is included in the specification to illustrate this arrangement. There are two claims, one for the article produced, and one for the method of its production.—No. 7689. May 27th, 1887. 8*d*.

Electric Marine Governor.—*R. B. Maddison, Sunderland.*—This apparatus is designed to control and avoid the racing of marine engines in rough and stormy weather. A cylinder is fixed horizontally to the stern post of the vessel, just below the water line, and is open at the fore end, and has a perforated cover at the after end. A piston is fitted at the front end of the cylinder, and a spring is placed between the piston and the perforated cover. Directly the water declines from light ship water line there is a cessation of the pressure against the fore side of the piston. The spiral spring being thus released, a rod is driven forward and presses an electric bracket, which is connected with a battery. On contact being made a slide valve admits steam into a small cylinder, by which means the throttle valve is closed. The reverse process takes place when the pressure of the water again acts on the piston. The inventor makes two claims.—No. 6584. May 5th, 1887. 8*d*.

Improved Micrometer Gauge.—*D. G. Brown & W. Lancaster, Philadelphia, U.S.A.*—The object of this invention is to provide a device for measuring the inside diameters of pipes or cylinders with increased accuracy. The arrangement of parts will be seen in the annexed diagrams. Fig. 1 represents an elevation of the gauge, and Fig. 2 an elevation of the threaded finger piece. A is a slotted tube having ears B B, by which the sections made by the slot may be drawn together by screws C C to take up wear. The tube is threaded on the inside to receive the finger piece D, which carries a milled flange D¹ and a pointed end E. Upon the finger piece D is screwed a collar F, a graduated flange

Fig. 1.

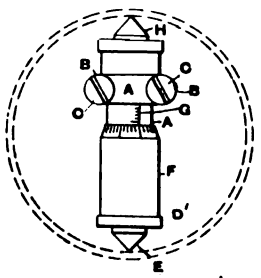
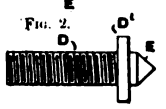


Fig. 2.



of which is adapted to overlap and inclose a portion of the tube A, which portion has an indicating mark G placed longitudinally thereon. The opposite end of A is provided with a movable pointed tip H; and the distance from H to E will measure the internal diameter. The screws of the finger piece and tube are provided with forty threads to an inch, while the flange F of the finger piece is marked off into twenty-five equal parts. It is thus evident that measurements of internal diameters can be made to the thousandth of an inch. The inventor makes five claims for the various combinations of parts.—No. 13703. October 10th, 1887. 6*d*.

Beaters of Thrashing Machines.—*J. Marshall, Gainsborough.*—According to this invention, the drum ends and foundation rings of the beaters are made with a number of projections round their peripheries. These projections are formed so as to form a seating for the beater beds; they have a flattened higher part which descends in a curve and terminates in a step at the part nearest to the centre of the drum. The beater beds are of iron or steel, and are formed correspondingly with the projections aforesaid.—No. 1248. January 26th, 1887. 6*d*.

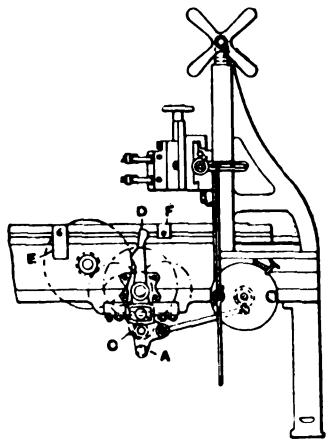
Lace Machines.—*A. M. Clark, London.* (*E. Darchicourt, St. Pierre les Calais.*)—The inventor substitutes lever guides through which the threads are led for the "stump bars" of bobbin net machines, and for the "fine bars" through which the warp threads are passed in Lever's lace machines. They also replace the pickers and Jacquard placed behind and above some machines. The guide eyes of the levers may be twisted or alternately flat and cranked. Three claims are made for the improvements described.—No. 1625. February 1st, 1887. 8*d*.

Waterproofing Leather.—*A. Smetham, Liverpool.*—According to this invention, the tanned butts are passed through molten paraffin wax or some similar substance, and then through some solvent, such as petroleum, for the purpose of removing the surplus wax. Two claims are made for the process described.—No. 1009. January 22nd, 1887. 4*d*.

Drums for Paper Making Machines.—*G. Bentley & J. B. Jackson, Bury.*—The flanges or projections on the inside of the cylinder and on the end disc are formed so as to abut firmly against each other, and thus prevent contortion of the drum or cylinder when the fastenings are screwed up. The joint may also be cemented. The inventors make one claim for the improvements described.—No. 2133. February 10th, 1887. 8*d*.

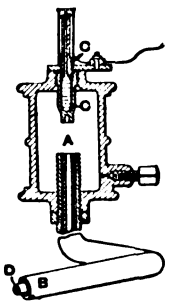
GERMAN PATENT ABSTRACTS.

Planing Machines.—*O. Müller, Neuschonfeld, near Leipzic.*—This invention relates to an automatic link motion for planing machines. The link motion is produced by a movable toothed



wheel work C, geared into a suitable combination of toothed wheels. C is attached to a lever A, which is actuated at D by the catches E and F.—No. 41280. March 9th, 1887.

Safety Device for Boilers.—*August Shütte, Oderberg.*—This apparatus consists of a vessel A which is connected to the boiler by two tubes B and D reaching to different levels in the boiler. A thermometer C is fixed in the top of the vessel. As



long as both tubes dip in the water a circulation of water through B and D takes place; but as soon as the water level sinks below the end of the short tube B, steam enters A and reaches C. The quicksilver in C rises, thereby establishing an electric circuit in an alarum apparatus.—No. 41364. March 4th, 1887.

UNITED STATES PATENT ABSTRACTS.

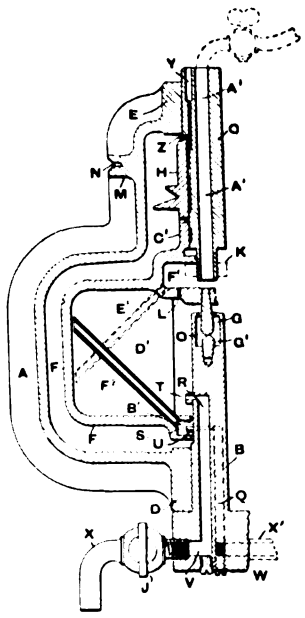
Registering and Recording Scale Beam.—*E. G. Fisher, Minneapolis, Minnesota.*—The travelling weight of a scale beam carries an indicating and recording mechanism, which consists of a train of wheels and a dial. One of the wheels gears with a rack on the upper edge of the beam, and thus the travel of weight is indicated by a finger on the dial. A graduated card can be fixed on the dial plate, and the indicating finger is provided with points which are made to puncture the card and record the weight. The inventor makes twelve claims for the several combinations.—No. 371831, dated 18th October, 1887.

Knife Blades.—*G. Havell, Newark, New Jersey.*—The object of this invention is to provide a sheet metal knife blade with a strong tang, and with a solid bolster fitted tightly upon the tang and shank of the blade. The tang is formed in one piece with the blade, and is made of a prismatic shape by compressing its edges. The bolster has a notch in it so as to fit the butt of the blade, and a central aperture to admit the tang; and the sides of the bolster are compressed with a die in order to close the central aperture against the butt of the blade. There are five claims.—No. 373527, dated 22nd November, 1887.

Gaseous Fuel.—*J. W. Mitchell, Bayonne, New Jersey.*—This invention consists of a process and apparatus for the production and combustion of gaseous fuel. Superheated steam and liquid hydrocarbon are injected together through the wall of a closed firebox or combustion chamber into a retort, where by the decomposition of the steam and the oil gas is generated. This gas is fed with a stream of heated air to support its combustion. The process is as follows: The water in the steam boiler is heated in the first place by the combustion of the oil. When the heat of the water is increased so that it boils, the steam which is given off passes through a superheating coil. On this taking place, the oil and steam are injected into the retort, where the gaseous product is ignited, and supplies further heat to the boiler. The furnace is thus supplied with gaseous fuel generated within itself. There are four claims for these combinations of parts.—No. 373468, dated 22nd November, 1887.

Seam for Wire Cloth.—*J. J. Sellers, Philadelphia.*—In securing the edges of wire cloth, a whipping thread is to be passed alternately round the first transverse wire and another transverse wire, and it is so arranged that this thread shall only pass over one side of the transverse wires. In uniting the edges of two pieces of cloth, the adjacent loops formed by the whipping threads are united with a connecting wire. With this construction it will be seen that the two pieces of cloth are joined in such a manner that there are no projections formed by the whipping wires on one side of the cloth, and that the edges are prevented from being bent or outwardly projected to form a rough or uneven surface. As the whipping wires are not passed successively round any of the transverse wires except the first, a tight and smooth seam may be obtained free from any warping or distorting of the cloth. There are three claims.—No. 372335, dated 1st November, 1887.

Liquid Separator.—*C. A. Backstrom, Trenton, New Jersey.*—This is an apparatus for centrifugally separating such liquids as milk. The machine is provided with a yoke and ring, which constitute a concentric ring or compass support, whereby the whole apparatus will naturally assume a position agreeing with the centre of gravity of the entire structure. The annexed figure shows a section of the frame A, and the bowl F, where the separation takes place. The bowl is supported by the



projections G G¹, and bears on the non-rotating shaft C. The milk flows through the supply pipe A¹ into the annular vessel F¹, then through the pipe E¹ into the interior of the bowl F. The blades inside the bowl are all perforated, except D¹, which is shown in the drawing. During the revolution the cream collects in a ring nearer the centre of support, and passes through R, V, and X, while the milk escapes through F², S, Q, and X¹. By manipulating the cock J, and a similar cock attached to the passage X¹, the inventor can regulate the quality of the resulting liquids which pass off through the two pipes, and thus control the quantity of cream which is taken out of the milk. There are seven claims.—No. 368047, dated 9th August, 1887.

Shuttle Motion for Looms.—*F. W. Wright, Rochester, N.Y.*—The object of this invention is to produce an efficient locking mechanism, whereby the shuttle may be automatically attached to and detached from the carriers. The shuttle is provided with a laterally movable locking lever, and the carriers have laterally movable catches adapted to engage the lever. Springs and stops are arranged on the carriers, so that the catches are held obliquely, in order to shift the lever by contact with its advancing end. There are three claims for these combinations.—No. 373423, dated 15th November, 1887.

Elevated Railways.—*D. D. Read, Boston.*—The inventor designed this arrangement of cars and supports with a view to their occupying as little air-space and foundation ground as possible. The road is constructed on the trussed suspension plan; and a single line of columns is used for a double track road, the trusses being supported on either side of the columns. The cars have centrally placed wheels at their base that sustain the weight, and similarly placed wheels above the car body are used to retain the car in an upright position, as the lower support has no appreciable width to afford the requisite stability. Five claims are made.—No. 373605, dated 22nd November, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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INDUSTRIES AND COMMERCE DURING 1887.

(Concluded from page 2.)

RAILWAY PROGRESS AND WORKING.

The general tendency of railway property in the United Kingdom during the last year or two has not been satisfactory. The profits realised on the capital invested have been decreasing instead of advancing. This is not due so much to a reduction of business as to an increase of working expenses, and a reduced range of rates and fares. The net receipts on the railways of the United Kingdom as a whole amounted in 1886 to quite £600,000 less than in 1883, although in the interval there had been 44 millions more invested in our railway system, and about 430 more miles of railway opened. The average rate of profit was highest within recent years in 1882, when it was 4·38 per cent., and again in 1880, when it was 4·38 per cent. on the total paid up capital. In 1886 the average had fallen to 3·99 per cent., and there is reason to believe that for 1887 it will not be higher than this figure, if it does not fall below it.

The reduced volume of business done by our railways may be taken as an accurate reflex of the extent of the depression that has occurred in our leading, and especially in our heavy, industries. For a number of years the progress of our goods and mineral traffic was remarkable. This movement proceeded until 1883, when it culminated in a total tonnage of over 266 millions of tons, of which 189½ millions were mineral, and 76½ millions were general goods traffic. Since then there has been a decrease of traffic and of receipts. The mineral traffic fell from a total of 189½ millions of tons in 1883, to 183½ millions of tons in 1884, and although there was a slight recovery in 1885, when the traffic amounted to about 183¾ millions of tons, this increase was not sufficient to compensate for the reduction of general merchandise traffic by nearly two millions of tons, which took place in the same interval. In 1886, the total goods and mineral traffic carried on our railways was 12 millions of tons less than in 1883. Hence we find that, as between 1882 and 1886, the receipts from general merchandise traffic diminished by over £800,000, while the receipts from mineral traffic were reduced by nearly £600,000. If this had happened coincidently with the maintenance of the same mileage and capital, it would have been bad enough; but as it was, it fell in with a large increase of both, and a consequently large reduction in the average earning power of the system, whether measured by the mileage operated or by the capital expended.

The diminution of goods and mineral traffic receipts has some set-off, however, in the increase of passenger traffic. The number of passengers carried on the railways of the United Kingdom advanced from 654¾ millions in 1882 to 725½ millions in 1886, and the receipts therefrom rose from about 25¼ millions to 26 millions sterling. It is extremely doubtful whether any conclusion favourable to trade can be drawn from this undoubtedly large increase of passenger traffic in the interval. About 20 millions of the increase occurred on the two principal metropolitan railways, and in their case it was largely stimulated by the exhibitions at South Kensington.

The rolling stock employed on the railways of the United Kingdom has been considerably augmented, while the traffic has thus remained all but stationary, taking one class with another, and while the gross and net receipts have been diminishing. In 1882 the total number of locomotives employed was 14,128; in 1886 it was 15,400. The number of goods waggons rose from 406,795 to 468,537. The number of passenger vehicles advanced from 31,250 to 34,216. The total number of vehicles and waggons of all kinds rose from 462,061 to 528,090—an increase of 66,029, or 14 per cent. This increase of rolling stock may not, however, represent any real increase of facilities to traders, or of the rolling stock actually available, so far as waggons are concerned, since some of the leading railway companies have recently been buying up private traders' waggons, and in such cases it is simply a transfer of the same stock from the hands of private owners, as to whose business there were no figures available, to those of the railway companies, whose affairs are made public by Act of Parliament.

In the present and recent circumstances of the railway interest, it is hardly probable that concessions of a very substantial character can be expected by traders. The ensuing session of Parliament will undoubtedly witness the re-introduction of the Railway Rates Bill, which is designed to impose certain restrictions, in the interest of traders, upon the often monopolist powers exercised by railway companies. Should that Bill at last become law, it will do much to limit and remove the more flagrant abuse of preferential rates, of charges in excess of parliamentary powers, and of terminal and other charges of which no proper account has been given hitherto. But the Bill is not designed to abolish or modify the maximum rates and fares authorised to be taken; and if these maxima, or any near approach to them, are continued, the position of the trading community, as a whole, is scarcely likely to be much improved. There is no doubt that there is substantial accuracy in the complaint that these charges are much higher than the now extremely narrow margin of industrial profits usually permit. It would, however, be well for the railways to consider, in their own as well as in the traders' interest—for in this matter they are identical—whether they would not be likely, in many cases, to develop business by a lower range of rates and fares. America has done wonders in this direction, and the railway interests of the United States were probably never in a more healthy condition than they are in to-day.

SHIPBUILDING.

There are no fewer than fifty-five ports in England and Wales at which shipbuilding operations are carried on, nineteen in Scotland, and three in Ireland. At these ports the net tonnage of the vessels built, not including those for foreigners, in 1886 is officially returned in the "Annual Statement of the Trade and Navigation of the United Kingdom," as follows:—

	No. of vessels.	Tonnage.
England and Wales	447	162,136
Scotland	203	112,072
Ireland	21	18,792
Totals	671	293,000

which represents the net addition to the register of the United Kingdom in that year. In the same year the tonnage of the merchant navy of the United Kingdom as a whole was officially returned at 7,321,335 tons, being 66,000 tons less than in the previous year. It appears, therefore, that after making due allowances for vessels removed from the register by wrecks and otherwise, the vessels added in 1886 were inadequate to keep up the register at its 1885 level.

Wooden ships or boats are still built at a good many ports. In 1886 there were no fewer than 256 vessels constructed of wood, having a total net tonnage of 14,363 tons, or, in other words, averaging rather under 60 tons each. The principal ports for wooden shipbuilding are Brixham, Dartmouth, Grimsby, Lowestoft, and Rye.

In steel, the number of vessels built on British account in 1886 was 194, of the aggregate tonnage of 141,020. Of this number 39 were sailing and 155 were steam vessels. The sailing vessels averaged 814 and the steam vessels 705 net tons each. There has been a disposition during the last few years to build in iron sailing vessels of larger dimensions than usual for cargo-carrying purposes. Of such vessels the number constructed in 1886 was 93 for British owners, their net tonnage being 92,337 tons, while 122 vessels were built as steamers, with only 44,923 net tons.

The number of vessels built in the United Kingdom for foreigners in 1886 was 65. Their net tonnage was 38,528 tons. Nearly one-half of the whole were built at Glasgow. The total number of vessels built in British possessions in 1886 was 491, of 43,010 net tons. Of this number 332, of 35,113 net tons, were built in Canada, and 106 vessels, of 5,541 tons, in Australasia. The Colonies evidently do not threaten to seriously compete with the mother country in shipbuilding just yet.

So far as the returns are at command, it would appear as if the amount of shipbuilding done in 1887 was appreciably greater than in 1886. The amount of work done on the five chief shipbuilding rivers in Great Britain during each of the last two years has been as under:—

	1887. Tons.	1886. Tons.	Increase in 1887. Tons.
The Clyde	185,362	172,440	12,922
The Tyne	104,284	82,757	21,527
The Wear	85,214	61,399	23,815
The Tees	35,346	20,476	14,870
The Mersey	10,282	20,302	Decrease. 10,020
Totals	420,488	357,374	63,114

The total increase of shipbuilding during 1887, so far as can be ascertained at present, is about 100,000 tons over 1886. The aggregate tonnage launched in iron and steel in 1887 was about 580,000 gross tons, the total number of vessels being 630, and the average tonnage per vessel being 921. On the Wear, however, the average size ran up to 1803 tons. There is a good deal of work on hand at present, and further orders are expected, so that shipbuilders can look forward hopefully to the immediate future.

TEXTILES.

Cotton.—The cotton trade can hardly be said to have had a satisfactory year, although the average prices realised have been a trifle better than those for the previous twelve months. In yarns, the difference has been about 3d. to 4d. per lb. Some of this difference, however, has been lost to the trade by the higher prices paid for the raw material. The average price of raw cotton over the year has been £2. 9s. 10d. per cwt., as compared with £2. 9s. 3d. in 1886. There has been a great deal of keen competition during 1887, both in the spinning and in the weaving departments of the trade. But it has been found difficult to make profits at the present comparatively high range of wages. There is no industry in which the operatives have obtained greater concessions within recent years than in that of cotton. The labour is still, however, relatively cheap, because so much of it is performed by women and children. The manufacturers of Lancashire are looking forward to being benefited by the completion of the Manchester Ship Canal, now fairly undertaken; but while this event will somewhat reduce their cost of transport, and thus place them in a better position to compete with foreigners, the competition that exists among our home manufacturers is too severe to be likely, under existing arrangements, to allow of their receiving any considerable profit. There has, indeed, been far too great an extension of productive resources in this industry, owing mainly to the facility with which mills could be run up under the Companies Acts, and the natural effect of over production has followed. The exports of cotton yarn from this country have been reduced largely within recent years. They were as high as 271 million lbs. in 1884; but in 1886 they had fallen to 254 millions, and in 1887 (first eleven months) they were only 228 millions. It is true that piece goods are much better, the exports having shown a steady increase; but while the development of the trade within recent years has been wholly in the direction of weaving, there was a fall of the average export prices of cotton yarn, from 13·25d. per lb. in 1880 to 10·84d. per lb. in 1886, and with an almost entire absence of profits in this branch of the trade.

The course of the export trade gives as good an idea of the condition of textiles generally as it is possible to obtain. In order that the concurrent movement of allied industries may be appreciated and compared, we have included them in the analysis that follows.

In yarns the business done in 1887, so far as it is illustrated by our exports, has not been equal to that done in 1886, as the following figures show:—

	1887. lbs.	1886. lbs.
Cotton	228,000,000	235,000,000
Jute	21,000,000	29,000,000
Linen	15,000,000	15,000,000
Woollen	37,000,000	42,000,000
Totals	301,000,000	321,000,000

The values of these different descriptions of yarn in the same years come out as under:—

	1887. £	1886. £
Cotton	10,325,467	10,631,767
Jute	207,414	253,071
Linen	855,417	856,198
Woollen	3,628,952	4,087,636
Totals	15,017,250	15,828,672

Dividing the quantities into the values for each of the two years, the results obtained show that the average prices per lb. were:—

	1887. Per lb. d.	1886. Per lb. d.
Cotton	11·0	10·8
Jute	2·3	2·5
Linen	13·6	13·6
Woollen	23·5	23·3

These figures show a slight improvement in woollen yarn, a decline in jute, a stationary attitude on the part of linen, and a slight improvement in cotton yarns. Prices, however, are still remarkably low. The following table shows the prices of yarns at different dates for the last 47 years, as calculated from the export returns of the Board of Trade:—

Year.	Cotton. Per lb. d.	Linen. Per lb. d.	Jute. Per lb. d.	Woollen. Per lb. d.
1840	14·39	11·14	—*	28·63
1845	12·37	10·93	—*	27·22
1850	11·66	11·61	—*	25·26
1855	10·44	12·32	—*	22·90
1860	12·00	13·85	2·90	32·46
1865	23·98	16·54	3·99	40·31
1870	18·92	14·42	3·72	33·73
1875	14·66	15·95	3·40	38·58
1880	13·25	14·25	3·33	30·33
1883	12·25	14·36	3·05	23·41
1886	10·8	13·6	2·5	23·3
1887	11·0	13·6	2·3	23·5

* Cannot be given for those years.

It will be noticed that although the prices that have prevailed over the last two years are exceptionally low, they are not the lowest in the history of the cotton, linen, and woollen industries. The year 1855 carries off the palm in this respect. Jute, however, has been lower in 1887 than it had ever been before. The exceptionally high prices shown for cotton and linen in 1865 are, of course, due to the American war. The lower prices of 1887 are also, of course, concurrent with a cheaper cost of production.

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In piece goods there has been comparatively little difference between the years 1887 and 1886. The quantities and values compare as under :—

	1887. Millions of yards.	1887. Value. 1=1000. £	1887. Average per yard. d.	1886. Millions of yards.	1886. Value. 1=1000. £	1886. Average per yard. d.
Cotton ...	4,448	46,933	2·53	4,471	46,220	2·48
Jute	220	1,873	2·04	194	1,625	2·01
Linen ...	149	3,836	6·17	151	3,837	6·09
Woollen..	232	15,159	15·7	229	14,770	15·5
Totals..	5,049	67,801	—	5,045	66,452	—

This little table, small and insignificant though it may appear, is really very valuable, for it shows that there has been a real revival in prices during the past twelve months. This revival appears in all textile piece goods alike, but it is most noticeable in linen and woollen goods. The improvement is little more than fractional, but in the textile industries prices and profits alike partake of this character, and a tenth of a penny per yard will often make all the difference between a good dividend and no dividend at all. The recent course of prices in textile piece goods is one of the most remarkable developments of economical production of which it is possible to cite examples. Plain cotton piece goods ranged between 5·79d. and 3·13d. per yard between 1864 and 1876. From the latter year they never got above 3d. per yard, but they did not fall below 2½d. until 1884-85, and the slight improvement in price in 1887 still leaves cotton piece goods at a lower level of prices than has been known in the history of the trade.

THE SUGAR INDUSTRY.

The sugar trade has claimed a large amount of attention during the past year, and especially during the last two months. The Sugar Bounties Conference, which held a number of sittings, resulted in a convention, under which the representatives of the several countries delegated engaged to propose to their several legislatures that no bounty, open or disguised, should be given on the exportation of sugar, and there are other clauses under which the contracting powers undertake not to impose duties on sugars, or to accord to raw or refined sugars for export any drawback, reimbursement, or abatement. It is hoped and believed that the result of the Conference will, on the whole, be advantageous to the British sugar industry. The course of that important manufacture for the last twelve or fifteen years has been extremely variable. Our exports of cane sugar from our own Colonies have fallen from 5½ million cwt. in 1879 to 3¼ millions in 1886. The imports of cane sugar from other countries have fluctuated, since 1872, between a maximum of 9 millions and a minimum of rather over 6 million cwt., while our imports of raw beet sugar have advanced in the same period from less than 2 million to over 8 million cwt. The prices of sugar in the middle of December have been as under for each of the last three years :—

	1887. Per cwt. s. d.	1886. Per cwt. s. d.	1885. Per cwt. s. d.
West India brown...	14 3 to 14 6	10 6 to —	14 6 to —
Java, off coast.....	17 3 „ —	13 6 „ 13 9	17 9 „ 18 3
Beet, 88 per cent.	15 3 „ —	11 1½„ —	15 7½„ —
French loaves.....	18 9 „ —	15 6 „ —	20 0 „ —

Both the imports into and the deliveries from the United Kingdom have been greater in 1887 than in 1886, though not so considerable as in 1885. The quantity in stock at the present time is larger than in either of the two previous years.

THE CHEMICAL INDUSTRY.

The past year has been rather more hopeful for the chemical trades, although prices have been too low to permit of a fair profit except in certain cases. In the alkali trade the volume of business done in the first eleven months of the year was under that done in 1886 to the same date, but the decline has been almost entirely in the exports to the United States. Taking chemical manures and other chemicals besides alkali, there has been an increase in the exports for the eleven months of about £320,000. Prices for the month of December in each of the last three years compare as under :—

	1887. Per ton. £ s. d.	1886. Per ton. £ s. d.	1885. Per ton. £ s. d.
Soda, crystal	2 7 0	2 9 6	2 10 6
	Per cwt.	Per cwt.	Per cwt.
Saltpetre, refined	1 0 9	1 1 0	1 2 6
Turpentine, American	1 8 6	1 6 3	1 7 0

One of the growing features of the chemical trade is the production of tar on a large scale in the manufacture of coke and in the process of iron smelting. The same new developments have affected the price of ammonia, so that these residual products have not been nearly of the same value to gas corporations as formerly.

THE SHIPPING INDUSTRY.

In seeking to fix the progress or regress of any particular trade or industry, there is no more excellent plan than that of borrowing concrete cases from available sources. Adopting this plan, we find that the Peninsular and Oriental Company, with their high prestige and admirable vessels, have had to complain of a very bad year. The inter-Colonial trade, and especially that between Bombay and China, has been remarkably unremunerative, owing to foreign and bounty-fed competition. To India the rates have also been abnormally low, as was found by the same company only so recently as October of this year, when their new steamer, the "Victoria," did not earn more than 10s. per ton on her Bombay freight. The tea rates from China have only been 20s. or 25s. per ton, whereas a year ago they were as high as 50s. It is, however, a set-off to some extent to these low rates, that within the last month or two it has been possible to find full cargoes outwards to India. The low rates of freight have not, of course, been always, or entirely, coincident with corresponding losses of profit. The working of steamships has been greatly economised even during the last few years. The economy has occurred in almost every branch of outlay. The reduction that has occurred in the cost of labour is indicated by the fact that while in 1877 there were 3·35 persons employed in the foreign trade per 100 tons of shipping, this proportion had in 1886 fallen to about 2·5 per 100 tons. In other words, there was a reduction in the ten years of about 25 per cent. in the number of hands required to navigate a given tonnage of steam shipping. Within the same interval there has been a very material reduction in the cost of fuel, owing to the economy introduced in engine power. This economy will, of course, vary in different classes of steamers and in different descriptions of coal. But taking one trade with another, it will most probably average about 1lb. per i.h.p. per hour. The effect of such economies is reflected in the working expenses of all the great shipping companies. The Peninsular and Oriental Company, for example, have found that, whereas in 1877 their expenses were at the rate of 22s. 3d. per mile navigated, including insurance and depreciation, the average had fallen to 18s. in 1886-87. On a single voyage to and from India, this would represent some £4,000, which is, of course, a very material factor. Steamships with the old compound engines, consuming over 3lb. of coal per i.h.p. per hour, are necessarily handicapped in competing with new steamers having triple expansion engines, and consuming considerably less than 2lb. Among trading vessels, therefore, there is much real distress and depression, which is only likely to be overcome by the somewhat costly, but apparently inevitable, process of introducing the newest improvements devised by the engineer and naval constructor.

During the first eleven months of 1887, the amount of business done in the shipping trade of the United Kingdom, as regards the entrances and clearances from our ports, was larger than in either of the two preceding years, the total volume having been—

	Tons.
In 1887.....	51,500,000
„ 1886.....	49,500,000
„ 1885.....	50,700,000

There has, in 1887, as in each of the two previous years, been a considerably larger tonnage of clearances than of entrances. The tonnage of vessels entering and clearing from and to the principal countries with which our business was transacted was in each of the last three years as follows (1 = 1000 tons) :—

	1887.	1886.	1885.
United States	7517	7390	7212
France	5258	5171	5087
Germany	4457	4451	4571
India.....	3107	3175	3295
Spain	3460	2949	2828
Holland	3135	2909	2933
Canada.....	1925	1982	1968

It will still be some months before we have particulars of the values of the exports from different ports in 1887, but those for 1880 and 1886 are compared in the following table :—

Statement showing the value of the total exports of the produce of the United Kingdom from each of the principal ports, in the years 1880 *and* 1886. (1 = 1000).

	1880. £	1886. £	Increase in 1886. £	Decrease in 1886. £
London	52,600	46,125	—	6,475
Liverpool	84,029	86,029	2,000	—
Hull.....	18,572	15,643	—	2,929
Glasgow.....	11,828	12,386	558	—
Southampton	9,306	5,385	—	3,921
Cardiff	4,161	3,850	—	311
Newcastle-on-Tyne.	4,528	3,668	—	860
Grimsby.....	7,236	7,233	—	3
Goole	3,003	4,870	1,777	—
Dover	1,396	1,258	—	138
Bristol.....	1,763	1,210	—	553
Middlesbrough	2,026	2,006	—	20
Newhaven	1,770	1,725	—	45
Folkestone.....	1,265	1,403	138	—
Leith	2,819	2,570	—	249
Swansea.....	828	2,837	2,009	—
Totals.....	207,220	198,198	6,482	15,504

Net decrease, £9,022,000.

The above table shows a remarkable falling off in the value of the produce exported from the principal ports except Liverpool, Goole, and Swansea. The decline in the case of London is especially noticeable, and suggests whether the Thames has not found its facilities for export trade, notwithstanding its fine system of docks, eclipsed by those of ports that are nearer to our great manufacturing centres.

There is almost of necessity, in a trade so varied and extensive as the shipping trade of the United Kingdom, a good deal of unavoidable movement of vessels in ballast. The tendency is for vessels to come to this country to receive cargoes in greater measure than that in which they carry cargoes hither. In other words, the clearances of vessels in cargoes is greater than the entrances of vessels in cargoes, notwithstanding our enormous import trade. Here, however, we are met by the difficulty to reconcile the greater tonnage of exports from the United Kingdom with the well known excess of the value of imports over that of exports. There are two ways of explaining this apparently anomalous and unlikely condition of things. The first explanation is that the exports from the United Kingdom are very largely of commodities that are very heavy and very bulky in proportion to their value, as, for example, coal, coke, pig iron, and steel rails. These necessarily occupy much more space and weigh much heavier than would Colonial produce, cereals, or almost any other commodity that enters largely into our import returns. The second explanation is that the imports into the United Kingdom are valued at the port of import, and therefore include profits and cost of freight, whereas the exports are valued at the port of export, and therefore minus the cost of freight. This, of itself, makes a very remarkable difference. The income from shipping in the United Kingdom has been estimated at over 50 millions sterling a year. Some have put it as high as 65 millions annually. If it is assumed that one-half of this amount belongs to the export trade, the difference of value against exports would be reduced from 81¼ millions to about 51 millions, and the difference in the value of our imports relatively to their bulk and weight is quite sufficient to account for the remainder.

GENERAL EXPORTS AND IMPORTS.

The amount of business done during the past twelve months has been very satisfactory, when compared with some preceding years, although still a considerable distance from equalling the maxima of a few years ago. The full returns for the year 1887 are not yet available, but a sufficiently accurate idea of the year's trade may be obtained by taking the twelve months ended November 30th, instead of the calendar year. In this way, we find that our exports compare as under :—

Value of exports of British and Irish produce and manufactures for the year ended 30th November, 1887, *compared with the year* 1886 :—

	1887. £	1886. £	Increase or decrease in 1887. £
Animals.....	729,308	546,288 +	183,020
Food	9,282,114	9,552,294 −	270,180
Raw materials.....	12,569,497	12,431,620 +	137,877
Textiles	106,424,184	105,329,277 +	1,094,907
Metals	34,163,601	31,703,398 +	2,460,203
Machinery	10,971,189	10,073,192 +	897,997
Apparel	10,195,427	9,764,049 +	431,378
Chemicals	6,917,267	6,726,858 +	190,409
Other articles	26,813,899	26,387,937 +	425,962
Total	218,066,486	212,514,913 +	5,551,573
Foreign and Colonial exports	58,489,259	56,683,894 +	1,805,365
Grand total ...	276,555,745	269,198,807 +	7,356,938

The above return is, on the whole, extremely gratifying. There is an increase in every item except food, and an especially large increase in our two greatest industries—metals and textiles. The imports into the United Kingdom during 1887 are in the next table presented and compared in a similar manner.

Value of imports from foreign countries and British Possessions in the year ended 30th November, 1887, *compared with* 1886 :—

	1887. £	1886. £	Increase or decrease in 1887. £
Animals.....	6,133,024	7,195,135 −	1,062,111
Free food	114,368,708	110,741,968 +	3,626,740
Dutiable food	25,764,267	25,435,008 +	329,259
Tobacco	3,383,119	3,844,457 −	461,338
Metals	15,777,484	15,145,438 +	632,046
Chemicals.....	7,636,597	8,009,278 −	372,681
Oils.....	6,143,822	6,067,830 +	75,992
Raw textiles.....	78,670,114	70,691,022 +	7,979,092
Other „	34,283,973	35,561,692 −	1,277,719
Manufactures	53,915,972	53,837,528 +	78,444
Miscellaneous	12,695,241	12,877,036 −	181,795
Total.....	358,772,321	349,406,392 +	9,365,929

It will be observed from these returns that the increase in our imports has been considerably greater than that

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BRITISH INDUSTRIES AND COMMERCE DURING 1887.

I.—Raw Materials.

Item.	Unit.	Quantity imported in 1886. 1=1000.	1887.	Value of Imports in 1886. 1=£1000.	1887.	Average value in 1886. £ s. d.	1887. £ s. d.
Cotton	cwt.	12,912	14,015	31,828	34,928	2 9 3	2 9 10
Flax	„	1,148	1,417	2,156	2,445	1 17 6	1 14 6
Hemp	„	1,086	1,321	1,544	1,904	1 8 5	1 8 11
Jute	ton	254	302	2,868	3,383	11 5 9	11 4 0
Silk	lb.	2,132	2,399	1,460	1,644	0 13 8	0 13 8
Wool	„	549,120	529,454	20,551	22,519	0 0 8¾	0 0 10
Goats' wool	„	17,568	16,823	1,035	775	0 1 2	0 0 11
Caoutchouc	cwt.	170	215	1,921	2,443	11 11 0	11 7 3
Hides	„	664	576	2,183	1,697	3 5 9	2 18 11
Ivory	„	8	9	403	430	50 7 6	47 15 6
Guano	ton	63	19	499	168	7 18 5	8 16 10
Esparto, &c.	„	177	179	913	851	5 3 1	4 15 1
Tallow	cwt.	914	829	1,169	992	1 5 6	1 2 8
Tar	barrel	115	133	63	68	0 10 11	0 10 4
Timber	load	1,486	1,628	3,210	3,054	2 3 2	1 17 6
Totals		587,817	569,319	71,803	77,301		

II.—Manufactured Articles.

Item.	Unit.	Quantity imported in 1886. 1=1000.	1887.	Value of Imports in 1886. 1=£1000	1887.	Average value in 1886. £ s. d.	1887. £ s. d.
Glass	cwt.	666	735	419	446	0 12 6	0 12 1
Iron	„	3,259	2,585	2,021	1,843	0 12 4	0 14 3
Paper	„	277	247	433	374	1 11 3	1 8 1
Woollen	yards	58,934	51,718	5,302	4,556	0 1 9	0 1 9
Woollen yarn	lb.	17,323	14,491	2,077	1,722	0 2 4	0 2 4
Zinc	cwt.	323	358	290	320	0 17 11	0 17 10
Totals		80,782	70,134	10,542	9,261		

which has occurred in our exports. The increase that is likely to be most regretted—perhaps, indeed, the only one that need provoke any such feeling—is the increase in our imports of manufactures, which, however, only amounts to £78,444. In our food supplies there is an increase of about four millions, excluding animals. The average imports of food per head of the population amounted in 1887 to about £4.

PRICES OF IMPORTS.

It is one of the most essential elements of prosperity and activity of trade, in a manufacturing country like England, that she should be able to purchase the raw materials of her industries at reasonable prices. During 1887 the range of prices, taken as a whole, has been similar to that of the previous year; but in some there has been quite a notable reduction. This is especially the case with esparto, timber, tallow, ivory, hides, goats' wool, and flax; but hemp and cotton have been rather higher in 1887, and this has been the case also with ordinary wool. In the whole range of raw materials, however, the average of 1887 was rather under that of the previous year. The above tables show the average import prices and quantities of raw materials and manufactured articles imported in 1887 and 1886, separately distinguished.

So far as the above figures enable an estimate to be formed—and they are really very valuable for that purpose—it is clear that in our leading industries we have experienced exceptionally keen competition during the past year. There has been an appreciation of any moment in the values of iron only. In other manufactures prices appear to have ruled lower than in 1886; but this is of course a matter that is largely affected by the character and quality of the products, which may not be quite the same in the years compared.

IRRIGATING MACHINERY ON THE PACIFIC COAST.*

(Concluded from page 4.)

Pit Pumps.—In Fig. 8 is shown the common arrangement of what are called pit pumps in California. When the water rises in the wells within suction distance of the surface horizontal pumps similar to that shown in Figs. 6 and 7 are employed; but when this distance exceeds 20ft. rectangular pits are sunk from 10ft. to 60ft. deep, as shown in Fig. 8. Two or more tube wells T are sunk from 50ft. to 150ft. below the bottom of the pit; and in these are inserted the suction pipes S, leading to the suction box A, on which the pump P is mounted. The driving shaft D is supported in thrust boxes B B, and when of several lengths is connected by clamp couplings. The pump being balanced, there is no thrust except that caused by the weight of the spindle and wheel. This is taken up in the thrust box E, which has an annular oil chamber, and collars that perform the double office of supporting the spindle and sealing the joint to prevent the entrance of air, thus taking the place of the common packing gland. The air vessel H is made rectangular in plan, with the two-fold object of giving it elasticity, so that it shall not be broken by water-shock in stopping, if the air cushion should fail, and also of allowing the valve to open fully. The uptake pipe U is usually made of sheet iron coated with zinc and soldered at all joints. It is found expedient to have the area of these pipes at least four times that of the pump discharge, when the head exceeds 50ft. A charging pipe N is carried up to the surface, where an air pump or steam ejector is employed to fill the pump. Among the principal objects aimed at in the present pumps are the greatest possible simplicity; easy separation into parts, so that the machinery can be raised out of the pits or lowered into them without tackle; access to all interior parts; and the highest efficiency possible under the circumstances. The circumferential speed of the pump wheels in feet per minute being approximately 500 times the square root of the head in feet, wheels of 24in. to 30in. in diameter can be used for heads up to 100ft. without the speed of the shafts exceeding the rules of safe practice.

Low Lift Centrifugal Pumps for Land Reclamation and Irrigation.—As the Sacramento and San Joaquin rivers approach the ocean, the sedimentary plains bordering upon them sink below the level of the winter and spring floods, and hundreds of square miles become covered with water from 1ft. to 10ft. deep. These plains are called tule lands, from a kind of soft reed of that name which covers the whole surface where water stands. When drained of water and cleared of the tule growth the soil is a bed of vegetable compost of such surprising fertility and strength that crop after crop can be grown in the same year. It is mainly on these tule lands that are produced those prodigious crops of wheat, barley, potatoes, &c., which have rendered California famous in agriculture. These fertile lands, lying near San Francisco, and reached by water, rail, and roads, are of great value, and their reclamation has been the object of costly and extensive efforts. The work has been attended with great difficulty, and the larger part of the area once drained has subsequently been lost again, in consequence of the fluctuations of the rivers being so uncertain, and the period of exact observation having not yet been long enough for determining the levels of high floods. Moreover, placer mining has sent down silt enough to change nearly all the levels during the past twenty years. The embankments when made of peat have not weight enough to resist the pressure of the water; and being buoyant are sometimes floated away bodily. They are so porous that the percolation is enough to require pumping machinery in most cases; besides which the rainfall in winter and spring has to be pumped out when the rivers are higher than the lands. The uncertainty as to the quantity of water to be raised, the absence of permanent foundations, and the speculative nature of the attempts to reclaim the land, require machinery not merely of a cheaper kind than elsewhere, but also of quite a different character from that employed in other parts of the world, where land drainage is mostly performed at central pumping stations constructed for a definite and permanent duty. The tule lands are divided into districts, for each of which there is an engineer, by whom all plans and estimates for pumping machinery are closely examined; and a guarantee of efficiency is required. Besides the reclamation of the tule lands, there is also the nearly analogous duty of pumping from rivers to irrigate what are called the bench lands, lying from 15ft. to 30ft. above the water level. The limit of the height to which water can profitably be raised by machinery for ordinary crops at the present price of fuel and cost of machinery may be set down at 25ft. to 35ft. Most of the pumps now in use are of small size, such as may be driven by threshing engines of 25 to 35 i.h.p., and are of the types already described. In Fig. 9 is shown a reclamation pump of the usual construction, which is mounted on a framing made of Oregon pine. This is a hard, stiff kind of timber, almost as strong as ash, straight grained and without knots, of which beams can readily be obtained 50ft. long and 24in. by 12in. section. For the smaller pumps iron bed plates are employed; and also for the larger, wherever the extra cost is not objected to; but the timber frames answer very well, provided the machinery is so arranged that its working shall not be interfered with by such flexure as the timber framing is liable to. The centrifugal pump is arranged with its spindle horizontal; and in order to avoid end thrust the wheel is made with open vanes. The interior of the casing is turned smooth; and the wheel is also carefully turned after having been fixed on its spindle. The engine E has two single acting cylinders, of which the diameter is usually equal to two-thirds that of the discharge pipe D from the pump, when the total lift is not to exceed 20ft. The driving shaft is of steel, and is connected with the engine by a compression coupling N. The bearing B is mounted on a planed iron seating, so that it can be slid back when the pump gland requires packing. By thus supporting the driving shaft close up to the pump, no bearing is required on the suction side of the pump, which would be objectionable on account of the obstruction it would offer to tule roots, weeds, straw, and other rubbish that finds its way into the pump.

All the parts have to be arranged for allowing of ready access to the interior of the pump and pipes. The suction pipe S is slung by a chain, so that it can be lifted away from the pump in case of the foot valve at F becoming choked. The inlet nozzle of the pump casing can be cleared from ordinary obstructions by removing the hand plate at H. The two side plates of the pump casing are easily removed. Whenever the wheel becomes clogged with tule roots, the suction pipe S and the plate on the same side are loosened and swung aside; the coupling N is also loosened, and the wheel can then be drawn out at the suction side to be cleared. The time of the whole operation need not exceed ten minutes. The pump is of a semi-portable character, and adapted to most cases, but not to all. When the head varies on the delivery side, as it does sometimes from 1ft. to 14ft., it is evident that a pump arranged in this manner would not answer. The pump and engine must of course stand above the water level, which varies both inside and outside the embankment. There is no means of working economically against a low head, except by submerging the pump wheels. The height of the suction lift must be more than the variation of the water inside the embankment. Consequently when the water is low on both sides of the embankment, as much as two-thirds of the work may be lost, since the syphon action of the discharge pipe cannot be relied upon. A bottom discharge for the pump would remedy this difficulty in a measure; but it would involve the addition of an air tight sluice valve in the discharge for starting the pump, and also a pneumatic or steam charging apparatus. The syphon action of the discharge pipe soon ceases, unless there is some means of continuously exhausting the air given off by the agitation of the water in the pump. To connect the discharge pipe with a condenser, or to employ other means of exhausting the liberated air, introduces a complication not compatible with the attendance commonly received by such pumps on the Pacific coast.

Submerged Pumps.—In Fig. 10 is shown a vertical pump of the Whitelaw type, of which several have been constructed on the Pacific coast from the writer's designs; it is one of the cheapest arrangements, and places the machinery well above the water, excepting only the pump wheel, which is submerged. The engine and boiler are placed on the top of the embankment M, and are generally raised 1ft. to 2ft. above the ground; the embankment itself is in most cases wide enough for a roadway on the top, whereby fuel can be hauled or access obtained to the works when the whole country is flooded. The pump casing is a vertical cylinder, having a suction nozzle at the bottom, and a flange at the top by which it can be suspended from the bottom of the trough T. The pump spindle is supported in three bearings as shown, and is driven by a band from the engine E. A pair of bevel wheels are sometimes employed at the top of the spindle, so as to avoid twisting the band. The wheel or runner R is curved upwards, so that the tips of the vanes terminate parallel with the sides of the pump casing. Inside the casing is inserted a central sheet iron cone C; and the current of discharge water, ascending through the widening annular space between the cone and the cylindrical casing, loses its velocity gradually as the area of passage enlarges; while at the same time the whirling motion with which it quitted the wheel is checked by means of curved blades B fixed on the outside of the cone, whereby the current is deflected upwards. The water has to undergo deflection through one more right angle in a pump of this kind, with curved runner discharging parallel to the axis, than when the discharge is at right angles to the axis. But although the efficiency may thereby be impaired to the extent of as much as 10 per cent., this is often of less importance than the countervailing advantages gained with submerged pumps. There is no charging to be done, no valves, and no pipes. Tule roots and other obstructions pass freely through the runner, and are thrown out against the pump casing, where they are soon worn away. The pump shown in Fig. 10 is for raising 400,000 gallons an hour, the cylindrical casing being 40in. in diameter, and the engine capable of developing 35 h.p. Similar pumps have been erected on the San Joaquin and the Colorado rivers, and have raised 660,000 gallons an hour. Nearly forty years ago Mr. Whitelaw's experiments at Johnstone, near Glasgow, demonstrated that a high efficiency could be attained with pumps arranged in this manner. The only impediment is in utilising the energy of the water after it leaves the wheel R. If the velocity is destroyed by impinging against the body of water in the uptake, the efficiency for low heads will not exceed 40 per cent. The pump shown was much improved by inserting above the wheel R the cone C having curved deflecting blades B, which change the motion of the water from a horizontal to a vertical direction. With careful attention to the various conditions accompanying the action of centrifugal pumps, this arrangement has much to recommend it, especially in economy of first cost. In the Louisiana district, about the mouth of the Mississippi river, pumps of this kind are extensively employed for low lifts, the action being analogous to that of a turbine water wheel inverted, and centrifugal effect being almost disregarded.

Bulkhead Pumps.—In Fig. 11 is shown a plan of a pair of centrifugal pumps arranged for driving the water through a

* A paper read before the Institution of Mechanical Engineers on the 30th September, 1887, by Mr. John Richards, of San Francisco. The discussion on the paper was held over till a subsequent meeting.

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FIG. 8.

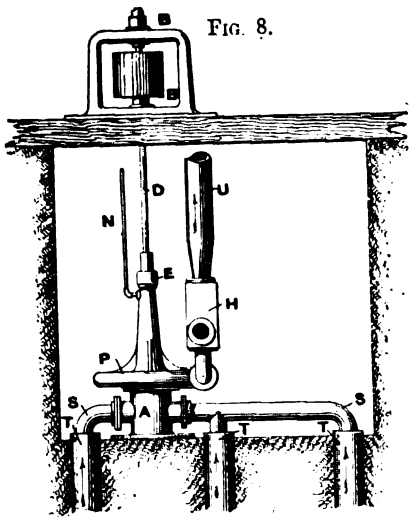


FIG. 9.

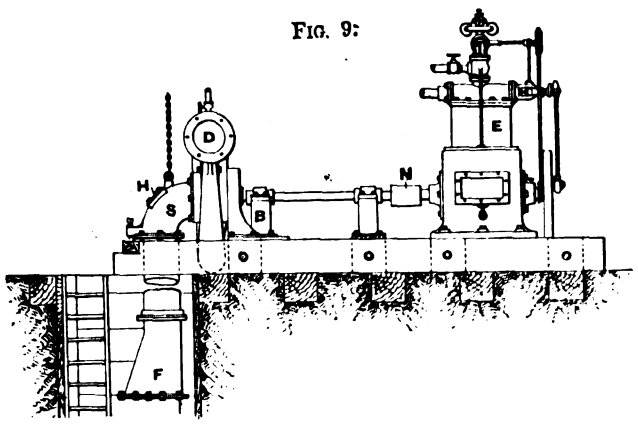


FIG. 10.

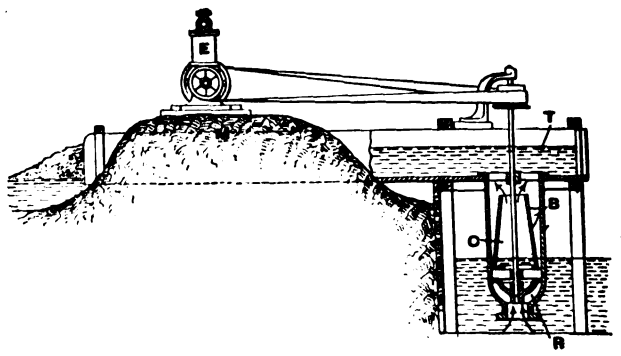


FIG. 11

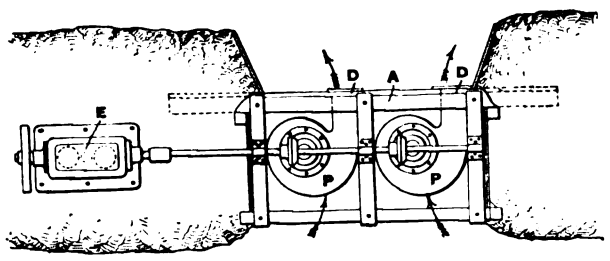


FIG. 12.

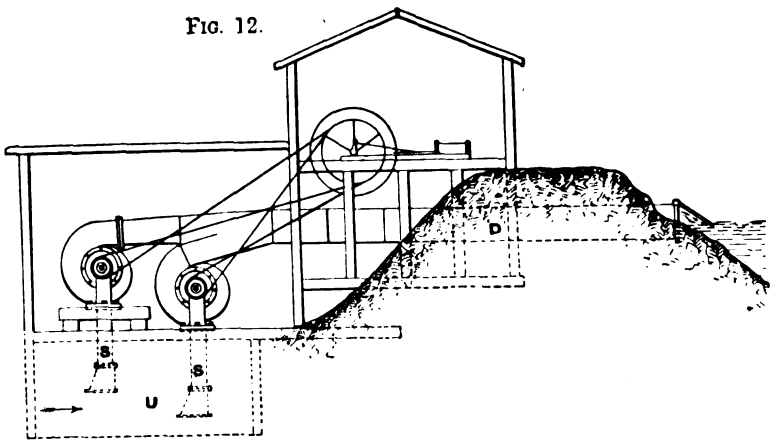


FIG. 14.

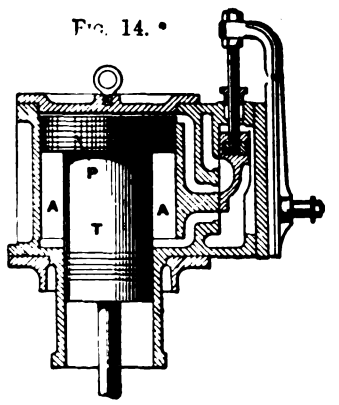


FIG. 13.

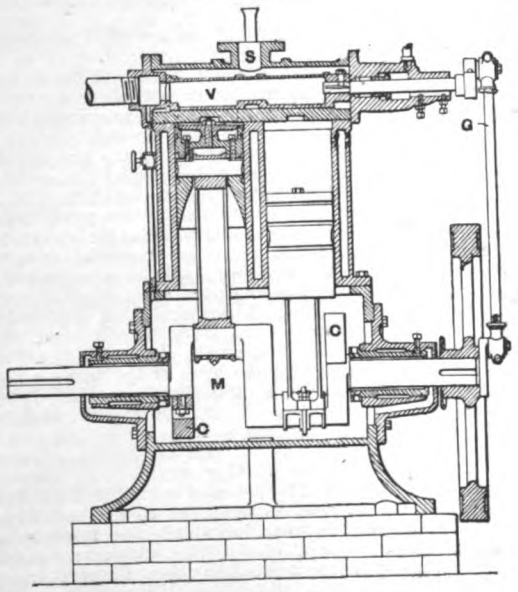


FIG. 15.

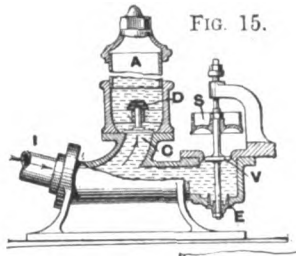


FIG. 16.

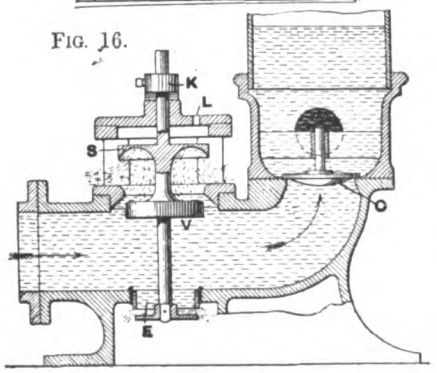
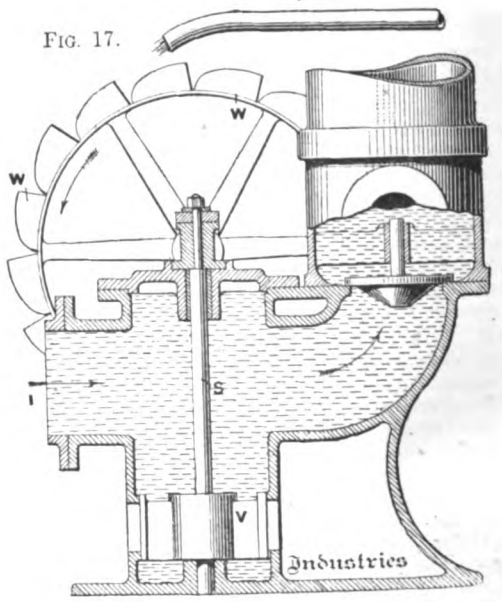


FIG. 17.



bulkhead against a head varying from nothing to 10ft. The pumps are submerged to a sufficient depth to require no charging, and consequently no valves are necessary. The area of the two discharge nozzles is 150 sq. in. each, and the quantity of water delivered is 500,000 to 800,000 gallons per hour. This arrangement is the least expensive that can be adopted for land drainage or irrigation; it was suggested by a Dutch engineer who had erected similar works in Java, and has been found in every way satisfactory. The embankment is cut through, and a strong timber bulkhead A is erected across the gap. The pumps P P are placed immediately behind the bulkhead, with their discharge nozzles projecting through it. Flap valves opening outwards are hung over the discharge nozzles at D, to prevent back flow through the pumps when not working; in dry seasons they are sometimes opened for letting water flow through for irrigation. The vertical pump spindles are driven by bevel gearing from a horizontal shaft. The engine E is single acting, with two cylinders of 10in. diam., and its speed is 300 revolutions per minute. The machinery shown in Fig. 11 was erected during 1885, on the Sacramento river, 75 miles from San Francisco, for draining tule lands.

Pumps driven by Bands.—In Fig. 12 is shown an arrangement for raising 900,000 gallons per hour by means of two centrifugal pumps driven by bands. The two discharge nozzles from the pumps are each 115 sq. in. area. The pumps have open wheels, and double suction pipes S, one on each side, not joined; each pipe has a foot valve of 100 sq. in. area. The suction pipes themselves serve as the supports for the pumps, being made strong and with large flanges to rest on the timber framing. The sump U is 6ft. deep, and the suction pipes dip into it to different depths, so that when the water supply falls short the higher pump will run empty or be disconnected, leaving the lower only to continue working. The average head in this case being only from 3ft. to 5ft., it was considered that the water could be driven more by direct push than by centrifugal force. The pumps were constructed accordingly with smooth iron vanes, bolted to a square extension on the pump spindle. The throats of the suction inlets were made very sharp, and brought in as close as possible to the inner tips of the vanes. The discharge pipe D carried through the embankment is 30in. bore, and is set with slope enough to let the water run down it from the pumps when the head at the discharge outlet is not too high. The engine is placed level with the top of the embankment, 15ft. above the pump floor. The whole of the machinery is mounted on wooden framing, being on treacherous ground; it was erected during the winter, when no other foundation was possible, and gives promise of standing well. Movement takes place, the whole structure sometimes going together, but excellent service has been done. The work was planned and its erection superintended by Mr. J. P. Van Loben-sels, a gentleman well acquainted with drainage work in Holland, and of considerable experience in such engineering matters. It drains the leakage and rainfall from 8000 acres of land, surrounded by embankments 15 miles long; the estate is on the Sacramento river, and is one of the best maintained in the valley. The embankments are of a superior character, being for the most part made of clay or loaded with clay; they sink, however, and have continually to be raised and strengthened. This plant has since been increased to a capacity of 2,400,000 gallons an hour, by the addition of a pump of 30in. bore, driven by a compound condensing engine.

Single Acting Engines.—For pumps directly geared to engines, the practice differs somewhat from that of English makers, but is much in advance of the methods employed in the Eastern States, unless it be in the case of one firm there, who have copied Messrs. Gwynne's pumps and drive them with pairs of single acting engines; of these, however, present knowledge will not permit comparison. The author at first employed single acting engines, as shown in Fig. 13. These are especially suited for driving centrifugal pumps where permanent foundations are wanting. Being wholly self contained, working at high speed with reasonable economy, and occupying but little space, they bid fair to take the place of double acting engines for the purpose. As the thrust on the connections and bearings is in one direction only, there is no compensation to look after, and no shake or knock. There are no glands to pack, and scarcely any oiling to do. The valves are of the oscillating cylindrical kind, the steam entering at S round the outside of the valve V, and exhausting through its interior. The connecting rods are of brass, made as light as possible. The crank shaft is of steel, with cranks opposite, and with counterbalances bolted on at C. The valve gear G is of the simplest construction, consisting merely of an overhung crank and connecting link; the eccentricity of the crank can be readily adjusted for regulating the lead of the valve, or reversed for running the other

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way. Automatic gear for controlling the speed by the cut-off is sometimes applied; but for regular duty, like pumping, the throttle valve adjusted by hand is quite as good, and is better understood by attendants. The crank chamber M is partially filled with a bath of water and oil, which is splashed by the cranks into all the bearings and also into the cylinders; no other oiling is required, except of the valve link, which is made hollow so as to be oiled at both ends while in motion. The cylinders are surrounded by a rectangular casing which serves as an air jacket, so that but little heat is lost by radiation. The objections to this class of engines are their dimensions in the direction of the crank shaft, a want of steam economy, and the low duty consequent upon the compression at the top of the upstroke, required to keep the bearings in contact and to avoid knocking. The difficulties that have been met with during the past ten or twelve years in maturing these single acting engines are considered by the writer to lie, not in the principle or mode of working, but in providing a suitable connection for transmitting the power from the pistons to the cranks on the driving shaft.

Differential or Compound Engines.—In later practice, the engines adopted are of the differential or compound type, as shown in Fig. 14. The steam is admitted first into the annular space A surrounding the trunk T, and after acting in the upstroke underneath, the steam is expanded upon the top of the piston P, acting then on the difference of area between the two sides of the piston, and expanding three times or more. The engines are made without stuffing boxes, except for the valve stems; and oiling is performed by enclosing the parts, as in the single acting engines. In this way a good expansion is attained with a single and simple slide valve; and the engine is reduced to the fewest and simplest parts possible.

Hydraulic Rams.—Owing to the extensive use of small hydraulic rams on the Pacific coast, some experiments were commenced at the beginning of this year by the author in conjunction with Messrs. W. T. Garratt & Co., engineers, of San Francisco, in order to see whether larger machines of the kind could be constructed for meeting the requirements of raising water from the mountain streams. As yet these experiments are by no means completed; but the author believes some of the constructive features are of sufficient interest to warrant their being appended to the present paper. The various phenomena that arise in employing the impact of water in hydraulic rams are such as to render the matter one of experiment, unless in cases where the intermissions or valve movements are controlled by independent machinery, that is, by some power independent of the flow or issue of the water passing through the ram. The latter is unquestionably the correct method, if the supplemental mechanism can be made durable and reliable, as no doubt it can. The first experiments made were with small rams having inlet pipes from 2in. to 3in. diam., as shown in Fig. 15, in which I is the inlet pipe and D the discharge pipe; C is the check or foot valve, and A the air vessel; and V and E are the escape valves fixed on the same stem. The two valves V and E being nearly balanced, the difference of their areas constitutes the measure of the upward or closing force, which is of course much less than in the case of a single valve. The valves fall by their weight in the usual manner; and are raised partly by the stream rushing out round the upper valve V, but mainly by the upward pressure of the issuing current against the curved shield S fixed on the valve stem. In working it was found that accurate adjustment was required to suit the head or fall of the driving water; and also that the shock was too great for the safety of large rams. The method was therefore changed to that shown in Fig. 16, in which the two escape valves V and E are arranged to pass up freely through their seats, and are stopped by an air cushion at the top. The waste water nearly all escapes at the upper valve V, small outlets only being provided in the lower valve E for permitting sand to escape if any should be carried into the machine. The closing is effected, as before, mainly by the upward pressure of the issuing stream against the curved shield S. When the valves are shut upward in closing, the shield enters the air chamber above it, in which it fits as a piston, and the momentum is thereby checked without the least shock. An air cock is inserted in the top of the air chamber at L, for regulating the amount of resistance offered by the air cushion. Additional weight if required is added on the top of the valve stem at K; it is found, however, that the higher the head the less is the weight required for opening the valves. Snifting valves were at first applied, but seemed unnecessary. Rams arranged in this manner work without noise or jar, and give a high efficiency for forcing four to five times the height of the propelling head, and are suitable in most cases for irrigating purposes; but when the resistance is increased, the elastic blow or percussive impulse of the current is not enough to raise the check valve C against the increased area caused by its lap. In Fig. 17 is shown another arrangement of hydraulic ram, in which the escape valve is opened by independent mechanism. The water enters at I, and the waste escapes at the bottom through four holes, which are alternately covered and uncovered by the four wings of the oscillating valve V, which is mounted on a spindle S. The valve is opened by means of the water wheel W and a tappet motion. The two tappets coming in contact at each revolution of the water wheel open the valve to such an extent as may be determined by an adjusting set screw. As soon as the tappets disengage, the valve is closed by the reaction of the issuing stream against its curved ribs or vanes, the motion being arrested by the tail of the tappet arm. In this manner the motions of the waste valve V can be controlled at will, and a greater efficiency attained than with the ordinary method of employing the force of the issuing stream for closing the valve by lifting it. Experiments have not yet been made to determine the most effective motion of the valve with respect to the time of closing; but the indications point to variable requirements in this respect, depending on the resistance offered or the height to which the water is being raised. The action of the machine is smooth and regular when the closing motion is not too abrupt.

GREAT NORTHERN TELEGRAPH COMPANY.—The traffic returns of the above company are: Receipts in December, 1887, £21,600; 1st January to 31st December, 1887, £264,480; corresponding months, 1886, £258,600; corresponding months, 1885, £284,720.

AUTOMATIC BILGE CLEANING ARRANGEMENT.

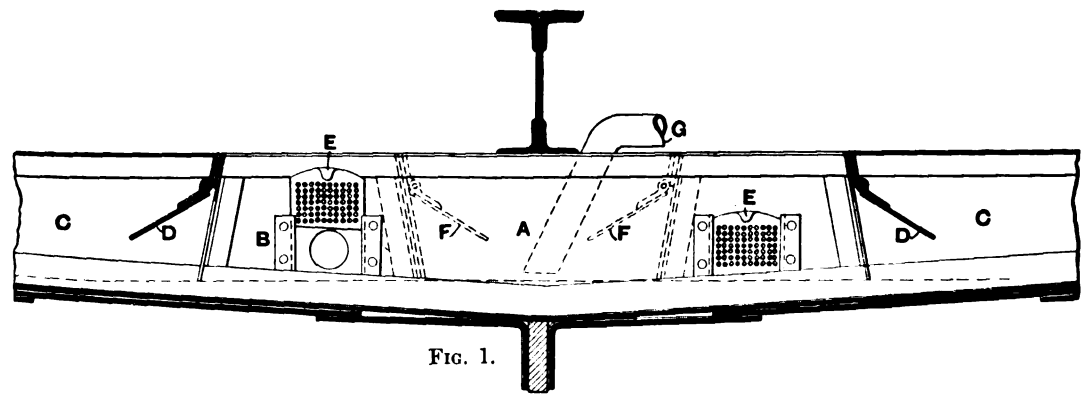


FIG. 1.

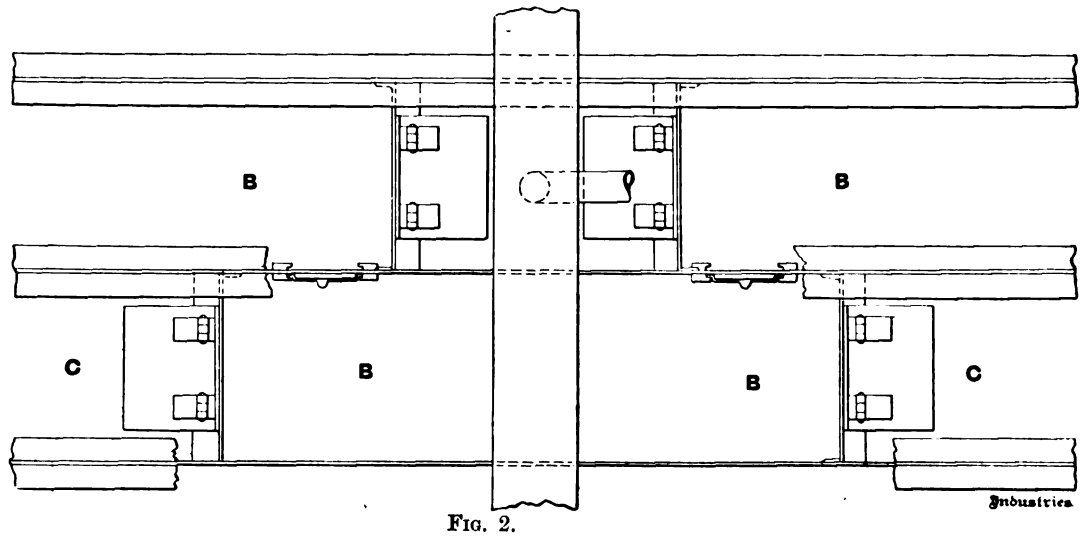


FIG. 2.

AUTOMATIC BILGE CLEANING ARRANGEMENT.

THE practical difficulties experienced in keeping bilge suction pipes clear are by no means small, and choked suction pipes are not a small factor in hastening the sinking of a vessel. Even in the most carefully conducted ship, substances other than water or oil sometimes find their way into the bilges, which, together with the mud deposited from ordinary bilge water, are frequent sources of trouble if not removed before the pumps or the pump suction pipes are choked. The ordinary mud boxes, made of lead, are frequently quite useless. In a recent case, on examining several of the wing suction pipes of a

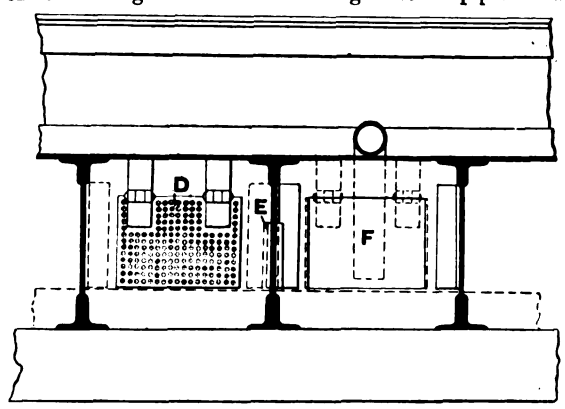


FIG. 3.

steamer, it was found that the mud boxes were rolled into ball shape, their sides having collapsed, thus preventing the water from reaching the suction pipes. The bilge suction pipes of new vessels are frequently liable to get choked, especially when they are hurriedly finished and sent to sea without sufficient interval for close examination and cleaning of all the bilges. A notable instance, of which we have a good recollection, was furnished by a large mail steamer, in which the numerous ordinary engine and boiler bilge suction pipes were choked, and therefore useless. Heavy weather prevailed at the time, and large quantities of water were being shipped. The water rose to the stokehold plates, *i.e.*, to about 6ft. in depth, and but for the presence of mind of those in charge of her, it is doubtful whether the vessel would have completed her passage. It was impossible to clear the mud boxes in time, and temporary suction pipes had to be laid, there being fortunately a number of lengths of ventilating piping available. Many other instances might be mentioned where trouble and danger have been caused by "choked pumps," but it has been sufficiently shown that any improvement in the present mode of fitting strum boxes is worthy of attention. Stephenson's patent automatic bilge cleaning arrangement, which would appear to meet all this difficulty, is illustrated in Figs. 1, 2, and 3. This arrangement is designed for removing automatically all chips of wood, small coal, or other matter which may find its way into bilges, to the wing spaces, from where it can conveniently be removed, and also to form a centre water space automatically confining the bilge water, thereby keeping the ends of the suction pipes covered so long as any water remains in the vessel. Fig. 1 is a transverse section through a portion of the bottom of a vessel fitted with this arrangement. Fig. 2 is a plan looking from above, and Fig. 3 a longitudinal section, and a short explanation of these illustrations will show the advantages claimed for Stephenson's bilge arrangement. A is the suction well, from which through the pipe G the water is drawn to the pump. The rolling of the vessel at sea causes the water, bearing with it such *débris* as may have got into the bilges, to flow through the perforated hanging doors DD, which open automatically outwards towards the more deeply immersed side of the vessel. On the return roll the flap valve automatically closes, preventing the return of the rubbish, but allowing the water to flow freely through the perforations. The water thus cleared then flows through the vertical perforated sliding doors E E into the after frame space, in which the suction well A is situated, and passing through the solid hanging doors F F, which are arranged to swing by the movements of the vessel in the opposite direction to the perforated doors D D, is retained in the centre suction well, thereby enabling the bilges to be pumped dry when the ship is rolling in rough weather, as well as when sailing on an even keel. The ordinary mud and strum boxes are dispensed with, which to some extent compensates for the extra cost of this improved arrangement, so that the difference will not be excessive, while the advantages are manifest. The spaces marked B are only available for water that has passed through the separators D D from the ordinary wings or bilges marked C. Mr. Stephenson submitted his arrangement to the inspection of Mr. B. Martell, Chief Surveyor of Lloyd's Register, and that body approved of its adoption; and during a trial of fifteen months in the s.s. "Ardgay," of Aberdeen, it has given every satisfaction. Messrs. Donkin & Nichol, engineers, St. Andrew's Works, Newcastle-on-Tyne, are the sole makers and licensees for this apparatus.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 10th January, 1888.

The Iron Market.—The higher prices announced last week by the merchants in their New Year's circulars have somewhat checked the course of business. Every observer of the market must have foreseen this effect. I have repeatedly pointed out of late that the brisk buying which has characterised the business in iron for some weeks past, was largely due to a desire on the part of consumers to anticipate the advance which has now taken place. They are, therefore, sufficiently provided with material for some time to come. The lull is, however, not likely to be of long duration, because it is becoming apparent that a further advance must shortly take place. Country buyers are already seeking to cover all their needs in the next three months, in anticipation of this further rise. Many would go to a more distant date, as late in many instances as the end of May; but manufacturers are unwilling, as I stated last week, to bind themselves beyond the first quarter, except at a price considerably above that now prevailing. These are facts which show unmistakably the tendency of trade. Reports received this week from the chief centres of the iron industry are characterised by a cheerful tone. Everywhere there is said to be firmness or an upward movement in prices. The demand steadily increases for nearly all classes of goods, and the prospects for the first half, at least, of the present year are very encouraging. In the Meurthe-et-Moselle several blast furnaces are to be blown in at once, the stocks of pig iron being exhausted, and the demand above the present rate of production. Longwy prices are: 33s. 7d. per ton for forge and 41s. 7d. for foundry pig. The Société des Forges de Denain et Anzin have obtained a contract for 8000 tons of rails for Italy, at the price of £4. 11s. 7d. per ton delivered at Venice.

The Metal Market.—The upward movement in copper continues, the latest official quotation being £88. It is, however, to be borne in mind that these quotations represent nothing more than purely speculative movements. Of genuine business there is now practically none. Consumers are existing upon the stock of metal they have in hand, or failing that, buy only sufficient to meet the most pressing needs of the moment. As evidence of the unreality of the official quotations, it may be stated that genuine purchases of copper for prompt delivery may be effected at a price much below £88. Tin remains unchanged. Lead is a little better; and spelter moves steadily upward. The following table shows the prices of metals at the end of each year since 1880, that is, for a period including the exceptional rate of 1881:—

December 31st..	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	£	£	£	£	£	£	£
Copper (Chili bars)	74·0	69·0	60·6	51·0	44·0	40·0	85·5
Tin (Banca)	118·8	104·0	91·6	82·8	101·6	108·6	170·8
Lead	15·1	13·35	12·0	10·3	11·45	12·45	16·0
Spelter (Silesian).	19·0	13·45	16·1	15·25	16·3	15·4	22·0

The true position of each metal and its stability in the market are shown in the following table, in which the closing prices for the year 1887 are compared with the highest and lowest prices of the last "fluctuation period," and the mean of these extremes:—

	Highest.	Lowest.	Mean.	Present.
	£	£	£	£
Copper	74·0	40·0	57·0	85·5
Tin	118·0	82·8	100·8	170·8
Lead	15·1	10·3	12·7	16·0
Spelter	19·0	13·45	16·22	22·0

Taking into account the greater activity in the consuming industries, the current rates of lead and spelter do not appear exaggerated; but those of copper and tin, particularly the latter, have reached a level which they cannot long occupy, being wholly out of accord with the conditions of the trade.

The Sugar Bounties Conference.—The prospect of the abolition of the sugar bounty system is occasioning some uneasiness among growers, some of whom seem disposed to diminish the acreage under beet cultivation next season; but in well informed circles no importance is attached to the recent conference held in London, which is regarded as merely a diplomatic expedient, the object of which has been already attained. The project, which involves the repeal of the law of 1884, is, in the opinion of many whose position lends weight to their judgment, for the present at least, wholly outside the field of practical politics.

BERLIN, 9th January, 1888.

The Coal Market.—Considerable inconvenience and loss have been caused in the coal market by interruptions of railway and river traffic through the severe weather of the last two months. Especially in Upper Silesia the lines have been blocked by snow, causing delay in delivery. If it be considered that the total yearly output of this district amounts to about sixteen million tons, it will be seen that even a slight disorganisation in the traffic must seriously affect the prosperity of the mines, which even under normal conditions is not very great. According to the report of the Breslau Government Office of Mines, which has just been issued, prices are steadily declining. Whereas, in the first quarter of 1885, the average price of coal at the pit's mouth was slightly over 4s. per ton, in the corresponding period of 1887 it was only 3·84s., and this has further declined in the third quarter to 3·74s, and there seems little hope of higher prices in future.

The Iron Market.—The crude iron market in Upper Silesia is fairly animated, and has been greatly strengthened by the pending negotiations between some of the principal blast furnaces in that district and the rolled iron syndicate, under which the annual supply of 30,000 tons of forge pig would be secured up to the end of 1890. Forge pig averages now from 50s. to 54s., and foundry pig from 55s. to 58s.; bars are readily taken at 140s., and profile iron at 155s. Heavy boiler plates are now quoted at 160s. The activity in rolled iron and steel of a month ago has somewhat diminished, but foundries are well employed. A circular has been issued by a number of leading manufacturers making enamelled and plain ware, in which they announce an increase of 20s. per ton in the price of their goods.

Chemicals.—It appears from the last report of the Elberfeld Chamber of Commerce that the original aniline dyes made in that district are gradually being replaced by the new azo compounds, which are not only more brilliant in colour, but also faster, and are especially suitable for the dyeing of cotton fabrics. Owing to these advantages, the new colours and dyes are in extensive demand, and as the works at Elberfeld control the patents, they may be said to have a monopoly for this branch of the trade. The manufacture of quinine and its compounds is at present not so lucrative a business as it was a few years ago. The average price of quinine, which some years ago was from £6 to £7 per lb., has now fallen to £2 per lb., and even at this low figure the article is a drug in the market. This state of things is partly due to over production, and partly to the discovery of other fever remedies, especially antipyrine, which is now largely used. With a view to improve the state of the market, the two largest quinine factories in Germany, viz., Friedrich Jobst, of Stuttgart, and C. Zimmer, of Frankfort-on-the-Main, have amalgamated under the title of Zimmer & Co.

The Building Trades.—Notwithstanding the unfavourable season there is a strong demand for building materials, and the prospects of cement, brick, and lime kiln owners for the approaching building season are favourable. Large orders for cement, building stone, and lime, at remunerative prices, have already been placed for delivery in 1888 and 1889. In consequence of this increased demand the Stettin Portland Cement Factory is now erecting four new large kilns. The present price for cement, as compared with that in January last year, is 1s. per ton higher, that for lime 6d. per ton higher, and for building bricks 8s. per thousand higher.

Corrugated Iron.—The employment of corrugated iron for roofs, walls, and floors has considerably increased since the new police regulation with regard to fire risks has come into force, and large quantities both of sheets and corrugated girders are now turned out by works in this town. The latter are extensively used for floors in factories and mills, whilst a special kind of corrugated sheet is used in the construction of fire proof stairs for dwelling houses. One large building in Berlin—the Circus Krembner—has been entirely constructed of iron, the walls and roof being formed of corrugated sheets.

Asphalt.—Although the experiments made with Professor Dietrich's patent asphalt paving in Berlin, in which the raw material obtained from the deposits in Vorwohl and Zimmer (province of Hanover) were employed, have not proved perfectly successful, the use of this asphalt as a filling for granite and wood paving is rapidly extending. This asphalt, mixed with powdered limestone, has also recently been introduced in buildings for preventing the walls from becoming damp. When the foundation walls have reached the ground level a layer of asphalt, in the form of thin rolled sheets, is applied, and the walls of the building are erected upon this layer, which is perfectly impervious to moisture. The demand for asphalt for various purposes is thus on the increase. To obtain a larger supply, the Egestorff works are now prospecting for new deposits in the neighbourhood of Hanover, and several new shafts are being sunk.

VIENNA, 9th January, 1888.

The Iron Market.—The first result of the new syndicate is a slight increase in the price of bar and profile iron and joists announced by the Prague sales bureau. The increase amounts to about 4s. per ton, making the base price for merchant bars 176s., and for joists 190s. at the works. The Alpine iron works announce that they do not intend to increase their prices, but prefer to await the condition of the market in the spring before making any alterations in their lists. The syndicate affects only the usual kinds of manufactured iron and steel in the market, but not some specialties which are only manufactured by a few works, or which are already covered by previous conventions. To the latter category belong rails, tyres, heavy plates for bridge building, and fine plates. The total production of manufactured iron and steel which comes under the syndicate's rules amounted last year to only 210,000 tons, and the quantity was divided between the syndicated works, according to a schedule drawn up in May, 1886. This, as I have already stated, has now been slightly amended, and the following is a list of the works and their limits of output, based upon the supposition that the trade during 1888 will be the same as that during last year:—

Name of Works.	Quantity In Tons.	Percentage.
Bohemian and Moravian group...	115,400	55·2
Alpine Company	43,500	20·8
Tetschen	19,300	9·2
Ternitz	9,700	4·6
Seven smaller works	21,300	10·2

It will be seen from this table that more than one-half of the total production falls to the Bohemian and Moravian group of iron works. These works, it may be mentioned, were the first to agitate for syndicating the trade in the beginning of 1886, and they have thus secured a leading position. The group consists of the Prager Eisenindustrie Gesellschaft, the Teplitz rolling mill, the Böhmische Montangesellschaft, the Witkowitz works, and several smaller establishments. In the schedule of production the Alpine company occupies the second position, their production being considerably below that of the former group; but the schedule is not a correct index of the quantity of work turned out by the Alpine Company, since their products consist in a great part of such manufactured iron and steel as is excluded from the operations of the syndicate. This company manufactured last year 46,000 tons of cast steel rails, tyres, boilers, bridges, fine plates, and French nails, so that their total production amounted to nearly 90,000 tons. On Saturday last tenders were received by the Kaiser Ferdinand's Nordbahn for the supply of 5200 tons of steel rails and about 2000 tons of accessories, such as fish plates, chairs, bolts, nails, switches, &c. The general condition of the iron market in Austria-Hungary has slightly improved, and in Hungary especially a firmer tone prevails. The Hungarian small arms factory is being financed by the Union Bank of Vienna and Messrs. Loewe & Co. of Berlin. It is now intended to establish this concern on a somewhat larger basis than that of the original project, so that the factory will be in a position to supply not only the requirements of the Hungarian army, but also those of other sections of the Austrian army.

Textiles in 1887.—The condition of the textile industries throughout this country has not been very prosperous during the past year, the quantity of textile goods produced being hardly up to the average of former years, whilst prices have been slightly lower. There was greater activity in those works which supply underclothing for the army; but private consumers during the whole year evinced a reluctance to enter into large transactions, which was undoubtedly due to the uncertainty of the political situation. Cloth mills and clothing factories have greatly suffered from the effects of the Roumanian Customs tariff, and their exports to that country, which formerly were considerable, have almost entirely ceased. The exports of silk and woollen materials to Germany, which also used to be flourishing in former years, fell off considerably during 1887. Spinning mills and cotton printing works during last year produced rather more than was justified by the requirements of the trade, and are now suffering from a glut in the market; but bleaching and dye works are in a satisfactory position. The demand for tricots and worsted goods has been fairly good, though not exceeding the average of former years.

BRUSSELS, 10th January, 1888.

The Coal Market.—Unscreened coal is quoted at 10s. 5d., nuts at 14s. 5d. to 15s. 2d., and in consequence of the increased demand coke is selling above its normal rate. It is probable, therefore, that there will be a rise in the price of small coking coal, especially as there is a prospect of blowing in more furnaces in the Northern district. On the whole, Belgian colliery owners have not much cause of complaint respecting last year, the latter months of which showed very favourable signs. The present year also promises well. There is more business being done in the coal market at present than at the same time last year. Owing to the improved condition of the iron trade, orders have largely increased for coal for rolling mills, &c. During the past year prices have risen from 5d. to 7d. per ton.

The Metal Market.—Prices continue high, though there have been some fluctuations; tin is quoted at £162 to £164, copper ingots at £88, spelter at £21, lead at £16, and regulus of antimony at £50. Foundry pig is firm. Higher offers have been made for the Rumelange furnaces, which passed, as I have already reported, provisionally into the hands of the Crédit Général of Liège and the Bank of Liège. There are several competitors for the purchase, the furnaces being well worked, and having proved profitable hitherto. There is a good demand for girders, sheets, and angle iron at firm prices. Railway waggon builders are well supplied with work; orders for 172 mail vans will be divided among various firms, including Eveard and the Société de Construction of Malines. In order to improve the engineering trades, the State railways will shortly proceed to give out contracts for the extension of Charleroi station. There will be required for the economic railways 326 trucks and 167 passenger coaches. Producers of raw iron are uniting with the owners of rolling mills in asking for the abolition of the Customs duty on foundry pig, on condition that they receive from the State railways a reduction of the rates on iron ore. Most of the ore is imported from the Grand Duchy of Luxemburg, and heavy rates are paid to Charleroi and Liège, which, in effect, are equivalent to an import duty.

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FLAX AND YARN MARKETS.—The flax markets this week exhibit more distinctly the tendency to weakness which appeared towards the middle of December. This is no doubt partly due to the influences of the season; but apart from these, buyers show hesitation and reluctance to deal largely. This reluctance arises mainly from the high prices asked by sellers. The best qualities, however, are eagerly bought up. A slight reduction of the current rates for the medium qualities would probably bring much greater activity, especially as it is now known that Russian flax is greatly inferior to last year's stocks. In view of the general complaints of the quality of Russian flax of 1887, it is surprising that it holds its position so firmly in the market. There is not much doing in yarns, but a better demand is expected towards the end of the current month.

ELECTRIC LIGHTING.—The Thomson-Houston Company has bought some ground in the Champ de Mars for the installation of steam engines and dynamos for lighting the Théâtre Molière. This company has also arranged with M. Meunig to light in the district of Ixelles, in which the theatre is situated, the Porte de Namur, the Théâtre Café, and part of the Chaussée de Wavre. A proposal has also been made to the local authorities to light the whole quarter electrically instead of by gas, but the offer has not been accepted. Electric lighting is making rapid headway, especially in Brussels, and among those who have lately adopted it are several cafés in the centre of the town, and the Foire de Leipzig emporiums. A syndicate is spoken of to promote the adoption of electric lighting, which will include Messrs. Mourlon, Gérard, & Co., and the Société Industrielle d'Electricité.

DÜSSELDORF, 9TH JANUARY, 1888.

THE COAL MARKET.—There is still great activity in the coal market. The demand for household coal has been increased by the cold weather of the last three weeks. The industrial qualities are much sought after. Coking coal and coke are rising in price. The following are the prices current in December, the figures in brackets being those for January of 1887: Gas coal, 7s. 1d. (7s. 2d.); household coal, unscreened, 5s. 9d. (5s. 7d.); round, 7s. 5d. (7s. 7d.); large washed "nuts," 8s. 3d. (8s.); medium, 7s. 10d. (7s. 6d.); small, 6s. 1d. (5s. 8d.); industrial qualities, unscreened, 5s. 1d. (4s. 10d.); round, 9s. 9d. (8s. 3d.); "nuts," 13s. 9d. (10s. 3d.); small, 2s. 6d. (2s.); coking coal, 4s. 7d. (3s. 8d.); foundry coke, 9s. 9d. (7s. 10d.); blast furnace coke, 8s. 4d. (7s. 2d.). The stability of the gas coal prices is due to the syndicate which controls the business of the gas coal mines.

THE IRON MARKET.—The last advance in the prices of pig iron declared by the crude iron syndicate has occasioned some uneasiness in the market. Makers of finished iron and steel have taken the alarm, and protest against the new rates on the ground that the state of the trade will not allow them to follow the movement. This circumstance would seem to indicate that we have now reached the highest limits of prices for crude iron. Some classes of finished produce will probably go a little higher; plates especially are likely to advance. There is not yet that animation in the markets which prevailed down to the end of the third week in December, but the influence of the holiday season is not yet wholly at an end. Progress is being made with the organisation of the sheet iron syndicate. The firms of Hender, Schlüter, & Vollrath, of this town, Franz Bicheroux & Sons, of Duisburg, Thyssen & Co., of Mulheim, and Felder & Co., of Kalk, have joined it provisionally for the first quarter of the current year. The Chain Makers' Association is seeking to fix for the whole of Germany a kind of sliding scale of prices dependent upon that of wire. The enhanced prices of iron goods and the dulness of the American markets have told unfavourably upon the export trade of the last three months of the year. I take from the Customs returns the following statistics of the exports down to the end of November, 1887, the quantities for the corresponding period of the preceding year being, for easy comparison, given within brackets. Pig iron, 194,387 (228,461) tons; scrap iron, 55,330 (47,504) tons; half finished iron and steel, blooms, puddle bars, and ingots, 37,080 (37,936) tons; finished iron and steel, bars, angles, and plates, 267,153 (229,147) tons; wire, 224,074 (217,464) tons; rails, 161,101 (146,271) tons; other railway iron, 38,488 (32,567) tons; manufactured goods, other than machines, 176,426 (160,604) tons. Total iron of all kinds, 1,154,039 (1,099,954) tons. The increase compared with 1886 is but 5 per cent., against 8 per cent. at the end of the third quarter. The skrinkage is chiefly visible in pig iron and wire.

LILLE, 10TH JANUARY, 1888.

TEXTILE MANUFACTURES.—Business in textile goods has been very quiet this week. Buyers, attracted from the markets by the Christmas and New Year's festivities, have not yet returned, and manufacturers are busy with their accounts; but next week a resumption of business may be expected. In the meantime, there is little that calls for remark. The tone of business generally is hopeful. At Roubaix the outlook for the woollen trade is very encouraging. In spite of the approaching sales of wool in London, announced for the 31st inst., the prices of the raw material remain firm. The cold weather has caused a brisk demand for hosiery, which has served to greatly strengthen the market for South American wool. The year begins under the best auspices, the commercial situation being healthy and strong, and the prospects of trade generally are encouraging.

THE FLAX AND YARN MARKETS.—Though the influence of the holiday season is still felt, there is considerable animation in the market for flax. The demand is strong for home grown produce, particularly Walloon from Douai and Bergues, and prices are very firm. Russian flax is much sought after. Dealings this week, though below the exceptional figures of the last fortnight, have been numerous and important, and prices show a tendency to improve. The situation continues to improve for yarns. The demand grows steadily, and spinners have been able to obtain another advance in prices. The medium and fine numbers are most sought after. In tows the situation remains unchanged, dealings being limited to the needs of the moment. A large amount of business is being done in jute, at constantly advancing rates.

THE IRON MARKET.—The present aspect of the iron market contrasts favourably with that which existed two months ago. In the place of doubt, hesitation, and languor, we have now confidence, eagerness, and animation. Orders come to hand freely. Merchants seek to contract six months forward; but, as I stated last week, manufacturers refuse to sell further forward than the end of March, except at a considerable advance on current rates. These rates are: £5 to £5. 4s. for bars; £4. 16s. to £5 for joists; and £6. 4s. to £6. 8s. for common plates. The latter are in strong demand at these prices. The advance is now fully secured, and the prospects are favourable to further progress.

FREE IMPORTATION OF SACKS.—A matter of considerable importance to the jute manufacturing industry of this district, and to the importers of grain, is just now being debated with some acrimony. Since the enactment of the English law prohibiting the shipment of grain in bulk, a large number of sacks annually enter France duty free. These sacks, which are practically new, having been but once used, are sold in the markets here, to the injury—it is said to the almost total destruction—of the native trade in those goods. The jute manufacturers are bringing pressure to bear on the Government to put an end to the anomaly by declaring these sacks liable to the ordinary duty. As the Minister of Commerce has shown himself to be favourably disposed towards the request of the manufacturers in this matter, it will probably be granted.

AMSTERDAM, 10TH JANUARY, 1888.

ART INDUSTRY EXHIBITION AT THE HAGUE.—A National Art Industry Exhibiton is to be opened this summer at the Hague, for which the Netherland Government have asked the States General a small subsidy. It is to consist of a main building in an ornamental style, surrounded by gardens, in which will be situated the various offices, restaurants, bars, &c. The gardens will be laid out by the Botanical Society of the Hague. The local executive committee of the Exhibition is a strong one. Mr. A. W. Stortenbeker is the architect.

RAILWAY CONSTRUCTION.—It has been officially announced that the proposed State railway from Rotterdam, along the new water way, to the seaboard at the Heck van Holland, which was mentioned a few weeks ago in *Industries*, will probably be finished by the end of 1889. This seems a rather long time, but the Government explain that the difficulties of construction have been underrated, and the soil between Schiedam and Vlaardingen has been found to be very marshy.

STEAM TRAMWAYS.—A Dutch-Belgian syndicate has been formed to buy up existing Dutch steam tramways and construct others in different parts of Holland. The first new line will be laid from Haarlem to Alkmaar in North Holland; a concession for this has already been granted by the Government to Mr. J. Holland, of Amsterdam, a member of the syndicate.

WINTERTHUR, 9TH JANUARY, 1888.

NEW INDUSTRIES.—Switzerland has frequently shown that she can rapidly develop any new industries which may be introduced into the country. Examples have been seen in the chemical industry, textiles (especially embroideries), and preserved provisions. The Customs returns are now being examined, with a view to ascertain what other new manufactures there may be room for. It appears that in 1886 there was imported sugar to the value of £560,000, which paid £110,352 duty. These facts have led to the establishment of a beetroot sugar factory at Hochdorf, Lucerne. Raw sugar only will be made, and operations will be to the extent of 1200 tons per year. This will also give an impetus to the Swiss agricultural interest.

UTILISATION OF WATER POWER.—Switzerland pays Germany annually for coals a sum of about £500,000, although hundreds of thousands horse power in rivers and streams are running to waste. With the progress of electrical science, something is now being done in the direction of utilising these forces, and two projects are now under consideration. The first of these is in connection with the Goldach water works, now supplying water to the town of St. Gall, and it is proposed to add a power plant to this works. For this purpose it would be necessary to build a reservoir of 26,700 tons capacity, so as to obtain constant water power, which would by means of dynamos be converted on the spot into electrical energy representing 315 h.p. Of this 250h.p. would be sent to St. Gall for lighting purposes, and 65 h.p. for working motors. The total cost of the installation is estimated at a little over £16,000, and allowing for a sufficiently low rental for the lamps, in order to be able to compete against the reduced price of gas which the promoters consider will necessarily follow the introduction of the electric light, they estimate that the net profit on the capital invested will be 13 per cent. The other proposal refers to the river Limmat, which is to be dammed up between Zurich and Baden by a weir, so as to obtain an available head of from 26ft. to 28ft. The influence of the weir would be felt for only about two and a half miles up the river. During the last ten years the minimum quantity of water passing from the lake of Zurich into the Limmat was 20 tons per second. This occurred in the exceptionally cold winter of 1879-80. At all other times the quantity was greater, but taking 20 tons as the minimum available, the promoters of this scheme estimate that 1600 actual horse power could be obtained from turbines placed close to the weir. This power would be converted into electrical energy, and then transmitted for lighting and motor purposes.

MADRID, 9TH JANUARY, 1888.

NEW MINES.—Since the rise in metals there has been a great movement in the mining market, and I have examined a number of schemes for the promotion of new copper mines. Many of these appear to be doubtful speculations, whatever the price of copper might be; but some should prove remunerative, if copper keeps above £70 per ton. There are some cases also in which the mines could be worked at a profit if prices were even lower, provided lines of railway were built at once. Lead and silver mines are also projected; in some cases these are old ones which have been closed owing to low prices. There are also antimony mines being offered. The Vielle Montagne Company and the Real Compania Asturiana are the only buyers on the spot for zinc ores, and, consequently, have command over prices and conditions.

THE NAVY.—The official announcement of the Government that they are prepared to consider offers for the building of three cruisers of 6500 to 7000 tons, of the aggregate value of £1,440,000, has caused much interest in industrial circles. It is stipulated that they are to be built in Spain and with Spanish materials. Spanish firms are to have the preference; but failing these, the order will be given to foreign firms, provided they engage to establish yards in Spain. It is possible that the order will fall into the hands of the Marquis of Mudela, whose establishment at Bilbao is managed by Mr. Martinez de las Rivas. There are at present only four blast furnaces at these works, but all the plant necessary for turning out the largest men-of-war is to be erected.

NEW YORK, 31ST DECEMBER, 1887.

COAL.—For the present year the coal production has been 31,000,000 tons, an increase of 2,390,000 tons over last year. In spite of this increase, coal is very scarce in Kansas and other parts of the West, and in Philadelphia a short time ago a coal famine seemed almost inevitable. About 1000 men in Philadelphia and 1500 in Elizabethport have been discharged by the Reading Railroad, and it is feared that it will cause a suspension of production throughout the entire Pennsylvania coal fields.

IRON AND STEEL.—The production of iron and steel for the past week has been better than for the corresponding week of 1886. There have been 341 furnaces in blast, having a total capacity of 142,000 tons weekly; and 246 out of blast, having a capacity of 59,000 tons. The weekly production is about 2000 tons less than a month ago, but about 18,000 tons better than for 1886. The amount of iron and steel imported from England during the first eleven months of the current year was 1,211,000 tons, against 725,000 tons for 1886, an increase of 67 per cent.; and the imports consisted chiefly of pig iron, unwrought steel, and tin plate. The Johnson Steel Street Railway Company lately purchased two hundred acres, for the purpose of erecting a rolling mill and steel plant. They have, however, partly abandoned their plan, and for the present intend only erecting a rolling mill. The building will be 350ft. by 150ft., and will be used for rolling their patent steel street rails. The mill will be in working order about next May, and will have a daily capacity of about 300 tons. During the past week 40,000 tons of steel rails have been contracted for, at prices varying from £6. 4s. to £6. 8s., averaging slightly lower than last week. Bar iron is weaker and the demand is less, not only in crude, but in many forms of manufactured iron and steel.

METALS.—The corner in lead, copper, and tin has had little effect in increasing prices during the last week, except in the case of tin. There is comparatively little dealing in copper, the price having declined one-fifth cent per lb., the quotation to-day being 17·9 cents, against 10 cents three months ago. Lead has declined one-fifteenth cent, and the boom in prices may be said to be over. Tin has advanced 1 cent, and prices seem fair to hold for a little time longer. One of the causes assisting speculation in keeping up the price of copper is the Calumet and Hecla fire, which is not yet extinguished. The experiment of using carbonic acid gas to check the fire has not been very successful. The gas was manufactured at the mine, and sent to a depth of 500ft. through a 4in. pipe. At first it seemed to have the desired effect, for on November 25th, at the mouth of a shaft 1700ft. above the fire, the temperature had been reduced from 128°F. to 88°F.; but later telegrams show that the method was not so efficient as it at first appeared.

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ENGINEERING PROGRESS IN 1887.

In his Presidential Address to Section G of the British Association, last year, Prof. Osborne Reynolds remarked that the completion of the Tay Bridge, the Severn Tunnel, the progress of the Forth Bridge, and the commencement of the Manchester Ship Canal in one year and in one country are sufficient assurance that as yet there is no lack of enterprise or sign of falling off in heroic undertakings. The first of these works, the Tay Bridge, is over two miles long, and occupied only five years in construction, and it was described in these pages at the time of its completion (see *Industries*, Vol. II., page 525), the engineers being Messrs. Barlow & Son, of London, and the contractors Messrs. W. Arrol & Co., of Glasgow. The fatal experience of the previous bridge, the varying bed of the Tay, the rapid current, the exposed situation, and the great length of the bridge, all rendered the work of designing and constructing it one of unusual anxiety and difficulty. Fortunately, the conditions of the case rendered it unnecessary that any unusual type of bridge should be designed, and the engineers wisely confined themselves to ordinary piers and girders of sufficient stability and strength. There are in all eighty-five spans, in lengths ranging from 50ft. to 245ft., and the greatest height above high water mark is 107ft.; the height in the centre or navigable spans is 79ft., which affords a headway of say 77ft. The bridge was successfully opened in June last, after having been thoroughly tested, and is an example of good design and workmanship in every respect.

The Severn Tunnel was really completed at the end of 1886; but as a description of it appeared in our pages (see *Industries*, Vol. III., page 289) during the past year, it may briefly be referred to. The inconvenience caused to traffic between Bristol and the towns of South Wales had long been felt, and so far back as 1871 plans were deposited for the tunnel which has since been constructed, and is four and a half miles long, the thickness of rock at the crown of the arch varying from 15ft. to 30ft. Great difficulties and consequent delays were experienced in its construction, and it was not until 22nd November, 1886, that the line was inspected on behalf of the Board of Trade, and it was opened for passenger traffic on 1st December, and since that time not the slightest hitch has occurred in its working.

During the year good progress has continued to be made on the Forth Bridge, of which Sir John Fowler and Mr. B. Baker are the engineers, and has been duly reported in these pages (see *Industries*, Vol. II., pages 4, 358; Vol. III., pages 15, 289, 454, 618). Professor Reynolds, in the address above mentioned, said the Forth Bridge was a structure the very thought of which causes those who have seen the place to hold their breaths, and of which the relative size may be best realised from the fact that, held out in arms an eighth of a mile long, at a height of 200ft. above the sea, as a mother might hold an infant, are structures no less than the single spans of the Britannia Bridge. Not only is the bridge distinguished by its design, but the methods of construction are novel. We would especially refer to the bold expedient of discarding any form of fixed scaffolding, and utilising the completed portions of the bridge as a base for carrying on the work. Moreover, the many interesting and ingenious machines and processes employed in manipulating the materials, due in great part to the fertile ingenuity of Mr. William Arrol, one of the contractors, some of which he described in a paper read before the Institution of Mechanical Engineers, seem in themselves to open up a new era in mechanical engineering. The various papers by Mr. Baker, Mr. Biggart, Mr. Wood, and others who are engaged on the work, are well worthy of study by all concerned in engineering. The masonry consists of Aberdeen granite and Arbroath stone, and the superstructure is entirely of steel. The design and construction have been criticised in various respects, but neither the engineers nor the contractors have any doubt of either their theory or their practice; and so far as we have been able to judge, their confidence seems to be well justified.

In the department of Civil Engineering, the most important event in the United Kingdom during the past year was without doubt the successful commencement of the Manchester Ship Canal. We have given a preliminary description and some general information regarding this great work, and we intend to keep our readers informed of its progress; but in the meantime it is sufficient to refer to the paper on it read by Mr. Leader Williams before the British Association (see *Industries*, Vol. III., page 337). Like many other great undertakings, this Ship Canal has not been by any means a sudden thought, but for many years has been in the minds of those interested in the prosperity of Manchester, and it affords another example of what may be accomplished by energy, perseverance, and pluck. So far back as 1825 an application was made to Parliament for power to construct a ship canal to the mouth of the Dee, Mr. Rennie being the engineer; but the attempt was unsuccessful. In 1840 it was proposed to render the Mersey and Irwell Navigation available for sea-going vessels, and later on other suggestions were made; but it was not till 1882 that the proposals for the Canal which is now being constructed took definite shape, and the prospectus of the Manchester Tidal Navigation Company issued to the public; Mr. Daniel Adamson being the moving spirit in the matter at the time. To Mr. Williams' paper we must refer for an account of some of the engineering problems involved, and to the parliamentary records for the legislative difficulties which had to be overcome. The expenditure of money in passing such a Bill as that required for the Manchester Ship Canal is a disgrace to our legislative system, and it is probable that the reform of that system may be hastened by the experience of the promoters of the Bill. The work of constructing the Canal has now been fairly inaugurated, and, in fact, the progress made, although bearing an infinitesimal proportion to the whole project, is yet sufficient to show the great magnitude of the undertaking. At the Manchester end work has been commenced, and at various points on the line ground has been broken. Steam navvies, dredgers, and all the most improved appliances are to be employed. If the same energy is continued during the work as has been displayed at its beginning, we have no doubt it will be completed in the time specified, that is, in four years. The Clyde, the Tyne, the Tees, and the Thames all show the importance of water ways for the development of industries and trade along their banks, and there can be no doubt that when the Ship Canal has been completed, and increased facilities given for shipping and carriage, it will add immensely to the trade and industry of Manchester.

The only great foreign engineering work in which we have much interest is the Panama Canal, for if it were successfully accomplished it would mean the revolutionising of a considerable part of our foreign commerce, the creation of a new branch of international politics, and a large number of diplomatic problems. We are now within a year of the time when M. de Lesseps promised that the Canal would be opened, and we believe that he still keeps to that date. But very serious financial difficulties are now beginning to appear, and M. de Lesseps has practically confessed that the future of the enterprise is in the hands of the French Government, and has pointed out that its failure would be a crushing national disaster, and having exhausted all means for raising funds, he asks for Government assistance. The great difficulty is to know what to believe regarding the progress the works have made. We are afraid that M. de Lesseps has either deceived himself or has been deceived upon this point. Various independent reports have shown this, and the latest which have been published confirm it. The United States of Columbia sent a special official to examine the works and report upon them, and he says that the reports which have been presented to the shareholders have been partial in their character and do not furnish an exact idea of the situation, and further, that they have greatly exaggerated the number of men employed. Instead of 15,000, as stated, not more than 5000 ever seem to have been employed, and the work performed seems to confirm this estimate. We shall observe with interest the developments of the next few months, for affairs have now reached a crisis, and we trust that some means will be found for completing the great work, although it must be confessed that its prospects are not by any means bright.

In the departments of Mechanical Engineering and Shipbuilding there has been no striking discovery or improvement, although there has been a considerable development on recent lines. This is especially the case in marine engineering, steel gradually replacing iron in construction, and the steam pressures used are becoming higher. Ordinary two-cylinder compound engines are being replaced with triple and quadruple expansion engines, not only in merchant but also in warships. Among the former the most improved designs are always to be found in the Atlantic steamers, as the great competition in that trade forces shipowners to take hold of everything which leads to economy. During the past year, however, only one important steamer has been added to the Atlantic fleet, the s.s. "Lahn," built by the Fairfield Company, of Govan, for the Norddeutscher Lloyd's Company, Bremen, of 5500 tons. Her engines are of the triple expansion type. There are five cylinders, inverted, with three cranks. The two high pressure cylinders are each 32½in. in diameter, the intermediate is 68in. in diameter, while the two low pressure cylinders are each 85in. in diameter, and the stroke is 6ft. The indicated horse power is 9500, that of the "Umbria" and "Etruria" being over 14,000; the "Servia," 10,300; and the "City of Rome," 11,890. None of these latter, however, have triple expansion engines, and consequently the speed attained is by a greater expenditure of fuel. The "Lahn," when on trial on the measured mile on the Clyde, steamed 19·46 knots, and maintained 18¾ knots per hour in a six hours' run. She has not yet crossed the Atlantic; but when she does her sailings will be watched with interest, although she is not intended to beat the "Umbria" and the "Etruria." Two British companies, however, are arranging to attempt this, viz., the Inman and International Company and the White Star Company, each of which is building a couple of vessels for the purpose. As these may be taken to represent the latest developments of merchant steamships, a short description of the former of these, now being built by Messrs. J. & G. Thomson, of Clydebank, may be given. They are 525ft. long on the water line, or 560ft. over all; 63½ft. beam, and 42ft. moulded depth; and their gross tonnage 10,000 tons. They have four complete decks, promenade (upper, main, and lower), with partial deck above promenade deck and partial deck below the lower deck. Speed has not been sacrificed to safety, and in addition to being minutely sub-divided these vessels have been so arranged that no bulkhead has a door below the level of the upper deck, for it was felt by the designers that only in this way can the benefits of minute sub-division be insured; because if, in an emergency such as happened in the "Oregon," the safety of the vessel depends on shutting water tight doors, the safeguard may vanish just at the time it is required. Moreover, the vessels are being fitted with two sets of engines, each driving a separate screw, and placed in separate water tight compartments, and the boilers are in three separate compartments completely cut off from each other. While, therefore, the vessels are well provided against collision, they are also very much better able to avoid collision by having two sets of machinery, one of which may be readily reversed, while the other is going ahead. They are fitted with double bottoms, having each a capacity of 1500 tons of water, which weight is available for purposes of immersion or stability at the wish of their commanders, while the double bottoms are a precaution against injury by grounding. The machinery is of the most improved type, the engines being triple expansion, and the boilers having forced draught on the closed stokehold system. The space occupied has thus been very much reduced, and consequently that available for passengers and cargo much increased. The vessels are fitted throughout with Messrs. Brown's hydraulic appliances for the dispatch or shipment of cargo or coals, for reversing the engines, and for steering, while the comfort and convenience of passengers have been attended to in every respect. Lastly, the ships have been specially arranged as armed cruisers, in which capacity their high speed, improved sub-division, and good turning power all render them highly capable of doing great service.

The steamers built for the Indian, Australian, and Channel trades have all been marked by a development in design and construction very much on the lines indicated above. Messrs. Napier, of Glasgow, have built the "Damascus" for the owners of the well known "Aberdeen," which may be looked upon as the pioneer triple expansion engine vessel, and have taken full advantage of the experience gained in the interval. Messrs. Denny, of Dumbarton, have built a vessel of 5000 tons, fitted with quadruple expansion engines. The Channel service is beginning to be as exciting as the Atlantic, some of the vessels added having great speed. The Fairfield Company, of Govan, have launched four paddle steamers. Two of those—the "Victoria" and "Empress"—run regularly from Dover to Calais, a distance of twenty-one miles, in a little less than an hour; while the other two—the "Victoria" and the "Prince of Wales," the Manx boats—when on trial on the Clyde, were driven from 22 to 23 knots per hour. Our space will not allow us to enter into particulars regarding other merchant vessels; but what we have given will be sufficient to show the type which is now being developed. It may be interesting, however, to note the increasing use of steel in shipbuilding. Of the 326 ships built in 1887 on the Clyde, 194, representing 148,596 tons, were constructed of steel, leaving only 46 vessels, of 36,286 tons, of iron, and these latter are almost entirely sailing ships. The increasing use of steel may be gathered from the following table, which shows the percentage of steel to total tonnage since 1879:—

	Total tonnage.	Tonnage of steel vessels.	Percentage of steel to total tonnage.
1879	174,750	18,000	10¼
1880	241,114	42,000	17½
1881	341,022	66,609	19½
1882	391,934	108,254	27⅔
1883	419,664	129,651	31
1884	296,854	133,670	45
1885	193,458	92,677	48
1886	172,440	116,932	68½
1887	185,362	148,596	80

In warships the triple expansion engine has now been adopted. Messrs. Napier & Sons, of Glasgow, have sent out large engines of this type for Russian men of war. The "Reina Regente," a protective deck cruiser of 5000 tons, built for the Spanish Government by Messrs. J. & G. Thomson, of Clydebank, depends for its safety from shot, not on a belt, but partly on a steel deck and partly on a minute sub-division of the structure, there being in all 143 compartments, most of which are in the vicinity of the water line. For a justification of this method of construction, reference must be made to a paper recently read by Mr. Biles before the Institution of Naval Architects, in which he produced data to show that the weight

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of a protective deck cruiser was so much less than that of a belted cruiser, that sufficiency of power could be added to the engines to secure one and a half knots more speed per hour. The Admiralty designers have evidently appreciated some of the good qualities of the "Reina Regente" design, and have ordered some cruisers on the same general principle. On the Tyne the most noteworthy warship that was built during the year was H.M.S. "Victoria," of 6000 tons total tonnage, with engines of no less than 12,000 h.p., and which we described at the time it was launched (see *Industries*, Vol. III., page 53), the builders being Messrs. Sir W. G. Armstrong, Mitchell, & Co. The other vessels produced by the same firm for war purposes were three revenue cruisers of small tonnage for the Chinese Government, and a hopper gunboat for the Admiralty. The Palmer's Shipbuilding and Iron Company built the cruisers "Orlando" and the "Undaunted," two of the five belted cruisers ordered by the Admiralty. The engines were horizontal triple expansion, and are good specimens of design and workmanship, and promise to maintain the high reputation of the firm.

In the department of General Mechanical Engineering there has been no very striking invention or development, and we must content ourselves with referring to our reports of the Manchester Exhibition for examples of good practice. That Exhibition will long be remembered as one of the most successful ever held, and its machinery department was most complete and worthy of attentive study.

In the department of Mining we so recently gave an account of "Fifty Years' Scientific Progress in Coal Mining" (see *Industries*, Vol. III., pages 535, 584), that it is unnecessary to enter on that part of the subject; but as bearing on the position of the coal trade throughout the world, the following statistics, which are the most recent available, will be of interest as showing the production of coal, the official value of the same, and the average value per ton in 1886:—

Statement showing the quantities of coal raised in different Countries or States, the number of employés engaged therein, and the average quantity of coal raised per employé per annum:—

	Production. Tons.	Value. £	Average price per ton. s. d.
United Kingdom....	157,518,482	38,145,930	4 10½
United States	96,055,000	29,422,400	6 1½
Illinois (only)	10,279,000	2,230,000	4 4
Germany	58,056,598	15,036,384	5 2
France	19,527,120	9,605,900	8 10
Belgium	17,285,533	5,701,680	6 7

	Tons raised.	Hands employed.	Average output per employé per annum.
United Kingdom...	157,518,482	519,970	302
United States.....	96,055,000	No returns.	—
Illinois (only)	10,278,890	26,804	383
Germany	58,056,598	217,581	266
France.....	19,527,000	109,426	178
Belgium	18,041,000	105,182	171

These figures are important in view of the new Act for the regulations of coal mines. We still produce on an average the best and cheapest coals, but in cheapness of production we are run pretty closely by Germany. The average cost of our coal is 4s. 10½d. per ton, and of German 5s. 2d.; but in 1872 and before that, German coal cost about 11s. In view of the restrictions of the new Act we must take care that we do not exclude ourselves from foreign markets.

During the past year a great amount of discussion has taken place on the subject of Technical Education, and considerable developments have been made in many of the institutions designed to afford a training in the theories of the various industries and arts. A Technical Schools Bill was passed for Scotland during the last session of Parliament, although that for England was withdrawn. Both of these measures were very imperfect, and in its present shape the Scotch Act is not likely to have much effect until, at least, public opinion has been educated in the matter. In order to assist in guiding this opinion in the proper direction, the National Association for the Promotion of Technical Education, with the Marquis of Hartington as president, has been founded, and it promises to be of great utility. No one can doubt that if attention be paid to education, and if the education be of the proper kind, containing as it should a due admixture of theoretical and practical training, we shall be able not only to maintain our present position, but to outstrip our neighbours, who for some years have been rapidly making up on us in those departments requiring scientific knowledge. In all the main departments of engineering, the record we have given above shows that we are still able to hold a prominent position in the industrial progress of the world.

STARCH.—Large quantities of starch are at present imported into Switzerland, principally from Germany; but a maize starch factory has now been started at Mels by Messrs. Oskar Neher & Co. This new establishment will be of importance to our textile industries, as maize starch is coming into greater favour than wheat and rice starch.

Notices of Meetings.

THIS WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Friday, 13th January, 7-30 p.m. Students' meeting. Paper to be read on "Railway Engineering in British North America," by Mr. Robert J. Money, Stud.Inst.C.E.

NEXT WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 17th January, 8 p.m. Ordinary meeting. Paper to be further discussed: "The Use and Testing of Open Hearth Steel for Boiler Making," by the late Mr. Hamilton Goodall, A.M.Inst.C.E. Paper to be read, time permitting, "The Erection of the Jubilee Bridge over the River Hooghly, on the line of the East Indian Railway," by Sir Bradford Leslie, K.C.I.E., M.Inst.C.E.

SOCIETY OF ARTS.—Tuesday, 17th January, 8 p.m. Foreign and Colonial Section. Paper to be read on "The Colonies and Dependencies of the Netherlands and of Portugal," by Mr. A. J. R. Trendell, C.M.G.—Wednesday, 18th January, 8 p.m. Ordinary meeting. Papers to be read on "Methods of Taking the Ballots," by Messrs. John Leighton, James Withers, and John Imray.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, 17th January, 3 p.m. Lecture on "Before and After Darwin," by Dr. G. J. Romanes.—Friday, 20th January, 9 p.m. Lecture on "Diffraction of Sound," by Lord Rayleigh.—Saturday, 21st January, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

ROYAL STATISTICAL SOCIETY.—Tuesday, 17th January, 7-45 p.m. Paper to be read on "Progress, Organisation, and Aims of Working Class Co-operators," by Mr. Benjamin Jones.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, 18th January, 7 p.m. Paper to be read on "Steel Sleepers," by Mr. H. T. Munday, Assoc.M.Inst.C.E.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, 18th January, 7 p.m. Paper to be read on "The Non-Instrumental Meteorology of England, Wales, and Ireland, 1878-1885," by Mr. G. M. Whipple, B.Sc., F.R.Met.Soc., F.R.A.S. To be followed by the Annual General Meeting of the Society, when the Report of the Council will be read, the election of Officers and Council will take place, and the President, Mr. W. Ellis, F.R.A.S., will deliver his address.

CHEMICAL SOCIETY.—Thursday, 19th January, 8 p.m. Papers to be read "On Morindon," by Messrs. T. E. Thorpe, F.R.S., and W. T. Smith, M.B. (Lond.); on "Manganese Trioxide," by Messrs. T. E. Thorpe, F.R.S., and F. J. Hambly; "Contribution to the Theory of the Vitriol Chamber Process," by Professor Lunge; and "Studies in Coal Distillation," by Mr. Lewis T. Wright.

ARCHITECTURAL ASSOCIATION.—Friday, 20th January, 7-30 p.m. Ordinary meeting. Paper to be read by Mr. Somers Clark, F.S.A.

PRICES CURRENT, 12TH JANUARY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		32 8	Cash
Scotch Warrants, m/n		42 2	"
Hematite Warrants, m/n		44 4½	"
Stocks in Stores. Scotch	942,773—Dec. for week,	67	Tons
Middlesbro'	344,112—Inc. "	3099	"
Hematite	211,180—Inc. "	175	"

Exclusive of stocks in makers' yards.
Market easier.

	No. 1.	No. 3.	
Coltness	52/6	44/6	f.o.b. Glasgow.
Gartsherrie	47/9	44/6	" "
Dalmellington	44/6	42/-	" Ardrossan
Eglinton	43/9	41/6	" "
Glengarnock	47/6	42/6	" "
*Derbyshire	—	38/-	f.o.t. Works.
*Lincolnshire	—	35/-	" "
*Lancashire	—	38/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 15 0	5 5 0	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 2 6	5 12 6	Manc'hr.
" Angles	5 12 6	6 2 6	"
Crown Sheets	6 12 6	7 2 6	"
" Hoops	5 17 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		8 5 0	"
" Ship and Girder		8 0 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

No. 1 Selected.	No. 3.	No. 4.
53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£21	15	0	to £22	0	0	
Copper:	British Cakes and Ingots	85	0	0	"	——		
"	Chili Bars	85	10	0	"	——		
"	Manufactured (strong)	90	0	0	"	——		
Lead:	Common Pig	15	10	0	"	15	15	0
"	English Sheet	16	10	0	"	16	15	0
Tin:	Straits	167	0	0	"	——		
"	Australian	168	0	0	"	——		
"	English Ingots	148	0	0	"	——		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—The market price has varied little during the week, Chili bars having been kept firmly at from £85 to £86, with little business doing. Manufactured copper remains at £90 "strong," with small demand. The high quotations are bringing out large quantities of old copper and brass, which enables the brass and copper manufacturers to keep out of the market, and to cover their small requirements on favourable terms. Large quantities of old copper rollers are being sent from this district to Birmingham. When these outside lots are cleared off the position of the copper market will be much stronger, and foreign buyers will have to pay full rates for their requirements.

TIN remains steady, Straits being quoted about £167 per ton, and English about £148. It is strongly held by speculators, but the prospect of larger supplies coming forward shortly makes buyers cautious, and very little business is being done.

LEAD.—Quotations are a little easier.

SPELTER remains unaltered, but the price is quite firm, and the arrivals are readily disposed of at full prices. This metal is in demand for forward delivery to cover large inquiries for galvanised iron and wire goods, and is likely to remain at present values.

OILS.

			£	s.	d.
Cocoanut:	Cochin	per tun	28	0	0
"	Ceylon	"	23	15	0
Cottonseed		"	19	10	0
Cod		"	19	10	0
Lard		"	43	0	0
Linseed		"	19	5	0
Palm, Lagos		"	21	10	0
Rapeseed:	English	"	25	15	0
Seal:	Pale	"	23	10	0
"	Brown	"	18	0	0
Sperm		"	41	0	0
Whale		"	14	0	0
Turpentine		per cwt.	1	10	0
Coal		per gal.	0	0	6
Petroleum	(Refined)	"	0	0	6 11/16
"	Spirit	"	0	0	7¾

CHEMICALS.

			£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals	lb.	0	1	2	to	0	1	3
"	" Liquid	gal.	0	1	2	—	0	1	6
"	Citric	lb.	0	1	8	—	.....		
"	Oxalic	"	0	0	4	—	0	0	4½
"	Sulphuric	ton	1	5	0	—	1	10	0
"	Tartaric	lb.	0	1	6¾	—	0	1	7
Alum:	Lump (powder 10/- ex.)	ton	4	15	0	—	4	17	6
Ammonia:	Carbonate	lb.	0	0	3½	—	.....		
"	Muriate (Grey)	ton	23	0	0	—	.....		
"	" (White)	"	26	0	0	—	.....		
"	Sulphate	"	12	15	0	—	13	0	0
"	Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder		ton	7	10	0	—	7	12	6
Bisulphide of Carbon		"	13	0	0	—	.....		
Borax		"	28	0	0	—	.....		
Benzole	(90%)	gal.	0	3	6	—	.....		
"	(50 90%)	"	0	2	9	—	.....		
Copper Sulphate		ton	22	0	0	—	23	0	0
Copperas		"	1	10	0	—	2	2	6
Kieserit		"	1	12	6	—	.....		
Lead:	Nitrate	"	24	10	0	—	25	10	0
"	White Sugar	"	28	0	0	—	29	0	0
"	Brown "	"	23	0	0	—	24	0	0
Potash:	Bichromate	lb.	0	0	4½	—	.....		
"	Caustic	ton	22	0	0	—	.....		
"	Carbonate	"	17	15	0	—	.....		
"	Chlorate	lb.	0	0	6½	—	.....		
"	Prussiate (Yellow)	"	0	0	7⅜	—	.....		
"	Sulphate (Basis 90%)	ton	9	0	0	—	9	10	0
Precipitate:	Red	lb.	0	4	1	—	0	4	2
"	White	"	0	4	0	—	0	4	1
Salts: Epsom	Bags	ton	2	10	0	—	2	12	6
	Casks	"	3	5	0	—	3	10	0
"	Glauber	"	1	10	0	—	1	15	0
Sulphur:	Sublimed Flowers	"	9	0	0	—	9	10	0
"	Recovered	"	4	10	0	—	4	12	6
Soda:	Ash	deg.	0	0	1	—	0	0	1⅛
"	Caustic (White, 70%)	ton	7	0	0	—	.....		
"	" (" 60%)	"	6	0	0	—	.....		
"	" (Cream, 60%)	"	5	18	0	—	.....		
"	Crystals	"	2	10	0	—	.....		
"	Bicarbonate	"	5	10	0	—	.....		
"	Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha		gal.	0	1	3	—	0	1	4
Tartar, Cream of		cwt.	6	12	6	—	6	15	0
Zinc Sulphate		ton	7	0	0	—	8	0	0

STEAM NAVIGATION IN THE DUTCH EAST INDIES.—The Dutch-Indian Steamship Company has given notice to the Government at Batavia to terminate its contract for carrying the mails, &c. This is a local company which maintains steam communication between the various islands; but the directors have practically decided to now extend their operations to Europe, by establishing a new line of steamers between Rotterdam and Batavia.

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HOME INDUSTRIES.

MANCHESTER, 12th January, 1888.

The Engineering Trade.—Engine builders have been well employed during the past few weeks with repairs, as is usually the case at holiday seasons. The improved state of trade is inducing manufacturers to get their machinery into good condition, so as to enable them to take full advantage of it. Except for export orders there is not, however, much new work being executed; but the amount likely to come from that source in the immediate future is considerable. Millwrights have been fairly employed during the holidays; but many of them are anxiously looking forward to a development in trade, so that they may obtain orders to replace those which they have at present on hand. Machine tool makers are finding inquiries more numerous, and although there is not yet such an increase in the bulk of work being executed by engineers throughout the country as to call for more machine tools, there is sufficient enterprise awakened as to justify many of them preparing for the prosperous days believed to be at hand. Boiler makers continue to be well employed, and the same remark applies to machinists. The latter are altogether better off than any others engaged in the engineering trades in the district, and there is hardly a firm making textile machinery which is not fully supplied with orders for many months to come. In some cases there will be no lack of orders during the year, and appearances point to a very prosperous time for machinists. There are rumours of extensions by various firms, amongst the most authentic being that of the acquisition of the premises erected by the late Mr. Evan Leigh by a very successful firm of spinning machinists. Up to the present, however, the rumour lacks confirmation. Loom makers commence the year full of work, but are hardly likely to have such a successful year as the last two. Locomotive builders and gas engine makers are better employed. It is gratifying to be able to note that the Board of Trade returns for the past year show a very substantial advance in the amount and value of the machinery and mill work exported, a great part of which comes from this district.

The Iron Trade.—The attitude of the market at present is one of anticipation. The various quarterly meetings are being held this week, and it is expected that iron will be materially advanced in price. There is beyond doubt a greater inclination to purchase generally, and an undoubted increase of production in various ways, so that the rise in pig iron is quite justified. The quotations for steel are hardening gradually, and it cannot now be bought at much less than £7 per ton for good brands of round and square bars. Boiler plates in this material have advanced from 25 to 30 per cent., and all round the position is better. Bar iron of common makes is now being quoted 2s. 6d. to 5s. per ton above the old rates, and there is an increasing disposition to decline forward sales. The various brands of marked irons are more awkwardly placed than common bars, as makers feel the competition of steel very severely. There is no doubt that this class of iron would be much higher in price if it were not for the fact that steel is used in its place wherever prices become nearly equal. Turning bars for shafting purposes are now at a base price of £5. 15s. per ton.

Large Copper Pans.—Messrs. Thos. Ryder & Co., of Manchester, have just completed some copper pans for a brewery in Liverpool, which are of an unusual size. The bottom plate is 9ft. in diameter, and formed of one copper plate hammered and raised at the edges for the flanges. This plate is 1⅛in. thick, so as to withstand the action of the furnace. Vertically the pan is in two sections, the lower one being bulged in the usual way, and having a depth of 3ft., and a maximum diameter of 11ft. 6in. Above this is a cylindrical portion 4ft. 8in. deep and 12ft. diam., this being surrounded at the top by a double flange 18in. wide. The thickness of the copper used varies from 1⅛in. to $\frac{3}{16}$in., and the cubic capacity is equal to 4400 gallons of liquor.

LONDON, 12th January, 1888.

The Money Market.—The comparative abundance of money, which keeps rates in the money market down to low figures, is a little surprising considering the evidences afforded on every side of the continuous improvement in trade. One would expect that less money would be forthcoming for lending purposes, and that less of it would be available for Stock Exchange uses when trade is expanding. Still there seems to be no diminution in the supply, and rates remain much below the official rate. The Bank rate becomes more and more an anachronism, for its movements seem absolutely unrelated to the actual conditions of the money market. One proof of the distinct improvement in trade all over the country is afforded by the dividends just declared by the joint stock banks throughout the kingdom. Their returns are most reassuring, and in many cases the dividends paid for several past half years have been exceeded. In the stock markets British Funds continue to stand unprecedentedly high. The new Local Loans stock is eagerly taken at a substantial premium, and Consols have recovered from the fall which set in upon the growth of fears of possible early conversion. The first issue of the new Local Loans annuities was made in exchange for Consols, whereby the Government lost a large portion of the premium, and those who made the exchange got a good bargain. When the exchanging was stopped, Consols strengthened, partly because of the hope that the official broker would resume the issue of the new stock on terms so advantageous to Consol holders. Needless to say, he did not. All British, Colonial, and corporation stocks have been exceedingly strong. Home railway securities maintain their position, especially the "heavy" ones. The foreign market is unsettled and weak. It has been shaken by the failure of a Parisian speculator, whose fall has also disturbed the market for mining shares. Thus, though copper itself gains, the shares of the leading copper mines have not moved correspondingly.

Companies.—Since our last report the following new companies have been registered:—Shippey Brothers, Limited, with a capital of £30,000, to carry on business as electrical engineers and lighting contractors; Wright, Butler, & Co., Limited, with a capital of £350,000, to carry on business as iron smelters, engineers, steel manufacturers, &c.; Lucigen Light Company, Limited, with a capital of £250,000; Morata Valley Company, Limited, with a capital of £120,000, to acquire certain mines, railways, and tramways in Spain; West Moodie's Gold and Exploration Company, Limited (Transvaal), with a capital of £100,000; the Santa Teresa Copper Company, Limited, with a capital of £250,000; Durban Roodepoort Gold Mining Company, Limited, with a capital of £90,000.

Railways.—The gross receipts of the twenty-two principal railways in the United Kingdom for the week ending 1st January, amounted to £1,114,368 on 15,814½ miles, as compared with £1,063,575 in the corresponding period of 1887, when the mileage was 15,706¾ miles. An increase is thus shown in the mileage of 107¾, or 0·6 per cent., and in the receipts of 4·7 per cent.

Picric Acid.—An Order in Council has been issued under the Explosives Act, 1875, declaring, as picric acid, picrates, and mixtures of picric acid with other substances are under certain conditions specially dangerous by reason of their explosive qualities, that—"(1) Picric acid when in process of manufacture or storage shall (for whatever purpose used or manufactured) be deemed to be an explosive within the meaning of the said Act for all the purposes of the said Act, subject to the exceptions following: (*a*) Picric acid when wholly in solution shall be exempt from being deemed to be an explosive within the said Act; and (*b*) picric acid which does not fall within the exemption above set forth, but which is being manufactured or stored in a factory, building, or place exclusively appropriated to the manufacture or storage of picric acid, and in such manner as effectually to prevent any picric acid from coming into contact (whether under the action of fire or otherwise) with any basic metallic oxide or oxidising agent, or other substance capable of forming with picric acid an explosive mixture or explosive compound, or with any detonator or other article capable of exploding picric acid, or with any fire or light capable of igniting picric acid, shall be exempt from being deemed to be an explosive within the said Act. (2) Picrates and mixtures of picric acid with any basic metallic oxide, or any oxydising agent, or with any other substance capable of forming with picric acid an explosive mixture, or an explosive compound (for whatever purpose used or manufactured), shall be deemed to be an explosive within the meaning of the said Act for all the purposes of the said Act unless such picrates or mixtures be wholly in solution."

Mining Accidents.—The number of persons killed by explosions in mines during 1887 was 142, an increase of 13 on the previous year. This shows a large decrease on the average of the ten years between 1876 and 1886, which amounts to 250.

The Navy.—There are at present being built in the Medway yards two second class cruisers, one sloop, one first class gun vessel, and one surveying ship. At Portsmouth only two vessels are in course of construction, viz., the twin screw cruiser "Melpomene" and the twin screw sloop "Nymphe."

GLASGOW, 12th January, 1888.

General Trade.—The holidays are in the too immediate past for trade to give any definite indications. The stream of shipbuilding orders has somewhat slackened, though a few of some importance are still being given. Engineering is fairly brisk. Boiler makers are also in some cases extremely busy. The coal trade has been affected by the holidays, and shipments have been moderate. The same cause has affected mineral shipments generally. Railway traffics show no exceptional feature. Goods traffic has slightly improved; but passenger traffic shows a slight falling off. The sugar trade is exceedingly active, and prices have still been tending upwards. Freights are not quite so firm as they were; the probability of a considerable accession to shipping in the early future naturally depresses the freight market to some extent.

Shipbuilding.—Messrs. Thomas Cook & Sons, who have the Khedive's concession for the passenger traffic on the Nile, have ordered from Messrs. Bow, McLachlan & Co., Paisley, three paddle steamers for this service. The vessels will be fitted with triple expansion engines, and will be luxuriously furnished. In addition to the large steamer, the contract for which we noted last week, Messrs. W. Denny Brothers, Dumbarton, have secured an order for another steamer of 5000 tons for the Compania Transatlantica of Spain. A contract has been placed with Messrs. David J. Dunlop & Co., of Port Glasgow, for two steel screw steamers, each of 500 tons gross, for passenger and cargo trade. The vessels will be supplied with triple expansion engines.

Shipbuilding.—It is reported that Messrs. Napier, Shanks, & Bell have booked an order for a large paddle steamer for a Japanese company. This firm has been fairly busy during the dull times with a number of small craft, and now have two vessels of large dimensions on hand.

Engineering.—Messrs. Bow, McLachlan, & Co. have contracted with the General Steam Navigation of Calcutta for two sets of engines for twin screw steamers for river service.

Iron and Steel.—Prices of pig iron appear for the moment to have given way. Warrants have dropped, and iron masters have reduced their prices. Steel makers are still busy. The large amount of shipbuilding material for which they hold contracts is in the meantime maintaining prices. The prices quoted at present are: Angles, £6. 10s.; ship plates, £7. 10s.; boiler plates, £7. 17s. 6d.; rivets, £7.

The Admiralty and Scotch Coal.—The coal masters in the Slamannan district have selected the coals of Arden and Stanrigg (Messrs. Wm. Black & Sons), Longrigg and Longriggend (Messrs. James Nimmo & Co.), and West Longrigg (Mr. James Gemmell), as typical of their district, for the purpose of the Admiralty trials which are shortly to be made.

The Electric Light at the Vienna Opera House and a Glasgow Firm.—A communication from Vienna to the *Glasgow Herald* states that the failure in the electric light at the Opera House has been found to be due to defective boilers, and that a new set of six boilers has been ordered from the Babcock & Wilcox Company, of Glasgow.

(From our own Correspondents.)

LIVERPOOL, 11th January, 1888.

The Timber Trade.—There is an undoubted improvement in the timber trade, and the prospects for the New Year appear much brighter than was anticipated a few months ago. The consumption of pine timber for the last month amounts to about 123,000 cub. ft., a marked increase on the amount for the corresponding month in either 1886 or 1885. Red pine is very scarce, and will meet with a ready sale. There is a large stock of oak in hand, especially in planks, amounting to about 117,000 cub. ft.: the consumption has been an average one, about 32,000 cub. ft., but at increased prices, and the stock on hand will, no doubt, realise fair prices. The R.B. and N.S. spruce and pine deals still maintain their higher rates, but there is no material improvement in the prices of Quebec deals. Pitch pine has slightly advanced in price. About 4000 cub. ft. of elm have been sold, leaving the present stock at about 39,000 cub. ft. A similar quantity of ash has been sold, leaving a stock of about 18,000 cub. ft. There is a demand for Honduras mahogany at satisfactory prices; Minatitlan and Tabasco is also in good demand, but the stock of both is very small. There is practically no Cuba or St. Domingo in stock, and suitable logs will find a ready sale upon arrival; curls are in good request. There is no African mahogany in the market. There is a good demand for Honduras, Mexican, and Cuban cedar, the stock, however, being very limited; but of South American and pencil cedar there is a good stock, and prices are low.

SHEFFIELD, 11th January, 1888.

Heavy Manufactures.—As an evidence of the increasing demand for iron, it may be stated that in the Sheffield district there are no fewer than sixteen additional puddling furnaces alight. This means a considerably enlarged output, yet stocks are comparatively small, and one or two firms have actually a difficulty in meeting requirements. Bars are selling at £5. 5s. to £5. 7s. 6d., and hoops at £5. 10s., and even £5. 12s. 6d. Crucible and Bessemer are in very large demand. There is more work at the gun shops of Messrs. Thos. Firth & Sons; and Messrs. T. Vickers & Sons are busy on shipbuilding material. At the armour plate shops of the Atlas and Cyclops Works operations are brisker, and Messrs. William Jessop & Sons are doing an extensive trade in crucible cast steel castings, There is also a more eager inquiry for railway material, not only for steel rails of various sections, but for tyres, axles, and springs; for the latter Messrs. Thomas Turton and Sons have recently received one or two excellent orders. For edge tools there is a better market, and both Sheffield and Dronfield houses are doing well. Colliery plant is also in more active request. At a number of the pits in the locality there have been many renewals, one colliery company alone having just put down no fewer than 6000 yards of steel hauling wire.

Order for Dredger Buckets.—The Hadfield Steel Foundry Company have secured the order for the whole of the buckets and general steel castings required for the dredger ordered by the Preston Corporation from Messrs. Fleming & Ferguson, as referred to in your Glasgow trade report in your last issue. The same firm has been successful in securing a good order for similar material from the Panama Canal Company.

LEEDS, 11th January, 1888.

Iron and Steel.—Trade in manufactured iron is much healthier, and now that Leeds has launched into steel manufacture, there may be a considerable development of the local steel trade during the year. The rapid improve-

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ment in the shipping trade has resulted in capital orders for Leeds, shipbuilding material of all kinds being in great request; prices for iron and steel plates are quoted with caution. Messrs. Tannett, Walker, & Co. are busy on hydraulic machinery, and will be for some months to come, having received several large orders. At Messrs. Kitson & Sons' there is more doing in the locomotive construction shops, and the firm are also sending out a number of steam tram engines. Fittings for Yorkshire mills are finding employment, too, for many hands; but there is little call for agricultural machinery.

TEXTILES.—The improvement in the heavy branches is having a beneficial effect upon the textile industries. There is undoubtedly more money stirring, and fabrics are bought up with much readiness. Fancy worsteds are selling well, and so are woollens in new patterns. The ready made clothing factories are busy with spring goods.

NORTH STAFFORDSHIRE, 11TH JANUARY, 1888.

THE IRON TRADE.—Since the holidays some good orders and specifications have been received, and inquiries are numerous. Makers are firm in regard to prices, but as a rule little, if any, advance is secured. The quarterly meeting of the North Staffordshire Coal and Iron Masters' Association was held at Stoke on Monday last, when a draft of proposed special rules for local collieries was presented by the committee who had been appointed for the purpose. After a lengthy consideration the meeting was adjourned for a month, to enable colliery proprietors to look further into some points upon which a discussion arose. Sales were generally deferred until the quarterly meeting to be held to-morrow at Birmingham. Amongst local iron masters there is a feeling of satisfaction at the re-construction of the old South Staffordshire Wages Board, by the decisions of which wages have been governed in this district. On the whole, a hopeful feeling prevailed with regard to the future, but no material rise in prices was anticipated for the present. Of the forty furnaces in existence only eighteen are now in blast. Messrs. Robert Heath & Sons have recently put one into operation.

THE POTTERY TRADE.—Work has now been generally resumed at the manufactories, and there is a fairly good outlook in this industry. The demand for manufacturing fuel is satisfactory, and some heavy contracts are being entered into for the next twelve months' delivery.

BIRMINGHAM, 11TH JANUARY, 1888.

THE HARDWARE TRADE.—The effect of the holidays has now passed off, and work has been resumed in most of the factories in the district. In the brass trade, however, and especially among the smaller manufacturers, the high price of copper is checking business. The reason for this is the increased value of stock, much of the old stock being sold off at the former low prices, and when the time for replenishing comes, a difficulty is experienced as regards capital. The buying public has not yet quite realised that the holders of copper will most probably be able to control the market for some time to come, and there is consequently a hesitation to place orders. These causes combined are influencing the market adversely. Business with foreign markets in general hardwares, guns, bedsteads, &c., continues to maintain itself very fairly. Washing machines, hinges, coffin furniture, brass and iron tubes, nails, picks, shovels, and iron tools are mentioned as being in good request.

THE IRON TRADE.—This industry shares the increased prosperity which characterises it generally throughout the country. The market is strong, and there are a large number of inquiries. Galvanisers are busy, but complain that in order to meet the increased value of black sheets and spelter they should be getting about £1 per ton more for their staple goods. Sheets are strong at £6. 5s. to £6. 10s. for singles, and £6. 15s. to £7 for doubles, with tubes and other varieties of manufactured iron at corresponding rates.

LEICESTER, 11TH JANUARY, 1888.

WOOL SPINNING AND YARN TRADES.—Up to the time of writing the trade of the New Year shows no improvement on that which we were having before Christmas. Though there is no increase of business, a very buoyant and hopeful tone pervades the market, and holders of wool are extremely firm in demanding late rates. Thus sales are only for urgent wants, as users are disinclined to buy beyond their immediate needs, and wool staplers are holding out. Country dealers and growers are also of the same mind, and will not part with their holdings at any reduction. It is not likely that much will be done in the wool trade before the next London sales. Spinners are cheerful, but they experience no pressure of demand, though a few fairly good lines are already booked. Inquiries are more frequent for yarns for the spring trade; but prices are still very unremunerative, and not quite in accord with the cost of the raw material; hence spinners are reluctant to book large contracts. Yarn merchants have not yet commenced to be active, though they are perceiving a slight movement in trade.

HOSIERY TRADE.—Business has re-commenced very quietly indeed; but on the whole manufacturers are not greatly dissatisfied, as there are indications of an improvement in the immediate future, and buyers have commenced to look round the new samples. There are some heavy Government contracts in hand in the district.

BOOT AND SHOE TRADE.—There is no improvement in the trade as yet; the depression of the latter part of last year continues, and short time is the rule in the town and district.

SOUTH WALES, 11TH JANUARY, 1888.

TRADE ACTIVITY.—The Dowlais Works are said to have obtained an order for 20,000 tons of steel rails for the Argentine Republic, the price named being £4 per ton f.o.b. Welsh port. It is also stated that the Cardiff Workmen's Cottage Company have leased a plot of land on the East Moors, in the neighbourhood of where the new Dowlais works have been commenced, and that six hundred workmen's cottages are to be forthwith built. The iron works at Treforest, which have been standing idle for many years, have been acquired by a company, of which Sir W. Lewis is chairman, and have been re-started under the named of the Forest Steel and Iron Works. It is also announced that preliminary arrangements have been made by some influential capitalists to construct another large dock at Milford Haven, an enterprise which will involve an expenditure of nearly a quarter of a million.

THE COTTON INDUSTRY.—Cardiff was some few years ago threatened with partial extinction by the Barry scheme; but circumstances seem to have worked in such a manner for its good as to make the very obstacles in its way only stepping stones for its progress. The influence and energy which were diverted to Barry have simply left a void which is being filled by new activities, and it is now actually stated that a number of Lancashire gentlemen interested in the cotton manufacture have a scheme on hand to erect a number of cotton mills, each to contain 50,000 spindles, the whole to cost upwards of half a million sterling.

CARDIFF WATER WORKS.—A special pumping plant to take water from the Ely River is about to be laid down to increase the supply which will be required by the Dowlais Company. The Barry Gas and Water Works Company have applied for a similar arrangement to be entered into with them as that which has already been detailed in *Industries* for the supply of the new Dowlais works.

BARROW-IN-FURNESS, 11TH JANUARY, 1888.

DREDGING AND DOCK WORK.—During the current year it is proposed to deepen Walney Channel, between the Barrow Shipyard and the Graving Dock, owing to the fact that much silting up has lately taken place, and the dock can only be approached at high water. It is also contemplated to extend the wharfage in the entrance basin of the Ramsden Dock, so as to afford greater convenience for an increasing shipping trade, which will in the ordinary course of things follow, firstly, the establishment of a service of steamers in connection with the Foreign Food Supply Company; secondly, the greater activity in the iron and steel trades; and thirdly, the contemplated great development of the shipbuilding and engineering trades of the port.

IRON AND STEEL.—The iron market has recovered from the weaker tone shown last week, when prices dropped 2s. per ton; but now prices are up again at 46s. per ton net f.o.b. for mixed numbers of Bessemer iron, and 45s. 3d. for No. 3 forge. There is a good inquiry for forward deliveries, and makers in the meantime are busy and are well sold forward. Stocks are less bulky than they have been, and deliveries both by sea and rail are well maintained. The steel trade is very active. There is still a great demand for shipbuilding material, and plates have advanced from £7. 5s. to £7. 10s. per ton net f.o.b., while angles are at £6. 15s. per ton. Rails are in good demand for both home and foreign markets; but although there is an improving tone, prices are steadily held at £4. 2s. 6d. for heavy sections. It is thought probable that an advance will soon be established, because makers are so full of orders and so well sold forward. All branches of the steel trade are busy, and the output is far in excess of any previous time.

MIDDLESBROUGH, 11TH JANUARY, 1888.

PIG IRON.—The pig iron market remains firm at 33s. per ton for No. 3 G.M.B. prompt, and 33s. 6d. to 34s. for forward delivery. Warrants are 33s. per ton cash, hematite warrants 44s. 6d. to 45s. The retrospect of the past year is full of hope and promise for the year which is before us. There are six more furnaces in blast at the close than at the beginning of the year, and, of course, the total make is greater. But the shipments, local consumption, and rail deliveries have increased more than correspondingly, so that stocks, which amounted to 652,445 tons at the close of 1886, stood at 637,682 tons at the close of 1887. Prices also compare favourably, the average of 1887 being 3s. 6d. above that of 1886.

MANUFACTURED IRON AND STEEL.—Finished iron still maintains the advance made at the close of the year, prices being fully maintained. Inquiries are more numerous than ever, and in some instances there is a difficulty in getting the work done. This has made a strong demand for forge iron, for which 32s. 6d. per ton has been paid. Common bars are £5, best bars £5. 10s., ship plates £5, boiler plates £6 per ton, all less the usual discount. The steel works are pressed with work. Indeed, the demand for ship plates is so great that the works cannot keep pace. From £6. 10s. to £7. 5s. is the price now being paid for steel plates; £7 is the average.

SUNDERLAND, 11TH JANUARY, 1888.

SHIPBUILDING.—The actual prospects of local shipbuilding can now be fairly gauged. At the present time work is actually in progress on twenty-nine vessels—twenty-eight steamers and one sailing vessel, either afloat or on the stocks—of about 59,000 tons gross register. This is less than at the beginning of 1887, when there were thirty-five vessels of over 67,000 tons; but the latter figures included a number of vessels thrown on the builders' hands, on which work was but nominally in operation. The work yet to be commenced forms, however, the most important factor of the future. In January, 1887, there were eleven vessels of 19,000 tons ordered, but not visible in the shipbuilders' yards. In January, 1888, there are twenty-five vessels of 53,000 tons, or nearly three times the amount of work. Altogether there is at least 112,000 tons of shipping at present building or to be built on the Wear, the bulk of which has been ordered during the last three months, as compared with 86,000 tons in January, 1887.

THE COAL TRADE.—Now that the statistics of the year 1887 have been compiled, it is satisfactory to find that there has been a substantial increase in the shipment of coals during last year. No less than 2,497,896 tons were shipped coastwise, an increase of 70,279 tons as compared with 1886; while 1,496,002 tons of coal were shipped abroad, an increase of 174,482 tons; and 63,921 tons of coke, an increase of 21,837 tons. The total shipment of coal and coke was 4,058,037 tons, and allowing for a slight decrease in the coke shipped coastwise, there was the gratifying increase of 266,429 tons. Sunderland to some extent prospered in 1887 by the diversion of the coal trade, consequent on the strike of the Northumberland miners.

NEWCASTLE, 11TH JANUARY, 1888.

SHIPBUILDING.—Since the opening of the year most of the Tyne shipbuilders have secured additional contracts, and the yards have generally assumed an appearance of greater briskness. Among other contracts placed may be mentioned one for the building of four steel steamers of large size, which has been obtained by Messrs. Hawthorn, Leslie, & Co., from a Scotch firm of ship owners. Messrs. Stephenson, of Hebburn, have just booked an order for a third vessel of large size. Messrs. Swan & Hunter are now engaged in laying the keels for four large vessels, a circumstance which indicates the early advent of an exceptionally brisk period in the yard. Messrs. Armstrong, Mitchell, & Co. are proceeding with the construction of two vessels, one of which is to be considerably over 400ft. long. This firm have no less than five vessels being fitted out beside the yard, and another steamer of special build and large dimensions will shortly be put off the stocks. Messrs. Dobson & Co. have put down the keel for a medium sized vessel this week, and the whole of their four berths are now occupied. Messrs. Palmer's frame furnaces are now kept going night and day, and there is reason to believe that this method of working will be continued for some months to come. Messrs. Edwards and Messrs. Readhead have both secured orders lately, and one or two other firms that have been doing scarcely anything for some years past are understood to have acquired sufficient work to make their establishments tolerably busy for the remainder of the year.

ENGINEERING.—Exceptional briskness continues to be the feature at the leading marine engineering establishments, and one or two factories that have not hitherto been busy with marine work, are now likely to share in the general activity. Messrs. Black & Hawthorn have some good orders for the modern type of marine engine, the execution of which will be commenced as soon as a large hauling engine is put out of the shops, which event is expected to take place early next week. This firm are now erecting a spacious new shop, which is to be used exclusively for the manufacture of the "Beck" gas engine. Messrs. R. Stephenson & Co. are now busy with the patterns for a set of marine engines, and the order for a second set has been obtained. The firm have also booked orders for a limited number of locomotive engines, and they are doing a good deal of work in the general repair line. At the Elswick Ordnance and Engineering Works the same brisk state of business is to be noted as has existed for many months past.

BELFAST, 11TH JANUARY, 1888.

SHIPBUILDING.—Increased activity is still the rule with this department, and the New Year opens with very bright prospects, almost all the yards on this side of the channel having a large amount of work before them. Several orders were placed just before the holidays, all for vessels of large tonnage.

ENGINEERS AND BOILER MAKERS.—Though still suffering from the late depression, there is a fair amount of business being done, and in several cases boiler makers have received orders sufficient to afford occupation for some months.

LINEN TRADE.—After the interruption caused by stock-taking and the holidays trade has brightened all round, and a large amount of business is being done, with prices somewhat firmer. In yarns there is a good business passing, with hardening prices. The trade in wefts is considerably improved, and in some cases better prices have been obtained. Tows have advanced 1½d. per bundle, and are still in satisfactory demand. Cloths continue in request at firm prices, and several good orders are in hand.

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SMILES' HOLE CUTTING MACHINE.

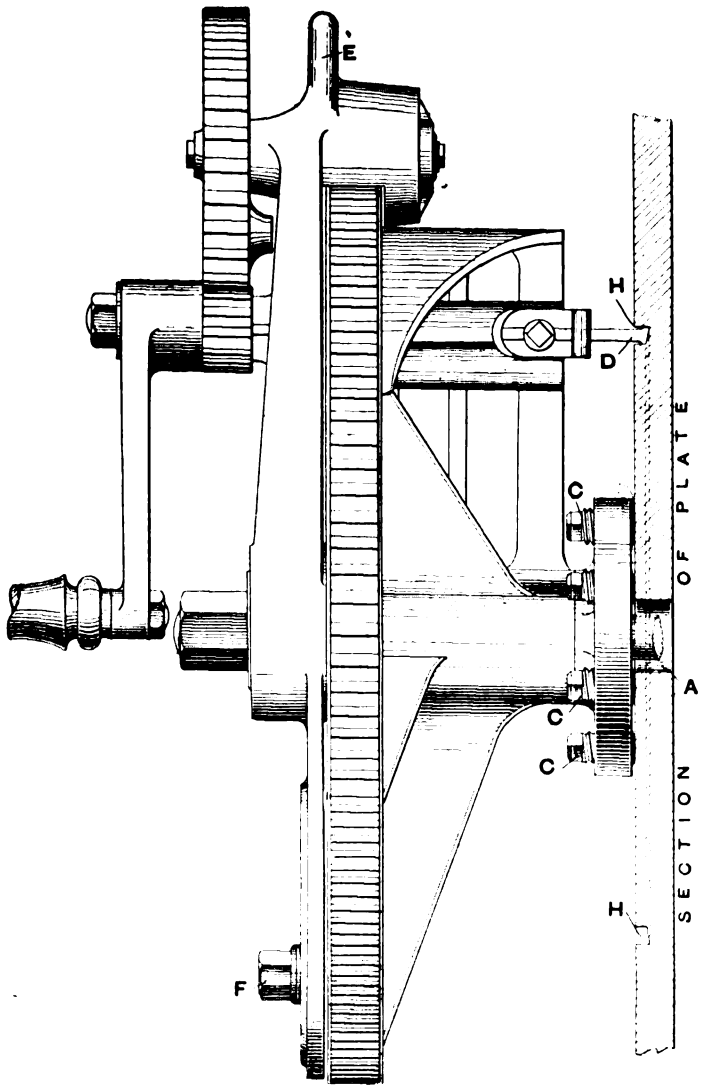


FIG. 1.—END ELEVATION.

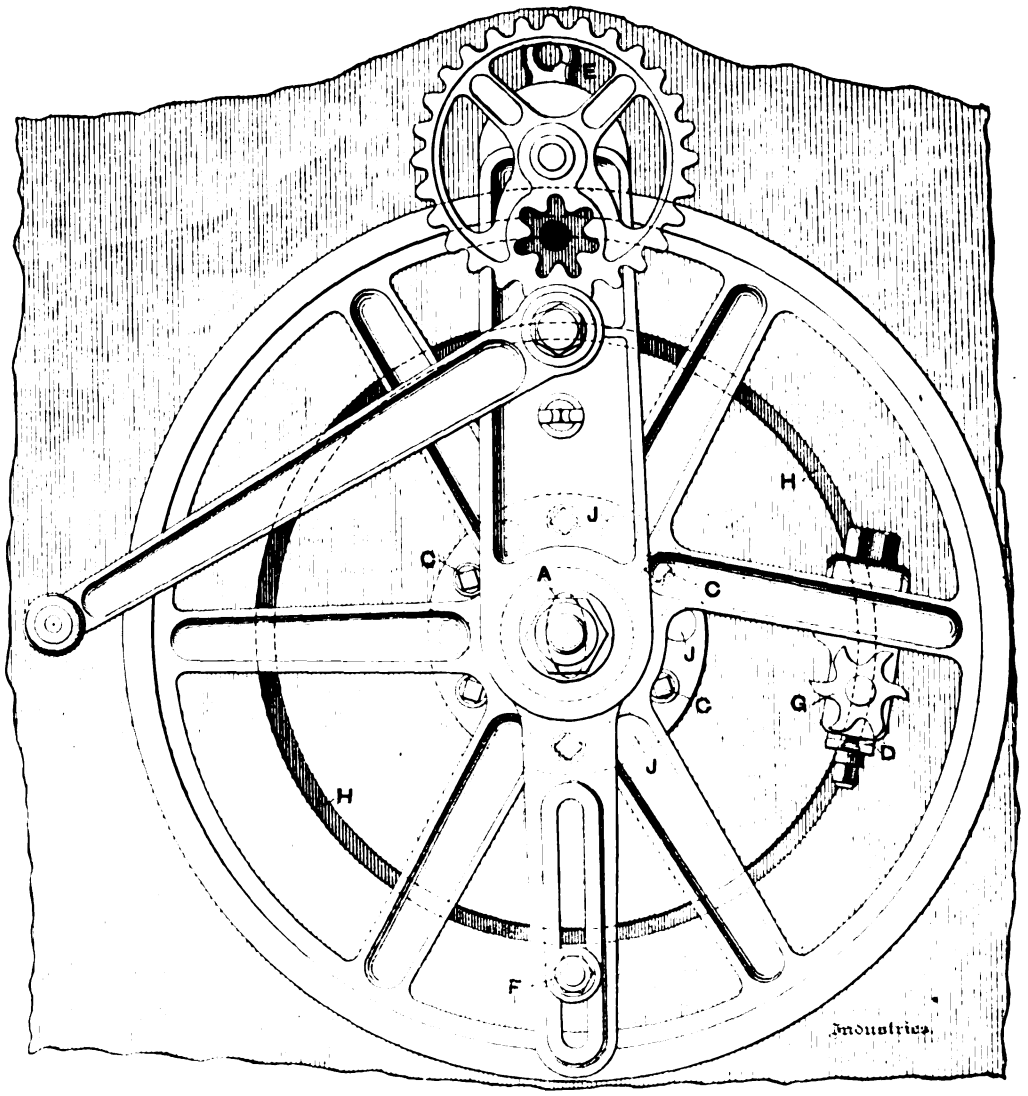


FIG. 2.—FRONT ELEVATION.

SMILES' HOLE CUTTING MACHINE.

MR. GEORGE THWAITES, of Stockton-on-Tees, exhibited at the late Newcastle Exhibition Smiles' patent hole cutting machine, shown in the above illustrations. The advantage claimed for this machine is that holes may be cut into the shell plates of a vessel by machinery after they are put in position, whereas formerly, especially in cases where sufficiently powerful hydraulic or steam machinery is not available for cutting or punching out the holes, the perforations had to be cut before fixing the plates in position. Special machinery for punching large holes does not appear to be economical, as time is lost in moving plates from one machine to another, and the first cost and maintenance of large hydraulic punching machinery is considerable. In order to overcome these disadvantages, Mr. Smiles designed the above hole cutting machine. It is made in three sizes, and our illustrations show the intermediate size, which is capable of cutting holes from 6½in. to 15½in. diam. The smaller size cuts holes from 4in. to 9in. diam., and the larger one holes from 8in. to 21½in. diam. These machines have been designed with a special view to lightness, while insuring strength and rigidity—steel and malleable iron being solely used in their construction. Fig. 1 shows an end elevation of the machine attached to a plate. A small oval perforation A is made in the centre of the proposed position of the hole, and an oval headed bolt inserted from the outside of the plate, and turned through 90° before screwing up. In some shipbuilding yards where the machine has been used, the hole for inserting the central bolt has been punched out at the same time as the rivet holes. If it be convenient to insert the central bolt from the inside of the vessel, the hole need not be oval. In cases where the plate is curved the machine is set by means of set screws C. The tool D lasts a considerable time, and may be easily replaced when worn out. An eye E is provided for attaching a rope for slinging the machine over the ship's side. In Fig. 2 a front elevation of the machine is shown attached to a plate. The pin F moves the star wheel G, thereby feeding the tool D. J J are tempered steel claws, which grip the plate so as to prevent the machine from turning round the central bolt.

COAL, IRON, AND COGNATE INDUSTRIES.

"THE probabilities of the continuation and development of the revival in trade during the year appear to outweigh the anticipations of the pessimist." Such was the conclusion arrived at in our review just twelve months ago with reference to the course of these trades during 1887, a conclusion which has been justified by the event. The Board of Trade Returns for December and for the past twelve months have now been issued, and from whatever standpoint regarded they cannot fail to cause satisfaction. The figures relating to our iron and steel exports show an increase for the month of 84,309 tons in quantity and £467,502 in value, as compared with December, 1886. In pig iron the month's increase is a substantial one, amounting to £88,347, or nearly 71 per cent., and is mainly due to an improved demand from the United States, Italy, and Holland; our trade with Russia and France being greatly diminished. The exports of railroad iron for December exceed those of the corresponding month in the previous year by as much as £230,274, or rather over 102 per cent. It is somewhat difficult to account for a decrease of £33,766, or 19 per cent., in the value of the past month's exports of unwrought steel, almost entirely attributable to a reduced trade with the United States. Having thus dealt with the main features of the returns for December, we are enabled to utilise our tabular statement for a comparison of the aggregate exports of the past three years:—

	Twelve months, ending December 31st. 1887.	1886.	1885.
	£	£	£
Pig and puddled iron...	2,741,507	2,254,497	2,029,816
Bar, angle, &c.....	1,447,977	1,373,071	1,620,484
Railroad	4,617,460	3,687,382	3,905,259
Steel, unwrought	2,094,454	1,493,669	1,027,460
Coal	10,176,402	9,837,338	10,633,151

Beyond the evidence thereby afforded of an improved business with foreign nations, the above figures must convey to the mind of the most casual observer one fact, very significant as a sign of the times, viz., that whereas the amount of bar and angle iron exported has slightly decreased during the past two years, that of unwrought steel has been more than doubled.

We have already furnished our readers with statistics relative to the home trade of the past year in the industries under review, and propose now rather to very briefly summarise the variations in the "tone" of the markets, and to notice the contributory causes. It will be in the recollection of those interested that until quite recently at home the promises of the opening months of 1887 had not been in any way realised. Indeed, a further fall in values had occurred, and in many instances prices ruled below the cost of production. It is perhaps unnecessary to do more than refer to the numerous failures which have occurred, and to the works which have been closed during the past twelve months, to conclusively prove the continuation of the depression. In the early part of December, however, a change occurred. At the various centres of the iron trade the price of crude metal advanced, and that of tin and copper rose by leaps and bounds. The latter was due to the operations of a wealthy French syndicate, assisted by a reduced supply of the metals in question. With regard to the former, it may be noted that, although stocks were still increasing, there had been some improvement in several branches of the finished product, and the influence of the Board of Trade returns also made itself felt. As to tin and copper, a tremendous fall from the abnormally high prices now reached through the exigencies of speculation is only a question of time; but there is reason to believe that a natural and legitimate expansion of demand, and, consequently, an advance in the price of finished iron, may more than sustain the improved tone of the pig iron markets. In face, however, of the enormous stocks existing at nearly every industrial centre, and of our high productive capacity—a considerable proportion of which is now lying dormant, but would be brought into operation if trade improved—it is difficult to discern any substantial indications of a materially higher cycle of prices in the immediate future.

With regard to the relations of capital and labour in the mining world, we confess to some disquietude. While advocating without stint the recognised right of the workmen to participate in the prosperity of their employers, should a revival in prices really occur, we cannot but deprecate the leaning of many of their present counsellors towards shorter hours of labour.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62, Ludgate Hill, E.C. (Watkins & Osmond.)
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Telephone number: 684, MANCHESTER.
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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

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Industries:

FRIDAY, 13TH JANUARY, 1888.

THE TRADE OF THE PAST YEAR.

THERE is a general feeling in the chief industrial centres that the New Year begins with better promise than did the old. The autumn revival of 1886 was dissipated ere 1887 had well begun; but this year the revival came later, and bids fair to last longer. The only cloud in the sky is the prospect of Continental war, and this prospect has any time during the past ten years played its part in unsettling men's minds, and in checking the development of trade. But for the moment affairs seem to have settled down into an approach to calmness, and for yet awhile it may be possible to avoid the rupture which the excessive armaments of the great Powers reduce to a question of time. The year that has just ended has been comparatively free from striking incidents. Only towards its close have the President's Message, the boom in shipbuilding, and the copper "corner," given the year some elements of excitement. The Presidential Message has, indeed, been one of its great events. The announcement of a policy of free trade by the official head of the nation in general, and of the Democratic party in particular, indicates a victory for free trade principles in the United States sooner or later. The effect upon our commerce of the abolition of the American tariffs is somewhat difficult to forecast, yet our trade must be affected to some extent even by the anticipation of reduction, though the party warfare between Democrat and Republican on the tariff question is likely to be very prolonged. The rise in freights consequent upon the growing quantities of our exports and imports, accompanied by a wreck list scarcely covered by the addition to the mercantile marine of newly built vessels, led in the last three months of the year to the placing of exceptionally heavy orders at all the shipbuilding ports. This revival of the shipbuilding industry, accompanied by a general movement in metals due to other causes, aided in bringing about a considerable amount of briskness in iron and steel, which, on account of depression in the engineering trades, had been languishing for some months. One of the events of the year has been the formation of the copper "corner," and the phenomenally rapid advance in the price of that metal. A syndicate of French speculators had carried on a successful speculation in tin, and having apparently very extensive resources, were able also to turn their attention to copper. They bought heavily, and their operations resulted in rapid advances in the price, partly justified by shortcomings in the production in Chili. To this speculation has been traced by some commercial writers the revival in trade. If the revival has no more substantial basis than the operations of a small though moneyed clique, we need not count seriously upon its permanency. The cause seems rather to be found, however, in the great expansion in point of quantity of the products of manufacturing nations, leading to increased demand for means of transport, and this demand affecting us apparently disproportionately from the increasing importance of our position as the carriers of the world. Another explanation might be found in a reaction from the excessive depreciation of prices, a depreciation resulting largely through suppressed panic, a universal feeling of despondency, and a want of industrial confidence. A comparatively slight incident may at times put an end to such a feeling and produce a reaction, and this incident has doubtless been supplied by the increased demand for shipping, and the advance, partly genuine and partly speculative, in metals. Among the other commercial and industrial events of the year has been the reputed discovery of gold in quantity in Wales. Gold has long been known to exist in Wales, and it has even been worked there; but the present announcement is to the effect that ore of undreamed of richness is awaiting reduction in the Welsh hills. There is something of the fairy tale about the story, in spite of the high scientific opinion with which it is supported. Should processes be perfected which have been in the course of development during the past year for the reduction of extremely refractory ores, and should the Welsh ore show even a much smaller weight of pure gold to the ton than is claimed for it, it may be a speculation both profitable to the company and important to the nation. Meantime, inflated talk about the settlement of the currency question and the depreciation of gold by transmuting the Welsh mountains into coin may well be left out of account. Two depressed industries have during the year raised their heads. The Scotch mineral oil trade, overwhelmed by the petroleum of America and Baku, brought to this country in tank steamers, early in the year found itself in an extremely depressed condition. Oil shares fell rapidly; conversion, and in some cases liquidation, followed; all suffered seriously. An attempt was made to reduce wages, which was resisted. The struggle lasted for some months, and finally was terminated by a compromise. Since then the companies have been recovering their position: stocks are lower, prices are higher, and altogether the industry is in a much more healthy condition than it has occupied for some time. Few trades in the country have felt worse and grumbled to better purpose than the sugar trade. The innocent victims of "a glut," the sugar refiners in London and Greenock found their occupation practically gone. The importation of bounty-fed sugar from abroad swamped them. Firm after firm, of the highest standing, came to grief, and extinction seemed to be the inevitable doom of a business which apparently could not bear up in this country in the struggle for "the survival of the fittest." But the sugar refiners pleaded their hard case eloquently, the Government yielded, and convened a conference to discuss the abolition of the bounty system. Judging from present results, the work of the conference has been highly successful. Its first session terminated after the practical settlement of the question in favour of the abolition of the bounties so far as the delegates present at the conference were concerned. During the sitting of the conference sugar rose rapidly, so much so that not a few who had previously lost by the fall recouped themselves by the advance. Many articles which have more or less sympathetic relations with sugar also advanced rapidly in price. And chemicals, though on this occasion they did not lead the movement, were sharers in the enhancement of prices. Though it is premature to estimate, with any approach to statistical accuracy, the amount of the rise which has taken place, there can be no doubt that a decided check to the downward curve of prices has been given, and unless untoward events supervene to cause loss of the advantage gained, that some considerable portion of the heavy fall in

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prices during 1885 and 1886 has been recovered. The general movement upwards in prices seems to justify the conclusion of the *Public Ledger*, which believes that "the sudden outburst of speculative activity during the early days of December has not been equalled since the year 1879." The year 1879, it will be remembered, marked the close of the crisis which came to a head in 1878. That the period of prosperity thereafter was of such brief duration was due largely to the wildness of the spirit of speculation which disorganised business and brought about the inevitable reaction.

Of legislation affecting industry passed during 1887, may be mentioned the Coal Mines Regulation Act, the Margarine Act, and the Merchandise Marks Act. A Bill dealing with boiler inspection and registration was proceeded with to some extent, and will probably be finally dealt with during the coming session.

THE COMMERCIAL DEVELOPMENT OF SHIPPING AND SHIPBUILDING.

II.

In our article last week we pointed out the general prominent position of British shipbuilding, but the volume of shipbuilding produced in this country has greatly varied as between one year and another, according as trade has been buoyant or depressed, as wrecks have been numerous or the reverse, and as the British Admiralty was giving out many or few orders. Within the last ten years we have produced as much as 900,000 tons in a single year, and as little as 350,000 tons in another. These extremes have not been greatly influenced by outside demands, for the tonnage built for foreigners has not usually been one-fifth of that built for our own requirements. The effect of such extremes has naturally been to unsteady the shipping and shipbuilding industries. It would be very desirable to secure greater uniformity, if that were possible; but shipbuilding follows the general trade of the world, and if that goes up by leaps and bounds, new ships must follow suit. Another matter that has caused a remarkable expansion of the trade within recent years, has been the extraordinary cheapness of tonnage. Until within the last five or six years, merchant steamers at less than £12 per ton were scarcely heard of. But within that period the cost of new tonnage has fallen as low as £6 or £7, which means that the ordinary market price of a new hull is not to-day much over one-half of what it was ten years ago. It is the opinion of many experienced shipbuilders that this low range of prices will be continued. Whether this is so or not, it must not be forgotten that the cost of production all round has been greatly reduced within recent years. Steel plates are not now costing much more than one-half of what they cost twelve or fifteen years ago. It is the same with angles, forgings, castings, engines, bolts and rivets, and everything else that enters into ship construction. This being the case, it is probable that there will be a larger demand for tonnage, relatively to the commerce of the world, than hitherto, since the tendency and effect of the cheapening of every commodity is to increase the demand for it.

In his new work, entitled "Uebersichten der Weltwirthschaft," published this year, M. Neumann-Spallart, a statist of the highest authority, gives the following table of the tonnage of sailing and steam ships respectively launched in the following countries, viz.: Great Britain, the United States, Germany, France, Italy, and Scandinavia in the period from 1873 to 1884:—

Year.	Steamships. No.	Steamships. Tonnage.	Sailing Ships. No.	Sailing Ships. Tonnage.
1873	680	470,457	3635	514,671
1874	595	381,567	4000	755,867
1875	586	261,033	3823	859,290
1876	533	194,484	3831	723,454
1877	597	279,670	3690	608,681
1878	713	380,095	3237	491,569
1879	656	427,380	2657	309,578
1880	807	508,773	2606	260,417
1881	861	635,941	2783	323,033
1882	1083	863,912	2738	389,107
1883	1370	994,797	2811	403,983
1884	1100	614,031	2849	409,378

Although M. Spallart does not carry his figures down to a later date than 1884, it may be remarked that during the two following years the production of tonnage has been much under that of the years 1883–84. Indeed, it is even doubtful whether the new tonnage constructed during the last two years has been equal to the replacement of the tonnage that has been removed from the registers of the world by wrecks and otherwise.

At the present time, the total tonnage of the merchant navies of the world amounts to about 20 millions of tons. In the latter half of the seventeenth century the total tonnage of the world's shipping was estimated by Petty at 2 millions. Nominally, therefore, our present tonnage is ten times that of two centuries ago. But this does not represent the full extent of the difference, for in the seventeenth century all the vessels employed were sailing ships, whereas there are now about 8,000,000 tons of steam shipping in the world, equal in carrying capacity to at least 24,000,000 of tons of sailing ships; and when to this we add about 12,000,000 tons of sailing tonnage we have a total of 36,000,000 tons, calculated as sailing tonnage only, or about seventeen times the estimated tonnage of the merchant fleets of the world in the time of Charles II. During the last six or seven years the total production of new tonnage in the whole of the leading shipbuilding countries of the world has averaged about a million tons per annum. About one-half of this tonnage goes in replacement of vessels lost by wrecks, &c.

The extent of the merchant navies of the principal countries of the world at the present time is indicated in the following comprehensive tabular statement—the most complete, we believe, that has ever been compiled—which we have extracted from Professor Neumann-Spallart's "Uebersichten:"—

Statement showing the Number and Tonnage of Steam and Sailing Ships in the Merchant Navies of the World.

Countries.	Steamships. No.	Steamships. Tonnage. 1=1000.	Sailing ships. No.	Sailing ships. Tonnage. 1=1000.	Steam and sailing ships. No.	Steam and sailing ships. Tonnage. 1=1000.
Great Britain	4829	4414	9944	3238	14773	7653
Ireland	557	417	2255	825	2812	1243
France	562	542	2128	386	2690	929
Norway	317	109	3958	1373	4275	1482
Italy	164	138	2324	753	2488	891
Spain	336	244	952	165	1288	409
Sweden	301	91	1690	367	1991	459
Holland	100	113	634	188	740	302
Russia	257	85	1720	210	1977	295
Denmark	191	92	980	150	1171	243
Austria	97	86	320	131	417	217
Greece	47	25	1013	194	1060	220
Belgium	53	79	11	5	64	84
Finland	47	9	750	201	797	211
Portugal	28	15	281	52	309	67
Hungary	12	7	132	61	144	68
Turkey (Europe)	14	6	285	47	299	54
Roumania	3	1	21	3	24	4
United States	2287	673	9633	1918	11920	2591
South America	166	79	578	173	744	253
Canada	272	76	3690	1000	3962	1077
Australia	465	139	917	208	1382	348
Other British Colonies	145	52	487	90	632	142
Spanish Colonies	95	42	427	50	522	93
Dutch Colonies	58	31	238	53	296	84
Other European possessions	26	21	192	31	218	52
Totals	11435	7599	45560	11885	56995	19485

The enormous preponderance of Great Britain is strikingly shown in this statement. It appears that reckoning, as before, one ton of steam tonnage as the equivalent of three tons of sailing tonnage, our own country can boast of 16½ millions of tons out of a total of 34 millions, being close on one-half of the whole. But it will further be observed that Great Britain has the advantage of possessing considerably larger ships, on an average. The total number of ships belonging to all nations is 56,995, and as their total is 19,485,000 tons, they would appear to average about 330 tons. The vessels belonging to the United Kingdom number 14,773, and aggregate 7,653,000 tons, or an average of 518 tons. In reference to steam shipping, it appears that the vessels of the British merchant marine average 914 tons, while those of the world generally only average 663 tons. This is a material gain to our own country, since large vessels are generally navigated with more economy than small ones.

The question of whether the future of British shipbuilding is likely to be equal to its past has been often put, and has been answered in many ways. The best test to which to bring the matter is probably that of the relative growth of shipbuilding and the commerce of the world generally. This inquiry, however, brings out some very curious results. The tonnage of the merchant navies of the world, at the present time, amounts to about 20 millions of tons, as already stated. Ten years ago the corresponding total was 19 millions of tons, or 5 per cent. less. But in this interval the commerce of the world, as measured by the entrances into and clearances from the ports of the ten principal ship-owning countries, has increased in a much more remarkable degree. The tonnage carried to and from the ten countries in question has advanced from 110 millions to 162½ millions of tons—a sure proof, one would think, that if our merchant marine has greatly increased, so also has the amount of work which it is called upon to perform. This is made clear in the following statistical statement, which shows the total entrances and clearances of sailing ships and steamers into and from the ports of Great Britain and Ireland, France, Russia, Germany, Holland, the United States, Belgium, Italy, Scandinavia, and Austria, during the period from 1873 to 1884:—

	Steamships. 1 = 1000 tons.	Sailing Ships. 1 = 1000 tons.	Totals. 1 = 1000 tons.
1873	59,706	46,876	106,582
1874	61,729	47,093	108,820
1875	64,916	45,184	110,000
1876	68,471	46,207	114,678
1877	72,935	46,753	119,688
1878	81,037	45,755	126,792
1879	87,045	46,659	133,704
1880	96,574	50,078	146,652
1881	99,298	45,230	144,528
1882	110,609	43,912	154,521
1883	123,738	40,100	163,838
1884	125,858	36,627	162,485

If these figures teach us any lesson, it is that of hope for the future. The rate at which we have provided ships for all the world has been growing, but so have also the necessities of the world's trade, taking one year with another; and as there appears to be as yet no limit to the expansion of trade, the demand for new tonnage must continue to increase.

Letters to the Editor.

ELECTRIC TRANSMISSION OF ENERGY.

To the Editor of "Industries."

Sir,—I have read with great interest your report on the trials made by a scientific committee with the transmission plant established between Kriegstetten and Solothurn, in Switzerland. The publication of these results, coming as it does at a time when electric transmission of energy, especially in its application to mining, is exciting public attention, your readers cannot fail to draw a comparison between what is done here and what is done abroad in this matter, the comparison being, I am afraid, much to the disadvantage of our own electricians. Data on transmission plant established in various mines in England have recently appeared in the scientific press. Among these is an account, published by you, of an electric mine pump in which the total efficiency for the indicated power to the water lifted is given as nearly 44½ per cent. In this plant an Immisch motor is employed for driving a pump in the mine. Now, taking the efficiency of the pump alone at 90 per cent., that of the reducing gear at 95 per cent., and that of the steam engine at 85 per cent., the total commercial efficiency between the power supplied to the dynamo on the surface and that obtained from the motor underground works out at 61 per cent. You do not give the distance of transmission; but from the general description, it would appear that this does not much exceed a quarter of a mile. Another account of a transmission plant was given by Mr. Frank Brain in a paper read before the South Wales Institute of Engineers, and I may incidentally mention that Mr. Brain, in a recent letter to you, claims this to be the largest electrical plant at present existing in England. The distance of transmission appears to be slightly over a mile. In this case the dynamo on the surface and the motor underground are both made by Messrs. Elwell-Parker. The power of the engine is given as 29·49 i.h.p., and the work done in water lifted as 10·36 h.p., showing an over-all efficiency of 35 per cent. Making the same allowance as before, for the loss of power in the engine, gearing, and pumps, the actual commercial efficiency of the transmission plant comes out at less than 50 per cent. In both cases you will see that the result falls far below that obtained by the Oerlikon firm in transmitting over a very much greater distance. Now, why should this be so? I am quite satisfied that Messrs. Immisch & Co. and Messrs. Elwell-Parker can build dynamos and motors equally efficient with those turned out by the Swiss firm; but yet in practical working the latter are far away ahead of their English rivals. I believe the true reason of this success is not that the Swiss firm know better than our electricians how to build dynamos and motors; but knowing it equally well, have the courage of their opinion, and resolutely set their face against the cheese-paring policy under which our own electricians try to outshine each other in the matter of obtaining enormous power from very little weight. If you want an efficient dynamo or motor you must make it big enough and heavy enough to do its work.

Now, what is the English practice and the Continental practice in this respect. We have recently heard something about a new dynamo, made by Messrs. Paris & Scott, which weighs only 80lb. per horse power output, and a modification has even been promised which will weigh only 30lb. per horse power output. An Immisch motor was shown a few weeks ago at the Institution of Civil Engineers, which, weighing 6cwt., could develop 10 h.p.; and the motor fitted by Messrs. Elwell-Parker to the electric tram car, which was tried last week, is said to weigh 16cwt. and to develop 25 h.p., being at the rate of 72lb. per horse power. I do not say that the desire to reduce weight is in itself objectionable, but I maintain that such reduction becomes objectionable if it involves a sacrifice of efficiency. Hitherto I have always been told that a substantial, well designed dynamo will at a moderate speed have an output of about 1 h.p. for every 100lb. of dead weight, and the Edison-Hopkinson machines, than which there are no others having an equally high efficiency, do even considerably exceed this margin of weight. So far the English practice. Now let us examine the Swiss practice. The type of machine employed must be called a light type, as compared with the Edison-Hopkinson dynamo, and yet you give in your report of last week the weight of a 20 h.p. machine as 72cwt. Speaking generally, we may therefore assume that these machines are much heavier than English makers would have constructed them, and I think we have to look to this fact as the reason why the efficiency of the plant is so unprecedentedly high. It has of late become quite a mania with English electricians to cut down the dead weight of their machines to an absurdly low point, and I feel confident that

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unless they abandon this policy, and build heavy and substantial machines, they will not be able to show results even approaching those you published last week.

Yours, &c.,

London, 9th January, 1888. ERG.

ELECTRIC LIGHTING FROM CENTRAL STATIONS.

To the Editor of "Industries."

SIR,—My directors have noticed your report of Mr. J. R. Williamson's paper in your issues of the 16th and 23rd ult. on "Central Station Electric Lighting," and there are a few explanations which I should like to make on this paper, if you would kindly allow me the space, viz.: The Grosvenor Gallery installation was commenced under the supervision of the engineers of the National Company for the Distribution of Electricity by Secondary Generators, Limited. Its subsequent working under Mr. Ferranti is the subject of litigation. The Lowrie Hall converter, which is a most efficient instrument, is worked under license from this company, who are the proprietors of the Goulard-Gibbs patents.

Yours, &c.,

J. E. PICKERING,

London, 7th January, 1888. Secretary.

TRIPLE EXPANSION ENGINES FOR TEXTILE FACTORIES.

To the Editor of "Industries."

SIR,—Can any of your readers inform me whether any makers have as yet applied the system of triple expansion to stationary engines for textile factories, which has been so largely adopted in marine engines, and with such beneficial results?

Yours, &c.,

Halifax, 8th January, 1888. H.

RAILWAY RATES.

To the Editor of "Industries."

SIR,—The letters on the above subject which have appeared in your journal during the last few weeks show that the public generally have a grievance against the railway companies, for where one person complains publicly, there are a dozen who do so privately. I have had from time to time my share of unpleasantness with some of the railway companies, of which I will give an example presently. I notice that at the monthly meeting of the Council of the Railway and Canal Traders' Association held this week, the secretary reported "that the average number of complaints as to excessive and unfair railway rates had been exceeded during the past month." What irony! To think that complaints must be as regular as clockwork, and commented upon if they exceed the average. Poor, long suffering British public! A resolution was unanimously carried at the same meeting, "That in view of the provisions contained in the Railway Bills of 1886 and 1887, with respect to preferential railway rates in favour of foreign produce, it is urgent that a test case involving this point be fought; and that steps be at once taken to raise a special fund for the purpose of insuring the initiation of proceedings prior to the introduction of the promised Railway Bill during the ensuing session, and their due prosecution subsequently. One point has not hitherto been noticed by your correspondents, and that is the effect of rivalry and personal jealousy between the chairmen and other officers of competing lines. This, in my opinion, prevents concessions to the public. One line will not work with another, and a return railway ticket issued by one company is not available for the return journey by the competing line. To give a case in point, the price of a return ticket from Peckham Rye to London Bridge is the same as to Victoria and to Ludgate Hill. I may return from either London Bridge or Victoria with a ticket taken to either place, these termini being on the same line of railway; but I cannot return from Ludgate Hill, which lies between the two, because the line is owned by a rival company. Is this not very absurd? If these two railways were in the hands of the Government, or if the companies were friendly disposed towards the public and each other, I should be able to travel from either of the three stations named.

I see an effort is being made to secure amicable working between the Southern lines, and the effect is a rise in their stocks, viz., 1¾ per cent. in the London, Brighton, and South Coast line, and ⅞ per cent. in the South-Eastern. It is doubtful, however, whether the reform can be carried out, as the chairman of the Brighton Railway has addressed a letter to the syndicate which has the object in view, stating that he has no difficulty in carrying out plans for peace and harmony with either the Chatham or the South-Western Companies; but Sir Edward Watkin has revived claims which entail disputes with the Brighton Company, and, in short, he does not see his way to cordial working with the South-Eastern under Sir Edward's presidency. Mr. Forbes, of the Chatham Railway, writes on "the waste of money and power going on under the present armed truce between at least one of the companies and the other two." Meanwhile a record of opinion is being signed by some of the shareholders of the South-Eastern Railway, stating that "no further time should be permitted to elapse before a vigorous effort is made to terminate the long standing friction, restlessness, and hostility manifested by this company towards the London, Brighton, and South Coast Railway and the London, Chatham, and Dover Railway Companies, and that in the mutual interests of the three Companies it is essential an arrangement be arrived at, based upon the principle of a working union, and having for its object the utilisation to the full of the unequalled resources of the three Southern railway systems, thereby yielding to the public demand." The record of opinion concludes by intimating that another chairman of the South-Eastern is desirable. Thus the game goes on, and the public are sacrificed to the chairmen. Is not the sectional character of the whole railway system ridiculous? My opinion is that railways should exist for the public good, and that anything which stands in the way should be removed by legislation. The principal grievances of the railway system, as conducted at present, are the differential rates, the excessive rates, the want of uniformity of rates amongst the various companies, the great number of classifications, and the diversion of traffic from its natural channel by canvassers.

Mr. Jeans, in his evidence before the House of Commons, stated that the average cost for all England of the railway charges for the raw materials used to produce a ton of pig iron was 5s. per ton for fuel, 4s. 11½d. per ton for iron ore, and 11½d. for limestone; this equalled 16 to 19 per cent. on the selling price of the iron, and as 7 to 8 million tons of pig iron were made annually it represented a very serious item. Comparing these prices with those paid abroad, they stand thus:—

	Average cost for England. Per ton per mile.	Average cost for France, Belgium, Germany, and the United States. Per ton per mile.
Iron ore	1·19d.	0·55d.
Pig iron	1·2d.	0·75d.
Manufactured iron	1·63d.	0·78d.
Steel rails	1·55d.	0·78d.

Thus it is seen that the foreign rates are considerably less than our own, and the effect is to weigh very heavily against the English manufacturer in the competition to which he is subject. The difference is about 5s. 8d. per ton against this country.

Besides the higher rates, the trader has to fight against the companies charging more than the legal rates. Two instances of this have recently been made public, and the curious thing about them is that the two companies declined to fight, preferring the payment of claims into Court rather than run the risk of losing their cases. The facts are as follow: The London and North-Western Railway Company charged 8s. 4d. per ton for conveying iron from Birmingham to a town in Staffordshire, 9½ miles distant; this, it was contended, was 5s. 4d. per ton too much, or 64 per cent. overcharge. In the second case, the Great Western Railway Company was the culprit, by charging 7s. 4d. per ton for conveying iron from Birmingham to Warwick, 22 miles distant; this, it was contended, was 3s. per ton too much, or 41 per cent. overcharge. The manufacturer refused to pay the charges at first, but as the companies refused to carry the iron the amounts were paid under protest. Upon being sued in Court for the excess, the claims were met by the refunding of the overcharges. These cases speak volumes, and are no doubt typical of what takes place in other parts of the country where manufacturers are more pliable.

Few people know enough of the proper rates to take a case into Court, but that overcharges are common I feel convinced. An instance occurred to myself only a few weeks ago which illustrates the principle on a small scale. I received a parcel from Derby, for which 2s. 4d. was demanded. This I paid; but upon my inquiring at the station the reason of so high a charge some ten or twelve days later, I was informed that a mistake had been made, and 3d. was refunded me. I am further informed that 4d. is for delivery to my house, which lies beyond the free delivery distance of a mile. I meekly acquiesce, and look in the published table of rates and find the rate should be 1s. 11d., and this amount, with 4d. for delivery, makes 2s. 3d. Why 3d. was returned to me out of 2s. 4d. is a mystery. I merely give this as an instance of the uncertain charges which are made for small articles as well as for large ones. If parcels are sent by post there is a fixed definite charge, with no extras for delivery outside a limited radius. We want the railway system of rates to be as simple as the Post Office system, and in my opinion the Railway Commissioners should fix the rates for parcels and goods as well as the fares for passengers, leaving the railway companies to carry whatever is presented to them at what speed they like, and with regard to passengers, in what comfort they like. The public would soon choose the lines which did the work the best. The present system of rates and charges gives room for peculation on the part of railway servants, because few people know the exact charge for a parcel by railway, and the temptations are such as no railway servant should be exposed to.

Yours, &c.,

Rye Hill Park, London, S.E., E. J. EDWARDS.
10th January, 1888.

EDDY CURRENTS IN ARMATURE WIRES.

To the Editor of "Industries."

SIR,—In the construction of large dynamos with heavy wire or bars of rectangular section, the eddy currents in the armature conductors become a factor for serious consideration, and render it necessary to introduce special means to reduce them. It is well known that these eddy currents form their circuit throughout the length of the portion of armature wire presented to the field magnets, as shown in Fig. 1, and it may be asserted, from

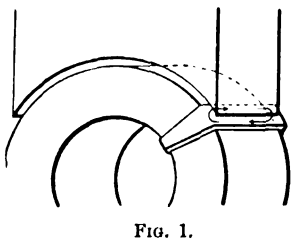


FIG. 1.

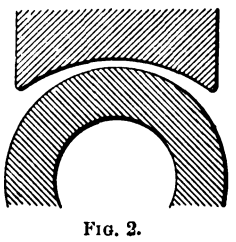


FIG. 2.

the result of experiment, that they are only generated when approaching and leaving the field. The strength or amount of eddy current depends on the speed with which the wire moves into and out of the magnetic field. These objectionable currents can be greatly reduced by shaping the magnet poles as in Fig. 2, so that the wire gradually enters and leaves the field. Cutting the corners in this way increases the efficiency of the machine rather than reduces it, for what is lost in extent of field is more than regained by the reduction of the eddy currents. The extent to which the corners of the pole pieces must be removed in this way depends on the dimensions of the armature conductor. If the wire is very broad, the poles must be cut so as to make the tangent line longer. The shape of the conductor, and its position relative to the armature core and the field magnets, have a greater bearing on the reduction of eddy currents than the shape of the field magnets. Rectangular wire, if wound flat on the core, presents the most favourable conditions for eddy currents, the reason being that electricity is generated in the edge of the wire that enters the field first, and closes its circuit through the part still to enter, as shown in Fig. 1. If the rectangular wire is wound edgeways on to the core, the eddy currents generated by the pole could only complete the circuit through the opposite side of the rectangle in opposition to the current generated by the core. What small amount of eddy current is generated in the top edge of the bar can be stopped by rounding this edge and shaping the poles as described. Round wire of any diameter is nearly proof against eddy currents if the machine be otherwise correctly proportioned. This latter point is necessary with all shapes of wire. It is probable that shaping the poles as shown in Fig. 2 would prevent eddy currents in the iron when toothed armature cores are used.

Yours, &c.,

J. D. F. ANDREWS.

THE THOMAS-GILCHRIST PROCESS.—The progress made in this process during the twelve months ending 31st October, 1887, is shown by the following: The total make of steel and ingot iron from phosphoric pig during this period amounts to 1,702,252 tons, being an increase over the make for the previous twelve months of about 388,621 tons. It will be noticed from the annexed table, that of this make no fewer than 1,222,732 tons were ingot iron containing under ·17 per cent. of carbon. The makes of the various countries for the twelve months ending 31st October, 1886, and 31st October, 1887, respectively, are as follow:—

	1886.		1887.	
	Total tons.	With carbon under ·17 %.	Total tons.	With carbon under ·17 %.
England	258,466	161,908	364,526	233,358
Germany, Luxemburg, and Austria	883,859	651,523	1,102,496	826,600
France	122,711	77,141	174,271	123,049
Belgium and other countries	48,595	36,712	60,959	39,716
Totals	1,313,631	927,284	1,702,252	1,222,732

WE have received a copy of the first number of "Examples of Antique Furniture," by W. S. Ogden, of Manchester. This work will be issued in twenty monthly parts, and each number will contain six plates illustrative of old English wood and metal work. Judging by the first number, we should think that the complete work will constitute an excellent hand book.

"A MODEL OF EXCELLENCE."—Our readers may be interested to learn that the model of the compound locomotive "Dreadnought," exhibited by Mr. F. W. Webb, locomotive superintendent of the London and North-Western Railway Company, at the late Manchester Exhibition, earned during its stay there the handsome sum of £127. 7s. 3d. This amount has been generously distributed by Mr. Webb amongst several hospitals and charitable institutions. From May to November the engine made 183,396 revolutions, equal to a linear distance of eighty-three miles. The earnings averaged £1. 10s. 8d. per mile, and, looking at this result, we may well advise our full-sized locomotives to *go* and do likewise.

STACKING COAL.—A very interesting paper on a new coal conveyer was read by Mr. James M. Dodge, at the recent meeting of the American Society of Mechanical Engineers. In the old system of stacking coal by hand the cost is about 1s. 3d. per ton, whilst the size of the stacks are necessarily limited. Mechanical stacking machines have been erected at the wharfs of the Philadelphia and Reading Railroad Company at Port Richmond, whereby the cost of stacking is reduced to a fraction of the amount given for hand labour, whilst the size of the stacks can be increased to as much as 20,000 tons. These mechanical stacking machines or conveyers consist of an endless chain about 150ft. long, and provided with scrapers 8in. by 20in. The chain is suspended in an inclined position by two sprocket wheels, one near the ground and below the dumping platform, where the coal is shot from the trucks, and the other attached to a pole which is steadied by guy ropes. The returning and upper part of the chain is supported by an idle pulley suspended from guys. The coal as it falls into the dump is pushed up by the scrapers, and thus forms a conical pile of about 75ft. in width at the base. In some cases the lower sprocket wheel is shifted from time to time, so as to extend the size of the pile laterally. When a pile is completed, the chain, the sprocket wheels, and guy ropes are removed to another place for the formation of a new pile, and the only portion of the plant left standing is the pole. A similar apparatus is used for re-loading the coal into cars after it has been stacked. A conveyer is used which is so constructed that it may be used sideways towards the base of the pile and kept running continuously, while it automatically attacks and conveys the coal towards the trestle from which it was originally dumped. At that spot there is a second conveyer which lifts the coal into a hopper, from which it is shot into the car. The re-loading conveyor is so constructed that it can be swung to the right or left so as to operate on either side.

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ELECTRICAL PROGRESS IN 1887.

The year that has just passed has not brought to light many startling novelties in the way of the application of electricity to industrial purposes, although considerable progress in matters of detail has been made. Generally speaking, the progress was comparable to that made in other branches of engineering; that is to say, known methods of utilising this particular force of nature have been extended, the size of machines and apparatus has been increased, constructive details have been improved, and a few new inventions have been made. The laws which govern the construction and working of dynamos are now so well and so generally understood, that it is possible to predict from an examination of the design of a dynamo what its capabilities will be when actually constructed, and the introduction of so-called new types is, therefore, not a matter involving any great risk of failure. The novelty in the type is, however, generally confined to the shape of the field magnets and the number and position of exciting coils. Engineers have gradually come to the conclusion that there is very little difference in the effectiveness of different arrangements, provided always that the cross section throughout the magnetic circuit be ample, and there be sufficient space on the magnet cores to wind the exciting coils on. Thus, whilst some of the earlier Gramme, Edison, Weston, and other machines had a large number of field magnet limbs, and a similar number of exciting coils, in later machines, such as the Siemens and Crompton, this number was reduced to four. The number was further reduced to three in direct driven dynamos with inverted poles, and then to two both for direct and belt driven dynamos, which appears to be the usual practice with most English makers. At the beginning of the year it was thought that with a two-coil magnet the greatest possible simplicity of construction had at last been reached. This was, however, not the case, and recently some firms, notably Messrs. Goolden & Co., and Mr. R. Kennedy, have produced machines with only one exciting coil on the field magnet. The new design is, however, hardly likely to come into general favour, because the total weight of the machine must be considerably greater than that of a two limbed single horseshoe machine, which is again greater than a two limbed or four limbed double horseshoe machine of equal output. The type of dynamo at present most in favour for ship lighting, and especially for Admiralty work, is the two limbed single horseshoe inverted pattern with drum armature, although some disc machines have also been installed. The size of dynamos required by the Admiralty during the past year was generally larger than in previous years. In all, thirty-eight sets have been required for war vessels, of which four were specified to have an output of 400 ampères, twelve were specified to give a maximum of 300 ampères, and the remaining 200 ampères, all at 80 volts pressure. The conditions under which firms were invited to tender for this Admiralty work were remarkable, and a proof that the construction of dynamos was regarded as an exact science. Not only was the speed strictly limited, as on previous occasions, but the weight of steam consumed per hour, per electrical horse power output, had to be stated by the contractor for each particular machine, and if exceeded on trial a fine was imposed. The Admiralty also stipulated that the temperature of any part of the machine should, after a prolonged run, not rise above a certain, and as most electricians thought, absurdly low limit. The fact that under such stringent conditions contractors cared to tender, and that the work was executed to the satisfaction of the Admiralty, is exceedingly creditable to our electrical engineers.

A large number of merchant vessels has been fitted with electric light plant, partly for internal lighting by glow lamps, and partly with arc lights to be used when coaling or taking in or discharging cargo at night. A few steamers have also been fitted with search lights, to facilitate canal navigation at night; but this use of electricity has not become so general as appeared probable at the beginning of the year, when night passages were permitted on the Suez Canal. Most ship lighting dynamos now are either direct driven or are connected with the engine by means of friction wheels, belt and rope gear being but seldom used. There has been no startling novelty in ship lighting plant, except perhaps Parsons' Turbo Electric Generator, which appears to find favour with shipowners and engineers in the North. This combined engine and dynamo, which was first shown at the Inventions Exhibition in London, in 1885, has since then been steadily improved by the inventor, and the splendid display and excellent performance of these machines at the Newcastle Exhibition last summer must have convinced visitors that what some years ago had seemed little better than a clever scientific toy had now been developed into a practical machine, capable of doing as hard work as any other modern dynamo, and with fair economy. The generators exhibited at Newcastle consumed only about 60lb. of steam per electrical horse power output per hour, but in the latest compound generators this consumption has been yet materially reduced. Briefly described, the generator consists of a double set of parallel-flow turbines, the steam entering in the middle and exhausting at both ends. To provide for the expansion of the steam whilst doing work, the angle between the blades (both in the barrel, which in an ordinary turbine corresponds to the wheel, and in the casing which similarly corresponds to the guide) and the plane of rotation becomes greater towards the ends; but as it was found that this device by itself was not sufficient to allow full scope to the expanding power of high pressure steam, two larger barrels were added at the ends of the original barrel, and by thus compounding the engine a greater range of expansion was obtained. Recently, Mr. Parsons has added a third pair of barrels, giving his generator a triple expansion. At the very high speed of from 8000 to 10,000 revolutions per minute, the change in the magnetisation of every particle of iron in the armature core takes place very much more rapidly than in ordinary dynamos, and it is for this reason that the usual rules of construction had to be somewhat modified in this case. At ordinary speeds, the more intensely the core can be magnetised the better, and most recent improvements have for their object to increase the strength of the field. With the turbo generator, a very strong field would, however, be objectionable, as tending to heat the iron core of the dynamo by hysteresis or molecular friction, and it is for this reason that Mr. Parsons employs very small field magnets of cast iron, and feebly excited. Owing, however, to the high speed, the output of his machines is nevertheless very much greater than that of ordinary dynamos having the same weight. The small weight and high efficiency of the Parsons dynamo, as well as its perfect automatic lubrication and its freedom from vibration, should make this type of machine particularly suitable for continuous current transformers.

As regards this class of apparatus, a great deal has been written during the year, but very little has been accomplished, and the transformer shown by Messrs. Paris and Scott, at the close of the Newcastle Exhibition, is almost the only machine which has as yet come before the public in this country. In Austria, Messrs. Jehl & Rupp seem to have worked in this field, but with what practical success we are unable to say. It is true that one of our contemporaries has from time to time published accounts of some wonderful machines invented by these gentlemen; but whether these existed on paper only, or were in actual practical use, has never been distinctly stated, and until that point is cleared up we incline to the belief that the Jehl & Rupp systems are merely projects, or at best experiments on a small scale. In this connection it is necessary to mention the work done by Mr. Edison, who already in 1881 began to take out patents for transformers or motor generators. His earlier machines consisted merely of a series of stationary induction coils connected with two commutators, which were revolved by a small electromotor; but in later designs he mounted the coils upon a continuous ring-shaped core and revolved this with its two commutators, suitable brushes making connection with the primary and secondary circuits. Later still he surrounded the induction ring with a stationary soft iron shield, and according to an American electrical paper he seems at present to be engaged in putting down a station at Llewellyn Park, near New York, for lighting his own and some neighbouring residences by means of continuous current transformers.

In central station work very little progress was made during the past year in England; but in America, and on the Continent, electric lighting from central stations has developed with marvellous rapidity. The Thomson-Houston Company, of Lynn, Massachusetts, have, during the year, practically doubled the capacity of their works, in order to satify the enormous demand for electric lighting plant for all parts of the country. The Westinghouse Company, who have adopted the alternate current system, have likewise been very busy with the erection of central stations; and as regards other companies, such as the Edison, the Western, the United States Electric Lighting Company, and others, they have all been actively engaged on central station work, and hardly a week has passed without news reaching us of new stations being started in American towns. On the Continent, the stations at Rome, Milan, Lucerne, and Berlin have been enlarged, and many of the provincial towns in Germany have started new stations. Compared with these achievements, our own central station work appears quite insignificant. The most important, perhaps, is that at the Grosvenor Gallery, in Bond-street, London, which has, during the year, considerably increased its area of supply. The small central station at Kensington Court, which was started in the beginning of the year, and which we described in our issue of the 18th February, has been successfully running ever since, and towards the end of the year a central station at Leamington was also successfully started. The Eastbourne installation was extended by the addition of a very fine compound engine and new dynamos, whilst the Brighton installation has also been increased. Originally only Brush dynamos, and Brush arc lamps, with here and there a group of incandescent lamps, were in use at the latter installation. Lately, however, a large alternate current machine has been erected for incandescent lighting in various parts of the town.

Some progress has also been made in alternate current machines and transformers, although the inventors and manufacturers have for obvious reasons preferred to keep back information in reference to these matters. Until about a year ago, the only alternate current machines available were those of Siemens, Ferranti, Elwell-Parker, and Gordon, though the latter was, properly speaking, not in the market, being only built for the immediate requirements of the company owning the patents. Within the year, however, several alternate current machines have been invented and successfully tried; and it is highly probable that the near future will see a considerable development in this branch of electrical engineering. The same is the case with transformers. At present, that of Mr. Ferranti is very extensively used, but Messrs. Lowrie & Hall have come into the field with a very neat design which is doing good work at Eastbourne, and Messrs. Gaulard & Gibbs are also bringing out a new type, resembling the Zipernowsky transformer in the relative position of the winding and core, though with this difference, that the latter, instead of consisting of iron wire, is formed of rectangular iron stampings.

In the application of electricity to motive power purposes, English engineers have not been left behind their American and Continental colleagues to the same extent as is unfortunately the case with central station lighting. Some good work has been done in electric transmission of energy and electric propulsion. Messrs. Immisch & Co., who make a specialty of electromotors, have put up several plants at mines for transmitting power from the surface to the workings, for pumping and other purposes, and have also sent transmission plant to several places in the Colonies. In connection with the Electric Traction Syndicate, they have equipped some tram cars with the necessary electrical apparatus, and the trials, which we described in detail in our issue of 29th July, proved very successful. Very good work was also done during the year by the Elieson Company, on the North Metropolitan Tramway, and the fact that notwithstanding the heavy and somewhat cumbersome machinery employed in this special "system" electric traction has proved perfectly reliable and successful, speaks well for the latent capabilities of propulsion by storage batteries. The actual cost per car mile has not been published. Mr. Elieson's original estimate was 4½d., though this has probably been exceeded. But even if the cost should amount to as much as 5½d., or even 6d. per car mile, tramway companies would find electric traction more economical than horse traction. It is easy enough to compete against animal power; but is there any chance of electricity being able to compete against steam power? According to Lord Bury, the answer must be in the affirmative, for he told the Institution of Civil Engineers, during the discussion on Dr. E. Hopkinson's paper on the Newry and Bessbrook electric tramway, that his syndicate is about to run electrically propelled trains on the Metropolitan Railway. In America, electric railways and tramways have during the year been also largely developed. As yet, most of the lines are worked on the direct supply system; but storage cars are now beginning to come into favour, and both Julien and Reckenzaun cars have been introduced. The latter are being built by Messrs. Wharton & Co., of Philadelphia, and about six hundred of these cars are now on order for different American tramway companies. The plant for transmitting power from Kriegstetten to Solothurn, in Switzerland, which was erected by the Oerlikon engineering works in the beginning of the year, has since then worked without a hitch, and recent trials, which we published in our issue of the 6th inst., made by a committee of scientific men, have shown that about 75 per cent. of the power at the generating station is actually available at the motor station, the distance over which the transmission takes place being close upon five miles. The very neat and ingenious application of electricity for operating portable machine tools, which was devised by Mr. F. J. Rowan, and greatly perfected during the year, deserves special mention. These tools are specially intended for the drilling, riveting, and caulking which must be done *in situ* on vessels under construction, and for which hand labour only has hitherto been available. A full description of these tools will be found in our issue of the 5th of last August.

In electrical measuring instruments the past year has brought but few novelties, although the want of good, cheap, and reliable instruments is fully recognised. Some years ago Sir W. Thompson, when lecturing at the Institution of Civil Engineers on absolute measurements, remarked that it is easier to ascertain the exact resistance of a wire than to ascertain its exact length, the object of the remark being to show of what a high degree of accuracy electric measurements are capable. It is no

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COMPOUND STEAM TURBINES.

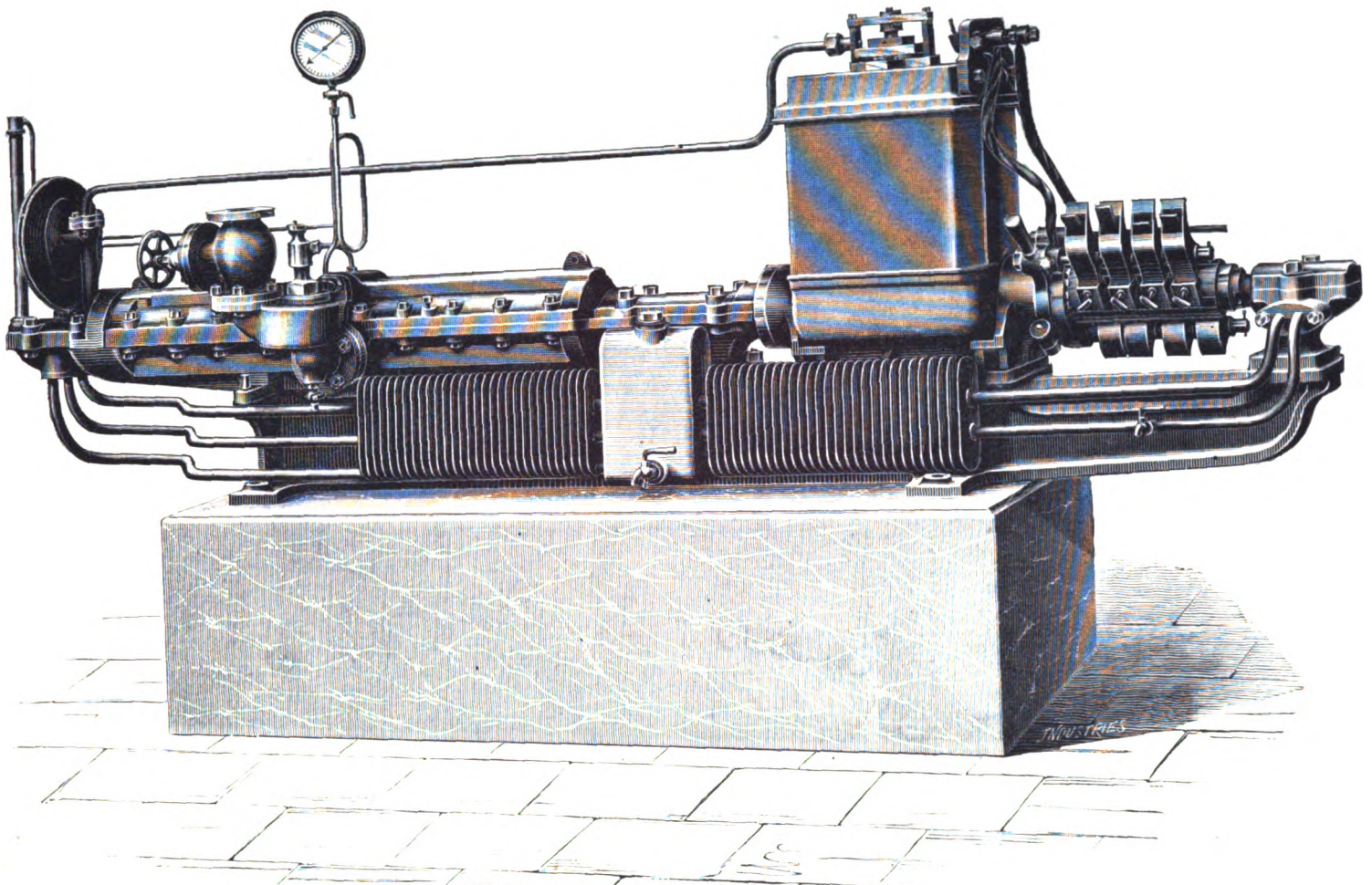


Fig. 1.

doubt quite easy to measure electric quantities with very high accuracy when the operation is carried out in the laboratory, and by the aid of very perfect instruments; but for ordinary commercial measurements of electric quantities, the apparatus generally supplied is not by any means of a very high degree of accuracy, whilst the circumstances under which the measurements must be made are generally speaking inimical to very exact work. Notwithstanding the large number of electric measuring instruments introduced within the last few years, there is as yet not one commercial instrument in the market which can be absolutely relied upon under all conditions. In making this statement we do not wish to imply that if proper care is taken, and the previous history of the instrument is accurately known, its indications cannot be relied upon; but it is seldom possible to take sufficient care of instruments, and generally quite impossible to determine by mere inspection whether the instrument has been damaged at some previous time. With an ordinary 2ft. rule we can be absolutely certain from mere inspection that it has not received an injury affecting its accuracy. With the ordinary scale and weights this is also generally possible; but when we come to electrical measuring instruments it is quite impossible, without very careful and detailed examination, to ascertain whether the instrument is in a trustworthy condition; and although Sir William Thomson's statement that a resistance can be measured with greater accuracy than a length is theoretically true, practically the reverse is the case, simple mechanical measurements of lengths and weights being possible with far greater certainty and accuracy than electrical measurements of potential and current.

The principal aim of all the more recent inventors or designers of electrical measuring instruments has been to produce types in which the possibility of accidental injury or loss of calibration is reduced to a minimum. The original form of ammeters or voltmeters where permanent magnets were used has been superseded by improved designs containing either electromagnets or weights or springs as a counteracting force, and a new class of instruments depending upon the heating effect of an electric current in a fine wire has also largely come into use.

Towards the end of the year Dr. Fleming brought out a new spring balanced voltmeter and ammeter, whilst Professors Ayrton and Perry introduced a very ingenious modification of the Cardew voltmeter, whereby the size of this instrument has been considerably reduced, and at the same time it has been made available for reading small potential differences. As regards integrating meters, Dr. Aron has further improved his clockmeter, making it self starting and self stopping, and also introducing a modification whereby it becomes applicable to the three-wire system; Messrs. Chamberlain & Hookham have brought out a new meter, which is in use at the Leamington installation, and Professor Forbes has devised the very beautiful meter depending on its action upon the movement of a column of air heated by a coil through which the current passes. Up to the present this is the only meter which gives absolutely the same reading whether the current be continuous or alternating.

COMPOUND STEAM TURBINES.*

We shall begin by describing water turbines and some of their performances, together with the necessary conditions for economy in motors of this class. We shall then describe the compound steam turbine, and draw a parallel between it and the water turbine, showing by the help of the latter that the conditions for high economy are fulfilled in the compound steam turbine. We shall then give figures to show what the theoretical economy of the compound steam turbine should be, and then deal with the dynamo and its combination with the steam turbine. Water turbines have been for many years in extensive use in Europe and America, and have, after many experiments, been brought to a very high degree of perfection, as is shown by the numerous tests that have been made to ascertain their actual efficiency. Perhaps the most carefully arranged and the most exhaustive of these experiments are those made by Mr. James B. Francis on the Tremont turbine at Lowell, Massachusetts. The result showed that the horse power indicated on the dynamometer attached to the shaft amounted in some cases to 79·3 per cent. of the total power of the water, whilst those made on another turbine of still more improved design gave an efficiency of 88 per cent. The theory of the turbine has been thoroughly dealt with and understood, and theoretical reasoning leads also to the conclusion that such a high efficiency in a turbine is quite possible provided that certain rules are adhered to in the design, and provided also that certain essential conditions as to the flow of water are provided for. All water turbines consist essentially of a set of fixed vanes, called guide blades, and a set of moving vanes called the wheel; the former guide the water towards the direction of motion of the latter. The important conditions for economical working being that the shape of the blades and the velocity of the wheel shall be so arranged that there shall be no shock or sudden change of the velocity of the water in passing from the guide blades to the moving blades, and also that as the velocity or energy of the water on leaving the wheel is lost it shall be reduced to the utmost extent by the formation of the blades. This leads us to inquire what has been found to be the best velocity of wheel to meet these conditions. In Mr. J. B. Francis' experiments, page 33, we find—

Experiment.	Per cent. of Velocity of wheel, of Velocity due to head.	Efficiency.
42	30	67
41	39	72
36	50	78
30	63	79·3

We have here then the speed which gives the maximum efficiency, and a measure of the diminution of efficiency corresponding to a reduced speed. The essential conditions for high efficiency are, as we have said, absence of shock and low residual velocity. These conditions, in the case of the water turbine, can be better obtained in the types called the outward or inward flow than in the parallel flow, for the large volume of water to be dealt with necessitates long blades of double curvature for the last mentioned type; these are objectionable, while it is more difficult to minimise the residual velocity of the water leaving the wheel. Principally these reasons have led to the more general adoption of the outward or inward flow types than of the parallel flow. After careful consideration, however, the parallel flow type seemed more suitable to the compound steam turbine, and has been accordingly adopted. Fig. 5 shows the arrangement of ninety complete turbines, forty-five lying on each side of the central steam inlet. The guide blades R are cut on the internal periphery of brass rings, which are afterwards cut in halves and held in the top and bottom halves of the cylinder by feathers; the moving blades S are cut on the periphery of brass rings, which are afterwards threaded and feathered on to the steel shaft, and retained there by the end rings, which form nuts screwed on to the spindle. The whole of this spindle with its rings rotate together in bearings, shown in enlarged section, Fig. 2. Steam entering at the pipe O flows all round the spindle and passes along right and left, first through the guide blades R, by which it is thrown on to the moving blades S, then back on to the next guide blades, and so on through the whole series on each hand, and escapes by the passages P at each end of the cylinder connected to the exhaust pipe at the back of cylinder. The bearings, Fig. 2, consist of a brass bush, on which is threaded an arrangement of washers, each successive washer alternately fitting to the bush and the block, while being

* A paper read before the North-East Coast Institution of Engineers and Shipbuilders by the Hon. C. A. Parsons.

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COMPOUND STEAM TURBINES.

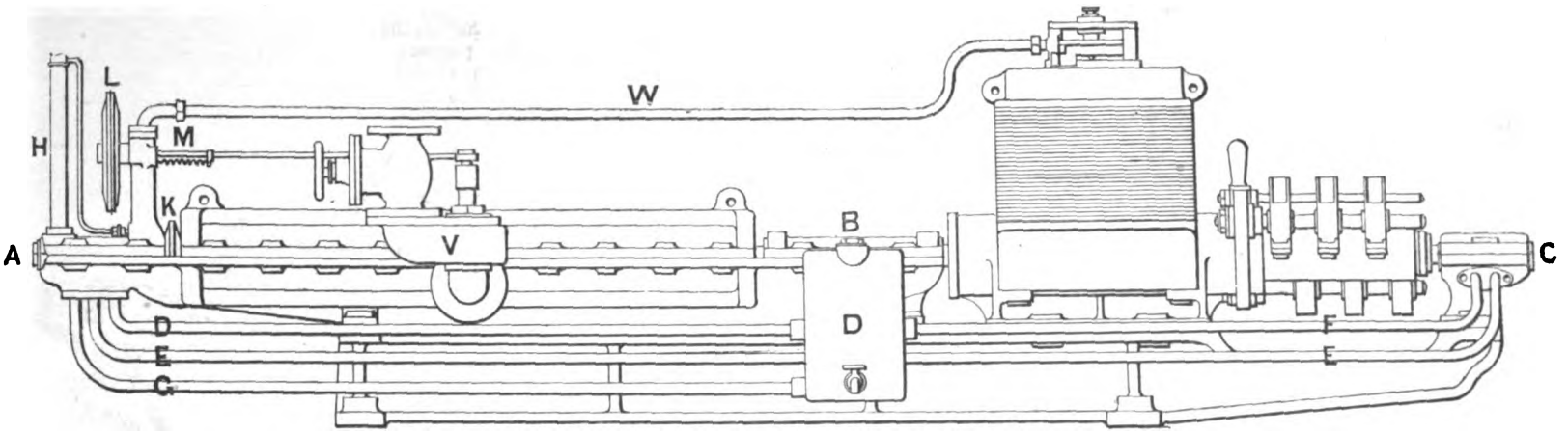


Fig. 1.

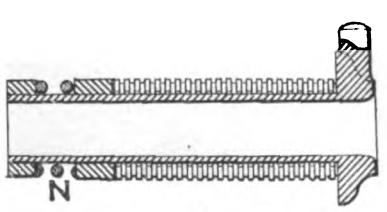
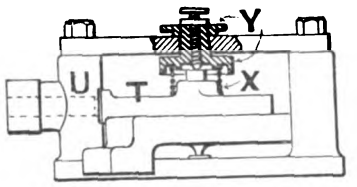


Fig. 2.



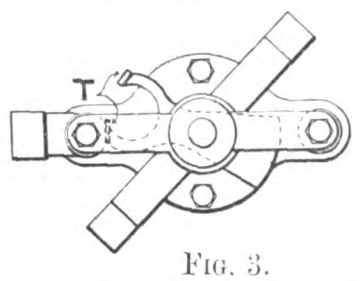


Fig. 3.

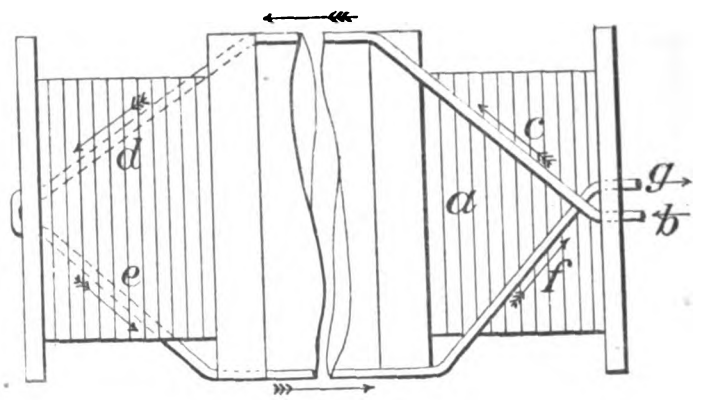


Fig. 4.

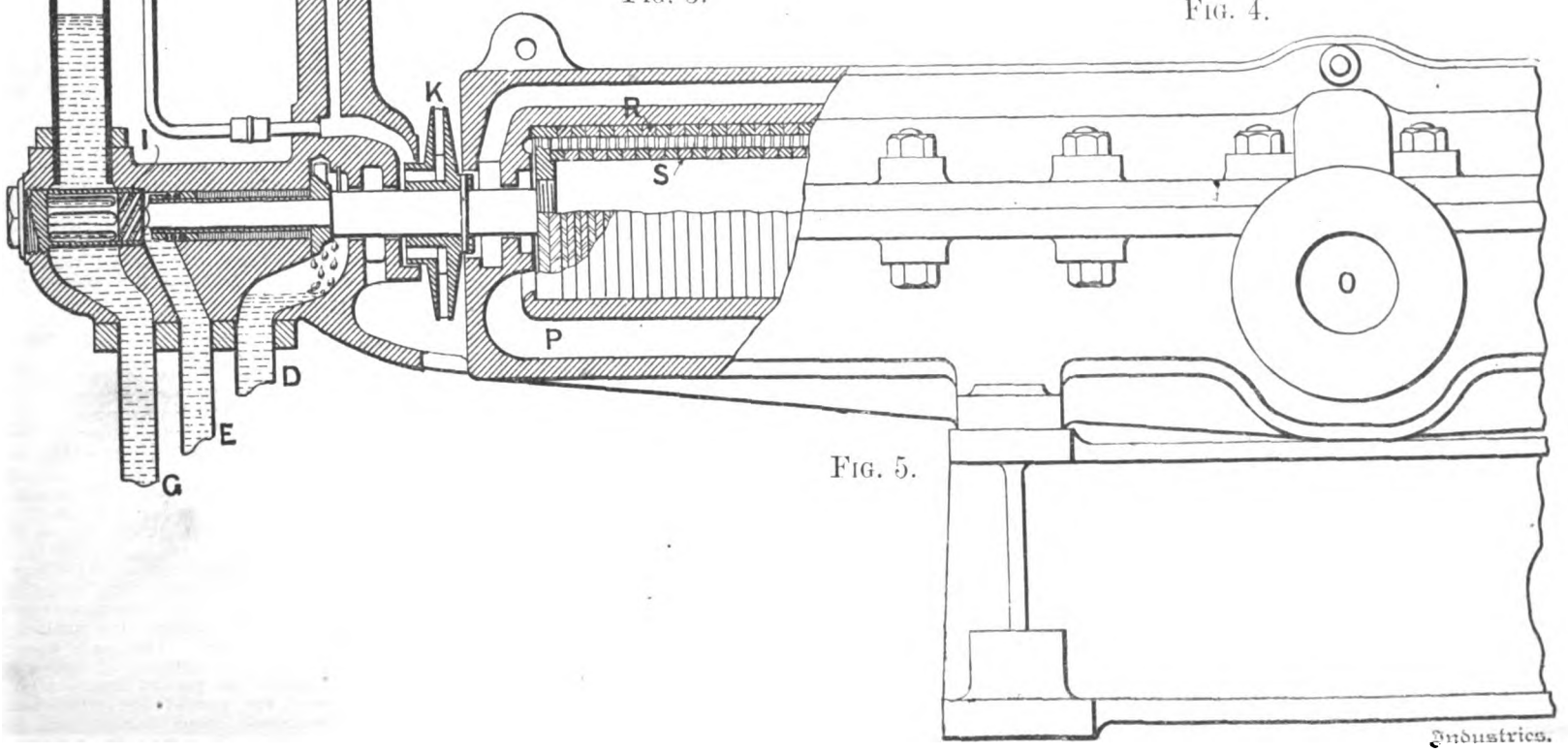


Fig. 5.

Industries.

alternately $\frac{1}{32}$nd smaller than the block outside, and $\frac{1}{32}$nd larger than the bush in the hole. One broad washer at the end holds the bearings central. These washers are pressed together by a spiral spring N and nut, and, by friction against each other, steady or damp any vibration in the spindle that may be set up by want of balance or other causes at the high rate of speed that is necessary for economical working. The bearings are oiled by a small screw propeller I attached to the shaft. The oil in the drain pipes D and F, and the oil tank D, lies at a lower level than the screw; but the suction of the fan K raises it up into the stand pipe H over and around the screw, which grips it, and circulates it along the pipes to the bearings. The course of the oil is as follows: The oil is forced by the propeller I and oils the bearing A (Fig. 1), the greater part passes along the pipe E to the end bearing C, some after oiling the bearing C drains back by the pipe F to the reservoir D, the remaining oil passes along through the armature spindle, oils the bearings B, and drains into the reservoir D, from which the oil is again drawn along the pipe G into the stand pipe H by the suction of the fan K. The suction of the fan is also communicated to the diaphragm L, and forms, with it and the spring M, the principal part of the governor which actuates the throttle valve V. Fig. 3 is the electrical control governor, which will be further described in connection with the dynamo. It acts directly upon the controlling diaphragm L by admitting or exhausting a quantity of air, and thus exercises a controlling influence upon it. For small differences of pressure the velocity of air or steam passing through orifices or short tubes is given by the same formula as that for water. The heads of pressure have to be calculated in each case in terms of the respective fluids, and for small differences of pressure the velocity of efflux is the same for the same head in all cases. This has been recognised as a fundamental principle; it has also been verified in some of the cases we are going to consider by actual measurements. We now proceed to consider the action and condition of the steam as it passes through the successive turbines; but, before doing so, it will be necessary to go into some calculation in order to form a correct basis to start from. The velocity of efflux of steam flowing from a vessel at 15·6lb. per square inch absolute pressure through an orifice into one at 15lb. absolute pressure is 366ft. per second, the drop of pressure of ·6lb. corresponding to a diminution of volume of 4 per cent. in the opposite direction. We must now suppose that the turbines are so proportioned and the blades so diminished in size that each one nearer the steam inlet O has 4 per cent. less blade area or capacity than the preceding one all the way from each of the exhaust ends up to the centre. If we work this out we find that after forty-five turbines the pressure will be about 69lb. above

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the pressure at the inlet. The steam will have followed some curve of temperature and volume very near the adiabatic; but on the isothermal side of it, the velocity of flow will be slightly greater near the inlet, in consequence of the increased temperature. The steam enters from the steam pipe at 69lb. pressure, it passes through the first turbine, consisting of a ring of guide blades and then a ring of moving blades, and falls 2·65lb. in pressure; the velocity due to this fall in pressure is 386ft. per second, its volume increases by 3·85 per cent. of its original volume, it passes the second turbine, falls 2·55lb., and again increases its volume in the same ratio, and so on till it reaches the last turbine, where its pressure is 15·6lb. before entering and 15·0lb. on leaving it to flow into the exhaust pipe. The velocity due to the last drop is 366ft. per second. The steam has, therefore, nearly the same velocity of flow for all the turbines; in other words, the error in assuming the velocity due to the head to be 376ft. per second throughout does not exceed 3 per cent. The velocity of the wheels at 9200 revolutions per minute is 150ft. per second, or 39·9 per cent., of the mean velocity due to the head throughout the turbines. On comparing this ratio of velocity of wheel to velocity of flow with that of the Tremont water turbine, we find a corresponding efficiency of a little over 72 per cent. Hence in the compound turbine we are describing, the velocity of the blades is sufficient to secure a very high return of useful effect. We may therefore assume that if the blades be equally well shaped in the steam turbine as in the water turbine, and that the clearances be kept small and the steam be dry, then each turbine of the set will give an efficiency of at least 72·5 per cent. We say at least, because as each turbine discharges without check into the next, the residual energy after leaving the moving blades is not lost, as it is in the case of the water turbine we are considering (it amounts to from 3 to 5 per cent. of the energy), but continues into the next guide blades, and is wholly utilised there in assisting the flow. This unchecked flow from one turbine to another is a great advantage of the parallel flow type over other types where a number of turbines are compounded. It also minimises the skin friction, as nearly the whole of the moving part is covered with blades, and there is consequently no appreciable loss due to this cause. As each turbine of the set gives 72·5 per cent. efficiency, it follows that as the steam at all points expands gradually without shock, that the motor as a whole will give an efficiency of at least 72 per cent. of the total mechanical energy of the steam, or, in other words, over 72 per cent. of the power derived from using the steam in a perfect engine, without losses due to condensation, clearances, or friction, and such like. A perfect engine working with 90lb. boiler pressure, and exhausting into the atmosphere, would consume 20·5lb. of steam per hour for each horse power; a motor giving 70 per cent. efficiency would therefore require 29·29lb. of steam per horse power per hour. We have now gone sufficiently into the question to show clearly that in the compound steam turbine we have a motor whose theoretical efficiency is very high indeed. The fact that at each turbine of the set the temperature is constant, enables us to predict that there can only be a very minute loss arising from condensation. This has been conclusively verified by experiments with superheated steam, coupled also with the fact that "for small differences of pressure gases and vapours act like liquids in flowing through orifices and tubes, in virtue of the small differences of pressure, and that the velocity of flow is regulated by the fundamental formula $v=8\sqrt{h}$." These three facts draw the analogy between the water turbine and the compound steam turbine for efficient working as close as it is possible to draw anything, and it does not seem too much to expect, in the larger sizes at any rate, an equally good efficiency.

The dynamo which forms the other portion of the electric generator, Fig. 1, is coupled to the motor spindle by a square tube coupling fitted on to the square spindle ends. The armature is of the drum type, the body is built up of thin iron discs threaded on to the spindle and insulated from each other by tracing paper. This iron body is turned up, and grooves milled out to receive the conducting wires. For pressures of 60 to 80 volts, there are fifteen convolutions of wire, or thirty grooves. The wire starting at *b*, Fig. 4, is led a quarter of a turn spirally *c* round the cylindrical portion *a*, then passing along a groove longitudinally is again led a quarter turn spirally *d* round the cylindrical portion *a*, then through the end washer and back similarly a quarter turn *e*, then led along the diametrically opposite groove, and lastly, a little over a quarter turn *f*, back to *g*, where it is coupled to the next convolution. The commutator is formed of rings of sections; each section is formed of short lengths; each length is dovetailed and interlocked between conical steel rings; the whole is insulated with asbestos, and when screwed up by the end nut forms with the steel bush a compact whole. There are fifteen sections in the commutator, and each coupling is connected to a section. The whole armature is bound externally from end to end with brass or pianoforte steel wire. The magnets are of soft cast iron and of the horseshoe type; they are shunt wound only. On the top of the magnet yoke is the electrical control governor, Fig. 3. It consists of one moving spindle, on which are keyed a small soft iron bar, and also a double finger T. There is also a spiral spring X attached at one end to the spindle, and at the other to an adjustable top head and clamping nut Y. The double finger T covers or opens a small hole in the face U, communicating by the pipe W with the diaphragm L. The action of the magnet yoke is to attract the needle towards the poles of the magnet, while by turning the head the spiral spring X is brought into tension to resist and balance this force, and can be set and adjusted to any degree of tension. The double finger T turns with the needle, and by more or less covering the small air inlet hole U, it regulates the access of air to the regulating diaphragm L. The second finger is for safety in case the brushes get thrown off, or the magnet circuit be broken, in which case the machine would otherwise gain a considerable increase of speed before the diaphragm would act. In these cases, however, the needle ceases to be attracted, falls back, and the safety finger closes the air inlet hole. There is no resistance to the free movement of this regulator. A fraction of a volt increase or decrease of potential produces a considerable movement of the finger, sufficient to govern the steam pressure, and in ordinary work it is found possible to maintain the potential within one volt of the standard at all loads within the capacity of the machine, excepting only a slight momentary variation when a large portion of the load is switched on or off.

The resistance of the armature from brush to brush is only ·0032 ohm, the resistance of the field magnets is 17·7 ohms, while the normal output of the dynamo is 200 ampères at 80 volts. This, excluding other losses, gives an efficiency of 97 per cent. The other losses are due to eddy currents throughout the armature, magnetic retardation, and bearing friction. They have been carefully measured. By separately exciting the field magnets from another dynamo, and observing the increased steam pressure required to maintain the speed constant, the corresponding power was afterwards calculated in watts. The commercial efficiency of this dynamo, after allowing for all losses, is a little over 90 per cent. In the larger sizes it rises to 94 per cent. Assuming the compound steam turbine to give a return of 70 per cent. of the total mechanical energy of the steam, and the dynamos to convert 90 per cent. of this into electrical output, gives a resulting efficiency of 63 per cent. As steam at 90lb. pressure above the atmosphere will, with a perfect non-condensing engine, give a horse power for every 20·5lb. of steam consumed per hour, it follows that an electrical generator of 63 per cent. efficiency will consume 32·5lb. of steam for every electrical horse power per hour. Again, with steam at 150lb. pressure above the atmosphere, a generator of the same efficiency would consume only 22·2lb. of steam per electrical horse power per hour.

The results we have so far actually obtained are a consumption of 52lb. per hour of steam for each electrical horse power with a steam pressure of 90lb. above the atmosphere. We, however, expect shortly to obtain results more nearly coinciding with those very high economies that theory has led us to believe possible with this system. In the larger sizes, so far as we have yet gone, we have invariably found increased economy, as in them the clearances are proportionately less, and it is easier to arrange the distribution of steam. Exceptionally low steam consumption is not the only essential attribute of an electric generator—there are other considerations, in most cases of more importance; these are steadiness of the current produced, freedom from accident, and simplicity, small first cost and cost of maintenance, little attention required, smallness of size and weight for a given output, and an almost insignificant consumption of oil.

To illustrate this, we will take the installation at the Phœnix Mills, Newcastle-on-Tyne, which has been running on the average of eleven hours daily for the last two years. Out of the original 159 Edison-Swan 16 c.p. lamps, sixty-five are still in good condition, having run 6500 hours at about standard brightness. Now, if the lamps had only lasted 1000 hours on the average, the cost of lamps renewed would have amounted to about double the year's cost of fuel as at present consumed.

At the Newcastle-on-Tyne Industrial Exhibition thirteen of these turbo-electric generators lighted the whole of the courts, giving a total of about 280 electrical h.p. During the whole run of the Exhibition the only noticeable accident which occurred to the installation was due to the blowing out of the packing in a branch steam pipe connecting another engine to the main steam pipe supplying the generators; but as there was no stop valve in this branch pipe the engineer in charge deemed it prudent to shut off steam at the boilers, thus stopping all the generators lighting the four courts for about three-quarters of an hour. This, however, was an accident quite external to the generator, and, as it happened, external to the main steam pipe supplying them. We believe that it was only on three occasions during the run of the Exhibition that a small group of lamps were extinguished for the few seconds necessary to enable a spare generator to be started and switched on to them. The seventeen generators were in two groups; had they been placed in one group the results showed that on all occasions one spare generator would have been sufficient to keep every lamp alight.

In regard to simplicity and cost of maintenance, we may say that in a 30 h.p. generator there is no part that three men cannot lift, and that every part is immediately accessible. After two years' working, of ten hours daily, we have found the wear very small indeed, in some cases almost inappreciable, the blades or vanes show no signs whatever of any cutting action of the steam. The commutators in the larger generators have generally withstood this amount of wear, while in some cases where they have been carefully attended they have suffered very little wear indeed. We have at the present time some important experiments being carried out in regard to the generators. It would, however, now be premature to foreshadow the probable results of these trials. We may, however, say that they lead us to conclude that, more especially in the larger sizes, a great increase in economy will be obtained, amounting to a reduction of from 20 to 25 per cent. of the steam consumption quoted in the paper. We may also add that we have now supplied generators giving a total output of 1280 electrical horse power—about two-thirds for ships, and one-third for land installation.

THE PHŒNIX FIRE OFFICE RULES FOR ELECTRIC LIGHT AND POWER INSTALLATIONS.—The eleventh edition of these rules has just been published, and contains some additions to the previous issues. Mr. Musgrave Heaphy, the able compiler of these rules, has on this, as on previous occasions, endeavoured to meet the just claims of electric light contractors, so far as this could be done without prejudice to the office which he represents, and to the many other fire offices which have adopted these rules. The additions chiefly refer to the introduction of alternating current systems, and we might specially mention one rule referring to the construction of transformers, in which Mr. Heaphy says that transformers should preferably be so made that a leak between the primary and secondary coils becomes impossible, or if this is not done an automatic arrangement should be added which will cut the current off if the difference of potential between the secondary circuit and the earth rises to 400 volts. Amongst the general rules referring to conductors, we would draw attention to No. 6, as this concerns a point which is often overlooked by electric light contractors. Under this rule conductors are not allowed to pass through party walls separating two risks unless with special permission from the Fire Office, and in that case provision must be made so that the conductors cannot become a means of communicating fire from one risk to the other.

CHEMICAL PROGRESS IN 1887.

A SUMMARY of the progress made in the chemical manufactures during the past year should include a consideration of those new discoveries in chemistry which may in the future be made the basis of manufacturing processes. It is not, however, an easy matter to select from the many new discoveries published from time to time in scientific journals, those which are certain to have industrial applications, since many processes which work well on a small scale are found to yield unsatisfactory results when tried on a larger basis. The distribution and economic erection of plant and the utilisation of waste products are matters which it is often difficult to regulate in a manner capable of rendering the process a remunerative one, even when the chemistry of the change has been clearly demonstrated in the laboratory. In the limited space at our disposal it is impossible to refer to the progress made in all of the various branches of the chemical industries. We cannot do more in the present article than briefly indicate the direction in which improvements are being made. The augmentation in production in nearly all the branches of chemical manufacture which was noticed in the year 1886 has been maintained, and in most cases a further development of trade has taken place. Increase in the supply has, however, been accompanied by a fall in prices in many chemicals, but the recent reaction in the metal market has to a considerable extent cancelled this diminution in price. The manufacturers of several articles in this country, and more especially in Germany, have by means of conventions succeeded in many cases in causing a marked improvement in prices, and considerable profits have been made in new articles for sanitary, pharmaceutical, and photographic purposes. The statistics for the current year are not yet completed, but we do not anticipate an unfavourable return. During the first six months of the present year our imports of chemicals, dyestuffs, and tanning substances show a slight falling off, while the exports for the same period were nearly the same in value as those of the corresponding period of last year. New drugs and Peruvian bark also showed a slight decrease, but the increase in price of quinine during the last few months, and recent improvement in the prices of pharmaceutical preparations, will probably alter this decrease. The Blue Book which was issued in October on our trade with the Colonies and foreign countries has shown that there was a diminution upon the figures of the previous four years both in imports and exports, with the exception of our export of chemical products and preparations, which showed a considerable improvement; and we expect that the returns for this year will show that this increase has extended to several other branches of chemical industry. Several important modifications in the different processes connected with the alkali trade in this country and abroad have been carried out during the past year. The yield of alkali by the Leblanc process has still further diminished, while there is a slight increase in the amount produced by the various ammonia-soda processes. In Germany the consumption of sodium carbonate has been gradually increasing, the increase being supplied by alkali produced by the newer process where 75 per cent., as compared with 22 per cent. in this country, of the total alkali is made on the ammonia-soda method. Germany is now competing with us in exporting alkali, but it is doubtful whether this competition will be a lasting one, owing to the geographical position of Great Britain and the cheapness of the raw materials in this country. The low price of alkali has caused the discontinuation of certain processes using hydrochloric acid, and several methods have been devised for replacing the Schaffner or Mond sulphur recovery process by one in which hydrochloric acid is not employed. Miller and Opl's method of converting vat waste into calcium sulphhydrate, and subsequently decomposing this by steam into sulphuretted hydrogen and lime, is now being tried abroad, and, if successful, the Leblanc soda process may have a little longer prolongation of its life. The production of a crystallised sulphide $Na_2S(6H_2O)$ by Schaffner and Helbig's process, Pechiney's method for the manufacture of sodium chlorate (and derivatives), and Mond's methods for obtaining ammonia, hydrochloric acid, and chlorine by means of nickel oxide, must not be omitted. Among the researches, which have been in progress for some time, with a view of obtaining chlorine and bleaching powder from calcium chloride residues, should be mentioned Solvay's process for decomposing it with silica at a high temperature, and Lake's recent American patents in the same direction, in which bricks are made from clay or silica and calcium chloride waste, which are subsequently decomposed at a high temperature by gases containing steam; caustic soda and the carbonates of the alkaline metals can also be made in the same manner if salt be added in the preparation of the bricks. With finely divided silica and salt, a mass suitable for the manufacture of glass, or, by melting with more soda, a soluble glass, is produced. Several substitutes for bleaching

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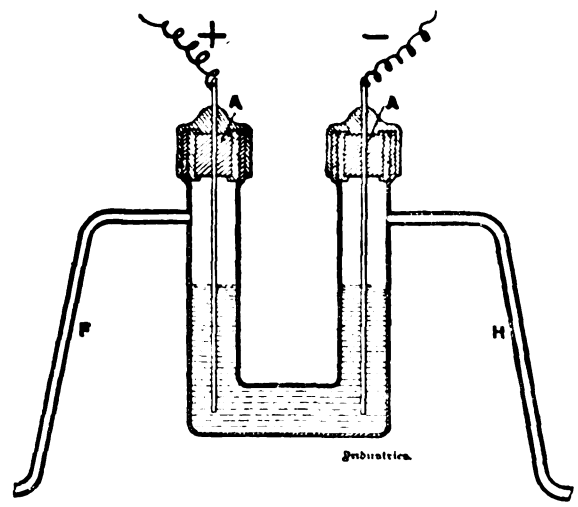
powder have been introduced, and in Hermite's method for the preparation of bleaching solutions by electrolysis, we have a fresh competitor in this field of industry. Brin has recently patented a bleaching liquid, which consists of an aqueous solution of hydrochloric acid saturated with oxygen under pressure. With oxygen prepared by his new continuous process from baryta, this bleaching liquid can be produced at a price which should affect the price of the commoner bleaching substances. It requires no acid, and may be used in a similar manner to hydrogen peroxide. Several bleaching solutions containing chlorine compounds of aluminium have also been introduced during the last year. In the Stassfurt salt industry the production of carnallite has increased during the present year, and the output in other potassium salts, *e.g.* kainite, is also good; the extended use of these salts as artificial manures in this country and America having given an impulse to this branch of industry. Fischer has also described a method for working up Stassfurt potash salt liquors containing large amounts of common salt, such as those obtained in the manufacture of saltpetre, by which the potassium chloride is recovered, partly in the form of artificial carnallite, and partly as pure crystals free from sulphate. The extended use of Thomas slag as a commercial fertiliser has caused considerable depression in the artificial manure and superphosphate industries. Thomas slag appears to be of great value on sandy, peaty, and loamy soils, and from results obtained by its use, considerable economy is effected. The marked increase in the output of basic steel in England during the past year from 146,000 tons in 1886 shows that the supply of slag for fertilising purposes is not likely to be less than the demand, and we may expect that manufacturers will be able to sell at still more reduced rates. The slag has during the last year been used for the preparation of a hydraulic mortar with considerable success.

In metallurgy, especially in the electro separation of metals from the ores, and the application of chlorine and bromine to the disintegration of metallic compounds, considerable progress has been made, and among purely chemical processes, Castner's method for the preparation of the alkaline metals deserves mention. Metallic sodium can now be prepared at a much cheaper rate, rendering it available in many directions, and will considerably reduce the price of aluminium, and render it of more general application in the arts. Parkes' new process for smelting refractory ores with special fluxes and subsequent disintegration by water instead of by a mechanical operation, is stated to give a better yield than any of the older methods for recovering gold and silver from their ores. In mineral colours we may notice the depression in the manufacture of ultramarine, the extended use of zinc white (oxysulphide of zinc), and the mixture of zinc oxide and lead sulphate, known as non-poisonous white lead, as substitutes for white lead and chromate of lead (vermillionette) in the place of vermillion. Several improvements in the manufacture of white lead have to be recorded in this country and in Germany. Condy's method for preparing white lead rapidly by precipitation, and Löwe's German patent for obtaining the same by the addition of a solution of basic acetate of lead to precipitated lead carbonate, enable the manufacturer to turn over his capital more frequently than by the older Dutch process. Lyte prepares a basic lead acetate by pouring a solution of the neutral acetate over finely divided lead, which converts the normal insoluble lead salts (carbonate, sulphate, &c.) into white basic salts which are being used as substitutes for white lead. Before passing to a consideration of the progress made in organic chemistry we may draw attention to the extended use of boric acid as a preservative, and the increase of the amount of this acid exported from Italy during the last year. The alkaline fluosilicates have been recommended for the same purpose under the name of salufer, and antimony fluoride has been introduced as a mordant in the place of tartar emetic and antimony oxalate in dyeing. The coal tar colour trade deserves foremost mention among the chemical industries in organic materials, and here we notice the introduction of several new and valuable dyestuffs. The depression in this industry in 1885 was followed by a considerable rise in 1886; although reduction in prices took place to a slight extent, it was then balanced by the increase in the amount sold. Here, as in some of the branches of industry already alluded to, Germany has taken the lead, and her export trade has increased considerably during the last two years. Several new colouring matters belonging to the group of secondary azo dyes have been introduced into the market, which have the valuable property of dyeing cotton without the use of a mordant. Another dyestuff, having the same property, which dyes cotton blue, both in acid and alkaline solution, was introduced abroad at the end of 1886, is obtained from the diazo-derivative of diamido-diphenetol and α-naphthol sulphonic acid. Some new naphthol and naphthylamine monosulphonate derivatives may also be noticed. Roshydrazine, obtained by the reduction of diazotised rosaniline, is the base of a new class of colouring matters, consisting of condensation products with aldehydes and ketones, which can be formed on the fibre. A new method for the preparation of the azines has been described by O. Witt, which may in the near future have several industrial applications. Carbon sulphochloride $CSCl_2$ is being used as a new reagent for preparing thiobenzoic acid and thiophenone and derivatives therefrom. A violet dye can be prepared by the direct action of this body upon dimethylaniline in the presence of dry zinc choride. Colouring compounds, termed thiamines, obtained by the action of sulphurous acid upon aromatic amines, have been patented, and nitrated products, capable of dyeing and printing various shades of brown, have been obtained from them. Fahlberg's saccharine as a substitute for sugar may now be considered from a commercial point of view, the difficulties experienced in the oxidation and preparation of orthotoluene sulphamide having been overcome by the discoverer. Extensive works have been erected in Germany for the manufacture of this article, and when a cheaper oxidising agent than potassium permanganate is employed, or a convenient recovery process adopted, a less prohibitive price for this new sugar substitute may be expected. We have already briefly alluded to pharmaceutical preparations, but we must draw attention to the demand for several of the new alkaloids, *e.g.*, cocaine, berberine, veratrine, and caffeine, the latter being used as a substitute for digitalis. Among febrifuges and quinine substitutes, acet-anilide or antipyrine is in great demand. It is now prepared on a somewhat large scale from ethyl aceto-acetate and phenylhydrazine, and subsequently methylating the condensation product. Aconitine nitrate, camphor monobromide, hydrastine, hyoscyamine, and ditaine are also preparations for which there appears to be an increasing demand. The use of lanolin as a base in pomades and soaps, and first introduced by Liebreich as a result of his investigation of the wool of sheep, and separation of cholesterin therefrom, may be cited as another contribution of recent chemical research to our smaller industries.

In the domain of pure organic chemistry of great theoretical interest, is the preparation of the base hydrazine N_2H_4, the synthesis of glucose recently alluded to in this journal, and Horbaczewski's researches on the synthetical production of uric acid. We must draw attention, in conclusion, to the recent isolation of the element fluorine, in France, by the electrolysis of anhydrous hydrofluoric acid. The gas liberated has most powerful chemical properties, and agrees in character with the other halogens, thus fully confirming the theoretical conclusions which had been arrived at as to its nature.

THE ISOLATION OF FLUORINE.

The element fluorine has at last been successfully isolated, and its chief chemical and physical properties determined. Many chemists, notably Faraday, Gore, Pflaunder, and Brauner, have endeavoured to prepare this element in the free state; but all attempts have hitherto proved futile. M. Moissau, after a long series of researches



with the fluorides of phosphorus, and the highly poisonous arsenic trifluoride, has finally been able to liberate fluorine in the gaseous state from anhydrous hydrofluoric acid by electrolysis. This acid in the pure state is not an electrolyte; but when potassium fluoride is dissolved in it, a current from ninety Bunsen elements decomposes it, evolving hydrogen from the negative and fluorine from the positive electrode. The apparatus employed in this process is constructed of platinum, and is made in the form of a U tube, as shown in the accompanying illustration, with fluor spar stoppers, through which the battery terminals, made of platinum iridium alloy, are led. The gas is liberated at about the rate of two litres per hour, and has very powerful chemical properties. It smells somewhat like hypochlorous acid, etches dry glass, and decomposes water, liberating ozone, and forming hydrofluoric acid. The non-metallic elements, with the exception of chlorine, oxygen, nitrogen, and carbon, combine directly with it, evolving in most cases both light and heat. It combines with hydrogen, even in the dark, without the addition of any external energy, and converts most metals into their fluorides. Gold and platinum are not attacked in the cold, but when gently heated are easily corroded. Mercury readily dissolves the gas forming the protochloride, iron wire also completely absorbs the gas, while powdered antimony and lead take fire in it. It is necessary in the electrolysis of the liquid hydrofluoric acid to cool the electrolytic cell by means of methyl-chloride to −50° C. Fluorine appears to thus fully confirm the predictions which have been made by chemists concerning its properties. It is by far the most energetic of all the known elements, and its position in the halogen series is established by its property of not liberating iodine from the iodides of potassium, mercury, and lead, and also of setting free chlorine from potassium chloride. With iodine it appears to form a fluoride. No compound with oxygen has yet been obtained.

THE SOCIETY OF CHEMICAL INDUSTRY.

On January 2nd, at a meeting of the Society of Chemical Industry, held at Burlington House, Mr. A. Gordon Salamon read a paper written by himself and Dr. J. J. Hood, entitled "A New Method of Removing Sulphur Compounds from Coal Gas." The authors stated that the purification of coal gas may be regarded from two points of view, viz., as a necessity and a difficulty, and that the latter is the bugbear of the gas companies, eased somewhat by the fact that the removal of all the impurities is not insisted upon by the Government, because the task is impossible. The impurities to be reduced are carbonic acid, sulphuretted hydrogen, carbon bisulphide, and some complex sulphur compounds. The carbonic acid is removed by means of calcic hydrate; oxide of iron, in the form of a bog iron ore obtained from the North of Ireland, is spread upon grids, and used to eliminate sulphuretted hydrogen. Between each exposure to the gas it is submitted to the action of common air, and after twelve successive exposures to the gas, it refuses to take up more sulphuretted hydrogen. This process, however, is expensive, the ore costing 30s. per ton delivered in London. Two tons of the ore are required to take up one ton of sulphur, and the sulphur afterwards obtained from it is free from arsenic. The used ore is then thrown away as absolute refuse. There is a loss of about 14s. on every ton of sulphur produced, exclusive of the cost of labour, which brings the loss to the gas companies up to 26s. The other sulphur compounds are more difficult to extract, and the present method is unsatisfactory. The weak affinity of carbon bisulphide for sulphide of lime is utilised, and the resulting waste product is the "blue billy" of gas companies: it is a nuisance to the managers and to the neighbourhood, although some few persons profess to thrive upon its evil odours. The new plan of the authors, they stated, involves no alteration in the existing plant of gas companies, and the substance utilised can be employed in the dry state. Its trials have mostly been upon a laboratory scale, and although it has also been tried with some tons of material, the experiments on a large scale are not yet finished. The reason that the matter has been somewhat early brought under the notice of the Society is, that the authors did not select the date at which their paper was to be read. So far, they were very well satisfied with the results on a large scale, but would not publish them until the series were complete. The substance they use is the "Weldon mud," from which the calcic chloride is removed by washing. After three decantations but two or three per cent. of the chloride is left. The mud is then dried, and forms a porous mass which crumbles between the fingers; it keeps well, being found not to appreciably lose its useful properties by exposure to the air; it consists of a mixture of hydrated oxides of lime and manganese. The following is the

Composition of the Prepared Weldon Mud "A."

MnO_2	28
MnO	9
CaO	11
$CaCl_2$	3
H_2O	46
Insoluble	3
	100

The $CaCl_2$, so largely removed, is liable to form a glaze over the mud, and to reduce its efficiency. When it contains no more than 3 per cent., the mud is suitable for the purpose. It absorbs carbon bisulphide, and then when exposed to the air does not give off a foul smell,

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so is likely to do away with the nuisance of "blue billy." The authors then exhibited a vertical tube about 8in. long by 2in. diam., plugged at the top and bottom with cotton wool, and filled with the prepared Weldon mud, through which they passed a stream of sulphuretted hydrogen all the rest of the evening; the tube gradually grew very hot, and the mud turned yellow as the absorption went on; from time to time during the evening, the chairman (Mr. D. Howard) testified that no smell escaped from the upper part of the tube. They had not found that the compound formed had any tendency to fire in the gas purifiers, and so neutralise the value of the process. They had proved that the oxide of calcium present was not the active agent in producing the results, and with seven revivifications they had charged Weldon mud with sulphur to the extent of 70 or 80 per cent. In making comparisons, it must be remembered that Weldon mud during the action grows greatly in weight, whilst bog iron ore loses a little in weight.

Comparison of Bog Ore with Weldon Mud sulphurised five times, and purified for one hour each time.

100 Bog ore (34 per cent. Fe_2O_3) took up 27 S.
100 Weldon mud (28 per cent. MnO_2) took up 61 S.

Sulphurisation of Weldon Mud "A."

Sulphurised and Revivified.	Sulphur per 100 of mud. By CS_2.	By acid.
1	19	25
2	37	43
3	42	53
4	45	58
5	57	66
6	60	70

With twelve revivifications it is not possible to get more than 50 per cent. of sulphur upon bog iron ore. The new process gets rid at present of 25 per cent. more than does the bog ore process of the complex sulphur compounds in coal gas, and the Weldon mud can be revivified by blowing air through the purifiers, without removing it therefrom. There are no by-products to give off evil smelling gases, and the residue can be restored to the condition of active Weldon mud after the sulphur is removed. Its value to the bleach maker is reduced by one-half; but the lime is separated by sulphuric acid, so he does not have to use hydrochloric acid. Bleach makers do not look on the presence of sulphate of lime with favour; however, in the present case they gain a sulphur precipitate worth £7 per ton, and can then return the mud to the gas maker, so that the whole cost is for the hire of the Weldon mud.

In the discussion, Mr. Mead argued that the present process with bog ore was a cheap one. Mr. Campbell contended that there must be an objectionable quantity of sulphate of lime in the used Weldon mud, as indicated by the figures given, and nothing had been said about the cost of the Weldon mud, which he expected must be at least three times that of bog ore, cost of carriage of the former excluded. Mr. Salamon would not go into the entire question of cost until the experiments upon a large scale were completed; but so far the inventors were exceedingly well satisfied with the results, and thought that even if the new compound did no more than to get rid of "blue billy," its use would be of enormous advantage.

Notes.

FLOUR MILLS IN ITALY.

There are in the province of Ancona, says Vice-Consul Tomassini, 205 flour mills worked by hydraulic, and three by steam power. These employ 376 adults and eleven boys under fourteen years of age. A mill at Camerala Picena, known as the "American Mill," is worked by a turbine of 120 h.p., an 80 h.p. steam engine being kept in reserve. The total estimated value of the production of these mills is £400,000 for wheaten flour, £160,000 for Indian corn flour, and £100,000 for flour from other inferior cereals.

ALUMINIUM.

We are likely before long to have a deluge of aluminium alloys. Two large works are at the present time being erected in this country for the production of these alloys—the one by Cowle's Company, and the other by the Aluminium Company, Limited. The former company use an electric furnace; the latter, Castner's modification of the Deville process. There is a question as to which process gives the best and the most economical results. The Cowle's Company have not yet produced, or at any rate they have not offered for sale, pure aluminium, while the Aluminium Company have produced and sold the aluminium in its pure state. There is probably but little demand for the pure metal, as such; but it is none the less clear that if pure aluminium is offered the range of its use may be indefinitely extended, whereas the production of alloys alone limits such range. It appears to be likely that before long aluminium alloys will largely take the place of iron and steel, and probably also of Delta and Muntz's metal, for purposes in respect of which great tensile strength and non-liability to corrosion are elements of importance.

HEATING RAILWAY CARRIAGES BY STEAM.

The number of fatalities caused in the United States by the use of the old car stove has rendered it imperative that some new method of heating should be devised, and the law passed by the Legislature of the State of New York in the same direction has resulted in experiments in steam heating being made by almost all the prominent railroads. The methods used are nearly the same on all lines, steam being taken at a low pressure, and distributed by means of pipes throughout the train. On the New York Central line a fixed 2in. pipe runs under each car, connection being made between the cars by a section of pipe moving freely with a ball and socket joint. Inside each car there are two pipes running the length of the car, with branches under each seat. The pipes inside the cars can be cut off from the main steam pipe underneath, allowing the temperature of each car to be regulated independently.

AN ELECTRIC CHESS RECORDER.

We had last week an opportunity of inspecting, at the offices of Messrs. Woodhouse & Rawson, of Queen Victoria-street, London, a new apparatus, devised by Dr. Wurstenberger, of Zürich, for automatically recording a game of chess as it is being played. The record is printed on a tape in the usual way, that is to say, by reference figures and numbers. As customary, the position on the board is defined by two co-ordinates, one referring to the distance from the left hand corner to the right, and the other to the distance across the board, the former being given by a letter, and the latter by a number In printing the record, the number is printed immediately below the corresponding letter for the white pieces, and with an intervening space below the letter for the black pieces. The pieces are provided with plugs which fit corresponding holes in the board, the plugs of the white pieces being of wood, and those of the black pieces of metal. The record is transmitted from the board to the printing apparatus by means of electricity, there being sixty-four separate wires joined into a cable. Each black piece, when being taken up or put down, completes by its metal plug a circuit which actuates an electromagnet. The armature of this magnet is then attracted, and displaces the spindle of the type wheel carrying the numbers longitudinally, and thus provides the wider spacing between the letters and numbers for the black moves. When the white pieces are inserted or withdrawn, no current is sent into this magnet, and the type wheel carrying the numbers remains close to and side by side with that carrying the letters. The plugs at the bottom of the chessmen have, however, also another function to perform. In being withdrawn or pushed in they deflect contact springs, and by this means a current is sent along that particular wire which corresponds to the square on the board from which a piece is taken up or on which a piece is set down. These wires terminate at the printing apparatus in forty-six segments arranged in two discs, thirty-two in each, and round each disc revolves a small brush, the motive power being derived from a spring, very much in the fashion of an ordinary Morse receiver, and the paper strip is at the same time advanced. As soon as the revolving brush comes opposite the segment connected to the wire corresponding to the position on the board which is to be recorded, the circuit through this wire and through another electromagnet is completed, by this means raising a roller and pressing the tape against the type wheels, as in all printing instruments. From our description it will be seen that the pieces must be taken up and set down slowly, so as to give the brush time to revolve until it meets the particular segment from which the current is sent to the electromagnet; but the inventor, in order to obviate this difficulty, has introduced a relay between the board and the printing instrument, so that the pieces may be taken up or set down as fast as may be desired. On our visit, however, we did not see this relay in action, it having been damaged during transit. Dr. Wurstenberger's chess recorder is a very ingenious piece of delicate electrical machinery, but it has evidently only a limited field of application. It would principally be useful in clubs, where it may be desired to record in one room the game being played in another; but as there are sixty-four circuits, it could not be employed for telegraphing the game to any distance.

THE PROMOTION OF TRADE WITH PERSIA.

An exhibition of Russian manufactures suited to Persian requirements is to be held this year at Tehran, and in referring to it the British Consul-General at Tabruz states that it is to be hoped such a display of Russian activity in commercial centres of the far East will serve to awaken our merchants and Chambers of Commerce to the necessity of quickening the pace of British enterprise in Oriental markets. A step in the right direction would be to send from time to time competent persons to study the principal markets of Central Asia and Persia. He remarks: "The imports into Persia from British India amount annually to considerably over a million sterling. The question suggests itself whether an exhibition at Ispahan or Tehran—whichever be most expedient—of British and British-Indian manufactures suited to Persian requirements, could not be also opened? Such an exhibition would doubtless stimulate the trade between Her Majesty's Indian possessions and the southern dominions of the Shah—England and Persia sharing mutual benefits."

PUBLIC WORKS IN ITALY.

The British Consul at Venice reports that the Italian Parliament has at last sanctioned the expenditure of £180,000 for the prolongation of the north-east breakwater of the port of Lido for a further distance to the sea of 500m., and for the construction of the south-west breakwater to a length of 2850m. The large dry dock is also to be lengthened at a cost of £10,000, in order to allow of ships of any size being docked in it. The opening of the port of Lido will greatly increase the importance of the arsenal of Venice. A contract has been made by the Berliner Maschinenbau Actien-Gesellschaft (L. Schwartzkopf) with the Ministry of Marine for the construction of a torpedo manufactory in Venice, which is already in progress. The Italian Government will take over the torpedoes to be made there, and the municipality is to construct a large basin near the port of Treporti, for the use of the Berlin firm, at the expense of the town.

MAGNIFICENT PRODUCTION OF TEXTILE ART.

In Ireland, as in all other parts of the world, subscriptions have for many months back been collected for the purchase of presents for the Pope on the celebration of his Jubilee. Of these none can lay any claim to the magnificence and grandeur embodied in the textile offering of the Passionist Fathers of the Holy Cross and Ligoniel Congregations, Belfast. The gift consisted of a table cloth and two napkins of a design and finish to which no description could well do full justice, and it may safely be said that no production of similar textile work has ever been able to excel, if ever equal it, in point of beauty, quality, and magnificence of detail. One feature of the presentation is, that it is the work entirely of Irish operatives, having been prepared and woven in the celebrated damask factory of Mr. Michael Andrews, Ardoyne. The articles are hand woven, the warp being of linen threads and the weft of the finest silk. The table cloth is $2\frac{1}{2}$ yards by 3 yards, while the design and style of the napkins are made to match. These latter are the sole property of the manufacturer, and are alone sufficient to testify to the high degree of excellence which the factory at Ardoyne has attained. The design may be described as an Italian scroll, with a frieze work, and an inner border of similar arrangement. The centre is decorated with the arms of the Pecci family, which is surmounted by a representation of the cross keys and tiara—the papal insignia. Over these again is shown a scroll with the words "Lumen in Cœlo," while immediately underneath appears the year of the birth of Leo XIII., "1810." Further down the design, below the Papal arms, another scroll is placed on which is inscribed "1837—Jubilee—1887." Towards the edges of both cloth and napkins the inscription, "Presented by the Holy Cross and Ligoniel Congregations, Belfast," appears, while the title of the manufactory, and the initials of Mr. Andrews, "M.A.," are worked delicately and beautifully in. The pendants of the fabrics are representations of the badge of the Passionist Order, and figures of the Irish harp enclosed in a wreath of the national emblem—the shamrock—form the side pieces. The warp threads used in the manufacture of this gift are probably the finest which have ever been produced in Belfast; the beam consisting of no fewer than 12,000 threads for the table cloth, and rather under 4000 for each napkin. The weft is of China warp silk of the most perfect quality, or, as technically termed, China organzine, and of which 250 to 260 shots per inch were thrown. This therefore makes it, so far as is known, the finest wefted cloth in existence. By the blending of the linen warp and silk weft in such a manner, the production has the appearance of a cloth of gold. The entire work is indeed so perfect, and was shown with such good effect on the purple draped walls of one of the reception rooms of the monastery at Holy Cross, that it was difficult to conceive it to be the production of mechanical ingenuity. With this presentation Leo XIII. possesses a specimen of one of the world's marvels in textile manufacture, and no doubt it will prove one of the chief attractions in the exhibition of his Jubilee presentations.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

30th December, 1887.

17910. Brook, E. ..... Looms.
17912. Prunier, E. ..... Force pumps.
17915. Fairweather, W..... Propelling ships.
17916. Longsdon, H. C..... Machines for smoothing textile materials.
17918. Richards, G..... Shaping machines.
17923. Smith, J. W..... Locomotive engines.
17939. Hawkins, R. B..... Rotary brushing machines.
17944. Speed, J. J. ..... Magazine fire arms.
17948. Gruhl, A..... Button machinery.
17954. Worth, J. S..... Cranes and hoists.
17955. Lee & Burnham ..... Knitting machines.
17959. Lee, E. W..... Knitting machines.

31st December, 1887.

17974. Thompson, W. P..... Type writers (*The Standard Type Writer Manufacturing Co.*).
17977. Robertson & Orchar. Machines for finishing woven fabrics.
17978. Corrigan, J. ..... Reeling machines.
17990. Hogg, T. C. ..... Hydrocarbon engines.
17995. Eadie, R., & others..... Ring doubling machines.
18006. Fantzen & Lutz..... Cocoa grinding apparatus.
18008. Ainsworth, J. T..... Mules.
18009. Gleed, A. W. ..... Machinery for grinding and crushing.
18014. Crampton, H. ..... Guns.
18016. Chwalla, G..... Manufacture of fancy pile fabrics.
18018. Burckhardt & Weiss... Surface condensers.
18019. McHugh & Ward..... Machines for embossing plastic materials.
18023. Hipkins, B. E. ..... Steam boilers.
18025. Adant, G ..... Apparatus for grinding sugar.
18029. McKean, J. A. ..... Apparatus for tunnelling rock.

2nd January, 1888.

11. Porteous, A. N. ..... Counterthrust engines.
12. Spittle & Sanders..... Improvements in engines.
16. Willcox, B. ..... Coupling for propeller shafts (*La Société des Usines Franco-Russes*).
17. Eckardt, E. M. ..... Pistons.
18. Craven, W. ..... Bearings for travelling cranes.
19. Pielsticker, C. M. ..... Compound steel plates (*Williamson*).
26. Willcox, B. ..... Machinery for lasting boots and shoes (*Chase*).
31. Grollimund, M. ..... Grain cleaning and separating mills.
33. Stuart, H. A. ..... Sewing machines
36. Gubbins, R. R..... Manufacture of bar iron.
45. Norris, W. ..... Button hole sewing machines.
51. Willans, P. W. ..... Pistons.
52. Jefferies & King ..... Thrashing machines.
53. Lea, J. P. ..... Steam engines.
54. Chouliac, A. L. A. ..... Rotary engines.

3rd January, 1888.

57. Allison, H. J. ..... Button hole attachments for sewing machines (*Pippey*).
62. Welshman, W. H. ..... Apparatus for shaping press tools.
67. Richardson, W. E..... Weighing machine.
70. Semple, H. ..... Bottle finishing machines.
72. Thompson, W. P..... Type writers (*Brown*).
91. Moore, F..... Machines for drying wool.
109. Abel, C. D..... Regenerative gas furnaces (*Glaser*).

4th January, 1888.

117. Williamson, D..... Rotary engines.
123. Dorman, W. H..... Circular knitting machines.
128. Adamson, D..... Steam boilers.
132. Robins, J. J..... Excavator.
141. Brown, J. H..... Magazine fire arms.
146. Christie, R. C. & oth... Controlling the recoil of guns (*Canet.*)
150. Hunter & McCreadie.. Picking motion.
152. Simon, G..... Magazine rifle.
156. Thompson, W. P..... Superheating steam.
159. Thompson, W. P..... Ploughs (*Ventzki*).
165. Gibert, F..... Propelling apparatus.
174. Norton, J. A..... Machine guns.

5th January, 1888.

183. Saxby, J., & others ..... Interlocking apparatus for railway signal levers.
190. Hall, C. E. ..... Slide valves and reversing gear.
191. Bennett, J. M..... Smelting furnaces.
192. Berry, H. ..... Hydraulic cylinders.
213. Yaryan, H. T. ..... Evaporating and distilling apparatus.
220. Anderson & Longridge Armoured ordnance.
221. Bourdil, F. F. ..... Piston packings.
222. Mackenzie & Armstrong ..... Fret cutting machine.

ELECTRICITY.

30th December, 1887.

17926. Hayne, W. E..... Safety fuses for electrical circuits.
17935. Cardew & Brett..... Incandescent electric lamps.

31st December, 1887.

17966. Rhodes, O. Y. ..... Electric batteries.
18015. Bernheim, E. I. ..... Electrical connections.

2nd January, 1888.

20. Sherrin & Sherrin..... Propulsion of velocipedes by electromotors.
39. Tyer, E. ..... Voltaic batteries.
40. Tyer, E. ..... Electrical block indicators for railways.
41. Tyer, E. ..... Voltaic batteries.
56. Johnson, J. Y..... Incandescence electric lamps (*Mace*).

3rd January, 1888.

100. Lake, H. H..... Apparatus for generating electricity (*Humans*).

4th January, 1888.

112. Joel, H. F..... Incandescent lamp holders and switches.
115. Baynes, S. W..... Insulation of electric appliances.
137. Pürthner, J. C..... Producing electric streams.
155. Boult, A. J. ..... Electrical turnstiles (*Ehrling*).

5th January, 1888.

208. Ross, O. C. D. ..... Utilisation of waste products from electrical batteries.

CHEMISTRY.

30th December, 1887.

17908. D'Andria, M..... Separating arsenic from hydrochloric acid.
17909. D'Andria, M..... Treating acid residues from galvanising works.
17921. Finch, H. ..... A new reagent for bleaching.
17925. Groth, L. A..... Black liquid prepared from aniline (*Collin & Errani*).
17946. Walker, A. J. ..... Apparatus for oxidising yeast.

31st December, 1887.

17969. Hermite, E., & others.. The manufacturing of bleaching liquor.
17970. Parnell & Simpson ... Carbonate of ammonia and sulphuretted hydrogen.
17980. Pumphrey, A. ..... Photographic films.
18022. Briant & Clowes ..... Yeast.

2nd January, 1888.

43. Pfeiffer, J..... Manufacture of dry calcium hydroxide.

3rd January, 1888.

86. Dechend, F. von ..... Reduction of nitro compounds.

4th January, 1888.

119. Williams, R..... Manufacture of cyanides.
120. Goodman, G. H..... Preparation of carbonaceous fuel.
170. Abel, C. D..... Sulpho acids of diphenylamine (*Zimmer*).
173. Solvay, E..... Sodium bicarbonate.

5th January, 1888.

181. Kenyon, H..... Treating iron saturated with matters containing sulphur and nitrogen.

MISCELLANEOUS.

30th December, 1887.

17906. Pluck, J. ..... Improvement in corkscrews.
17917. Shanks & Burnside. .... Improvements in float cocks.
17919. Heys, D. S..... Balancing weights for windows.
17920. Moon, G. W. ..... The construction of wheels.
17922. Fisk, T. ..... An improved pipe connector.
17929. Carter & Carter ..... Apparatus for ventilating.
17931. Jackson, T. ..... Syphon tap.
17932. Stanton, F. B. ..... Railway buffers.
17933. Garner, R. ..... An improved gulley trap.
17934. Drummond, F. A..... Water gauge for steam boilers.
17936. Pottier, C. ..... Hot air stoves.
17937. Altmann, A..... Regenerative lamps.
17938. Cook & Ingham ..... Retorts.
17940. Allen, F. J. B..... Burners for lamps.
17941. Davis, M. ..... Lamps (*Eckel & Glinicke*).
17942. Allen, F. J. B..... Lamps.
17950. Wright & Mackie ..... Apparatus for working heated glass.
17952. Abel, C. D. ..... Azo dyestuffs (*Actiengesellschaft für Anilinfabrikation*).

31st December, 1887.

17961. Williams, M. C. ..... Horizontal beam compasses.
17962. Bagshaw, W. ..... Instrument for measuring the average pressures of diagrams.
17963. Purves, D. ..... Valves.
17967. Gregory, B..... Manufacture of blue bricks and fire bricks.
17968. Wilson, W. ..... Ventilator.
17972. Statham, S. E..... Vulcanisation of objects made of pure india-rubber.
17976. Vickery, A. ..... Saddle bars.
17985. Middleton, C..... Regulating the supply of gas.
17987. Bowie, MacN. C..... Gas lamps.
17991. Tuff, J. R. ..... Velocipedes.
17992. Howarth, G. ..... Callipers.
17993. Winterflood, J..... Ventilating cowls.
17996. Cooper, E. W. ..... Rotating chairs.
17997. Potter, C..... Carts and vehicles.
17998. Nicholls, P..... Manufacture of boots.
18000. Murrie, J. ..... Governors.
18004. Prandstätter, M..... Recording apparatus for carriages.
18007. Allan & Holmes..... Adjustment of sliding sockets upon their rods.
18012. Woodruff, O. D..... Meat cutters.
18013. Walter, F. ..... Bottling apparatus for aerated liquids.
18017. Lake, H. H. ..... Call bells (*Russell*).
18020. Thornton, J. ..... Pipe coupling.
18021. Nicholson & Allcock Horse rakes.

2nd January, 1888.

2. Archer, T. ..... Controlling the running out of ropes and chains.
3. Bradsworth, A. ..... Automatic signal for picking and finishing machines.
5. Eshelby, J. ..... Oil lamps.
6. Holden, G. H..... Stop motions for twisting and doubling frames.
7. Hanson, J. ..... Railway chair.
9. Plenty, E. P..... Forced draft closed ash pits.
10. Hargreaves & Carr ... Slide valve.
21. Evans, A. G..... Removing scale from steam generators (*Livock*).
22. Groombridge & Rickman..... Lock bolt.
25. Edelboum, I..... Ventilator.
28. Eli, A. J. ..... Lamps for burning petroleum.
29. Barnard, J. H..... Slow combustion stoves.
30. Bay, A. V..... Dampers for steam boilers.
35. Sewall, J. H. ..... Apparatus employed in heating railroad cars.
42. Tyer, E. ..... Apparatus for securing safety of traffic on single lines of railway.
47. Pont, A. de ..... Process of producing imitations of ivory.
48. Pont, A. de ..... Process of treating horn waste.
50. Morgan, D. J. ..... Improvements in ships' lights.

3rd January, 1888.

58. Dion, L. O. ..... Method of fastening strips of leather together.
60. Hall, W. P. ..... Railway ties.
61. Gregory & Gilfort ... Spring safety hooks for couplings
79. Fairweather, J. I..... Ball valve for cisterns.
85. Wilkes, J..... Tools used in mining and quarrying.
87. Thompson, W. P..... Method of producing dyes for use in making wood type (*Satchell & Page*).
94. Haddan, H. J..... Lock fastenings (*Kristoffy and others*).
98. Lake, H. H..... Rails, sleepers, &c. (*White*).
99. Lake, H. H..... Soil fertiliser distributors (*Peabody*).
103. Davids, C. H..... Apparatus for numbering or counting.
106. Lake, H. H..... Brakes for railways (*Schauffler and Bayon*).
107. Kapteyn, A. P..... Automatic brake.

4th January, 1888.

113. London & Stuart..... Sight feed lubricators.
116. Weston, T. R..... ... A mechanical trap.
118. Brooks, S..... Smoke consumer.
122. Carus-Wilson and Bayley..... Lock nut.
126. Cole & Cole..... Gas govenors.
134. Beal, W. H..... Driving appliances.
135. Hargreaves and Bardsley..... Gas regulators.
136. Weber, F. A..... Heating and ventilating.
139. Wardale, J. M..... Bow drill.
142. Brown, A. M..... Wheels and pulleys.
143. Chandor, L..... Lamps.
145. Radford, H. G..... Block fuel.
147. Flohr, O..... Friction clutches and hoists.
158. Thompson, W. P..... Regenerative gas lamps (*Schmidt and others*).
163. Edgley, M. W..... Water taps.
166. Thame, J. R..... Manufacture of paper boxes.
167. Wood, E. A. ..... Bow rudder.
168. Liddell, W. A..... Gabions.
169. Langen, C. J. ..... Apparatus for drying
171. Wild-Wirth & Wild... Production of chromo-lithographic surfaces.
172. Marth, R..... Collapsible boats.

5th January, 1888.

177. Healey & Thwaite..... Application of gaseous fuel for treating towns' refuse.
184. Lee, A. H..... Gearing for velocipedes.
185. Clifford, A..... Fire extinguisher.
186. Lewthwaite, S. ..... Gas heating apparatus.
188. Whitehouse, J. ..... Cutting tools.
189. Vereker & Yeates..... Starter of tram cars.
195. Collier, L. ..... Feeder for guiding mills.
201-2. Thompson, W. P..... Wood type (*Setchell*).
203. Gittus, H..... Belt fastener.
206. Bourdon & Morel ..... Warming railway carriages.
209. Nibbs, F. I. ..... Driving gear for velocipedes.
210. Spackman, H. ..... Lamps.
211. Morris, R ..... Filters.
212. Pasquet, P. G..... Lubricators.
216. Haddan, H. J. ..... Ball bearings (*Hellmann & Fichtl*).
217. Trott, H. ..... Regulating the flow of water in pipes.
218. Vaughan & Foster..... Hooks for cranes.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

7th January, 1888.

12521. Normanville, W. de ... Rotary engines.
17063. Nicholls, H. M. ..... Printing machines.

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17129. Southall & Clegg..... Apparatus for sorting, cleaning, and travelling coal.
8. Turnock, J. R..... Steam engines.
19. Chappell & Chappell. Propelling ships and boats.
310. Lapage, R. H. ..... Compound engines.
447. Haddan, H. J. ..... Crushing apparatus (*Newerburg*).
910. McFarlane, L. ..... Paper making.
1358. Jackson & Martin..... Sewing machines.
1878. Stevens, S. ..... Metal folding machines.
2876. Justice, P. M. ..... Rolling mills (*Daniels*).
3049. Tranter, W. ..... Small arms.
3132. Rickaby, A. A. ..... Casting rings of metallic packing.
3224. Newton, H. E..... Condensing apparatus (*Theisen*).
3294. Alley & MacLellan ... Apparatus for making moulds for casting.
3297. Whalley & Wells..... Brake mechanism of looms.
3306. Greenhalgh, J., & others Opening and cleaning cotton.
3368. Flather, A. ..... Jacquard machines.
3635. McCulloch, A., & others Spinning machinery.
3871. Sykes, T. S. ..... Machine for cutting samples of fabrics.
4624. Newton, H. E..... Propulsion and steering of vessels (*Merlette*).
5472. Stinton, E. ..... Shaft bearings.
5981. Korting, E. ..... Gas motors.
7309. Leader, A. W..... Sewing machine.
11915. Boult, A. J. ..... Steam engines (*Case*).
13689. Firth & Shackleton ... Combing machines.
13705. Stewart, C. F..... Machine for making dowel pins.
13770. Hiron, H. F..... Anchors.
16331. Hennecke, W. H. A. ... Thrashing machines.
16404. Lake, W. R. ..... Propulsion of tramway vehicles (*Patton*).
16555. Lilienthal, O..... Tubular boiler.
16741. Allison, H. J. ..... Grain binders (*Milwaukee Harvester Co.*).
16781. Vaughan, G. E..... Machines for bagging chaff (*Andrews & Beaven*).
16782. Lake, W. R. ..... Boiler furnaces (*Dashiell*).

ELECTRICITY.

7th January, 1888.

1654. Kingsland, W..... Secondary battery cells.
2851. Parker, T. ..... Automatic switch for electrical circuits.
3197. Salomons, Sir D. L., and others..... Secondary batteries.
3469. McEvoy, C. A. ..... Electric primers for firing breech loading guns.
4478. Maynard, C..... Carrying telegraph wires.
11448. Sellon, J. S..... Secondary batteries.
16128. Munns, W. H. ..... Telephones (*Sunderland and Monjo*).
16669. Bailey & Warner ..... Secondary battery combined with a miner's lamp.
16728. Heintz, A..... Incandescent electric lamps.

CHEMISTRY.

7th January, 1888.

15942. Kellner, C. ..... Cellulose.
3144. Pattinson, H. L..... Hydrates of barium and strontium.
3389. Towlson & Weldon..... Aniline blacks.
3670. Lloyd & White ..... Manufacture of cast steel.
16592. Offen & More..... Yeast.

MISCELLANEOUS.

7th January, 1888.

17145. Laval, C. G. P. de ..... Cream separators.
185. Harrison, J. A. ..... Lubricating cans.
579. Thomas, T. C. J. ..... Lamps.
1551. Torkington, J., & others Economising gas.
1811. Thompson, W. P..... Warming and ventilating (*Smead*).
1818. Sneade, W. S. ..... Rollers for grinding pigments.
2601. Ramsay, H. ..... Guard for hoist wells.
2848. Kimberley, W. ..... Plough and sash fillister planes.
2867. Brooks, S. H., & others Self contained spindles.
3119. Atkins, W. ..... Spirit lamps.
3156. Capewell, G. J. ..... Nail extractors.
3183. Langfield & Martland Heating railway carriages.
3231. Sutton, J. W. ..... Knife cleaning machines.
3248. Béjot, A. J. ..... Apparatus for printing in colours.
3279. Prince & Symmons..... Hydrocarbon lamps.
3282. Brown & Pickstone ... Improvement in bobbins for winding yarns.
3344. Smith, R. W..... Bicycles and tricycles.
3350. Griffin, S..... Stuffing boxes.
3359. Davis & Turner..... Supply of gas to gas stove hot plates.
3362. Swan, J. W. ..... Detection of explosive gases in mines.
3374. Barlow & Barlow..... Mounting wire or metal healds.
3461. Bischof, G. ..... Apparatus for purifying water.
3568. Girling, G. G..... Manufacture of artificial stone.
3617. Craig, A. F., & others ... Separating mineral from substances of different specific gravities.
3657. Chantrell, W. S..... Lubricators.
3789. Hunt, H..... Fire grates.
3890. Taylor, J..... Ventilator.
3916. Williamson, T. ..... Saw sets.
4381. Auton, R. ..... Artificial fuel.
4485. Clark, A. M..... Process of ornamenting glass (*Brunetti*).
4818. Taylor, S..... Metal covered roofs.
5982. Enzinger, L. A. ..... Filter presses.
8696. Notley, W. ..... Safety lamp burner.
11707. Allison, H. J..... Wind gauge sight for fire arms (*Lyman*).
11987. Beale, W..... Tyre for road vehicles.
15869. Hayes, W. R..... Ventilators.
16361. Grassler & Elliot .... Automatic pipe coupling for heating railway cars.
16411. Henney, J. ..... Heating railway carriages.
16517. Furnival, T., & others.. Printing machines.
16541. Reid, S..... Lubricators.
16596. Henderson, A. C..... Conveyance of sand from dredging operations to any desired spot (*Bony*).
16600. Browning & Waddle... Lids of gas retorts.
16716. Bray, G..... Gas govenors.
16742. Ricketson, J. C..... Indicators for marine engines.
16785. Heimsoeth, B..... Pipe coupler.
16804. Boult, A. J..... Improvements in flushing cisterns (*Booth & Parker*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 30th September, 1887, inclusive.)

Year 1883.

4567. Haddan, H. J. ..... Boilers, flues, and cylindrical vessels (*Prégardien*).
4570. Mewburn, J. C. ..... Sifting paints or colours (*Matter*).
4572. Youngjohns, W. ..... Loom shuttle.
4573. Barlow, R. ..... Portable electric lamps.
4575. Lake, W. R. ..... Printing presses (*Huber & ano.*)
4578. Thompson, W. P..... Dynamo-electric machines (*Sheehy*).
4579. Stout, C. ..... Engine direction indicators, &c.
4580. Maccallum, J..... Packing, &c., goods.
4584. Brooks, A. G. ..... Extracting oil, &c. (*Gregory*).
4585. Warden, A. W..... Galvanic batteries.
4587. Williamson, W. B..... Cans for milk, &c.
4592. Imray, J. ..... Baryta or strontia treatment of molasses, &c. (*Leplay*).
4594. Varley, F. H., & others Dynamo-electric machines.
4599. Imray, J. ..... Valve for intermittent flow of fluids (*Kaiser*).
4602. Heath, T. E..... Loading vessels.
4605. Love, J..... Retarding and stopping ships.
4606. Grey, C. ..... Bulwarks of ships
4607. Clark, A. M..... Converting reciprocating motion into rotary motion (*Bush and another*).
4615. White, F. H. ..... Folding baskets.
4617. Thomson, Sir W. ..... Generating, &c., electric currents
4620. Rowland, G. ..... Flues of steam boilers.
4624. Griffiths, J. ..... Purifying smoke.
4625. Gardner, H. ..... Signalling between vessels (*Mowbray*).
4634. Lilley, G. C. ..... Ascertaining ships' courses.
4638. March, O., & another... Electromotors.
4644. Aitken, H. ..... Treating carbonaceous substances, &c.
4649. Bull, H. C. ..... Gas.
4651. Bailey, W. H., & another Valves.
4653. Lake, H. H. ..... Submarine exploration (*Toselli*).

Year 1882.

4550. Shaw, J., & another ... Indicating presence or absence of water in cisterns.
4574. Tweddell, R. H..... Hydraulic machines.
4585. Maughan, B. W., & ano. Aërial and marine navigation.
4609. Tweddell, R. H., & ano. Raising, &c., portable riveting machines, &c.
4632. Couchman, J. W..... Furnaces.
4636. Webster, J. ..... Bismuth, &c.
4668. Miller, S. ..... Velocipedes.

Year 1881.

4160. Doering, F. B..... Tunnelling and rock boring.
4195. Davidson, C. J. ..... Compound for coating surface of iron.

Year 1880.

3891. Scott, A., & others..... Treating sugar, &c.
3897. Clements, E..... Washing machines.
3951. Childs, A. B..... Cog wheels, &c. (*Wegmann*).
3953. Hunt, B..... Hoisting coal, &c. (*Brown*).

Year 1879.

3887. Hill, E. J., & another... Suspending and detaching boats.

Year 1878.

3854 Samuelson, B., & ano... Harvesting machines.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Preparing Wool for Spinning.—*J. W. Smith, Bradford, Yorkshire.*—In the improved machine for drawing and preparing wool and other fibres the inventor dispenses with the usual creels at the back for supporting the supply bobbins, and with the spindles and flyers used for twisting and winding the slivers delivered by the front rollers. The slivers to be reduced or drafted are placed in cans in a practically untwisted condition, and each can is placed on a plate revolving at such a speed as to give the necessary amount of twist to the sliver before it enters the nip of the back rollers. The slivers are drawn or reduced by the front rollers, and are deposited in revolving cans in the front of the machine. Claim: The described process of reducing slivers, which consists in dispensing with the rotating spindles and bobbins for receiving the reduced fibre, and substituting cans from which the sliver is drawn on one side of the machine and delivered into similar cans on the other side.—No. 2039. February 9th, 1887. 8*d*.

Gas Engines.—*H. J. Haddan. (W. Gavillet & L. Martaresche, Paris.)*—This invention includes improvements in the cylinder, in the lubrication of the piston, in the arrangements for electrically igniting the gases, and in the introduction and evacuation of the gas. The first figure shows a longitudinal section of the cylinder, and the second an end view of the same. The fore

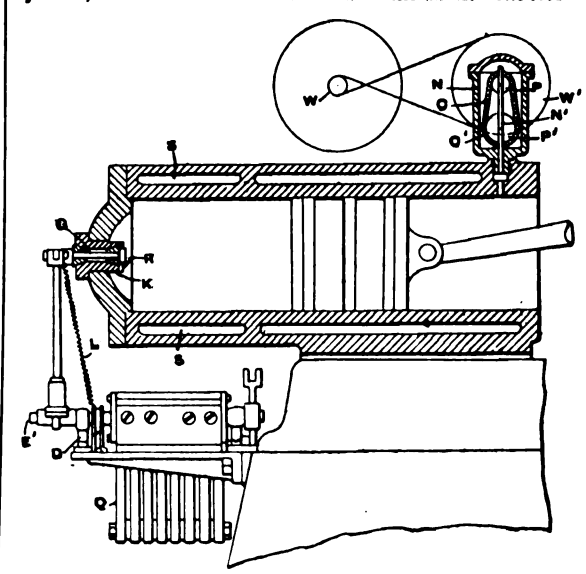


Fig. 1.

part of the cylinder has a cavity, through which circulates a stream of cold water, and in the hinder part a cavity S^1 serves to hold some non-conducting substance. The receptacle N contains the oil used by the automatic lubricator, and N^1 is a tube having a notch at its upper extremity and conducting the oil into the cylinder. A small brush O^1 fixed to an endless chain O^2 dips into the oil. This chain, by turning on a pulley P, conducts the brush before the notch of the tube, and leaves therein the necessary oil. The motion is imparted to a pulley W fixed on the shaft of the governor. The ignition mechanism

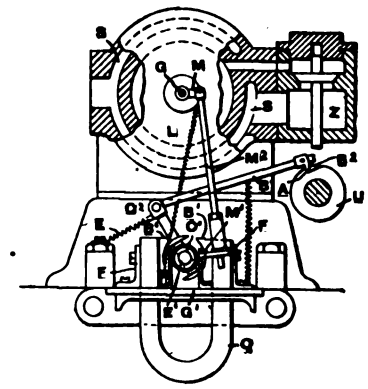


Fig. 2.

consists of a bundle of magnets Q, furnished at their extremities with poles B^1 of soft iron, and fixed to the bed plate G^1 by the bronze brackets F. Between these poles B^1 a bobbin C^1 revolves on the shaft E^1, having two poles united by a core of soft iron on which the induction wire is coiled. When the machine is at rest, the poles of the bobbin are attracted by the poles of the magnets. If the bobbin is made to undergo an abrupt rotary displacement, caused by the action of a cam V on the engine, an induction current is generated in the coil of the bobbin which gives the necessary spark for ignition. The generated current travels to the cylinder along the spring L, which also serves for actuating the shaft G through the crank M. This shaft is provided with a contact R, which is withdrawn from the bronze piece K by the movement of the bobbin. The disc U with the catch A serves to give the periodical displacement of the bobbin. There are seven claims.—No. 2194. February 11th, 1887. 8*d*.

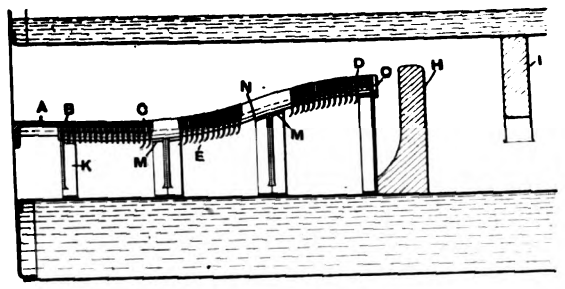
Forging Circular Articles.—*C. Fairbairn, Sale, Cheshire, and M. Wells, Manchester.*—This invention relates to apparatus for forging articles of circular transverse section, such as balls or elongated projectiles, by subjecting them to rolling pressure between the faces of two oppositely revolving discs, shaped to the contour of the articles to be forged. One of the shafts on which the discs are mounted is slightly inclined, and is placed in a plane a little to one side of a plane passing through the axis of the other shaft. The faces of the disc are thus slightly eccentric and inclined to one another. By making one of the discs somewhat larger than the other, and thus obtaining a greater surface velocity, the blank is gradually advanced towards the narrowest part of the gap between the discs. The faces of the discs are grooved obliquely to radii. Two claims are made for forging apparatus constructed as described.—No. 1804. February 4th, 1887. 8*d*.

Rotary Engines.—*G. Dietz & E. Tamsen, Hamburg, Germany.*—A disc, on which two blades or pistons are placed at diametrically opposite points, is mounted on a shaft concentric with the cylinder. At opposite points in the circumference of the cylinder are placed two sliding gates, which divide the

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annular space in which the pistons travel into two parts. The steam is conducted to slide valves placed on one end of the cylinder, the valve rods, together with the sliding gates, being operated by means of a cam on the shaft of the engine. Each slide valve communicates with the annular steam space by openings on each side of one of the sliding gates. The piston disc is rotated by admitting steam above one gate and below the other, the other steam passages being used as exhaust ports. To reverse the engine the exhaust ports are used as steam inlets, and the steam inlets as exhaust ports. The sides of the blades or pistons are tapered towards the circumference of the cylinders, and the sides of the gates are tapered to a point inwardly. A tight joint is thus maintained between the gates and pistons as the former are withdrawn to allow of the passage of the latter. Packing rings are inserted in the sides of the piston carrying disc, for the purpose of making a steam tight joint with the cylinder ends. The inventors make four claims for the improvements in rotary engines described.—No. 15261. November 8th, 1887. 8*d*.

Boiler Furnaces.—*A. Schreiber, Dresden, Saxony.*—This invention involves some improvements in the construction and arrangement of the furnace bars. The figure represents a sectional elevation of the furnace fitted in the fire tube of a steam boiler. A is the ordinary dead plate; from B to C the bars are laid horizontally, and from C and D the bars are made to rise in a curve both longitudinally and transversely. The shape of the longitudinal curve will be seen in the figure, and



in the transverse section the middle portion of the bars rise to a greater height than at the sides. The lower edges of the curved bars are formed as at E to assist and direct the entrance of air from the ash pit; and horizontal grooves in the upper surface of the bars and vertical grooves formed on one face serve to provide distance pieces and air passages between the bars and on their upper surfaces. The bridge H is built in the flue so as to leave a passage for the supply of the necessary air to inflame the carbonic oxide; and for effecting a more complete intermixture of the heated gases, the inverted bridge I is also built in the flue, as shown. The fire bars are supported by angle irons K, the upper ends of which are fitted with brackets M. On these brackets are carried rails N which hold the bars. The fuel is laid thinly over the raised portion of the grate, and the smoke and unconsumed gases from the lower parts ascend to and mix with the flames from the more highly heated incandescent fuel in the centre. The four claims made are: (1) For the curved and arched fire bars; (2) for the lower edge E, and for the air channels formed in the bars; (3) for the means and appliances for supporting the fire bars; and (4) for the general construction and combination of the parts.—No. 14758. October 29th, 1887. 6*d*.

Brick Making Machines.—*C. Chambers, jun., Philadelphia, U.S.A.*—This invention includes several improvements in the construction of that class of machines known as the Chambers' brick machines. The diagram represents a general view of a machine made on the improved pattern, but does not show all the details of the mechanisms employed. The clay is dumped from a platform into the tempering case A, by way of a vertical hopper B. This hopper is formed with its base broader than its

FIG. 1.

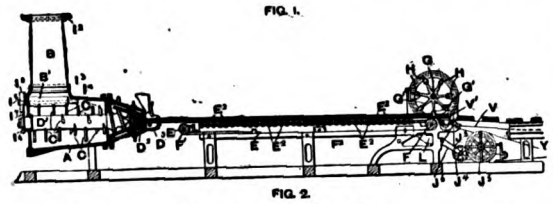
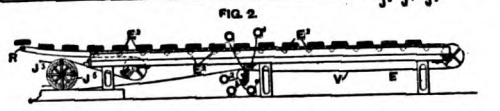
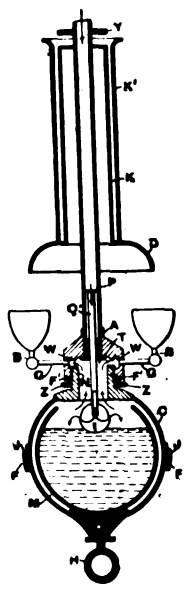


FIG. 2.



top, and its corners are rounded off so as to prevent the clay clogging. A feeding roller B^1 is placed in the tempering case, in order to make the passage of the clay easier. The pugging shaft D^1 is studded with tempering knives, the position of which on the shaft is designed somewhat differently from hitherto, with the object of obviating their tendency to hold the clay up and obstruct the feeding motion. The screw D forces the clay through the die D^2 and the sanding box D^3, whence it issues in the form of the long bar X. The belt E carries the bar along over supporting rollers E^2. These rollers, instead of being made of greater width than the belt, are, according to this invention, to be smaller than the belt and of the same width as the bar of clay. The principal improvement in the machine relates to the cutting off mechanism. The wheel G carries elastic bows H, whose function is to hold the cutting wire. In order to secure the rectangular shape of the extremities of the bricks, an arrangement of wheel and cam is introduced, but is not shown in the figure. The wire is formed somewhat differently by bringing over the end so that the straight converging sides form an acute angle, and by twisting the contiguous parts of the wire so as to form a long twist, and then winding a part of the end of the wire with a loose coil around the adjacent main portion of the wire. There are several other devices designed, one for cleaning the cut-off wires, another relating to the specific construction of the pulley F, and another relating to the slide plate for operating the cut-off regulator. A bifurcated frame O, secured to the under side of the longitudinal pieces, is used for supporting the return part of the off belt V. A bow clamp is introduced to afford a ready means of drawing towards each other the limbs of the elastic bows H, so as to allow of a quick attachment of the wires to their ends, and to replace broken wires with new ones whilst the machine is in operation. The device consists of a lever with a handle and arm, to which is hinged a double yoke, the lever and yoke thus forming a toggle joint. The inventor makes twenty-nine claims for these improvements and their combinations.—No. 6496. May 3rd, 1887. 1*s*. 3*d*.

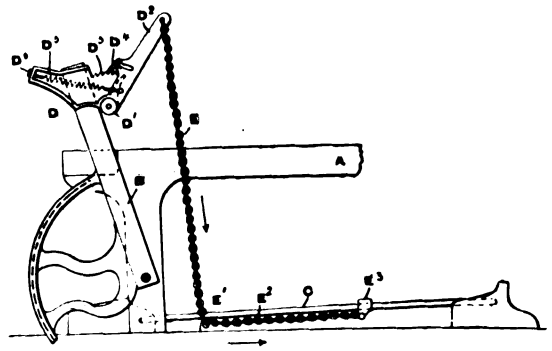
Carburetting Gas Lamps.—*A. Kitson, Philadelphia, U.S.A.*—The object of this invention is to provide an easy means of replenishing the carburetting vessels, a simple regulating device which shall be automatic in its action, and a valve for shutting off the organic vapour from the atmosphere when the lamp is not burning. The gas enters the apparatus through the pipe P, to which is fitted the collar A. On the lower part of the collar is screwed the neck N of the carburetting vessel C. The supply pipe P is surrounded by a casing K, to which is attached the bell-shaped disc D. This disc is situated immediately over the burners B, and is used for bringing the heated products of combustion into contact with the pipe P. The vessel C is in two parts, which are joined at J, and may be unscrewed by means of the handle H. The interior vessel M contains the organic material used for enriching the gas; and the supply of this material is replenished by unscrewing C, and inserting a



new vessel M in place of the exhausted one. At the bottom of the supply pipe is fitted tightly a bushing T, through which the small tube Q slides freely. At the lower end of this tube Q is attached a float I. This float rests on the surface of the hydrocarbon, and serves to keep the tube Q always at the same distance from the carburetting material. As the material falls during its consumption the float and tube fall with it, so causing the gas to travel the same distance at all levels before impinging on the material. A regular amount of vapour is thus generated. The bushing T is drilled with several small holes, and by partially unscrewing it from the supply pipe an outlet for the gas is provided direct from the pipe to the burners through these holes. The quality of the enriched gas can thus be controlled. The screw in N allows for the shutting off of the gas from the burners. The neck of N comes in contact with the ring-shaped wedge W when it is screwed far enough up, so preventing the access of the gas and vapour to the pipes G when the lamp is not burning. The inventor makes thirteen claims for these improvements.—No. 12229. September 9th, 1887. 8*d*.

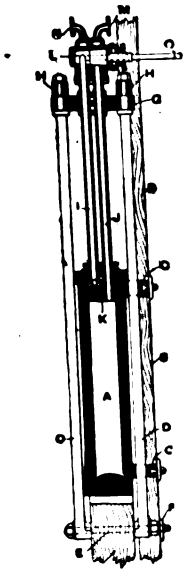
Expansive Gear.—*J. Tickle, West Bromwich.*—Two slide valves are placed one at each end of the cylinder in separate steam chests. On the back of each steam chest is a double beat valve operated by a cam secured to a horizontal shaft driven from the governor spindle by means of bevel gearing. The lifting cams are made with a quick termination to the lift to allow the valves to close suddenly, and to admit varying volumes of steam the cams are moved backward and forward. To effect this movement of the cams the governor spindle is hollow, and contains an inner spindle furnished with a rack on its upper part gearing, with toothed quadrants on the inner end of the governor arms. The inner spindle is thus depressed or raised, as the governor rises or falls. The bevel wheel which drives the valve operating shaft is loosely mounted on the governor spindle, and is partly rotated in either direction by the movement of the inner spindle. Three claims are made for the improvements described.—No. 2155. February 11th, 1887. 8*d*.

Mules and Twiners.—*W. T. Watts, Stalybridge.*—By this invention an improvement is introduced into the mechanism which effects the "nosing motion" of the winding-on apparatus. The figure represents an elevation of several parts of the self acting mule. A is the framing, B the ordinary radial arm and quadrant, and C the rod between the shaper plates of the usual shaper mechanism. To the arm B is secured a bracket D, which has a stud D^1 in it, forming the fulcrum of the lever D^2. This lever is the "nosing arm," and it carries a stud on one side for a bowl, which, when the arm B moves inwards, will come upon the ordinary winding on chain. On one side of the nosing arm a slot is formed for an adjustable stud, upon which a pawl D^4 is jointed; the free end of this pawl works upon ratchet teeth formed upon a segmental part D^3 of the bracket D. One end of a helical spring D^5 is secured to the arm D^2, and the other end is connected with a projection D^6 from the bracket D. The spring tends to draw the nosing arm towards itself, but the pawl resists the pull of the spring, and holds the arm D^2 in whatever position it is set. When the bowl at the end of the



lever D^2 presses upon the winding chain, the strain upon the nosing arm is resisted by the pawl and ratchet, and as the cops build the spring is stretched more and more. An automatic arrangement for adjusting the apparatus as the cops grow larger is partly shown in the diagram. A chain E, one end of which is attached to the extremity of the nosing arm, passes through the eye of a bracket E^1 secured to the floor, and is fixed at its other end to an arm of a bell crank lever. A chain is attached to another arm of this lever, and to a collar E^3 adjustable upon the rod C. The chain E moves in the direction of the arrow as the cop builds, and the nosing arm is thus drawn down in opposition to the force of the spring. The inventor makes three claims: (1) For the combination of radial arm, nosing arm, pawl, ratchet, and spring; (2) for the combination of these parts with the chain E; (3) for the general arrangement.—No. 1786. February 4th, 1887. 8*d*.

Pile Driving Apparatus.—*J. Garvie, London.*—This invention consists of a method of introducing steam through tubular piston rods into the cylinder or monkey of a pile driver. In the accompanying diagram, A represents the monkey, and B the frame of the engine, along which the monkey moves up and down, being held in position by the slides C. The two rods D are fixed at the lower end to the pile by the bolt E, and the slide F keeps the pile in a vertical position. These rods are fixed



to the cross head G, and are provided with springs H to relieve the shock. The cross head carries two piston rods I and J, which are fixed to the piston K at the bottom, and are connected at the top with a three-way cock L. The opening M affords an inlet to the steam, and N an exit; O is a plug, made in two pieces, which regulates the steam in the cock. By turning the plug O, the steam is allowed to descend the rod I, and it discharges through the openings over the top of the piston, and thus lifts the monkey. Whilst this goes on, the exhaust steam escapes through J into the atmosphere at N. In the reverse motion, the steam descends through J, and the exhaust steam passes up through I, and escapes through N. This apparatus can also be used with hydraulic pressure. There are four claims.—No. 302. January 8th, 1887. 8*d*.

CHEMISTRY.

Dyeing with Aniline Black.—*W. J. S. Grawitz, St. Maur, France.*—Textile fabrics when dyed with aniline black present a brownish tinge, which is usually changed into a blueish tinge by the action of a hot soap bath. This soaping, however, renders the fibres greasy to the touch, and imparts a disagreeable odour to them. According to this invention, the brown tinge is eliminated by the following treatment: A bath is made of certain proportions of water, sulphuric acid, and sulphoricinate of soda, and the cotton is plunged therein. The fatty matter made by the action of the sulphoricinate on the acid combines with the aniline dye. The cotton thus treated is passed through an alkaline bath, and may afterwards be sized and dressed, and is quite devoid of smell. The inventor makes two claims, one for the process, and one for the new industrial product thus obtained.—No. 11182. February 5th, 1887. 6*d*.

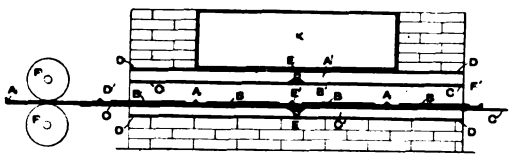
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MANUFACTURE OF CAUSTIC SODA AND POTASH.—*L. Mond and D. B. Hewitt, Northwich, Cheshire.*—This invention consists of improvements founded upon the process included in Wise's Patent No. 4364 of 1882. In that specification is described a method for making caustic alkalies by heating their respective carbonates with oxide of iron in retorts. The improvement suggested is to use a very pure and fine carbonate of soda, obtained by heating the bicarbonate of soda produced in the ammonia-soda process to a temperature of 300°C., instead of the ordinary low test carbonate made by the Le Blanc process. This object may be advantageously effected by using a cylindrical furnace, revolving on a horizontal axis, and lined with fire clay blocks, in such a way as to form a number of projecting radial ribs. The material introduced into the furnace is lifted up by the projecting ribs to a certain height, and then falls through gases which pass along the furnace, so that the nearly pure carbonic acid formed in the interstices of the mass becomes replaced by the gases, and no longer hinders the progress of the reaction. The process can in this manner be completed in a few hours, and at a reasonable expense of fuel; and thus a great economy is effected, as well as an improvement in the manufacture of the alkali. There are seven claims.—No. 1974. February 8th, 1887. 6*d.*

COLOURING MATTERS.—*O. Imray. (Farbwerke vormals Lucius und Brüning, Hoechst-am-Main, Germany.)*—This invention relates to improvements in the production of alkylised diamidobenzophenonamine chlorides, and the conversion of these into alkylised diamidobenzophenones and yellow colouring matter of the class of the auramines. The patentee claims the production of mono and di-substituted amides of the dialkyl-amidobenzoic acids, by the action of aniline, orthotoluidine, &c., upon the chlorides of the dimethylamidodiethylamido-ethyl-methyl-amidobenzoic acid; the production of halogen compounds of the same by treating them with oxychloride of phosphorus and phosgene; the production of condensation products from these halogen compounds; and the production of tetra-alkyl-diamido-benzophenones from these condensation products.—No. 1694. February 3rd, 1887. 6*d.*

MISCELLANEOUS.

DECORATING GLASS.—*C. A. Durand & R. P. Engelmann, Paris.*—This invention consists of a modification in the processes of preparing and burning decorated glass. A suitable drawing on prepared paper, made with varnish, which is capable of resisting the attacks of fluoric acid, is sprinkled with rosin and fixed by means of gum on a sheet of glass coloured superficially. The glass is heated and the rosin thereby melted, and the paper is then removed with water. The glass is exposed to fluoric acid, and the printed parts retain their original colour, whilst the rest of the surface is eaten into by the acid. The explanation of the furnace will be effected by means of the accompanying figure, which shows a longitudinal section of the same. The cast iron or fire clay slabs A, supporting the painted or enamelled sheets

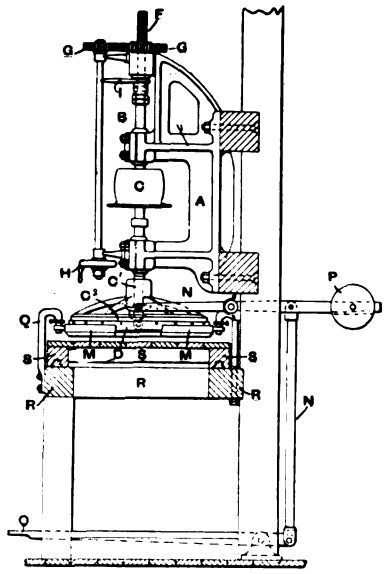


B, are advanced by the aid of a drawing mechanism shown at F. These sheets B pass between two other cast iron or brick slabs C, which are maintained at a sufficient heat for the fusion of the enamel. The middle space B^1 serves as a hot chamber through which the sheets pass one after the other, whilst the top and bottom spaces A^1 and C^1 admit the air to the flames at E, which are used to heat the furnace. The cold sheet enters at D^1, and is gradually heated during its approach to the middle E^1, and is again allowed to cool as it passes through the remaining part of the furnace. By this process panes measuring 8ft. by 7in. can be burnt in one hour. There are three claims.—No. 13723. October 10th, 1887. 8*d.*

COAL CUTTING MACHINES.—*T. Bower, R. W. Bower, & J. Blackburn, Woodlesford, and F. Mori, Leeds.*—These improvements refer to the employment of an electric motor for imparting motion to coal cutting machines generally. The motor is most conveniently placed on the frame work of the machine, and is of any approved form, while the electric motive force is supplied to it through suitable cables from a dynamo engine of high potential. A system of specially arranged gearing serves to engage the motor with the effective machinery of the coal cutter. Between the motor and the dynamo a cut-off motion is employed for the regulation of the speed of the motor, and consequently of the speed of the cutter. Though preferably the motor is placed in the frame work of the machine, it is also admissible according to the invention to place the motor at any convenient spot, and to allow the motion to be transmitted by belt or by static induction. The inventor makes one claim.—No. 1857. February 5th, 1887. 6*d.*

FEED WATER HEATERS.—*A. MacLaine, Belfast.*—The feed water heater which is the subject of this invention is formed of an outer shell or casing, inside of which is placed a hollow perforated cone, whose lower extremity is attached to the body of the outer casing. Inside this cone, and entering through its summit, is the perforated end of a steam pipe communicating with the boiler of the engine. Round the cone, and between it and the outer shell, comes the feed water from the hot-well, and it is drawn through the perforations of the cone in jets caused by the suction of the boiler feed pumps, which are connected by means of pipes to the bottom part of the outer shell. The steam supply intended for the heating of the feed water is conveyed to the inside of the perforated tube, and through the holes of which it expands outwards in jets into the space between the tube and the cone. The jets of steam and feed water there commingle, and an exceedingly rapid condensation of the steam supply takes place, and at the same time an effective heating of the feed water. An arrangement is also made for the extraction of the oil and air from the water. The sectional area of the feed water heater is made much larger than that of the feed water pipes, so that the water in the heater has time to settle, and the oil therein to rise to the top, before its passage through the perforations. A recess is formed round the inside of the upper part of the shell above the level of the entrance of the feed water, and from this recess the accumulated oil rises into a receiver placed at a higher level, and arranged with cocks, gauge glass, and fittings for drawing off the extracted oil at intervals. The air given off in the condensation also rises with the oil, and the receiver is provided with a cock at its upper extremity for releasing the imprisoned air. The claims made are three—for the arrangement of the heater, for the use of the receiver for extracting the oil, and for the combination of these two parts.—No. 3701. March 11th, 1887. 8*d.*

SAWING MACHINES.—*A. B. E. Nilsen & H. L. Mathiesen, Fredriksstad, Norway.*—This invention relates to the sawing machinery used in cutting the bottoms of casks and barrels, and has for its object the substitution of a circular sawing blade for the ordinary vertical blade, which moves all round the whole periphery. The circular blade is fixed round a rotating wheel of the same size as the ends or bottoms required, and the plane of this wheel is parallel to the material from which the piece is to be cut. The accompanying figure is an elevation of the apparatus constructed for the carrying out of this invention. A is a stand which is secured to a support, and mounted therein is a vertically rotating spindle B carrying a horizontal wheel C^2. Upon the circumference of this wheel the saw blade D is fastened by



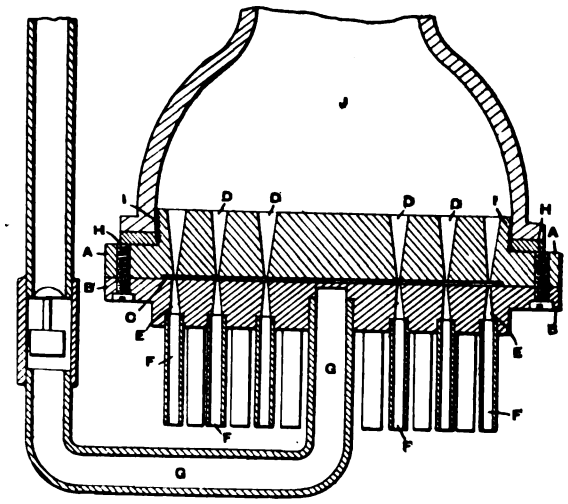
screws. The spindle B is driven by the pulley C, and is raised or lowered by means of the screw F, the gearing G, and the wheel H. A fork I is provided, in order to prevent the screw F from turning with the spindle. The sledge S carries the wood to be cut, which is firmly held in its place by the ring M. This ring encircles the saw wheel, and is pressed against the wood by means of levers N, which are operated by the treadle O. The counterweight P is used to raise the ring, and a long staging R is placed beneath the saw. When the carriage with the wood thereon has been placed under the saw wheel, the workman depresses the treadle O, whereby the ring M is caused to press on the wood. As the saw rotates, the wheel H is to be turned so as to cause the saw to descend further into the wood. The inventor makes three claims.—No. 14403. October 22nd, 1887. 6*d.*

PISTON SPRINGS.—*G. Robson, Sunderland.*—This invention more particularly applies to spiral coil springs of any section used in the packing of pistons, and consists in corrugating the spring in the direction of the junk ring and the flange of the piston. The elasticity of the corrugations affords the necessary pressure to keep the piston rings against the junk ring and the flange of the piston. The inventor makes one claim for the improvement described.—No. 9394. July 2nd, 1887. 6*d.*

HUMIDIFYING AND VENTILATING APPARATUS.—*P. M. Justice, London. (G. Kesselring, Turin, Italy.)*—An air trunk or shaft is led under the floors of the rooms to be ventilated, and the rooms are connected to the trunk by means of pipes provided with ports. Outside the building, and connected at one end to the air trunk, is an underground conduit, the other end of which terminates in a well open to the air. To impart the desired humidity to the air, water jets or spraying devices are situated in the conduit. The water flows off into the well, the level of which is maintained at about the floor of the conduit. The air may be forced through the conduit and trunk by a fan or pump, and any suitable means may be employed for exhausting the impure air from the rooms. Four claims are made for the improved combined humidifying and ventilating apparatus described.—No. 14973. November 3rd, 1887. 8*d.*

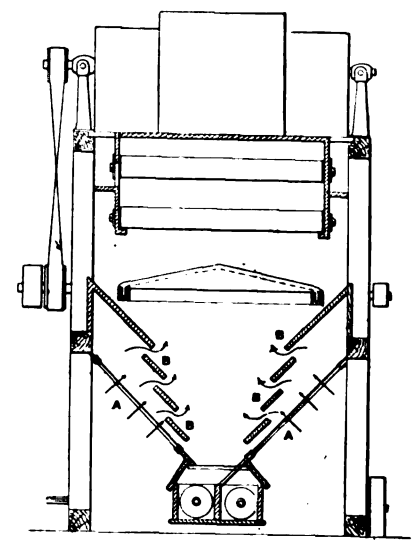
PITCH CHAINS AND CHAIN WHEELS.—*H. Randhahn, Eisenberg, and F. W. Hering, Osterfeld, Germany.*—The improved pitch chain consists of links which may be rectangular or circular in section and shape. Some of the links are provided with pins which project laterally from either side. The chain wheel round which the chain passes has a central groove formed completely round the circumference. The perpendicular links fit into this groove, while the horizontal links lie upon rings surrounding the circumference and adjoining the grooves. The projecting pins fit between two rows of teeth formed all round the circumference, so that the chains are effectually geared to the wheels, whilst the teeth serve to guide the chain in its place. The teeth are made wider at their roots, so as to hold the pins upon the chain, and their points are so formed that the links readily leave them. Those of rectangular shape are preferable, as they fit better into the groove, and for large wheels the use of a considerable number of intermediate links between those provided with pins is advisable. The inventor makes five claims for these improvements.—No. 1788. February 4th, 1887. 8*d.*

VACUUM APPARATUS.—*W. L. Horne, Meriden, Connecticut, U.S.A.*—This invention includes several improved forms of apparatus for producing a vacuum by means of the frictional contact of the air with liquid. The vacuum is caused in two cases by a moving body of liquid, and in a third case by bringing the air in frictional contact with the liquid, whilst the liquid is kept stationary, and by moving the passages containing the air rapidly within the liquid. This third form is used in connection with a liquid reservoir, and requires power to operate it; and the first two forms require a liquid supply having a certain amount of pressure. In all these forms valves are dispensed with. The figure illustrates the mechanism employed in one of the first cases, and shows a vertical section of the vacuum pump. Of the two main plates, A is provided on its under side with a recess C, so that a space between them is insured when the plates are brought together; and tapering holes D are drilled in it, having their smaller diameter in the



lower face of the plate. The lower plate B is also perforated with holes E, which are so shaped that their smaller diameter is a short distance below the upper face of the plate. Their openings are to face the openings of the holes D, and are to be made of a slightly greater diameter. The plate B is also fitted with pipes F, which form continuations of the passages E; their function is to hinder the return of air once expelled through the tubes. The liquid is admitted through the enlarged end J of the supply pipe, and passes through the openings D and E, carrying with it some part of the air from the pipe G, which is connected with the vessel to be exhausted; and by a continuance of the flow of liquid, the vacuum can be perfected to any extent. The inventor makes twenty claims for the combinations in the three forms of the apparatus described in the specification.—No. 14539. October 25th, 1887. 11*d.*

MIDDLINGS PURIFIERS.—*H. Simon, Manchester.*—According to this invention several screens of porous fabric or of granules loosely arranged are placed in the passages by which the air is admitted to the purifier. In manufacturing towns the air is often laden with many impurities, such as soot, and the material under treatment thereby suffers some depreciation in quality and value. The object of this invention is to cleanse the air by causing the deposit of the vitiating constituents of the air on



these movable screens. The diagram indicates the position and arrangement of these screens. The air passes through the screens A, and is deflected and distributed by means of the obstructions B. The inventor does not limit himself to this particular sort of remover of impurity, and claims the application of any screen or dust catcher for the purpose of cleansing the air supplied to the middlings purifier.—No. 1461. January 29th, 1887. 6*d.*

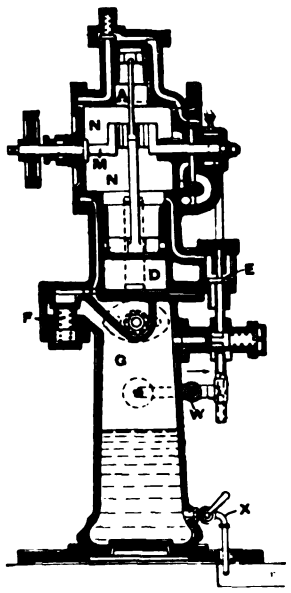
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Wire Nails.—*J. E. Emerson & T. Midgley, Beaver Falls, Pennsylvania, U.S.A.*—The lower portion of the improved wire nail is corrugated, and the outwardly curved surfaces are provided with barbs or projections to prevent the withdrawal of the nail. The upper portion of the nail and a small portion above the point are smooth and cylindrical. The die for forming the nail is constructed in halves, and contains the teeth or cutters for cutting the barbs or projections. Five claims are made for the improvements described.—No. 15246. November 8th, 1886. 6*d*.

Refining Hydrocarbon Oils.—*S. Pitt, Sutton, Surrey.* (*T. G. Hall, Chicago, U.S.A.*)—In carrying out the process embodied in this invention, a cylindrical converter is made use of, which may be provided with tubes or not, immaterially. The converter is preferably of a large size, about 10ft. in diameter and 30ft. in length, and is to be filled half way up with small pieces of granite. The still must be constructed so as to bear a temperature of 460°F. Into the bottom of the still, crude Canadian oil, together with a quantity of steam, is injected by means of a steam injector. In the presence of the highly heated blocks of granite at these temperatures the sulphur leaves the oil, and in the form of sulphuretted hydrogen passes into the water, where it can be detected by the usual tests. The vapours of oil and water are condensed in the ordinary way, and the oil and water are separated by gravity. Other materials besides granite may be used in the purification, such as quicklime, marble, and cryolite, all of these substances being effective agents in the removal of the sulphur from the crude oil. The inventor claims the process of manufacturing hydrocarbon oil, which consists of subjecting the mingled vapours of oil and water to extensive converting surfaces of some such material as mentioned at a high temperature, and in condensing the said vapours.—No. 15256. November 8th, 1887. 4*d*.

GERMAN PATENT ABSTRACTS.

Gas Motors.—*Jacob Faber, Elberfeld.*—The mixture of gas and air passes through the valve E into N, and is forced by the pump D through the valve F into G. From there it enters the combustion chamber behind the pistons of the cylinders A, arranged round the shaft M, and is there ignited. In order to obtain a



mixture of gas and air when starting the engine, the space G is partly filled with water, the remaining space being occupied by air. Now the valves W and X are opened, the former admitting gas into G, the latter discharging the water; thereby the space G is filled with a mixture of gas and air, which is easily ignited.—No. 41483. September 17th, 1886.

Organs.—*Brauner Bros. & F. Drexler, Vienna.*—The iron valve B is pivoted in the centre and has a weight C attached to it. B closes either pipe A^1 or B^1 according to an electrical circuit being

Fig. 1.

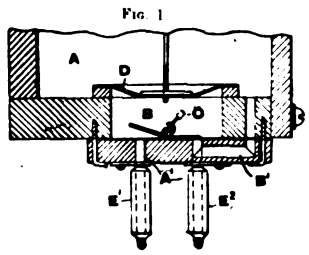
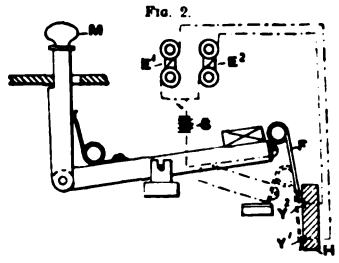


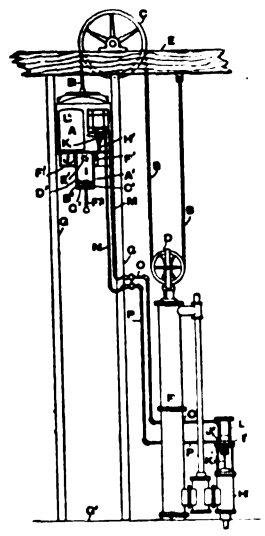
Fig. 2.



established in the electromagnet E^1 or E^2. The pipe A^1 leads into the open air, whereas B^1 connects the wind chest A, constantly filled with air, with the space under the diaphragm D. The closing of the electric circuit in either E^1 or E^2 is effected by moving M up or down, and thereby sliding the spring F over the contacts Y^1 and Y^2 fastened to H, and connected to the electromagnets E^1 and E^2 by insulated wires. The other ends of the magnet's coils are connected to one pole of the battery S, while the other pole is connected to the spring F.—No. 41610. October 14th, 1886.

UNITED STATES PATENT ABSTRACTS.

Elevator.—*C. G. Otis, Brooklyn, N.Y.*—This invention consists of a device for starting and stopping elevators by operating on the valve of the motor from the interior of the car by means of compressed air. In the diagram A is the car, B its supporting rope, which goes over the pulley C and under the pulley D. The latter pulley is fixed to the end of the piston rod of the apparatus F, which supplies the motive power. The valve H controls the

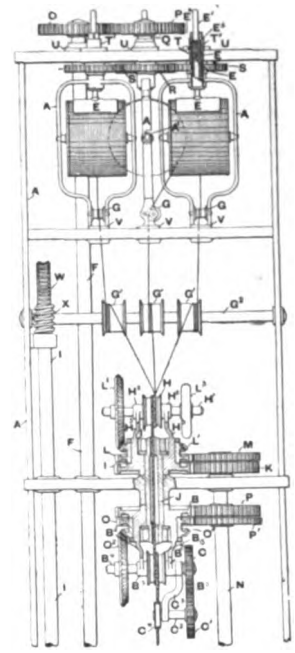


passage of the fluid into the motor F. At the bottom of the car A is an air pump I of any convenient construction. Its piston B^1 is provided with openings C^1, which carry flap valves D^1. The piston rod F^1 is of short length. At the upper end of the cylinder are openings E^1 into an air chamber J, and they are closed by flap valves F^1. A pipe H^1 leads from the chamber J to a valve K, which is operated by a lever L^1 projecting into the interior of the car. From this valve branch out the two flexible pipes M and N, which communicate with the valve operating device L. When the car has reached its lowest position G^1, the piston B is forced up the pump I, and the air therein is compressed into the chamber J. This air can be used to move the piston J^1, either up or down, by means of the lever L^1 and the cock K, and the pipes M and N. The car can thus be started or stopped by a person inside it. The inventor makes four claims for the apparatus described.—No. 369297, dated 30th August, 1887.

Cop Tube Machines.—*F. Moss, New York, and R. Cook, East Newark, New Jersey.*—Improvements are here introduced into the machines for making spirally wound paper cop tubes of the kind used for spinning yarn on mule spindles. The improved machine is mounted on a frame in which is journalled a driving shaft. The shaft carries two pulleys, one fast and the other loose, and two geared tooth wheels, which drive by means of intermediate mechanism the cop tube spindle and the paste distributing band respectively. The cop spindle is conical in form and rotates rapidly, and the tube produced tapers externally and internally. The paste distributing band is so arranged that it may be pressed against and withdrawn from the spindle at pleasure by means of an arm and lever. An automatic arrangement for starting and stopping the machine consists of a spring pressed rod and a cam secured to it, together with a shipper bar and its spring. A throwing off device is also included in the invention. An arm or bracket slides longitudinally on the cop tube spindle, and is connected at one end to a bar, which is held in position by a spring. The arm of the bracket is actuated by a mechanism connected with the starting and stopping apparatus. A strip of paper is held by the operator, who introduces it between the spindle and the belt. The paper is wound on the spindle, and is formed into a solid mass by the paste. By the movement of one handle by the operator, the machine is stopped, the belt withdrawn from the spindle, and the cop tube forced off. The inventor makes three claims for the combination of rotary spindle, paste distributing band, automatic belt shipper, and throw-off mechanism.—No. 373566, dated 22nd November, 1887.

Boiler Furnaces.—*J. Bowe, Chicago.*—The object of this invention is to secure an even and regular draught, and to supply automatically the suitable and necesary quantity of air for the economical combustion of the fuel, and also to provide a means for the completion of the combustion of the gases before their entry into the flues. For the furtherance of the latter object, a bridge wall is built at or about the height of the grate, and is carried back to the rear of the furnace. A raised portion of this wall is in the form of an inverted arch, and is provided with combustion flues and an annular space between it and the boiler. This space permits a portion of the heat to pass between the boiler shell and the bridge wall, so that the boiler is heated throughout its entire length. The bridge wall, being built back to the rear end of the furnace, fills the space usually employed as a combustion chamber, and prevents the formation of eddies in the draught. Opposite the flues which penetrate the raised part of the bridge wall, and just over the furnace doors, are tubular openings in the furnace shell, for the purpose of admitting air into the space above the grate. The ends of steam pipes are led into these openings, and the discharge of steam from these serves to inject the necessary air for the proper combustion of the gases given off in combustion. The supply of this air is regulated automatically, and it is so arranged that most air shall enter directly coal has been added, and that the quantity shall decrease as the combustion proceeds. A small vertical cylinder or dash-pot is suspended on the outside of the boiler, and is filled with oil or water. The piston which fits it has a small hole in it, covered with a flap valve, and the piston rod is weighted and enters the lower end of the cylinder. This piston rod is connected with a valve in the steam pipe, which supplies the steam for the injection of the air, and also with a secondary swinging door of the furnace. The mechanism is so arranged that, when the door is opened and coal put on, the piston is raised to its greatest height in the dash-pot, and the secondary door is opened to its utmost extent to allow of the freest possible entry of air to the grate; at the same time the steam cock is opened and the jet of steam injects the air into the space over the grate. Afterwards the piston gradually slides down the dash-post by reason of the weight attached, and automatically shuts the steam cock and the secondary furnace door, thus decreasing the draught. Eight claims are made for the combinations of parts.—No. 371872, dated 18th October, 1887.

Rope Making Machine.—*T. B. Dooley, Boston.*—This is an improved machine for twisting the strands together with uniform tension throughout the entire length of the rope. The shafts F I N have motion communicated to them by means of bevel gears from a prime mover not shown in the diagram. The shaft F, together with the gear wheels O P R and S S S, transmit their rotation to the fliers A, which carry the spools. E represents a saddle constructed to rest upon the twine on the spool, and fit thereover when the same is full. Extending up from the saddle and through the hollow spindle T of the fliers is a rod E^1, having a pin E^2 secured therein a short distance below its centre. T is provided with a bushing E^3, which has a diameter sufficient to permit a spiral spring E^4 to surround the stem E^1. This spring bears upon the pin E^2 and upon a shoulder E^5 on the nut T^1. The saddle E is thereby pressed downwards on the twine, causing a tension in the strands as they are drawn off; and when the bobbin becomes empty the resilient force of the



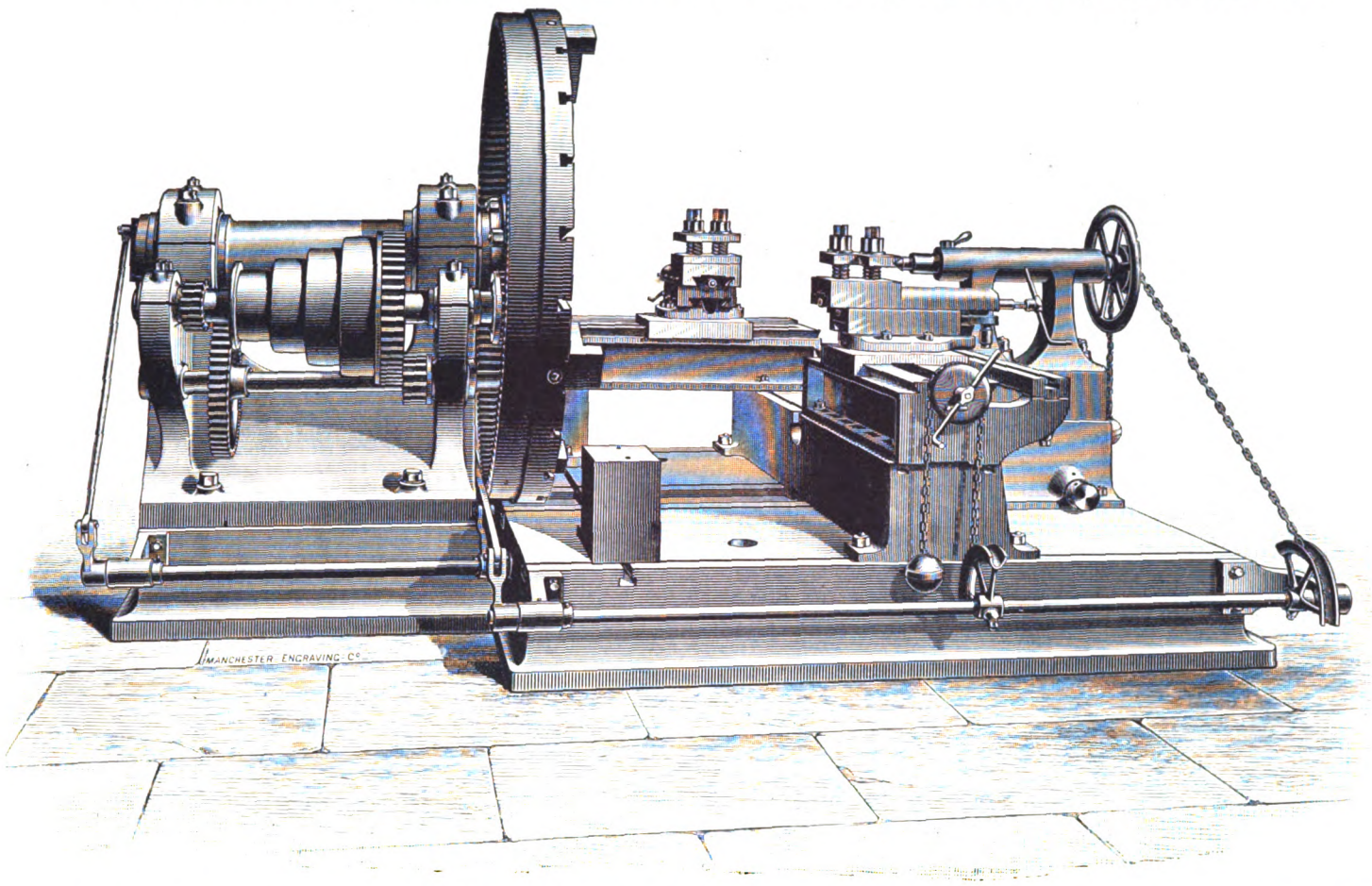
spring relaxes, and the tension is lessened, thus compensating for the increased strain necessarily exerted on the strands to turn the spools when the radius becomes smaller. The strands are then led over the pulley G, and the rotation of the fliers tends to twist them. The twisted strands proceed over the wheels G^1, which are turned by the action of the worm and wheel X and W. The mechanism shown in the lower part of the figure is intended for the union of the strands and the formation of the cord. The shaft N, carrying on it the gear wheels M K P^1 P^2, transmits motion through these wheels to the wheels L^1 I^1 B O^2 respectively. It is so arranged that the shaft H, carrying the flier spool H^1, shall rotate by means of the bevel L^2, and at the same time its bearings H^2 revolve through their connection with I^1. The toothed gear K is provided with one less tooth than M; and the arrangement of the gearing B and O^1 is similar to that of M and K. The twisted strands are taken up and fed forward to the rope flier spool H, where they are laid up into a rope by the revolving head, through the motion imparted to it by the gear wheels on the shaft N. The inventor makes eight claims for these improvements.—No. 373800, dated 22nd November, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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AN IMPROVED FACING LATHE.

CONSTRUCTED BY MESSRS. HETHERINGTON & CO., ENGINEERS, MANCHESTER.



AN IMPROVED FACING LATHE.

WE illustrate above an improved facing lathe recently constructed by Messrs. Hetherington & Co., and specially designed for use in a general engineering establishment. The face plate, which is 7ft. in diameter, is fitted with a four-jawed chuck, and revolves on a cast iron spindle having a 10in. neck. The face plate is driven by means of an internal toothed wheel into which a pinion gears, and the machine can be either used with single, double, or treble gearing, and is therefore of a powerful type. The slide rests are two in number and are compound, being fitted with self acting feeds. They are carried by a saddle extending across the bed plate, and are arranged so that they can be swivelled when required for longitudinal sliding. For this work the rest is arranged as shown in the illustration, and it may be noticed that its free end is sustained by a pillar placed conveniently near to the face plate. The rests can be also arranged to follow a former when curved or profile is required. The loose head stock is also arranged as a boring head and fitted with a self acting ratchet feed, this being very convenient in many instances. A fly wheel for instance could thus have its rim faced and surfaced or its boss faced, while the latter was being bored. The lathe is provided with a very massive bed and is strongly designed throughout. It weighs altogether about 12 tons, and is well finished, and the workmanship throughout is of a high class character.

NEW MALTING AND SCREENING MACHINERY.

ONE effect of the abolition of the duties on malt has been to increase the trade in foreign barley. The hampering effect of the Excise restrictions, by which everything in connection with malting was done under stringent rules and regulations, prevented any experiments in the use of what may be briefly described as Eastern barleys or barleys grown in a hotter climate than that of the temperate regions of Europe. These barleys all swell when wetted considerably more than English, French, and German barleys. Hence the maltster using these dry barleys would find himself mulcted in higher Excise duties than on English grown barley, since the duty was always levied by measurement after the grain was wetted or steeped. The duty being now abolished, the maltster is free to import his barley from any quarter he may think fit, and accordingly the trade in barleys imported from France, Germany, Denmark, the Danubian provinces, and the Eastern countries already referred to, has largely increased. The trade with the latter countries is, however, the most important. This development in the foreign barley trade places maltsters situated on the coast or on a navigable river at a great advantage over those in our inland towns. Hitherto most malting has been done in the inland towns, such as Newark, Grantham, Burton, Lichfield, and other towns —proximity to the barley grower being of importance. Now this consideration is of less importance than formerly, and when foreign barley is used for malting purposes in the inland towns, the question of railway rates for transporting the grain is a serious item. The maltster on the coast can ignore this question. He can receive his barley from all countries direct into his granaries, and is in a good position for delivering his malt to all brewers in easy reach of the coast.

We recently had an opportunity of inspecting some extensive new maltings and screening machinery, which have been erected by Messrs. Free, Rodwell, & Co., at Mistley, Essex. This town is favourably situated on the navigable river Stour at a distance of 10 miles from Harwich, and steamers of 500 tons burden and sailing vessels of 350 tons can be unloaded at Mistley. Messrs. Free, Rodwell, and Co. unload the imported foreign barley direct from the ship's hold into their granaries. In addition to having facilities for dealing with foreign barleys, this firm have railway sidings in all parts of their works in direct communication with the Great Eastern main line, so that they are in a position to receive English grown barley or to dispatch malt by rail to all inland towns. The malt from Smyrna barley is fast growing in favour with brewers, as it possesses some properties which have a more rapid fining effect upon beer than English and many other barleys, the effect being that the process of brewing can be finished two days earlier than with English barley. This is an advantage of no mean importance to brewers in large towns where space is valuable, and London brewers especially appreciate the advantage greatly, as they can deliver beer to their customers within six to seven days from the commencement of operations. Thus one effect of the abolition of the malt tax, by encouraging the use of Smyrna barley, is to enable the London brewer to turn over his capital more quickly than formerly. Unfortunately Smyrna barley, as imported, has serious defects. From the slovenly habits of the cultivators of the soil, tares, grass, and other seeds are abundantly mixed with the barley, and the rude method of thrashing by oxen on an earthen floor contributes dirt and rubbish to further deteriorate the quality of the barley. These defects are well known to dealers in barley, and have checked the probably more rapid increase in its use. Good cleaning machines are a desideratum if Smyrna barley is to be used for malting purposes. Hitherto agricultural implement makers have designed their screening machinery with a view to its being used upon English grown barley, or at any rate for barley grown by farmers who take the trouble to keep their land clean and free from tares, and who use thrashing machines of some description or other.

Messrs. Free, Rodwell, & Co. appreciating the fining properties of Smyrna barley, and the probable rapid increase in the trade, have, after one or two experiments, put down a most complete set of screening machinery. After passing through the screening machinery, the barley is as clean as the finest English grown sample. The machinery has been constructed by Messrs. Vangelder, Apsimon, & Co., of Sowerby Bridge, and is capable of cleaning 200 bushels per hour. Briefly described, the barley passes through two sets of machines. The first, known as the "Victoria separator and eccentric grader," does the rough work, separating the sample into coarse refuse, large tares, and three grades of barley. This machine is, in principle, a series of five reciprocating sieves, with different sized perforations. These sieves or screens deliver at different spouts, the material passing over them, and are worked from an upright shaft by eccentrics and connecting rods. An exhaust fan acting on the barley sucks up any fine dust or light grains, and delivers the refuse which collects in an enlarged pocket of the main pipe by a spout into sacks. The exhaust can be regulated by a movable sluice to any degree of suction. It can readily be understood that simple sieves will not extract broken or half corns, nor tares of a diameter equal to that of the barley. This machine alone is, therefore, insufficient to do the whole of the work, and the final cleaning is done on other machines, consisting of six pairs of cylinders, each about 2ft. diam. and 8ft. long. The cylinders are arranged in pairs, one over the other, the upper cylinder acting as a separator to extract the smaller tares and half corns from the whole barley, and the lower as an ordinary screen. The upper cylinder is not perforated, but covered with hemispherical indentations smaller than the length of a grain of barley, though larger than a half grain. Hence the half grains,

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tares, and other seeds left from the first machine fall into the indentations or recesses, and are carried round in them until they fall into a trough below, in which an endless screw works, and delivers into sacks at the end of the machine. The whole grain barley, which is thrown against the side of the upper cylinder above its horizontal centre line, is kept from going round with the cylinder by a series of scrapers, resting on the cylinder as it revolves. The full grains, of course, cannot fall completely into the recesses in the cylinder, and anything projecting from the recesses is pushed out by the scrapers, and by them conducted into the feeding trough to be presently described. The barley is fed to the different cylinders by an endless screw working in a trough at the ends of the cylinders, and at right angles to them. In this trough are openings delivering the grain into the cross or feeding troughs, one to each upper cylinder. In these cross troughs revolve blade propellers throwing the corn, as mentioned above, against the revolving cylinder in an oblique direction. The barley is thus being continually thrown up by the blades and returned to the trough by the scrapers, and at the same time gradually advanced by the oblique action of these blades. In this way the seeds and half corns are gradually separated as the barley travels along the trough and cylinder. The barley passes then through the lower or screwing cylinder, where it is acted upon by a second exhaust fan to draw off all light corns and other refuse which is useless for malting purposes, and which had escaped the action of the first machine.

The foreign trade in barley is capable of great increase, and it is therefore of importance for a maltster to be alive to the necessity of being supplied with the most efficient screening machinery able to deal with all classes of barley, from the Smyrna with its heterogeneous rubbish to the best English, in which only broken corns have to be taken out. This year the crop of English barley is deficient, and this deficiency must be supplemented with supplies from abroad. Hence efficient screening machinery is at the present moment of considerable importance. It must, however, not be supposed that screening machinery is only useful on foreign barley. In a very dry summer English barley is brittle and easily broken in thrashing. Broken barley is useless for the brewer, and the machinery above described could, with advantage, be used for separating these half corns even in English barley. The improvements in screening machinery just described may be said to be due to the abolition of the malt tax, a result probably not contemplated by the introducer of the Bill.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting held on the 10th of January, the paper read was on "The Use and Testing of Open Hearth Steel for Boiler Making," by the late Mr. Hamilton Goodall, Assoc. M.Inst.C.E., which gave the experience of the author in the use of open hearth steel for boiler making since the year 1875, and described numerous experiments to ascertain the cause of the difficulties met with in working the plates. To avoid spoiling a plate by taking pieces from it for the purpose of testing, a drifting test was adopted, in which washers were prepared from the material removed from the plates in making rivet holes, and drifted in a special machine to the bursting point by means of a series of drifts having a taper of $\frac{1}{4}$in. in 5in. In the majority of tests the washers were drilled out at right angles to the surface of the plate, but in some cases they were drilled out parallel to the surface; the outside diameter of the washers was $\frac{1}{16}$in. with a drilled hole $\frac{1}{4}$ (0·234) in. in diameter. Tests were also made to ascertain the load on the drift necessary to break the washer, and to establish some relation between the elongation of a washer and the elongation in a length of 8in. of plate. Preliminary tests, with washers cut from shell plates, having an average tensile strength of 26 tons per square inch, gave an average drifting diameter of 0·645in.; from back tube plates and furnace stiffening rings it was 0·644in., corresponding to an extension of 27 per cent. in 8in. These sizes were taken as the normal diameters for a good plate. The investigations of the author were specially directed to obtain a solution of the difficulties experienced in using steel plates, and included experiments on the welds of furnaces, the effects of hammering, of compression, of punching and shearing, of flanging, of annealing, and tests of defective plates. With respect to welds of furnaces, tests were made with washers taken from five stiffening rings, flanged after welding; three of them were good welds, and gave an average drifting diameter of 0·447in.; the diameter of the other two was only 0·328in.; a diameter of 0·406in. was considered to indicate a fairly good weld. In a further test of washers from another stiffening ring $\frac{1}{2}$in. thick, the diameters varied from 0·625in. to 0·312in., the elongation being reduced to about 3 per cent. in 8in. This plate manifested no outward signs of being damaged. Tensile tests proved that heating the ends of shell plates and hammering to the required curve for butt straps or lap joints was, in some cases, injurious, the elongation having been reduced from 28 down to 6 per cent. in 8in. The plates were then set up cold, as tensile tests indicated that apparently no harm was done by this. But a number of drifting tests soon showed that the effect of cold hammering was to reduce the ductility of the material; the extent was equivalent to an average loss of elongation in 8in. of from 5·01 to 7·89 per cent. Nor did annealing restore the ductility, as in all cases annealed washers from the unhammered part of the plate gave a larger drifting diameter than from the hammered part. Cold hammering was therefore also abolished, and all bending was done in the rolls. Drifting tests of washers taken from a flanged end plate, which cracked in riveting, were given. These showed considerable irregularity in the quality of the material, the results leading the author to believe that steel was distinctly inferior to iron in its ability to resist the effects of heating and hammering, which he attributed to an absence of homogeneousness. Compression did not seem to be injurious. Drifting tests were made with washers cut from burrs punched out of plates, and from plates squeezed up in a hydraulic riveter under a pressure of 20 tons per square inch. The thickness of the burrs had been reduced by the compression from $\frac{13}{16}$in. to $\frac{3}{4}$in., and that of the plate from $\frac{13}{16}$in. to $\frac{3}{4}$in. and $\frac{23}{32}$in. The drifting diameter of the former was 0·614in., and of the latter 0·687in.; hence it was concluded that compression up to 20 tons per square inch was not injurious. With regard to punching and shearing, experiments were made to determine how much it was necessary to chip off the edge of a plate so treated to prevent its cracking when stretched in flanging. Washers were taken from near the punched and the sheared edge, and from the solid part of a plate. The result was that the average drifting diameter of washers cut out at $\frac{1}{32}$in. from the edge was a little less than from the solid plate; hence an amount of $\frac{1}{32}$in. was all that was necessary to remove from the edge of the plate. When a piece of $\frac{3}{4}$in. plate was flanged to a right angle, with a 3in. inside radius at one end, diminishing to a square corner at the other, washers drilled out of the top of the radius and tested showed from their drifting diameters that a large radius was preferable to a small one; but that even with a large radius the inside suffered from the compression to which it was subjected. The drifting diameter of washers taken from the corner of a shell plate, which cracked while being thinned under a steam hammer, varied from 0·5in. to 0·687in., representing a difference of elongation in 8in. of from 15 to 31 per cent. This method of thinning corners was therefore abolished, where practicable, in favour of scarfing them in a machine, although further tests of washers cut from plates worked in both these ways gave results almost identical. A plate overheated through flanging was found not to have sustained so much harm as might have been expected. The author specially wished to direct attention to the following points: (1) Was a steel plate damaged by local heating? (2) If damaged, was it restored wholly or partially to its original strength and ductility by annealing? (3) Had tests been made to determine these points; or, if not, were any results published to show that a certain percentage of steel plates had failed, while, under precisely the same conditions, the percentage of failure with annealed plates had been less? From numerous tensile tests of plates unworked and locally heated, it appeared that sometimes the breaking strain was apparently increased by annealing, and sometimes diminished, the majority being in favour of the latter; with the elongation of the tensile and drifting tests, the reverse was the case. Drifting tests were made with washers cut from the saddle plate of a furnace, from a top back shell plate, and from a furnace stiffening ring flange. In the former, the average tenacity and ductility were reduced by annealing, while, in the latter, the results with annealed and unannealed washers were practically identical; from this it did not seem that there was any advantage in annealing plates. With regard to the effects of heat, and respecting defective plates, the results of tensile and drifting tests, taken from a back tube plate of special quality mild steel, an ordinary back tube plate, a middle back plate, and a top back plate, which cracked or otherwise failed in working, showed in some cases considerable drifting variation, and much irregularity in the ductility of the material. A diagram was given of the possible combination of contiguous particles in a plate, as represented by the equivalent elongation in 8in. In the opinion of the author the want of uniform ductility was the only remaining difficulty in the use of steel plates, and one which steel makers might remove, if they could, by a thorough mixing of ingredients, make a homogeneous material; he believed if this were done little more would be heard of cracked plates. Finally, the author stated the results of tests of plates of a higher tenacity then generally used; but the plates had not been specially prepared, and did not represent the best results obtainable. He suggested that if steel makers could increase the thickness of ingots, and improve the homogeneity of the metal, there was little doubt but that plates of much higher tenacity could be used than at present. Probably in addition to the special mild steel for the plates of furnaces, and the other quality, which was the same for flanging purposes and for shell plates now in use, it might be possible for steel makers to introduce a third quality for shell plates only, and by gradual steps to obtain a considerable increase of tenacity of the material. At the same time, a uniform width should be specified for the samples tested, and some stipulations made as to the minimum proportion to be allowed between the breaking strain and permanent set. From figures supplied by Mr. E. D. Leavitt, jun., of Cambridgeport, Mass., of tests of steel boiler plates, the average elastic limit was equal to 70 per cent. of the average breaking strain; whereas, in specimens tested by the author, it had been as low as 48 per cent., and had never exceeded 66 per cent. The paper concluded with a record of the experience of the author in regard to rejected and spoilt steel plates for boiler making as compared with iron since 1875; the failures in working, and from defective plates, being greatly in favour of steel.

MODERN MACHINE TOOLS.*

Before commencing his address on the above subject, Mr. Dixon first thanked the members for electing him president, and remarked that being better acquainted with the construction of machine tools than any other branch of engineering, he had chosen this for his subject. He then went on to say that it was not necessary to go far back to find a time when machine tools, beyond the foot lathe, the drilling machine, and a rude apparatus for boring cannon, did not exist, or if existing, were of the most primitive form. Watt found in the year 1764 that some of his greatest difficulties arose from the absence of any machine where-with to do some parts of the work, his chief one being the necessity for some means of boring cylinders. With his first engine cylinder he had differences of diameter to overcome, so much as $\frac{1}{8}$in., and it is said that its piston remained leaky though he packed it with "paper, cork, putty, pasteboard, horse dung, and even old hat." When he at last got one bored, he was so pleased that he wrote one of his friends, and said that "he had his cylinder now bored so perfectly that you could not get half a crown between the cylinder and the piston anywhere." The necessity for the accurate construction of steam engines gave rise to many inventions, and the history of the development of machine tool making explained why Manchester became such a centre. It seems to have been in the workshops of Mr. Joseph Bramah, of London, that attention was first systematically given to the construction of machine tools. In the year 1795 Bramah invented the hydraulic press, and had doubtless felt the very keen demand for means of accomplishing many desired mechanical constructions. In addition to the hydraulic press, with which his name will ever be associated, he gave very considerable attention to machine tools. Being the inventor of a new lock, he found it necessary to devise a series of special machines for their manufacture, and it was on this work where a revolving cutter or milling tool was probably first employed for producing plane metallic surfaces. About the year 1802 he brought out many improvements in tools, and it was in his workshop about this time that Maudsley, his foreman, first introduced, if not actually invented, the slide rest; an invention which more than any other has undoubtedly advanced the construction of mechanism to its present efficiency. Although it was probable that the slide rest was in use in France to some extent before Maudsley's time in England, it is not likely that he knew what was being done in France, although he may possibly have seen a model of one introduced into England from Holland. Joseph Clement succeeded Maudsley as Bramah's foreman, and on the death of the latter, in 1814, commenced business on his own account, employing only about thirty men of the highest class, one of the chief being Whitworth. Clement largely improved the slide lathe, and invented that exceedingly perfect and beautifully simple contrivance known as the "Clement" driver. A noted group of men of the last generation sprang from these workshops, including Roberts, Muir, Lewis, Nasmyth, and Whitworth, Roberts being the inventor *par excellence*, whose fertile brain was ever ready to pour out new designs and invent to order, while Whitworth duly recognised the fundamental importance of mechanical accuracy in machine tool construction, seeing clearly that machine tools being simply instruments for reproducing upon objects some essential part or parts of their own construction, it was absolutely essential that they should be perfect. While Watt, in 1769, rejoiced that his cylinder was so well bored that he could scarcely get a half-crown piece between the piston and the cylinder, Sir Joseph Whitworth, in 1840, produced cylinders and pistons so perfect as to differ by less than one-millionth part of an inch in diameter. Reference was then made to the work of Sir Joseph Whitworth in establishing a true plane, standard measurements, and screw threads, the latter at present being gradually adopted as a standard on the Continent of Europe. In considering the fitting of a well equipped establishment, adapted for general engineering work, reference was made to the foundry and the great advances in lifting plate and wheel moulding appliances. Mr. Dixon mentioned a curious practice he had met with in a Belgian workshop, which was, he believed, the only place in the world where moulds are made from drawings only, or more correctly without patterns, and these not simple ones, but extremely difficult ones. The castings seemed perfect in every respect, and he was assured by one Corliss engine builder who had all his castings made by this process that there was distinct economy in it. He simply sent his drawings to the foundry, and had made no patterns whatever since its adoption. The development of the smithy tools, beginning with the steam hammer invented by Nasmyth in 1838, and ending with the hydraulic forging machines of Whitworth, was next mentioned. The class of cold and hot saws and mechanical hammers were also mentioned, and the author then passed on to consider the subject of planing. The planing machine was entirely the development of the present century, and about its origin an exceedingly hot controversy had raged. It was very probably developed by several people; but it certainly existed in a fairly perfect form about the year 1820, in the works of Fox, of Derby, widely noted for his excellent productions in textile machinery and tools. The first publication having reference to it was in 1825, when Clement, of London, received the award of the Society of Arts for his machine. From the table driven by a chain and running on numerous friction rollers it was by Whitworth much improved, as he recognised the vast importance of accurate slides. The forms of these slides were originally vees, or one vee and one flat, and these vees, after gradually increasing in the angle, have steadily approached, and have now in the most improved machines become flat slides. These, with vertical guides to prevent the lateral motion of the table, are capable of taking heavier cuts with the same strap power, the vertical guides preventing the possibility of the table yielding when taking heavy side cuts. For most ordinary dimensions of objects, say up to 30ft. by 10ft., it is still the practice to reciprocate the work upon a table rather than traverse the tool; but this raises an important feature in machine tool construction—to determine the limit at which it is more profitable to move the cutter to the work rather than the work to the cutter. Considering the question of space alone, the former requires for an object 30ft. long, a shop length of at least 60ft., whereas by the latter it would be accomplished within a length of about 36ft., an important consideration. Considering the question of the weight of the object, it would certainly seem more natural to manipulate the tool rather than the work. This has been, to some extent, adopted, particularly in those immense side planing machines, where objects of any size may rest upon a foundation plate, and have the sides planed 10ft. or 12ft. high, by a tool traversing either longitudinally or vertically. In the most modern planing, the various motions of the tool are so arranged as to plane every side except one (that upon which it rests on the table) of a complete cube, and these perfectly true with each other, and also at one setting. Machines adapted for cutting in both directions were introduced by Whitworth many years ago, in the well known "Jim Crow" tool box, and in recent

*Abstract of Presidential Address to the Manchester Association of Engineers, given by Mr. Samuel Dixon, M.Inst.M.E., 14th January, 1888.

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years an attempt has been made to revive the practice of cutting in both directions; but so far, except on special objects, without very encouraging results. Some of the lines upon which it is probable the future planing machine will be developed might be indicated; but as its very existence is menaced by the advancing milling machine, it would not be profitable. The next group of machines are the boring machines, a very considerable family, even without considering the special varieties. The process of boring is one of great antiquity, and was first employed for cannons, the method of fixing the cutters in a revolving head being not very widely different from the practice of to-day; but accurate boring does not go beyond Watts' day. The method of procedure for such objects as cylinders differs somewhat in practice, but in most cases it is by a boring head carrying the cutter traversing on a stout bar. The most modern practice seems to be to take a heavy, roughing cut through the hole, and then finish by a light cut having a traverse of some $\frac{3}{32}$in. to $\frac{1}{16}$in. per revolution, thus avoiding the wear of the tool, which, of course, tends to make the hole conical. The boring of large objects is one giving rise to many special forms of machines adapted for particular purposes; but the general tendency of all modern work among large objects is to machine as many parts as possible at a single setting, thereby insuring greater accuracy, and the saving of the time required to transport the object and re-set it upon another machine. Take the case of the Corliss engine cylinder. Not only must the machine be capable of boring and facing up the main cylinder, but it must also be able to bore at the same time two of the transverse holes for the circular valves, to face or mill their flanges, drill and tap all the stud holes, insert all the gland studs and cut them off to a given length, and with every operation within the control of a single workman. The slotting machine invented by Roberts about the year 1820 remains much the same in general form to-day as when it left his hands, though it has now grown to enormous proportions. This machine, together with its sister, the shaping machine, invented by Nasmyth, have been very greatly improved in detail, which tends to eliminate their points of weakness, and to give them greater solidity and capacity for heavy cutting without vibration. Drilling machines have advanced in solidity and accuracy of construction, which has been aided by the introduction of the twist drills, now very systematically produced in America and England. As these enable much heavier cuts to be taken, it has been necessary to largely increase the strength of the machines, both to drive these drills and also to resist the increased strains brought upon them. Among the more universal drilling machines, such as the radial machine, modern practice demands that not only shall holes be drilled, but where necessary shall be instantly tapped by the machine, so as to insure perfect accuracy, and dispense with the tedious and imperfect practice of tapping holes by hand. An excellent method of doing this is by having two spindles upon the same saddle, running at different but relative speeds, so that instantly the hole is drilled the second spindle, by a single movement, can be brought over the exact centre of the hole, and the hole tapped any desired depth. This can be done without stopping or reversing the machine, and without altering a single belt. The next group is that of lathes, which are probably a high development of the potter's wheel. The first step from the potter's wheel to that of turning an object between two centres was a very great one, and came about gradually, it being hardly likely that anyone could reason it out. With the introduction of the slide rest by Maudsley and the extension of these principles to the slide lathe by Clement a great advance was made, which was steadily continued for many years; but during recent years there have been vast strides made, necessitated mainly by the increased magnitude of the work to be accomplished, and also by the increased competition. The chief direction has been in the multiplication of cutting tools, for a workman cannot now be permitted to gaze vacantly at the slow advance of a single tool. The number permitted on any lathe for general work should never be less than two, in shafting lathes three tools, in a lathe for heavy forgings four to eight, in pulley lathes four to six, and in fly wheel and rope pulley lathes from eight to sixteen tools should cut at the same time. Our steel works for producing heavy forgings now require the construction of enormously powerful lathes with four, six, or eight tools, each capable of taking a cut 1$\frac{1}{2}$in. deep by $\frac{1}{4}$in. thick, or capable of cutting off something like 5cwt. of steel per tool per hour. With constructions steadily increasing in size, the consideration of how to turn the heavier pieces has led in many works to the great neglect of the cost of producing the small pieces, such as studs, pins, screws, &c., and as these form a most important part of all mechanism, they are a fine test of the efficiency of any workshop. If the time taken to produce a small stud or screw in any workshop is noted, the general tone of the establishment can be easily arrived at. There is nothing so trying as some of the smaller screws, it being frequently found that the screwing appliances are either very primitive or very badly kept. Formerly it was the practice to forge, centre, and turn every stud, pin, and screw between centres; about the most costly process that could be devised. To-day, in the best workshops, this is almost entirely dispensed with, the innumerable host of studs, pins, screws, &c., being turned direct from the solid bar, the cost being but a small fraction of the original process, and the quality of the work produced much superior. It is not merely in small diameters where it is advantageous, but it is often economical for diameters so large as 4in. In such lathes, instead of a single tool, a series of five or six tools arranged in a capstan or circular rest are used, each adapted in form to the several operations, and so arranged that any one can be brought into operation instantly. This species of lathe is one of the most valuable improvements of recent years. A lathe of this type for use where a great number of small screws are made, has been still further developed by being rendered entirely automatic, so that in establishments for the manufacture of screws in great quantities, these machines need only the bar to be put in, and all the operations of advancing the bar, turning, facing, heading, pointing, screwing, and cutting off the stud, are performed quite automatically. The most beautiful example of this was one adapted for watch screws, at the Inventions Exhibition, where the screw was completely turned, and cut off from the wire, and then passed over and presented to a saw and the head nicked—all being automatically done. A comparatively recent development of the lathe has been for the purpose of making articles in duplicate. Modern methods requiring greater system and interchangeability of parts, has necessitated the perfect control of the tools of the lathe in their movements, both as to diameter, and also as to the length turned. The next group is milling machines, the most modern of all, and well worthy of the great attention paid to them by engineers. So far as extended practical use is concerned, they are modern, but by no means modern considered as a process of cutting metals. This process of cutting metals by means of revolving circular steel cutters, having a number of cutting edges, was used to some considerable extent by Clement about 1830 for grooving taps, &c., by fixing a revolving cutter to the slide rest of a lathe. It was here probably where Nasmyth and Whitworth first became acquainted with the system. The simplest form of milling is that of a number of separate tools fixed in a revolving head so that the ends project and form cutting edges. This is a kind of cutter which is largely used, having a diameter of several feet, for many purposes of rough cutting, such as squaring up parts of girders, cranks, &c. The great step in milling was the introduction of the emery wheel for the purpose of sharpening the cutters, and being in considerable doubt as to whether the emery wheel was first made in this country or introduced from America, the author made careful inquiries, and found it was the invention of the late Mr. George Hannay, of Ulverston, brother of Mr. Hannay, of the firm of Schneider & Hannay, the original founders of the Barrow Steel Works. The introduction of the emery wheel, and speedy invention of numerous highly ingenious ways of using it, supplied the great and long felt want for sharpening the circular cutters without softening them. Another step of smaller moment was the introduction of spiral cutters, tending towards increased finish of work. One of the great advantages of using circular cutters as against the single pointed tool is the increased cutting speed at which they can be used. In an ordinary sized cutter there is ordinarily thirty to forty teeth, and as each cutting edge is therefore in operation but about one-tenth of a revolution, and cooling down the remainder of the revolution, it may be run for this short period at a considerably increased speed. The highest cutting speed for wrought iron, with a tool continuously employed, is known to be 20ft. to 30ft. per minute; but when milling a cutting speed of 60ft. to 80ft. per minute can be employed, and the saving of time by using the milling cutter is from 20 to 50 per cent. Many persons consider these milling cutters very fragile; but it is curious to note that the snipping and fracture does not occur when actually cutting, but when running the work against the cutters before the self acting feed motion is put on. This suggests a remedy, which is, never to allow the workman to run the work up against the cutter by hand, or until he can feel it, but to stop, say a short distance from it, and set it in the self acting feed. There is no group of machines which so thoroughly test their own sound construction as do milling machines, for unless the greatest solidity, together with the highest accuracy of construction, be employed, they are practically worthless. When well constructed they promise to become one of the most capable tools of the constructive engineer, for not only is the work produced in greater quantity, but it is also more perfect, and requires little or no further finishing at the hands of the workman. In addition to the ordinary forms of straight lines and circles of which constructions are usually made up, this process of cutting metal lends itself very advantageously to the machining of irregular forms, or profiling, as it is called. Probably the finest specimen of machine work the author had seen was a connecting rod, with its straps, steps, cottar holes, cottars, and everything complete, which had been finished entirely by machinery, and had never been touched with the file. This was done by a foreign firm, but it was quite exceptional. A list of the special machines for locomotives with which the author was acquainted comprised at least forty-five distinct tools specially dedicated to the construction of locomotives, without considering the machines employed in producing the numerous fittings, such as injectors, &c., and of those ordinarily used for repairs. Formerly the thread of a screw bolt was formed by its being made to revolve between a set of dies, which were so horribly designed that the thread was more pressed upon the bolt than cut out, and the bolt had to be traversed backwards and forwards several times before anything approaching to a complete thread could be obtained; to-day, after a thorough study of all the special features entering into the process of screwing a bolt, it is possible to produce a most perfect thread to a standard diameter, pitch, &c., at a single passage of the bolt through the dies, even in bolts up to 3in. or 4in. diam., and without the slightest necessity to stop or reverse the machine. Among small bolts, say $\frac{3}{4}$in. diam., but twenty years ago a production of something like half a gross per hour would have been considered good work, and these would have had but indifferent threads; but to-day as many as six gross per hour can be produced with perfect threads. Apart from the numerous machines used in forging the nuts, &c., there is an extremely interesting series of machines for producing bright nuts, and just as it was in former years regarded a masterpiece of handicraft to produce a perfect bright hexagonal nut by hand, so it is to-day a by no means contemptible performance to produce one of these same nuts rapidly by a series of special machines.

After remarking that there were several special branches in which there was a great call for special tools, the author said that the advance in the making of boilers was very remarkable, and was necessitated by the high pressures now demanded. Another important step was the introduction of steel plates, giving as it did the opportunity of obtaining plates of almost any size, so that to-day plate planing machines, adapted for plates up to 30ft. long, and rolls to correspond for bending plates up to 1$\frac{1}{2}$in. thick, are made. In addition to the many special machines adapted to particular types of boilers, such for instance as the flanging and the turning and drilling of the Adamson flues, the Galloway tube, &c., there are numerous machines adapted for various types of boilers. Formerly, with iron plates and low pressure, the punching of the rivet holes was considered quite sufficient; but to-day, with high pressure and steel plates, the boiler maker cannot afford to run the risk of damaging a steel plate by punching, and his reputation by the consequences which would arise from a flaw escaping undetected. When the demand was first made for having all rivet holes drilled after the plates were in position it was considered to be an enormous increase upon the cost of a boiler, and doubtless the primitive appliances then available for drilling the shells, flues, &c., were highly suggestive of such a result. With the demand has been a rapid development of special machines for this purpose, commencing with the simple radial arm drill, then the two-headed horizontal drill of independent action with the boiler shell suspended from the crane. This machine necessitated the marking out of the plates. The next step was with three horizontal drills around a circular table, upon which the shells were mounted and divided circumferentially by mechanical means. This machine was improved considerably in detail and gave good results; but the latest improvement is a machine in which six drills, all under the control of one man from a single position, are in operation either upon the circular or longitudinal seams, so that now the cost of drilling a boiler is no more than that of one with punched holes. In summarising a few of the leading features of what may be considered as the modern machine tools, accuracy of construction takes the first rank, and this refers not only to the accuracy of a new machine, but to all those costly though highly essential adjustments for retaining its original accuracy during its lifetime. The machine must be accurate in itself, and also be capable of producing thoroughly accurate work by the exercise of moderate skill on the part of the workman, for well known impediments have rendered it desirable to rely as little as possible on the highly skilled workman. Solidity of construction is also essential, giving vastly increased capacity of production, the competition of to-day demanding the accomplishment of any given work in the least possible time. It should be noted how important it is in metal cutting machines that all parts should not only be able to resist breaking strain, but that they should be sufficiently massive to resist vibration, as the effect of every vibration is plainly seen upon the work. The effect of vibration is also felt in the durability of the cutting edge of a tool, for, where both the work and the tool can be held with an unflinching tenacity, the durability of the cutting edge will be very greatly increased. The rapid wear of a tool is often brought about by the snipping of the edges from the vibration in the first instance, rapid deterioration setting in immediately afterwards. The development of appliances for the rapid changing and accurate setting of work is also essential, and can be shown to be so by examining the machine tools of any large workshop, and noting down on one side the machines actually at work, and on the other side those not actually cutting, but stopped for adjusting, setting, or changing work. The proportion will vary with different classes of machines; but it is surprising to find how many are stopped from one cause or another. Here is one of the points where the construction of specialties in quantity gives an advantage, for where the work is in sufficient quantity special appliances are quickly contrived not only for insuring accuracy, but for the rapid changing and setting of work. A further essential feature is the adaptation of almost all machine tools to the particular requirements of each workshop. This has been brought about by machine tool construction having become a highly special branch of engineering, to which many engineers have exclusively devoted themselves, and which permits such experienced men from an inspection of any piece of work to say almost instantly what is the best method of proceeding, and from their special knowledge of the adaptability or combination of the wide families of machine tools, to effect quickly any desired modification to suit a particular work. Tools play such an important part in the world that the intellectual standard of a nation may be judged by the tools it uses, and in like manner the productive capacity of any firm can be fairly estimated by an inspection of the machines and tools employed. Reference was then made to the question of foreign trade, and it was pointed out that it was necessary to include delivery to the customers' works in quoting prices. It was not the author's opinion that any return to protection was advisable, and in his opinion the great thing is to improve our pace, by increased economy in our production, by the improvement of our business capacities for dealing with foreigners, and by the continual exercise of that fertility of mind in invention which has earned for Englishmen the respect of the world, and which causes foreigners often to exclaim that an Englishman is always practical. In addition to the technical training of the workman, he should be supplied with sound geographical and commercial knowledge, so that he might be fully acquainted with the true nature of the competition which threatens him all over the world. The high duties of some countries are not always against England, as often the competition is among three or four nationalities apart from the internal competition. In Italy, for instance, the English engineers have to compete with Swiss, German, French, Belgian, and sometimes Austrian firms; but the heavy duties are levied on each alike. Without questioning the higher average ability of Englishmen, the hours of labour and the rate per hour at which labour can be purchased abroad cannot be ignored. One remaining point of considerable importance is, that many of the oldest engineering concerns in this country are heavily burdened with antiquated machinery. Many of them have grown up in those good old times, when the question was simply, "Can you do it?" and not in these competitive times, when the question is, "How much can you do it for?" A notable feature in good machine tools is that they do not so much wear out as become antiquated; hence in some workshops machines are in use of which the owners are very proud, but which years ago should have been superseded by others capable of doing at least twice the amount of work. They are retained simply because they are capable of doing a certain work, which is all very well if the question of cost be neglected, or it may be, as in the case of limited companies, that they represent a certain sum in the company's stock book. Looking boldly at this question of capital account, the vital consideration in any workshop is the workman. If a workman's wages be put at £80 per year, and considering interest on capital and depreciation on machinery at the rate of 10 per cent., it will be seen that the workman is a sort of animated machine, and the representative of a capital sum of £800, so that the question is not whether a man can profitably occupy a certain machine, but whether the machine can profitably occupy the man.

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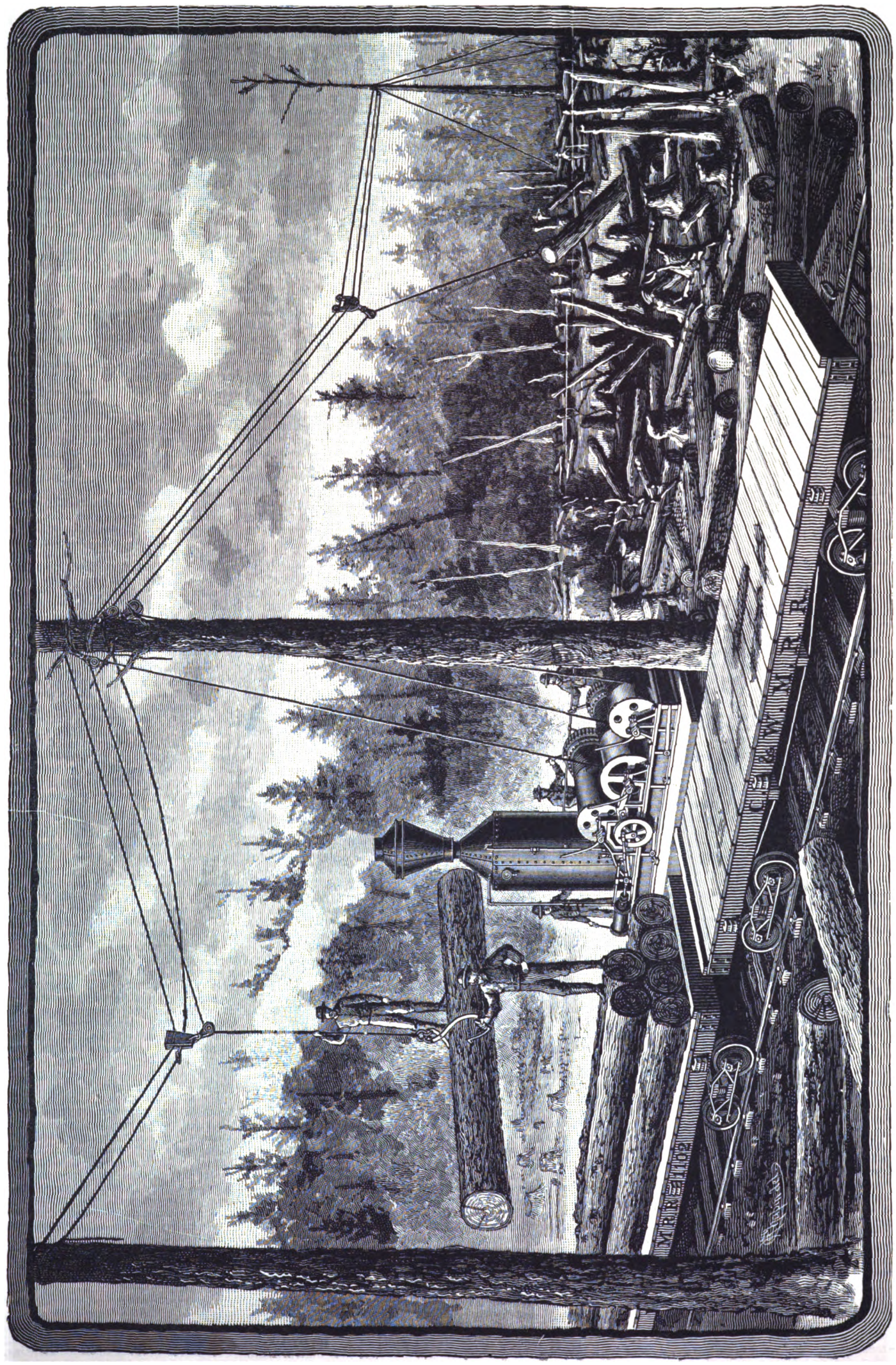


Fig. 4.—Steam Skidding and Loading Machine.

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LOGGING IN CANADA.

II.

(Continued from page 5.)

THE day's work commences at dawn, and ends at nightfall. The log makers proceed, in twos or fours, to their allotted localities. When working in twos, both first fell their tree with hatchets, one man working on each side of the trunk; and, when felled, cross-cut it into the requisite lengths. When four men are working together, which is found as a rule to be the most effective plan, two do the felling and butting, while the others confine themselves to cross-cutting. Practice has rendered these men so proficient in the use of the axe as to keep tree felling machinery out of the field; for, in spite of the fact that steam tree fellers are used on a large scale and to great advantage in many countries, they would hardly show a saving of time in a Canadian pine forest, where many of the trees are of small diameter. As a matter of fact, tree felling machines work to the best advantage on hard wood trees of considerable diameter, say 4ft., 5ft., or 6ft., for under such circumstances they have more work to do at a time, without being shifted; and again, the hardness of the wood does not perceptibly influence the speed at which these machines work, whereas increase in either diameter or hardness of the timber effects a very marked diminution of the output when it is a question of felling by hand.

To give an idea of the rapidity with which pine felling is carried out in Ontario by hand, it may be stated from actual observation that a tree 24in. diam. was felled by two men in 4 minutes 20 seconds. When down, one of the "fellers" marked it into lengths for the cross-cutters, who took three cuts in it in as many minutes, while the above mentioned feller was "bark marking" the lengths for purposes of identification, and his companion was trimming the ragged butt end, which latter operation took 6 minutes 45 seconds. Thus, in the space of a little over 11 minutes, a 24in. standing tree was converted into three finished logs, ready for transport. It is probable that this is somewhat above the average rate of working, as these men saw they were being timed, and were consequently on their mettle; but, in any case, it is interesting to know that such a point of efficiency can be reached. A gang working at Bissett's Creek, on the Ottawa river, in which there were eight log makers all told, and which was visited by the writer on the 20th March, 1886, had, from the 1st October of the previous year until that date, "made" 20,496 logs of good timber, the average measurement being 17½in. diam. This represents an average of seventeen logs a day to each man, without reckoning in the "culled" or rejected logs, which are necessarily numerous.

It is important in felling the trees to see that the trunks fall clear of all obstacles, and in such a position as will allow of their being removed with comparatively little difficulty. This is no easy matter in thick forests; but it is regulated with considerable skill by these men, who, by the manner in which they notch the trunks, seem to be able to make them fall in any desired direction. In fact, an experienced woodman will have no difficulty in indicating beforehand the exact position which his tree will take when felled. While the log makers are at work as above described, another set of men are employed in cutting the necessary roads for the passage of the timber. The first road to be cut is that which leads down to the river, branching off from which are the numerous side tracks, which terminate at the various spots where the woodmen are at work. It is usual to construct the main road of a sufficient width to allow of two sleighs passing each other, whereas the side tracks are as a rule only just the necessary width for the passage of one sleigh at a time. When the road makers have completed a track up to a site where felling is going on, "roll-ways" are constructed on the side of the road at suitable distances from each other. A "roll-way" is a frame work of logs, made up to about the height of the floor line of a sleigh, with an incline leading up to it, and is used for the purpose of raising the logs to a convenient height for loading them on to the sleigh. When trimmed (as in Fig. 2), the logs are ready to be dragged to the roll-ways on the first step of their long journey. For this purpose they are handled in much the same manner as is usual in most other countries, being turned and adjusted by means of the ordinary cant hook and crowbar, until the skidding tongs (A, Fig. 3) can be fixed, or a chain can be placed round one end of them, when they are hauled through the intervening bush by a team of two horses to the nearest roll-way, on to which they are placed ready for the sleighs. A useful appliance for shifting the position of the logs by hand is the pair of lug hooks shown at B, Fig. 3. It is not usual to fell trees of a smaller diameter than 12in., and it is understood that the lessee of the timber "limit" is to take every reasonable precaution not to injure any young growing timber thus left behind. It is also greatly to his own interest not to fell more timber than can be got on to the river before the thaw, since it would be waste of labour for which he would have to pay. Logs remaining in the forest until the following season become often so worm-eaten and otherwise injured as to be not worth transporting. To regulate the log making to suit the capacity of the transport requires a certain amount of judgment, as will easily be seen when it is borne in mind that some of these timber "limits" extend over hundreds of square miles.

Before the logs leave the forest they have to undergo the careful scrutiny of the "culler," who, with the aid of the ordinary "Scribner's scale," registers the contents of each log in his book, marking the unsound, as already mentioned, with a "cull." The number of culled logs is also

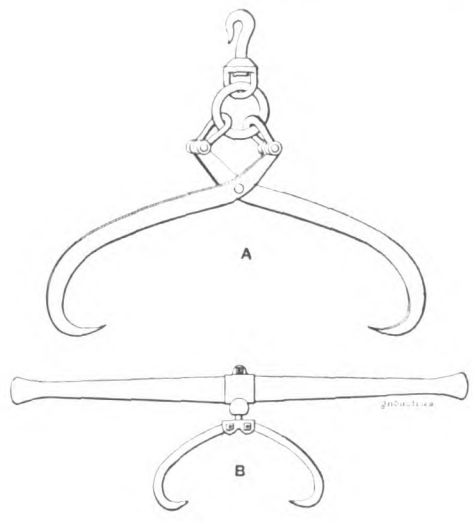


FIG. 3.

carefully noted, and though they are not measured individually, an average is struck which is considered sufficiently accurate for the assessment of Government dues, which have to be paid on culled as well as on good timber.

An interesting and ingenious system of handling timber by mechanical means in the forest has recently found a footing, more especially in the United States, on account of the fact that railways are greatly taking the place of water ways for the transport of logs in that country. This system, if not dependent on the presence of a railway, at all events lends itself better to being worked in localities where a line of rails can be laid down. The inventor, Mr. Butters, of Michigan, calls it a "steam skidding and loading machine," and as that somewhat comprehensive title describes the operations it is destined to perform, and the engraving (Fig. 4) shows very clearly the way the apparatus is fixed, a brief description of the *modus operandi* is all that is necessary. A special form of winding or "skidding" engine is first of all run into the centre of the tract of forest to be cleared. If a line of rails can be laid down to the spot where the engine is to be eventually fixed, it will facilitate its being placed in position, and will also furnish a rapid means of

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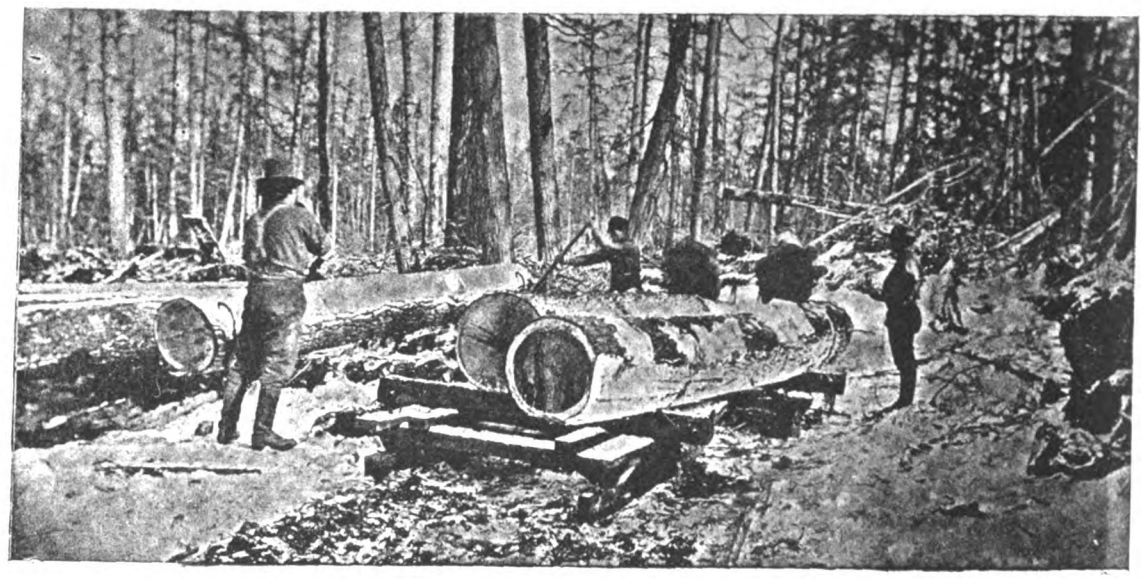


FIG. 2.—HANDLING LOGS IN THE FOREST.

dispatching the logs on their way. If, however, there are no rails, this system can be worked in any place to which it is possible to bring the skidding engine, as the machine can of course load sleighs as easily as railway trucks. The skidding engine is fixed close alongside the railway track, or sleigh road, as the case may be, and a strong tree is left standing on each side of the road, as shown in the illustration. Between these trees is stretched a wire rope of sufficient strength to bear the weight of the heaviest log to be lifted. On this rope, at a point immediately above the conveyance to be loaded, a pulley block is hung, through which passes the rope for lifting the logs. To one end of this rope are attached the dogs for holding the timber, and the other end is passed through a second pulley fixed to the tree nearest the engine, and thence round one of the winding drums of the engine itself, so that the log can be raised and lowered as required. The lifting block is kept in position by two steadying ropes, one from each tree. As regards the "skidding," which may be taken to mean, in this instance, collecting and hauling, this is carried out by the same engine in much the same manner as the loading, only that, instead of a stationary block, a travelling block is required, and as it must move both ways, it is worked by two drums instead of one, from the engine, one drawing it with the log towards the place for loading, and the other taking the empty line back into the forest. The block travels along a wire rope between one of the trees near the engine, and another at as great a distance off it as practicable, collecting all the logs within reach. After clearing one district of the felled timber, the rope is detached from the tree and made fast to another, which has been left standing at a suitable spot in another district, at a similar distance from the centre tree. Thus an area of considerable size can be cleared without moving the loading engine, the delivery line representing the radius of the circle to be cleared, the direction of which can be changed as required on the circumference, but bringing the logs always to one centre for loading. It is claimed for this apparatus that it can be fixed ready for work in from two to three hours. The economy effected by this apparatus over hand labour must necessarily depend on local circumstances, such as the positions of the trees, and the facilities for getting the engine to the required place; but when at work, and manipulated by half a dozen labourers, it is meant to take the place of the men and horses above mentioned, who haul the logs through the forest to the "roll-ways," and also those who stack the logs on the "roll-ways" and load the sleighs.

(To be continued.)

THE COST OF PRODUCING COAL IN BELGIUM.

IN the course of an American consular report on the mining industry of the Liège district, some interesting figures are given, showing the cost per ton of producing coal between 1882 and 1886. In 1882 the cost amounted to 1·24fr. per ton, which increased slightly in the following year, when it was 1·34fr. Since that date a steady diminution has taken place, the cost being 0·96fr. in 1884, 0·85fr. in 1885, and 0·62fr. in 1886.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 17TH JANUARY, 1888.

THE IRON MARKET.—There is still hesitation on the part of Parisian consumers, who, being sufficiently provided for present needs, prefer to wait till the course of events has become more clearly discernible, so that the markets remain quiet. But these conditions are limited to Paris. Throughout the country, consumers exhibit a growing eagerness to buy. From all the centres of the iron industry an active and increasing demand is reported. The markets in some parts, notably in the North, are animated, and prices are very buoyant. There is no change to note in the base prices, but in most transactions for forward delivery these are slightly exceeded. For the second quarter, manufacturers require a considerable advance on the present base prices. Judging from the steady current of business now flowing, trade is rapidly recovering. The tone of affairs generally is hopeful, and the prospects of the near future encouraging.

RESULTS OF THE BREWERS' EXHIBITION.—For once everybody seems satisfied with the results of the Brewers' Exhibition recently held in the Palais de l'Industrie. M. Prévet, in a report addressed to the Minister of Agriculture, says that the ends in view in forming this Exhibition, which were in the first place to make French beer better known and appreciated, and in the second place to bring to the notice of brewers the best processes and apparatus, have been fully attained. The Exhibition has, he adds, given immediate results. Public opinion has been turned in favour of the home made product, which change shows itself in greatly increased orders to the exhibitors. The results have been, according to M. Prévet, equally beneficial to the makers of machinery and apparatus for brewing. The exhibits have shown, he says, that the national industry has nothing to fear from foreign rivals. M. Prévet concludes with a recommendation to establish in France a Brewers' Laboratory and School of Brewing similar to those already existing at Munich and Copenhagen.

THE FOREIGN TRADE IN BEER.—France is becoming more and more a beer producing country. A great advance has been made in this direction in the course of the last five years especially. There has been a steady increase in the consumption of beer throughout the last decade, but since 1884, when the imports reached their highest value, there has been a rapid decline in the quantities of beer purchased abroad. The diminution has taken place chiefly in the trade with Germany, and may be due in part to political antipathies; but other countries, except England, have also suffered. At the same time the exports of French beer have constantly increased. The value of the beer imports in the first eleven months of the year, which amounted to £711,720 in 1884, dropped to £670,760 in 1885, to £592,440 in 1886, and to £447,880 in 1887. The exports increased in value from £52,680 in 1885 to £57,200 in 1886, and to £59,820 in 1887. The imports of foreign beer into France in the first eleven months of 1887 amounted to 4,786,628 gallons. Of this quantity 3,819,552 gallons entered from Germany, 396,000 gallons from England, 42,240 gallons from Austria, and 528,836 gallons from other countries.

THE TRAMOND-LEBEL RIFLE.—The following are some of the distinctive features of the Tramond-Lebel rifle, which the Government small arms factories are turning out with all possible speed: The calibre is only 8mm. With this small bore and a suitable bullet a very low trajectory is obtained. The bullet, of unusual length and weighing 15grm., has a muzzle velocity of 1800ft. per second. To enable it to withstand without serious deformation the enormous pressure exerted upon it, the metal used is lead hardened with antimony, and this is coated with German silver to give it greater resisting power. The result is marvellous accuracy in shooting. There is some talk of a smokeless powder, the invention of M. Vieille, the Government explosives engineer, to be used with this arm. For present use, however, a modified form of the ordinary gunpowder is being manufactured.

PRIZE FOR ELECTRIC LIGHT INSTALLATION.—Among the subjects for which the Société Industrielle of Amiens has offered a prize, is "the best electric light installation in an industrial works." The light must have been in operation for at least a year, and it must be proved to be cheaper than gas made on the premises. Further, the installation must be equivalent to a gas system of not fewer than three hundred jets. Detailed plans and descriptions must be sent in before the 30th April next.

BERLIN, 16TH JANUARY, 1888.

THE COAL MARKET.—An important change in the condition of the German coal market is imminent, since the period for which the colliery union was established is drawing to a close. A meeting of the representatives of Upper Silesian coal mine owners was held in Kattowitz a few days ago to consider the formation of a union to regulate the total output of the district, and to endeavour to form a sales bureau similar to that of the rolling mills. Should this convention be formed, it will almost completely rule the prices of coal, the only difficulty in the way being the importation of foreign coal, which is admitted duty free. The exports of Westphalian coal and coke from Hamburg amounted to 549,460 tons in 1887, against 518,930 tons in 1886, and 536,510 tons in 1885. The imports of English coal during the same periods were 1,230,000 tons, 1,210,000 tons, and 1,138,700 tons, respectively. These imports are likely to considerably increase if the coal owners in Upper Silesia should attempt to artificially raise prices.

THE IRON MARKET.—Now that the influence of the holidays has finally subsided and business has returned to its normal channels, it is possible to form an estimate of the probable course of trade in the near future. On all hands it is expected that the output of the Upper Silesian blast furnaces will, during the present quarter, fall rather short of the requirements, notwithstanding the fact that the export trade to Russia, which last year amounted to about 15 per cent. of the total production in the district, has been entirely stopped. The great activity in all branches of the finished iron trade has increased the demand for crude iron to such an extent that the whole production can now be placed in the home market. At the present moment there are twenty-eight furnaces in activity, producing the same quantity as thirty-two furnaces eight years ago, the increase of output per furnace being due partly to improved methods, but principally to the prevailing tendency of working up richer ores. The ores at present worked up are spathose iron ore, magnetic iron ore, and a very rich purple ore, the greater quantity being imported from Hungary, Poland, and Thuringia, although a fair amount of ore is also raised in Upper Silesia. In this connection it is worth mentioning that the business of producing crude iron has a tendency to be differentiated into branches. Formerly, Silesian mine owners smelted their own ores, but now their tendency is to simply raise ores and sell them to the blast furnace owners. This is obviously more expedient in a trade which is bound to import some of the ores. To give only one instance of this tendency to differentiate production into distinct branches, I might mention that the Henckel iron ore mines have taken the lease of the large ore deposits belonging to the town of Beuthen, in Upper Silesia, and have blown out their own furnaces, thus restricting their business entirely to the production of ore. Owing to the favourable prospects of the market, some of the Upper Silesian works are contemplating extensions, by erecting new rolling plant, new blast furnaces, and in one case, also a plant for the production of open hearth steel, in which specialty the Upper Silesian district is as yet far behind Westphalia.

A SYNDICATE OF WIRE NAIL MAKERS.—The present tendency to syndicate all the trades which admit of such a measure is again exemplified by the proposed syndicate of German wire nail makers. The majority of manufacturers in Upper Silesia and Westphalia have already definitely agreed to join this syndicate; manufacturers in Saxony are favourably disposed to it, and those in Southern Germany propose to form a separate syndicate, but will abide by the prices fixed by the general syndicate. As far as can be gathered at present, the object of the syndicate is not so much to unduly increase prices, but rather to give the trade greater stability. The total annual consumption of wire nails in Germany is estimated at 66,000 tons, whilst 43,000 tons are annually exported. One common sales bureau for the home market is to be established at Berlin, and another for the export trade at Hamm. The necessary steps to finance the undertaking have already been initiated with Berlin banking firms. The turnover in the trade is estimated at slightly over £1,000,000 per annum.

VIENNA, 16TH JANUARY, 1888.

THE COAL MARKET.—Bohemian coal is at present being largely exported to Germany, *via* Bodenbach and Eger, from the Buschtehrader collieries. The price obtained is higher than can be got in the eastern parts of Bohemia, where the Silesian coal competes. This export traffic forms a considerable source of profit to the railways. During the past year the Salgo-Tarjauer Company produced 500,000 tons of coal, or 25,000 tons more than in 1886, at a profit of 9 per cent The Nord-Ungarische Kohlenbergwerks Actiengesellschaft produced 266,200 tons at a profit of 8 per cent.

THE IRON MARKET.—There is no change to be reported in the iron market, as traffic has been hindered by the excessively cold weather which has been experienced since the holidays. The prospects for the year are good, and as a number of large railways, projected some time ago, will probably be built, an increase in the consumption of iron is likely to follow. It also appears that the building trade will be busy this year, and that large orders will be received for girders. Orders have been given by our sugar factories for new machinery, and some fresh work in the way of locomotives and waggons will assist engineering shops through the quiet season. The annual report of Messrs. Ganz & Co., one of whose specialties is chilled railway wheels, states that the past year's business was fairly satisfactory; twenty-three turbines were installed by the firm during the year. The Schlick'sche Foundry executed some important orders for bridge work, but owing to low prices and foreign competition, only a small dividend is declared. The Rinia-Murany-Salgo-Tarpauer Iron Works declare a dividend of 6 per cent. on the last business year, and pay 3 per cent. to the reserve and depreciation funds.

ELECTRIC LIGHTING.—The Vienna Society of Electricians appointed some time ago a committee to draw up rules and regulations for the public supply of electricity, which will be submitted to Parliament with a view to obtain a kind of Electric Lighting Act for Austria. The committee have finished their labours, and their report will be laid before the members at the next general meeting of the Society. It will then be discussed, and, if necessary, amended, after which the Society will finally adopt and recommend it as the basis of a Bill to be introduced in the next session of Parliament.—Messrs. Czeija & Nissl, of this town, have just brought out a new search light, which has been specially designed for use on torpedo boats. The lamp is self feeding and works perfectly well, not only when placed vertically, but even when inclined to an angle of 65° from the vertical. —The Allgemeine Elektrizitäts Gesellschaft, of Berlin, is now establishing a branch at Vienna. The company has commenced negotiations with the Imperial Continental Gas Association, with a view to taking over their electric light works in the Schenkenstrasse, and the installation at the Vienna Opera House. This company will also be represented at the forthcoming Exhibition in the Prater by an installation of 90 arcs and 1500 glow lamps, lighting the park to the west of the Rotunda, and a portion of the interior of the latter. The rest of the lighting will be divided between the following firms: Siemens & Halske, of Vienna, Egger & Co., Kremendky, Mayer, & Co., Krizik, Ganz, & Co., and Brueckner, Ross, & Co., who will install an aggregate of 180 arcs and 2000 glow lamps. As in 1883, a special feature of the Exhibition will be model rooms furnished in various styles, and lighted by glow lamps, for which purpose about 750 lamps will be required. In the Emperor's pavilion there will be 100 glow lamps. Generally speaking the electric light will be installed not as an exhibit, but with a view to produce the best illumination of the other exhibits. The total motive power required is estimated at 600 h.p. There will be telephonic communication by means of Fostin-Herrman underground cables between the Vienna Opera and the Rotunda.

MILEAGE TICKET BOOKS.—The administration of the Austrian State railways has just introduced, for the convenience of commercial travellers, a system of paying for tickets which has already been tried with good results on some of the American railways. This system consists in the issue of mileage ticket books available for one year, and containing coupons to the aggregate value of 150fl., but costing only 123fl. The coupons are of different value, viz., of 5kr., 10kr., 1fl., and 5fl., and upon handing in at the booking office such a number of these coupons as will make up the right fare, an ordinary passenger ticket for any distance, and available by any train, is issued. If all the coupons are used before the expiration of the year, a second mileage book of the value of 30fl. can be bought by the original holder. To prevent the use of these tickets by others, the mileage book, which contains the photograph of the owner, must be presented when asked for by the officials; but the owner is permitted to pay with coupons for the tickets of persons who accompany him.

BRUSSELS, 17TH JANUARY, 1888.

THE COAL MARKET.—There is plenty of business being done, and the market is firm. Nuts are quoted at from 12s. 7d. to 15s. 2d.; unscreened household coal at 8s. 5d. to 9s. 7d.; small coal at 4s. 5d. to 6s.; and coke at 11s. 2d. The situation remains good, especially for coal for industrial purposes, with the exception of hearth coal. Owing to the scarcity of coal for metallurgical purposes, prices show an improvement, and business in this branch would be better still were it not for the traffic on the canals being stopped. The rates for household coal for the home market have been maintained, but the same has not been the case with the exports, though the volume of business is increasing. In France, which is our principal export market, the collieries of the Nord and Pas de Calais used to turn out only small quantities, which were sold at rates of about 2s. 6d. to 3s. dearer than Belgian coal; but now the output has been largely increased, and the price is nearly as low as that of our own coal. Sales of Belgian coal have been made in Paris at 1s. 3d. per ton less than last year, owing to the low offers from French collieries.

THE METAL MARKET.—At present attention is mainly being directed to the prices of coke and pig iron. Coke has risen to such an extent that the cost of producing pig has considerably increased, with the result that it has to be sold at higher rates, while at the same time finished iron has proportionately advanced. This is causing great difficulties, the only solution to which at present would be a rise in finished iron, but the demand is not sufficiently large to warrant this. There has been some increase in the orders for finished iron, especially for Italy, in consequence of speculative purchases. Generally speaking, however, there are not many orders for delivery after the first quarter of this year, and though many makers have more work in hand than they can well manage, they expect to have to restrict their production by April. Those rolling mills which have blast furnaces of their own are in a better position than the others, as, being to a certain extent independent, they were able to engage themselves further ahead at the time when orders were pouring in; the Cockerill, Sclessin, l'Espérance, and Grevignée works are in this favourable position, and several of them have also collieries of their own. The Ougrée iron works, which turn out specialties, are also well employed. Locomotive builders have very little to do, and it is expected that several works will have to close; it would be well if the State railways would take this opportunity of ordering new locomotives and rolling stock, of which they are much in need. The last contract for two

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lots of ten carriages each was given to Nicaise & Delaeve at £1831. 12s. for each lot; the Franco-Belgian Company and Sineffe both quoted £1832.

Flax and Yarn Markets.—Business in home grown flax has further decreased. Prices have now a marked downward tendency. No serious drop is apprehended; but, on the contrary, it is generally believed that a small reduction will bring prices to their true level, and thereby give occasion to a steady course of business. At Courtrai the market is dull and heavy. At Bruges the demand is less, and prices are giving way. At Ghent the conditions are somewhat different; the market is well supplied with home grown flax, and all on offer finds ready purchasers at prices that tend in favour of sellers. A large amount of business has been transacted in Russian flax, which maintains its price. The situation has slightly improved for linen yarns; a better demand has sprung up, which, in the present condition of affairs, seems likely to continue and to increase. The high prices of cotton yarns deter buyers from dealing beyond the needs of the moment in that class of goods.

Society of Engineers and Manufacturers.—This Society has been in the habit of organising every year in the Palais de la Bourse special scientific and industrial exhibitions. During 1888 the following Exhibitions will be held under their auspices: (1) Engineering tools and instruments; (2) processes, materials and products for the reproduction, enlargement, and reduction of plans and drawings; (3) plans and models of workmen's dwellings, and constructive details in connection with the improvement of the same. The first two Exhibitions will be international. The Engineering Tools Exhibition will be opened on the 3rd proximo, and will continue for about a month. No charge is made for space, the only expense being the cost of installation, which, as a rule, will not be over £1. Communications should be sent to M. le Président du Seconde Comité de la Société Belge des Ingenieurs et Industriels, Palais de la Bourse, Brussels.

DÜSSELDORF, 16th January, 1888.

The Iron Market.—Business has resumed its accustomed course, and the iron market has again become animated; but the prospect is not wholly cloudless. The feeling of uneasiness occasioned by the recent advance in pig iron, which I reported last week, has not abated. Manufacturers are beginning to perceive the true bearing of the situation on the export trade. They contend, and the contention admits of easy proof, that in the present state of the foreign trade they cannot compete in neutral markets so long as they have to pay the rates now current for their raw material. Meanwhile, however, buying goes on apace for delivery in the second quarter of the year. Forge, hematite, and basic pig are the classes chiefly in request. The demand is still in excess of production, though the latter is being pushed to the utmost. Stocks at the blast furnaces now scarcely exceed 30,000 tons of all sorts, except foundry pig; the latter amounts to about 20,000 tons. The imports of English pig in the month of December were very heavy. The Board of Trade returns show that the direct exports of pig iron to Germany amounted in that month to 7240 tons, against 3819 tons in the same period of 1886, while the quantity landed in Holland reached 19,479 tons, against 11,333 tons. As evidence of the confidence with which the future is regarded, I may mention the fact that Herr Stumm, of Neunkirchen, has acquired an extensive tract of land on the Upper Mosel, at Ücklingen, in the district of Diedenhofen, for the purpose of erecting a set of blast furnaces in that rich iron-bearing country. The following are the present base prices of the goods enumerated, the figures in parentheses being the prices six months ago: Spiegel pig of 12 per cent. manganese, 52s. (50s.) per ton; Rhenish-Westphalian white forge pig, 50s. (43s. 6d.); basic pig, 45s. (42s.); Luxemburg forge pig, 35s. 2d. (34s. 6d.); Luxemburg foundry pig, No. 3, 41s. (40s.); German foundry pig, No. 1, 57s. (55s.). Common bars, £6. 2s. 6d. (£5. 10s.); common plates, £7 (£6. 15s.); boiler plates, £8 (£7. 5s.); sheets, £7. 11s. (£6. 15s.) a ton.

Copper Prices.—The present abnormal situation of the metal market renders the tenders for the railway contracts received at Cologne on the 10th inst. specially interesting. The offers, which include the cost of delivery at the central works at Nippes, were as follows: For 35 tons of copper rods, eleven tenders, highest offer, £100; lowest, £89; mean, £91. 4s. per ton. For 15 tons of copper sheets, eight tenders, highest, £100; lowest, £89; mean, £92. 2s. For 10cwt. of copper wire, nine tenders, highest, £107. 10s.; lowest, £90; mean, £96. 6s. For 7 tons of copper tubes, six tenders, highest, £105; lowest, £92; mean, £100. 2s. For 20 tons of copper plates for locomotives, there were two tenders of £104 and £103 delivered at Berlin, and one tender of £104. 10s. delivered at Frankfort.

The Sugar Crop.—The heavy falling off in the sugar-beet crop of 1887 is showing itself in the short duration of the campaign, which is already ended for a large proportion of the manufacturers. The drought of August and September occasioned an incomplete development of the roots. According to the latest official estimates, the quantity harvested last year in Germany amounted, in round numbers, to seven million tons, which is 1·3 million less than in 1886. But the yield of saccharine matter has been extraordinarily high, so that the deficiency in quantity has been in part compensated by the quality. Improved culture has year by year improved the beet. To obtain one ton of raw sugar we needed 10·76 tons of roots in 1878, 11·57 tons in 1879, 11·22 tons in 1880, 10·31 tons in 1881, 10·36 tons in 1882, 9·26 tons in 1883, 9·07 tons in 1884, 8·44 tons in 1885, 8·20 tons in 1886, and (apparently) 7·75 tons in 1887. The slight fluctuations observable are due to the influence of the seasons. Thus every acre of land under beet cultivation now yields 1·39 times the quantity of sugar obtained ten years ago. As the duty, calculated on 10·15 tons of roots to the ton of raw sugar, will, this year, amount to only 131·7 marks, instead of 172·5 marks, there will be a bounty of 40·8 marks per ton on all sugar exported.

LILLE, 17th January, 1888.

Textile Manufactures.—We are not yet wholly clear of the season of stock-taking, and as long as the course of business is thereby retarded, the true tendencies of trade cannot be fully discerned; but there are many symptoms of renewed life, and no lack of evidence to strengthen the hopes raised by the state of trade at the close of 1887. Business has been sufficiently animated in the second week of the year to justify the expectation of a larger volume of trade all round after this week, and this gives a healthy tone to the market. A fair amount of business has taken place in linen goods this week. Prices remain low, but there are indications of speedy improvement. The business in raw materials exhibits more buoyancy. Flax is in strong demand, and yarns are moving steadily upward. This rise in yarns must lead to an advance in cloth, and the movement once begun is likely to continue till a more remunerative level is reached. At Roubaix the situation is one of expectation. The time has not arrived for a general revival in the woollen trade, but there is a firm belief that we are on the eve of a period of great activity. A manufacturer writes: "The year 1888 begins in the best possible condition, and we cannot doubt that it will bring us a larger volume of trade in all kinds of woollen goods, and more remunerative prices than we had in 1887." German buyers have dealt largely in combed wool this week at about 5 francs per kilo. A move in the cloth market would bring about general activity.

Flax and Yarn Markets.—There has been another week of animation and firm prices in the market for flax. Home grown is in brisk demand. All the circumstances of the trade point to continued activity in this class of goods. Russian has been less sought after this week, but a large volume of business has nevertheless been transacted, and prices have moved in favour of sellers. A characteristic feature of the yarn market this week is a slight retardation of business accompanied with rising prices. Weavers have bought largely of late, and are therefore sufficiently provided with yarns for some weeks to come, and spinners have work enough in hand to keep them employed till the end of the first quarter. The latter consequently exhibit no eagerness to press sales, and have not hesitated to further advance their rates for the medium and finer numbers, which are the class of yarns most sought after. Jute yarns still command a large business at steadily advancing prices.

The Iron Market.—There is now a steady course of business in iron, free, on the one hand, from distrust and hesitation, and on the other, from unhealthy excitement. Consumers exhibit some eagerness to buy, but cannot be induced to deal in distant "futures" at the higher rates asked by the manufacturers for such bargains. For delivery in the first quarter transactions are effected readily enough. Merchants, however, are contracting on the manufacturers' terms for delivery in April and May, a circumstance significant of a belief on the part of the former that the latter are able to maintain the existing union, and thereby to control the market for some time to come. Clearly the situation is a strong one, and the constantly improving prospect fully justifies the very hopeful tone which now prevails in this locality. Prices are unchanged, but show a tendency to harden in some directions.

MADRID, 16th January, 1888.

The Barcelona Strike.—This strike is gradually being overcome, and masons are daily returning to their work. There is, however, no very good feeling between the contractors and workmen, and it is probable that the former will meet with serious difficulties in carrying out their contract for the exhibition buildings in time. The work is, however, being actively proceeded with in the meantime.

Electric Lighting.—Fourteen petitions have been presented to the municipality of Madrid to use the public thoroughfares for laying cables for the supply of electric light and power; but, in the unbusiness-like manner in which such things are dealt with by our local authority, no decision has been come to, and it is difficult to say when there will be. In the meantime a very badly managed company, who have a provisional authority to lay cables, is supplying about a thousand incandescent lights and some eighty Gramme arcs. On the other hand, the Madrid Gas Company pretend that they alone have the right to lay underground cables for electric light. In fact, everything relating to distribution is in such a state of chaos, that even primary batteries would have a chance of adoption if their working expenses could be brought down to a point at which the cost would be about equal to 8s. per 1000ft. for gas. Isolated installations, with engines of any kind, require a license from the authorities, and might therefore in many cases meet with difficulties.

NEW YORK, 7th January, 1888.

Railways.—There is a scarcity of rolling stock, owing to pressure of goods in transit; but rates are very low. Some of the Western railroads have reduced their rates to such an extent that heavy losses must be the result. The Western railway lines entering Chicago have, after three months' work, completed the installation of a plant of 35 to 50 ton scales at the stock yards. They will in future weigh all live stock, and charge for transport by weight, instead of by the car load. The track of the Chicago, Santa Fé, and California Railroad bridge across the Mississippi at Fort Madison, Iowa, has now been completed, forming a connection between the States of Illinois and Iowa. The extension of the Chateaugay Railroad to Saranac Lake has also been finished. The Martin system of steam heating has been substituted for stoves on the Erie Railway. The Westinghouse brake has been adopted on the New York Central and Hudson River Railroad both for passenger and freight cars.—The Mexican Government has just granted a concession for a railway to commence at Tepic, in the State of Jalisco, running north-west to Mazatlan on the coast, and thence north-west through the State of Sinola, connecting with the Southern Pacific Coast at Yuma, Arizona Territory. The new line, which will be rather circuitous, will tap a very rich mining district, and is expected to be completed in three or four years.—The freight committee of the Trunk Line have adopted a higher scale of rates for iron and steel manufactures, which will come into force next week. During the past year, 12,724 miles of new main line track were added to the railway system of the United States. The number of new lines is 364. Four States and two Territories, viz., Kansas, Nebraska, Texas, Colorado, Dakota, and Montana show together an addition of 6400 miles, or about half the total mileage added. The total cost of the new lines is estimated at £65,000,000. The total railway mileage of the United States at the close of the year was in round numbers 151,000 miles.

Car Heating.—In answer to a circular from the Secretary of the Treasury inviting suggestions from car builders and others as to the best means of constructing and heating cars, so as to prevent loss of life and property, 216 communications were received. Of these twenty-eight proposed to heat the cars by steam from the engine, twelve by hot air from the engine, twenty-three by heat from an independent car, twenty-six to heat and light by means of electricity, thirty-four by means of improved heaters or stoves in the cars, eight suggested specially constructed safety cars, having the heating and lighting done by gas.

The Navy.—The keel blocks for the new 6000-ton armoured cruiser have been laid at the navy yard here, and the buildings are nearly ready for the machine tools. The engines of the cruiser "Chicago" were severely criticised by foreign engineering journals; but, though the machinery was different from that of any war vessels that had been built, its practical success on one of our merchant vessels satisfied the designer that the "Chicago" would fulfil the requirements as to speed and horse power. A trial trip of this vessel was made recently with very successful results. The maximum speed obtained was 16·83 knots, and the mean for the six hours' run was 15·1 knots, making the proper allowance for tides. The boiler rooms are fitted for forced draught; but during this trial it was not used, as the boilers with natural draught furnished all the steam required. The maximum horse power obtained was 5248 i.h.p., and the mean for the entire run was 5084 i.h.p. Both engines worked very well, and did not require slowing down from beginning to end of the trial.

PHILADELPHIA, 7th January, 1888.

Iron and Steel.—Prices have been steadier during the past week, and a considerable business has been done in bar iron. An order for 15,000 tons of steel rails has been placed in Eastern Pennsylvania. Orders for only 200,000 tons of rails for delivery this year have been received so far, but prospects are good for the continuance of last year's railway building "boom." The ship yards along the Delaware, while not working up to their full capacity, seem to have plenty of work on hand. A memorandum issued by Messrs. Cramp, during the late meeting of the American Society of Mechanical Engineers, showed that they had work on hand for seven new ships aggregating 41,000 i.h.p. They have 1500 men employed at present, their total capacity being 2600.

Electric Railways.—The last year has seen a wonderful growth in electric railways. There are now in the United States over 80 miles of road on which the motive power is electricity. Eighteen towns have plants in operation, in lengths varying from 1 to 11 miles. Contracts have been made for roads, and they are now being constructed in seventeen other towns, and there are fifty-nine projected roads. The greater part of the mileage is divided about equally between the Doft and the Van Depoele systems.

Dry Dock.—The necessity of a dry dock at Erie has been felt for many years, and numerous attempts have been made to secure the necessary capital. Now the project seems in a fair way to be realised. The syndicate, which has just purchased the Gogebic ore range, have through an agent secured the ground necessary to build a ship yard and dock. They propose putting on a fleet of fourteen vessels to carry their ore to the lower lake ports, and will begin work as soon as the season opens.

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BOILERS OF THE GUNBOAT "CERAM."

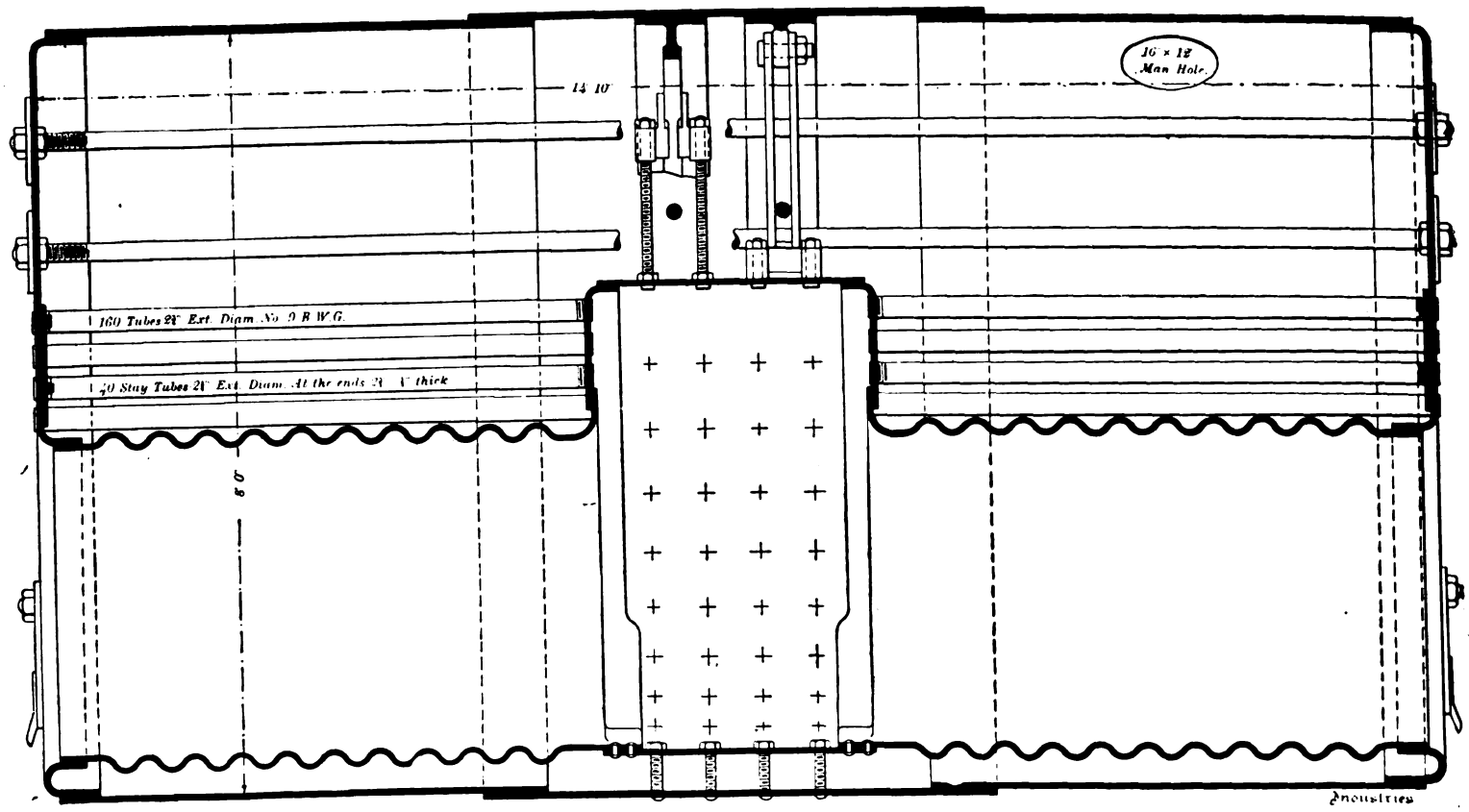


FIG. 7.—LONGITUDINAL SECTION.

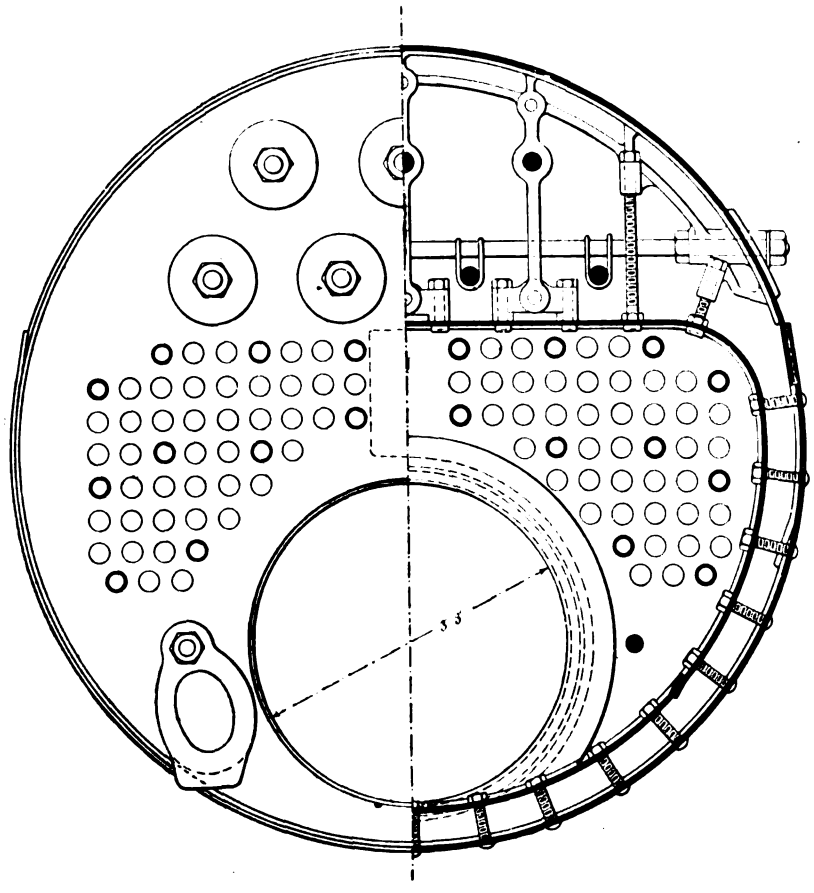


FIG. 8.—TRANSVERSE SECTION.

ENGINES AND BOILERS OF THE GUNBOAT "CERAM."

WE give above sectional views of the boilers of the gunboat "Ceram," and on page 62 and our two-page supplement for this week, will be found illustrations of the engines of this vessel, which is a gunboat belonging to the Dutch Colonial Navy. The engines are of the triple expansion surface condensing type, the cylinders being 20in., 29in., and 46in. in diameter, and the stroke 29in. The high pressure cylinder is fitted with a liner of Whitworth compressed steel ½in. thick, the space between the body of the cylinder and the liner being utilised for jacketing. The pistons are of cast steel, with junk rings of the same material, and fitted with Buckley's piston rings of much lighter section than usual. The slide valve of the high pressure cylinder is cylindrical, and is made in that form for the purpose of bringing the inlet steam to the centre of the valve. The intermediate and low pressure valves are flat, but work under a strong cover, with false ports, for relieving them of the steam pressure. The valve arrangement consists of Bremme's gear, with the eccentrics on the couplings of the crank shaft. The vertical rods of the gear are connected by a ball joint to a floating lever, which actuates the three valves. For reversing the engines a reversing engine is used having a 7in. steam cylinder, with 19in. stroke, cast in one piece with the intermediate cylinder, and placed between this and the high pressure cylinder. The piston rod of the reversing engine actuates, by means of a small connecting rod, a lever on the reversing shaft. The valve of the reversing cylinder is moved by a rod fixed to a hand lever, turning round a small eccentric on the reversing shaft, so that the valve is closed by a movement of the reversing shaft, equivalent to that given to the reversing handle. The reversing of the engines from full speed ahead to full speed astern is brought about in two seconds. The reversing shaft is carried in a pipe cast in one piece with the guide of the high pressure crosshead. It will be seen from the illustrations that the pin forming the crosshead is attached by two bolts to the connecting rod. In this arrangement, the piston rod ends are solid and without any cover, so that the brasses can be easily adjusted to the pin with the connecting rod disconnected. The brasses are closed up by a wedge worked by a screw from the front of the piston rod, this position being much more convenient than that of the nuts of the ordinary cover. The piston, connecting rods, and the crank shaft are made of steel, the latter being made in three equal parts. The corners of the crank webs are cut off, as shown, in order to reduce the weight. The bed plate is made entirely of cast steel, and as light as possible while maintaining the necessary strength and rigidity; the total weight being only two tons. The foundation in the ship is formed by heightening the frames, and bending them into such a shape as to fit the bed plate. The shaft brasses have no flanges, but are kept in place by pins fitting into holes bored in the bed plate and cover. The eccentrics on the couplings are also without flanges, so as to leave the eccentrics free to move forward and backward with the shaft without bearing against the eccentric rings. The air and circulating pumps are single acting and cast in one piece. They are made of brass, while the feed and bilge pumps are of gun metal.

The columns supporting the cylinders consist of drawn steel tubes, 3in. external diameter, and ⅜in. thick; but turned out of tubes ⅝in. thick, to get the necessary thickness in places where holes had to be bored through them. At the ends where they fit into the bosses on the cylinders and bed plate, they are forged to a smaller diameter, giving greater thickness of metal where the thread is cut. The condenser is made entirely of copper, the shell having corrugations at intervals, instead of the rings usually riveted on to it, to strengthen it against collapse; and the covers have radial corrugations for the same reason. Condensers made on this system are light, and have the additional advantage of having no rivet holes.

There are two double ended boilers of 8ft. 2in. diam. and 15ft. in length, with one corrugated furnace at each end of 3ft. 3in. mean diameter. The working pressure was fixed by the naval authorities at 120lb., as, at the time when these engines were designed, a higher

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pressure was not customary, especially for ships stationed in India. The boilers are made entirely of Siemens-Martin mild steel, all holes being drilled in position. The whole of the riveting was done by hydraulic riveters. It will be observed that the top of the combustion chamber is stayed in a rather unusual manner; but the builders think that this plan, or something equivalent to it, is the most effective way for strengthening this part of the boiler. They argue that so long as the boiler shell is utilised for staying the combustion chamber in the ordinary way, no other resistance can be obtained than that due to the stiffness of the shell plate, for the shell being in equilibrium may be deformed to a comparatively large amount before any considerable resistance is obtained. In the usual method of shaping the sides of the combustion chamber, the required tension on the stay bolts is only effected by the two outer rows acting as struts and keeping the shell plate in its circular form, the part of the plate between these two rows acting as girders for the middle row of stays.

In boilers where steam pressures of 180lb. to 200lb. are to be used, this staying of the sides of the combustion chamber to the shell will have to be carefully attended to, otherwise leakages or accidents may occur. Referring to Fig. 7, it will be observed that there are two bridge stays in the middle of the breadth, which are arranged to allow a man to pass from one end of the boiler to the other. The bridges to which the vertical stays are attached have I section, and are made of cast steel, the outside being turned in the lathe to a true circle, and afterwards riveted to the shell. Forced draught can be supplied by closing the stokeholds, the air being drawn from the engine room and forced into the boiler space by a fan of 5ft. 6in. diam., made by Messrs. Allen & Co., of London. An air pressure of 2in. of water is easily obtained; but this pressure was not fully utilised at the trial trip. With about half that pressure, the engine indicated 804 h.p., against 606 h.p. as obtained with natural draught. The propeller is made entirely of Delta metal, and the ship is composite and sheathed with brass, and has the following dimensions: Length, 150ft.; breadth, 25ft. 6in.; mean draught, 9ft. 4in.; displacement, 510 tons. Referring to our illustrations, Figs. 1 and 2 show front and end elevations of the engines and Fig. 3 a plan; Fig. 4, slip and resistance curves while running with a four bladed propeller, and also with two blades removed. Figs. 5 and 6 show a longitudinal section and end elevation of the condenser, and Figs. 7 and 8 longitudinal and transverse sections of the boilers. We understand that the engines, when running at their full power, and at 130 revolutions per minute, worked with very little vibration.

SHIPBUILDING NOTES.

On Saturday afternoon the s.s. "Endeavour" was successfully launched from the shipbuilding yard of Messrs. R. Stephenson & Co., Limited, Hebburn. This is the first vessel that has been launched by the firm, but preparations are being made for carrying on shipbuilding work on an extensive scale, and already several orders have been booked. The dimensions of the "Endeavour" are as follow: Length, 300ft.; breadth, 40ft.; depth, 27·1ft.; and 2500 tons gross register. She is intended for general trade, but will be fitted with lofty 'tween decks for carrying emigrants. She will also be fitted with "sentinel" steam gear by Alley and McClennan, of Glasgow, Harfield's patent steam windlass, water ballast and double bottom, and triple expansion engines of 200 n.h.p. She is being built to the order of Messrs. McIntyre & Co.

The Blyth Shipbuilding Company, Limited, launched from their yard at Blyth, on Friday last, a finely modelled screw steamer, 242ft. long, 33ft. beam by 16½ft. depth of hold, built for the firm of Messrs. W. Lamplough & Co., of London. The vessel is built on the "well-deck" principle, with long, raised quarter deck, bridge amidships, topgallant forecastle, customary water ballast arrangements, and to Lloyd's highest requirements. The cabin accommodation is under the bridge deck. There are four large hatches for cargo, and alongside are four of John Smith and Sons' powerful steam winches. Harfield's patent windlass is placed on the forecastle deck. Donkin and Nichol's patent combined steam and hand steering gear is fitted in the wheel house on the bridge deck, and hand steering gear aft. The engines are of the triple expansion type, of 150 n.h.p., and will be fitted by the North-Eastern Marine Engine Company, Wallsend. As the vessel left the ways she was named the "Godmunding" by Mr. John Nixon, of Blyth. Immediately after the launch the vessel was towed to the Tyne by two powerful Blyth tugs, to have her engines and boilers placed on board.

On Saturday morning the fine steel steamer "Locksley Hall," which has been built by Messrs. Palmer & Co., Jarrow, for the well known "Hall" Line, was taken to sea for her trial trip. She is a vessel with splendid accommodation for some sixty first class passengers, and is 380ft. long, 45ft. broad, and 30ft. deep.

There was launched from Messrs. W. B. Thompson & Co.'s shipbuilding yard, at Dundee, last week, what is believed to be the largest and most powerful steam tug afloat. She is a vessel of 750 tons gross register, is fitted with engines 400 n.h.p., and will be propelled by twin screws, each driven by an independent engine. Her dimensions are: Length, 218ft.; breadth, 31ft.; and depth of hold, 15ft. 6in. The tug is built for the Retriever Steamship Company, Limited, Liverpool, and has been made suitable for towing purposes on the Hooghly.—A vessel built by the same company for the same service a year or two since was purchased by the Government. She is now known as H.M.S. "Hearty."

Messrs. Harland & Wolff, Belfast, have just completed one of the largest sailing vessels afloat for Messrs. Brocklebank and Co., Liverpool. She has been named "Sindia," and is rigged as a barque with four masts; and her gross tonnage is 3060.

Notices of Meetings.

THIS WEEK.

ARCHITECTURAL ASSOCIATION.—Friday, 20th January, 7·30 p.m. Ordinary meeting. Paper to be read by Mr. Somers Clark, F.S.A.

ROYAL INSTITUTION OF GREAT BRITAIN.—Saturday, 21st January, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

NEXT WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 24th January, 8 p.m. Ordinary meeting. Paper to be read with a view to discussion, "The Erection of the 'Jubilee' Bridge carrying the East Indian Railway over the river Hooghly, at Hooghly," by Sir Bradford Leslie, K.C.I.E., M.Inst.C.E.—Friday, January 27th. Students' meeting. Paper to be read on "Pumping Machinery in the Fenland and by the Trentside," by Mr. Lawrence Gibbs, Stud.Inst.C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, 24th January, 3 p.m. Lecture on "Before and After Darwin," by Dr. G. J. Romanes.—Friday, 27th January, 9 p.m. Lecture on "The Exploration of Masãi Land," by Mr. J. Thomson.—Saturday, 28th January, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

LIVERPOOL ENGINEERING SOCIETY.—Wednesday, 25th January, 8 p.m. Discussion on Mr. A. W. Brightmore's paper, on "Some Recent Experiments on Iron and Steel and Riveted Joints." The subject of "The Architects' and Engineers' Registration Bill, 1888," will be introduced by Mr. J. Price.

SOCIETY OF ARTS.—Wednesday, 25th January, 8 p.m. Ordinary meeting. Paper to be read on "Theatres, and Fireproof Construction," by Mr. Walter Emden.—Friday, 27th January, 8 p.m. Indian section. Paper to be read on "The Public Health in India," by Mr. Justice Cunningham.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, 26th January, 8 p.m. Ordinary meeting. Discussion on Mr. C. Cockburn's paper, on "Safety Fuses."

PRICES CURRENT, 19TH JANUARY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		32/-	Cash
Scotch Warrants, m/n		40/11½	"
Hematite Warrants, m/n		43/3½	"
Stocks in Stores. Scotch	942,782—Inc. for week,	9	Tons
Middlesbro'	346,191—Inc. "	2079	"
Hematite	212,074—Inc. "	894	"

Exclusive of stocks in makers' yards.
Market under control of the "bears."

	No. 1.		No. 3.		
Coltness	51/-	.....	44/-	f.o.b.	Glasgow.
Gartsherrie	47/-	.....	43/6	"	"
Dalmellington	43·6	.....	41·6	"	Ardrossan
Eglinton	42·9	.....	40·9	"	"
Glengarnock	47/-	.....	41/6	"	"
*Derbyshire	—	.....	38/-	f.o.t.	Works.
*Lincolnshire	—	.....	33/6	"	"
*Lancashire	—	.....	38/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 15 0	.....	5 5 0	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 5 0	.....	5 15 0	Manch'r.
" Angles	5 15 0	.....	6 5 0	"
Crown Sheets	6 12 6	.....	7 2 6	"
" Hoops	5 10 6	.....	6 0 0	"
"Siemens-Martin" Steel Boiler Plates		.....	8 0 0	"
" Ship and Girder		.....	7 15 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

No. 1 Selected.	No. 3.	No. 4.
Prices, per ton 53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£20	10	0	to	£21	0	0
Copper: British Cakes and Ingots	80	0	0	"	81	0	0
" Chili Bars	75	2	6	"	75	5	0
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	2	6	"	15	5	0
" English Sheet	16	2	6	"	16	5	0
Tin: Straits	166	10	0	"			
" Australian	167	10	0	"			
" English Ingots	148	0	0	"	150	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—A fall of from £10 to £12 has occurred since our last, prices having touched £74. 15s., since which the market has recovered, the price being £75. 5s. to £75. 2s. 6d. as we write. This appears to be influenced by the action of the syndicate, who are now said to be treating with some of the largest producers of copper, so as to arrange for the command of their output for the next two or three years. Their object is stated to be to maintain the prices at a higher level, by regulating the output, and preventing the price going below a fixed basis, which is understood to be about the present price of Chili bars. The position of copper does not therefore appear to be greatly affected by this fall, as "strong" copper remains firm and is no lower. The supply of copper is no larger, and the stock is mainly held by a powerful syndicate, who are quite able to handle it. Trade in all branches of the copper manufacture is very slack, and will continue so until uncertainty changes to a confidence in the stability of the new basis of value.

TIN remains firm and prices unaltered, the whole stock being firmly held by a strong syndicate.

LEAD is a little easier, the supplies being large.

SPELTER is a little easier, but the stocks are small and the demand active.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	28	0	0
" Ceylon	"	23	15	0
Cottonseed	"	20	0	6
Cod	"	19	0	0
Lard	"	43	0	0
Linseed	"	19	0	0
Palm, Lagos	"	21	10	0
Rapeseed: English	"	25	5	0
Seal: Pale	"	23	10	0
" Brown	"	18	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	6
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	8
" Spirit	"	0	0	7¾

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	8	—		.....	
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6¾	—	0	1	7
Alum: Lump (powder 10/- ex.)	ton	4	15	0	—	4	17	6
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	13	0	0	—		.....	
" Liquor	lb.	0	0	3½	—		.....	
Bleaching Powder	ton	7	10	0	—		.....	
Bisulphide of Carbon	"	13	0	0	—		.....	
Borax	"	28	0	0	—		.....	
Benzole (90%)	gal.	0	3	6	—		.....	
" (50 90%)	"	0	2	9	—		.....	
Copper Sulphate	ton	22	0	0	—	23	0	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	24	10	0	—	25	10	0
" White Sugar	"	28	0	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	6½	—		.....	
" Prussiate (Yellow)	"	0	0	7⅞	—		.....	
" Sulphate (Basis 90%)	ton	9	0	0	—		.....	
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	7	0	0	—		.....	
" " " 60%)	"	6	0	0	—		.....	
" " (Cream, 60%)	"	5	18	0	—		.....	
" Crystals	"	2	10	0	—		.....	
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	3	—	0	1	4
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

MACLAINE'S PATENT PERFECT PISTON COMPANY, LIMITED.—At the annual meeting of the shareholders of this company, held on the 13th inst., a dividend of 100 per cent. free of income tax for the year 1887 was declared.

INTERNATIONAL GEOLOGICAL CONGRESS.—The fourth session of this Congress will be held in London this year from September 17th to 22nd, both inclusive. The organising committee have nominated Professor Huxley as honorary president, and Professor Prestwich as president.

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HOME INDUSTRIES.

MANCHESTER, 19th January, 1888.

The Bolton Strike.—Our readers will remember the protracted strike of engineers which occurred during the past year at Bolton. When work was resumed it was agreed to leave the matters in dispute for settlement by a Board of Arbitration, in which both parties were represented. On the failure of these negotiations the case was submitted to Mr. S. Pope, Q.C., as arbitrator, who, on the 16th inst., announced his decision. Stated briefly, his judgment was to the effect that no reason for an advance of wages existed, and that the men were not entitled to it. The result, therefore, of the long fight and its attendant annoyances and loss, is to leave matters precisely as they were. It is to be hoped that the Board of Arbitration will not be disbanded, but will be enlarged and formed into a body by which all such disputes may be settled in a rational manner.

The Cotton Trade.—The situation is much the same as at the time of our last notice of this trade. Continuous contest is going on between buyers and sellers, in which neither, speaking broadly, are gaining much ground. So far as export yarns are concerned, the notable feature is an increase of shipments to the Continent; but in most cases the offers for this class of yarn are low, and not acceptable to spinners. The latter are, however, holding their own, and in special lines, such as bundled yarn, prices are very firm. The fluctuations of the cotton market have no marked effect upon spinners, nor do they induce business on the part of buyers. Manufacturers find it extremely difficult to obtain new contracts in the place of the old ones at the prices which they desire to get. At the same time, in most classes of goods there is no disposition to accept the low prices offered, and the result is that very little business is being transacted. The persistently low offers which they are receiving deter them from placing orders for yarn except at lower rates, and the market all round is quite free from any tendency towards large buying.

The Iron Trade.—The market for pig iron is very little influenced by the weaker tone of the Glasgow and Middlesbrough markets, and makers are holding very firmly to quotations. In bar iron, however, a stronger tendency is observed, common bars being now quoted £5. 2s. 6d. to £5. 5s. per ton; and the iron merchants of the district have advanced their quotations 10s. per ton for bars from stock. The very low rates prevailing for common bars have long been unprofitable, and the present advance is consequently quite justified.

The Ship Canal.—The call of £1 per share due on the 16th inst. has been well paid, and a gratifying feature is that a large number of the persons meeting the call have paid up their shares in full. This fact indicates that although Stock Exchange quotations are still much below par, there is nevertheless public confidence in the work. The construction of the Canal is making satisfactory progress, and it is reported that at the Eastham end the work is advancing rapidly, and that a large amount of plant is already on the spot.

LONDON, 19th January, 1888.

The Money Market.—The reduction in the Bank rate has not made any difference to the course of the money market. The Bank rate fulfils a useful function of its own, but it has ceased altogether to affect the current rates for money. These remain very easy, and the demand is slight. The stock markets are excessively dull in every department. The railway dividends announced so far have been disappointing, and have depressed the stocks of the companies concerned, and there has been a general feeling of dulness in home railways. British funds have been adversely affected in sympathy with a drop in the foreign market. So far there is no perceptible and distinct reason for this feeling abroad, but there is an instinctive dread of coming complications. A feature of the week has been the forcing down of the price of copper by the Paris syndicate, which is determined to spoil the market for those mining companies which have refused to come to terms with the conspirators. It is rather hard that the mines which have striven thus to act fairly to the consumers, and to preserve their own independence, should be thus victimised; but the occurrence shows how completely the syndicate has the market at its mercy. The shares of the copper companies have not fallen, as they would have done had the reduction in the price of the metal been a legitimate trade movement, and not a mere phase of a corner.

Companies.—Since our last report the following new companies have been registered: The Italian Gold Mining Company, Limited (California), with a capital of £90,000; Claringburn, Wilde, & Co., Limited, with a capital of £15,000, to purchase the business of a hosiery machine builder, carried on by Mr. J. A. Claringburn in Liverpool-st., Nottingham; the Thomas Lamp Company, Limited, with a capital of £50,000; Death's Fibre Machine Company, Limited, with a capital of £12,000; Anglo-American Bangor Slate Company, Limited, with a capital of £120,000; the Mannesman Tube Company, Limited, with a capital of £300,000; Stephen Thompson & Co., Limited, with a capital of £50,000, to carry on business at Wolverhampton as tin plate manufactures and iron masters; the Type Setting Syndicate, Limited, with a capital of £50,000, to acquire the patent rights in Great Britain of the Thorne type setting and distributing machine (described in *Industries*, Vol. III., page 69); Credenda Seamless Steel Tube Company, Limited, with a capital of £100,000: Foxes Bridge Colliery Company, Limited, with a capital of £121,000; Anglo-Sheba Gold Mining Company, Limited (Transvaal), with a capital of £70,000; Goldfields of Uruguay, Limited, with a capital of £300,000: Rocky Bar Wide West Gold, Limited (U.S.A.), with a capital of £120,000; Cerro de Pasco (Transvaal) Goldfields, Limited, with a capital of £375,000; Boord & Son, Limited, with a capital of £600,000, to carry on business as distillers, brewers, &c.; the Hull Brewery Company, Limited, with a capital of £200,000; and F. H. Lloyd & Co., Limited, with a capital of £20,000, to carry on business at the James Bridge Steel Works, near Wednesbury, as steel founders.

The Board of Trade Returns.—The favourable tendency of trade shown in the November Board of Trade returns is maintained in those for December. The total exports for that month amount to £20,385,464, an increase of £3,231,954, or 18·9 per cent. over those in December, 1886; and the imports amount to £34,173,968, an increase of £3,162,685, or 10·2 per cent. The exports of iron and steel, machinery and mill work, hardware and cutlery, chemicals, wool, and cotton piece goods show marked advances. The total exports for 1887 amount to £221,398,440, being an increase of £8,965,686, or about 4 per cent. over 1886; the total imports amounted to £361,935,006, an increase of £12,553,920, or about 3·5 per cent.

Iron and Steel.—As mentioned in the foregoing paragraph, the exports of iron and steel for the month of December show a large increase, the value being £2,191,485, as compared with £1,723,983 and £1,588,782 in the corresponding month of 1886 and 1885. The value for the year was £25,000,336, against £21,817,720 and £21,710,738 in 1886 and 1885. Italy and the United States have largely augmented their purchases of pig iron, and the latter country has also bought bar, angle, bolt, and rod iron largely. British East India has drawn on us for a great quantity of railway material. Exports of unwrought steel to the United States show a decrease.

Textiles.—Although prices of wool during the past year fluctuated to some extent, the rise and fall were not very marked as a rule, and the rates, taken generally, were much the same at the end of 1887 as at the same period of the previous year. The condition of the trade is very sound, although prices are below the average of the past ten years. In the hemp market there has been but little doing, but there has been an improved demand for Manilla.

Shipbuilding.—In their review of the past year's shipping trade, Messrs. Angier Brothers point out that the tonnage output of 1887 shows a large increase on that of 1886, and yet the majority of builders have turned out far less than half the tonnage their yards are capable of producing. Under these circumstances it is easily explained why prices remained until quite recently at £6 to £7 per ton for ordinary cargo boats, and in proportion for the finer class, and about £10 per ton gross register for sailers. Owing to the rise in metals which commenced in October, the prices of new steamers have now advanced about 10 per cent.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 8th January, amounted to £1,069,354 on 15,830¾ miles, as compared with £1,021,023 in the corresponding period of 1887, when the mileage was 15,706¾ miles. An increase is thus shown in the mileage of 123¾, or 0·7 per cent., and in the receipts of 4·7 per cent.

Harbour Works at St. Heliers, Jersey.—The construction of the new harbour works at St. Heliers is proceeding rapidly, under the direction of Mr. W. R. Kinipple, of 2, Westminster Chambers, London, in succession to Sir John Coode. Dredging operations are being carried out, and a length of 200ft. of the new breakwater is already built.

The Bankruptcy Act, 1883.—A return has been issued showing that the number of receiving orders in the High Court and in the County Courts having bankruptcy jurisdiction was 4838 during 1887, as compared with 4860 in 1886, and 4345 in 1885.

The Use of Accumulators for Telegraphic Purposes.—For some time past the Exchange Telegraph Company has been using E.P.S. accumulators to work the Stock Exchange "tapes" from their office in Cornhill, with very satisfactory results. There have been employed 210 accumulators, arranged in three series of seventy each, in place of 2000 primary batteries, which were previously installed for the same purpose.

GLASGOW, 19th January, 1888.

General Trade.—Judging by the increase in traffic on the Scottish railways, the improvement in general business seems to be diffusing itself over the whole country. The aggregate increase for the week is about 10 per cent. Shipbuilding orders have for the time ceased to come in. Dulness has supervened both in the iron market and on the Stock Exchange, and after the sudden revival people are beginning to inquire whether there will be any permanence in the improvement.

Shipping.—The shipments of pig iron during the past week were 5934 tons. Coals show a falling off of about 20 per cent. Freights outwards are still firm. Those homewards are, as a rule, not so high. The Bombay Indentors' Association have renewed their agreement with the three Glasgow-Indian lines—the Anchor, the City, and the Clan—for freights between Glasgow and Bombay. It is an indication of the hardening of freights that the rate under this agreement has been advanced 2s. 6d. per ton.

Copper.—The movements in the copper market are of exceptional interest in local circles, because one of the chief producing companies—the Tharsis Company—has its head quarters here. The *Glasgow Herald* is responsible for the publication of a rumour to the effect that a preponderating influence in this company is being gradually acquired by French shareholders, who have always taken a large interest in the concern, there being several French directors on the Board. The Mason and Barry Company and the Tharsis Company have both held out against the French copper corner, and it is not unreasonably supposed that this French buying of Tharsis shares, and the simultaneous drop of £5 in the price of copper, are dictated by the same necessity, viz., that of bringing these companies to terms.

Iron.—The price of iron has experienced a sharp fall. It is said that this has been due to the efforts made to reap the benefits of the recent advance by those who had brought in the rising market, and also to the operations of speculators who are "bearing."

Edinburgh Cable Tramways.—Though these tramways are now nearly completed, and though one section at least might be opened to traffic, a dispute, which is now the subject of litigation in the Court of Session, has prevented them from being opened. A provisional arrangement, at the suggestion of the Court, has been made, by which the tramway will be inspected by engineers, and a certificate granted if their report is satisfactory.

Cassel Gold Company.—The directors of this company have made a call of 2s. 6d. per share upon the new shares. The fluctuations in the value of these shares have been periodically sources of excitement on the Stock Exchange. From a discount of 1s. they went up in a few weeks to 19s. 6d., a premium of 9s. 6d. They have since fallen back. On the day of the announcement they fell 3s., and reached 13s. 6d. The experiments are still progressing.

Physical Society of Glasgow University.—A meeting of the above Society was held on Friday evening in the Physical Laboratory of the University; Mr. Maclean, president, in the chair. An interesting paper on the "Testing of Lubricants," was read by Mr. Bunji Mano, M.E. The paper gave a description of results obtained from experiments made by the author in the University of Tokio, Japan. Besides giving an account of the apparatus and the method of experiment employed, Mr. Mano called special attention to the fact that in estimating the value to engineers of various lubricants, their constancy of action in keeping a cool surface with a low co-efficient of friction and a high temperature of decomposition was of much more importance than their cash value.

New Railway Bridge.—The two main girders, each weighing about 90 tons, of the new bridge over the Glasgow and South-Western Railway, at Stevenston, Ayrshire, have been placed in position. The girders had been constructed upon a wooden stage, and were erected at right angles to the line, so that by slewing round one end they reached their permanent position. The girders have been erected by Messrs. James Goodwin & Co., of Motherwell.

(From our own Correspondents.)

LIVERPOOL, 18th January, 1888.

The Vyrnwy Water Works and the River Mersey.—At a recent meeting of the Water Committee, Mr. Deacon, the water works engineer, submitted plans and a report made in accordance with instructions received after the Board of Trade inquiry, held a few weeks ago, of the proposed method of carrying the water mains underneath the bed of the river Mersey. Two alternative plans were shown; one with a tunnel carrying three lines of pipes, the other with a tunnel for carrying one line of pipes. The latter plan was adopted, and ordered to be submitted to the Board of Trade for approval. The engineer also submitted to the same meeting a drawing and report of a deviation of the Great Western Railway, agreed upon by the engineer of the Great Western Railway and himself. The committee also approved of a plan and report of a deviation of the line of culverts from the straining tower. The tender of Messrs. Davis Brothers for executing work in connection with the inlet and outlet of the Llanforda and Cynynion tunnel, and the Morda syphon pipe, was recommended for acceptance. It is expected that the dam will be closed next October, when the new lake will at once commence forming, thus enabling the new supply of water to be delivered in Liverpool a few months afterwards.

The Proposed South End Ferry.—At the last meeting of the Mersey Docks and Harbour Board, the recommendation of the Works Committee, that the Board refuse the application of Mr. R. A. Macfie to construct a floating landing stage at the South End, was carried by fourteen votes to five. The argument against the construction of such a pier and landing stage was that the ferry would be fraught with inconvenience to the traffic of the great system of docks at the South End; and judging from a case recently before the Court of Passage, might put considerable responsibility upon the Board. Mr. A. Holt said a high level railway would meet all the requirements. On the other hand, it was stated that if only few people used the ferry there would be no inconvenience, and if many used it, it would show that such a thing was needed. There is great

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disappointment manifested at the decision of the Board, especially at the South End; for it was hoped that with the construction of this pier, and the consequent increased traffic to the Ship Canal works, the present depressed state of trade in this neighbourhood might be revived. The question will not be allowed to rest here, and further action in the matter will be taken.

SHEFFIELD, 18th January, 1888.

Iron and Steel.—Notwithstanding the smallpox epidemic, which is at present harassing the local trade, and interfering with operations at a few works, there is great activity in the heavy branches. Manufacturers find their order books filling more readily than in the first quarters of the past seven or eight years, and the iron and steel markets are still firm, with a tendency to advancing prices. The war rumours have had the effect of making Messrs. Thomas Firth & Sons very busy on gun material; and it is anticipated that Messrs. John Brown & Co. and Messrs. Charles Cammell & Co. will obtain extensive orders for heavy ordnance from the Government. These concerns have recently laid down huge plant for the purpose of manufacturing such ordnance; and it is a significant fact that Herr Krupp, of Essen, who was through the Atlas Works at the end of last week, has ordered for his gun works a large hydraulic forging press, similar to the one he saw at Messrs. John Brown & Co.'s. It is said that Messrs. Tannett, Walker, & Co., hydraulic machinery makers, of Leeds, have obtained the order, and that it may be followed by further demand for machinery of this character from the same quarter. Steel rails are selling easily at advanced quotations, and tyres find a market at an advance of 10s. per ton. Railway springs are also in active demand; indeed, there is a healthier inquiry for all classes of railway material. Shipbuilding material is more urgently required than it has been for some months past, and Messrs. Vickers, Sons, & Co. have large orders on hand for marine work. Orders for armour plates come in tardily; but the two armour plating firms—the Atlas Works and the Cyclops Works—are engaged on the turrets of the "Nile" and the "Trafalgar," which are giving a good deal of employment. In sheep shears and edge tools trade is brisk, chiefly on Colonial account. The stove grate makers are moderately busy in Sheffield, but at Rotherham the Wheathill Foundry Company have given their moulders and other workmen a fortnight's notice of reduction of wages, and the men have intimated that they will resist the reduction. The activity in the iron trade has spread beyond the Sheffield border. The Sheepbridge Iron Company are doing a much better trade in pig; and the blast furnaces at Ilkeston, after being idle for two years, have been blown in within the past few days.

NORTH STAFFORDSHIRE, 18th January, 1888.

The Iron Trade.—At the quarterly meeting held at Birmingham last week, some good orders were secured for this district. In finished iron a slight advance was obtained on the lowest rates which prevailed last year, while in pig iron an advance of 3s. to 4s. per ton was asked by producers. In the latter, however, most consumers are fully bought for the next three months at late rates. It remains to be seen whether the improvement in price can be maintained until they are again in the market.

Crewe Locomotive Works.—The men employed in the London and North-Western Railway Company's works are still on short time, and in face of the large stocks which have accumulated, there is not any immediate prospect of a change in present arrangements. A statement has been promulgated that a portion of these works are to be removed to Anderton, near Bolton, it being said that the lease of part of the company's property at Crewe was about to expire. As a fact the whole of the works are erected on freehold property, and additions to them are being constantly made, and there is no truth in the statement referred to.

The Cheadle Coalfield.—A company has been formed, under the title of the Cheadle Railway, Mineral, and Land Company, Limited, with a capital of £250,000, of which £100,000 is already subscribed and allotted, to construct a line of railway from Cheadle through the Draycott estate to Cresswell station, and among other things to develop the Cheadle coal basin, one-third of which has been secured by the company, and is estimated to produce over 60,000,000 tons of coal. Two pits have already been sunk upon one part of the property to a distance of seventy yards, and have reached the first seam of steam coal, 5ft. in thickness. The area acquired by the company for mining purposes consists of nearly 1300 acres.

BARROW-IN-FURNESS, 18th January, 1888.

Iron and Steel.—There is a falling off in activity in hematite pig iron and in steel rails. It is thought that this position has been brought about by speculators realising their stocks. Although quotations are lower, makers are very firm and well supplied with orders, and consequently can wait until prices improve. Pig iron is quoted at 44s. per ton net f.o.b. for mixed numbers of Bessemer descriptions, and at 43s. 3d. for No. 3 forge and foundry iron. Steel rails of ordinary heavy sections are quoted at £4 per ton net f.o.b. Billets are in brisker request at £4. 5s. per ton. Plates for shipbuilding are in very full demand, and are quoted at £7. 5s. per ton, with angles at £7. 10s. net f.o.b. There is prospectively a very brisk trade in shipbuilding material, and at Barrow arrangements are in progress for increasing the producing power at the steel works in this department. A new plate mill, which works most satisfactorily, has been started this week, and another mill is to be erected along with some additional Siemens-Martin furnaces. One or two very important orders for shipbuilding material have been placed during the week, and the local shipbuilding works are likely soon to be very busily engaged, as well in the shipbuilding as in the engineering departments.

Development of the Steel Trade.—It is proposed to erect Bessemer steel works in connection with the Whitehaven Hematite Iron Company's Works at Cleator Moor, in Cumberland. This is one of the oldest iron producing firms in the North-West of England, and although their works are situate some four or five miles from the coast, they are alongside of a valuable bed of iron ore, and quarries of suitable limestone for fluxing purposes; and the Company at Lowca, near Whitehaven, contemplate adding new mills to their plant for the manufacture of Siemens-Martin steel for ingots and castings, and the rolling of steel sheets and bars. At the West Cumberland Iron and Steel Works recent improvements have been effected to increase the output, and the same thing has taken place at the works of the Barrow Steel Company; while Messrs. Cammell, at Workington, have recently commenced a new rail mill.

Coal Prospecting.—It is thought that if coal exists at all on the Furness peninsula, it will be found at the southernmost point of Walney Island, because the dip of the mountain limestone is proved to run in that direction. A company have been boring with the diamond rock drill for some time past, and have reached a depth of 1450ft. They are still in the red sandstone, but expect soon to pierce the coal measures, if any exist at this place.

MIDDLESBROUGH, 18th January, 1888.

Pig Iron.—Since the commencement of the year the pig iron market has not fulfilled the hopes of the speculators who counted upon a continuance of the advance. For a time it remained firm at the price attained, but eventually it has gradually yielded, until 1s. 9d. of its gain has been lost. As low as 32s. has been accepted for No. 3 G.M.B. prompt, but 32s. 3d. is the average price per ton early delivery. Warrants are 31s. 10d. per ton cash, and hematite 43s. 6d. to 44s. 6d. per ton for Nos. 1, 2, and 3 mixed. Forge iron maintains its price at 32s. per ton, as the finished iron trade still retains its briskness, and the demand is good. The shipments of pig iron up to the 16th of the current month are not so good as in the month of December, being 25,895 tons, as compared with 40,282 tons; but they are much better than those over the same period in January, 1887, which were only 17,369 tons. The home consumption is much greater.

Manufactured Iron and Steel.—Finished iron maintains the improvement it made in the latter part of the year. Common bars are £5 to £5. 2s. 6d.; ship angles, £4. 15s. to £4. 17s. 6d.; engineering angles, £5 to £5. 2s. 6d.; sheets (singles), £6 to £6. 2s. 6d.; ship plates, £5 to £5. 2s. 6d.; boiler plates, £6 to £6. 2s. 6d. per ton less 2½ per cent. on trucks at manufacturers' works. Finished steel is not so brisk in the meantime, and prices have settled somewhat. Prices are—rails from £4. 2s. 6d., ship plates from £7, ship angles from £6. 10s. on trucks at works for cash less the usual discount. The North-Eastern Steel Works have been laid off since Christmas for repairs. The manager has taken occasion, as the time for resumption of work comes on, to insist that the men shall detach themselves from the Union of Steel Workers, and, if they like, form one of their own. The men object, and so the manager and men are in dispute, and in the meantime the men are locked out. Lloyd's surveyor has not yet visited the Eston Steel Works.

Shipbuilding.—The prospects of this industry in the district are bright and hopeful. Several of the orders recently given out have come to the Cleveland Dock Yard, whilst the other yards are said to be similarly situated in proportion to their capacity.

SUNDERLAND, 18th January, 1888.

Shipbuilding.—Gradually increased activity is becoming general in the local shipbuilding yards, owing to the laying down of steamers lately ordered. It has been stated that many of the orders recently booked were given out by parties speculating on a general and continued rise in the value of steam shipping.

Marine Engineering.—It is fully four years since the prospects of this important local industry were so promising. Every day brings additional activity. The alterations to the Scotia Engine Works are being carried on energetically, and it is understood that several orders for triple expansion marine engines have been booked by the proprietors.

The Shipping Trade.—During last week 68,205 tons of coal were shipped, as compared with 74,683 tons in the corresponding week of last year—a decrease of 6478 tons, largely due to the foggy weather delaying the arrivals and sailings of steamers. An even larger falling off, viz., 17,621 tons, was experienced at Tyne Dock. Coke, patent fuel, bottles, cement, fire clay goods, &c., were the remaining exports; the imports being iron ore and timber. Outward freights are somewhat higher, but there is no improvement in Black Sea, American, or homeward freights generally.

Iron Works.—Local rolling mills and forges are now well employed, especially the latter, the forging of keel and stem bars, stern frames, and heavy forgings for marine engines keeping five forges in operation day and night.

NEWCASTLE, 18th January, 1888.

Rope Works.—An active business is still to be noticed at each of the principal rope manufactories. Such establishments as Messrs. Haggie Brothers, Gateshead; Messrs. Hood, Haggie, & Sons, Willington Quay; and R. S. Newall and Sons, Washington, being particularly busy, owing to the fact that in addition to the home trade, their proprietors have many important foreign contracts in hand. Messrs. Dixon & Corbitt and R. S. Newall & Co. are also firms to which this remark may be correctly applied, the foreign contracts forming a very large proportion of the total work on hand.

Leather Works.—The improvement which has taken place in general trade has beneficially affected the leather industry in this district, and the change is especially noticeable in connection with the production of such descriptions of india-rubber goods as are used for engineering purposes.

Glass Works.—The Gateshead Stained Glass Company have developed a very active business lately, and they have now as many orders on hand as they can conveniently deal with, even by utilising their resources to their utmost extent. One of the contracts now in progress is the stained glass for a new church which is being erected at Jesmond, by Mr. Charles Mitchell, partner in the great firm of Messrs. Armstrong, Mitchell, & Co., Elswick. Pressed glass works at Gateshead, Lemington, and South Shields are still busy, and the plate glass company at the latter place is experiencing a rapidly increasing demand for their product. Such establishments as are devoted to the manufacture of lamp chimneys, globes, &c., are exceedingly busy; and the few remaining bottle works that are in operation, are much busier than they have been. The principle of making "metal" in "continuous tanks," instead of in the old fashioned "pots," has now been generally introduced into these establishments, and has had the effect of cheapening as well as accelerating the production.

Potteries.—The local demand for earthenware has been considerably stimulated of late, and as large orders for goods of this description are also coming to hand from distant centres, the continuance of the satisfactory state of business now existing is assured for some months to come.

Soap Works.—Business at the local soap works is somewhat depressed at present, and the competition of other districts is proving particularly severe. Though a portion of their trade appears to have been temporarily diverted, manufacturers do not despair of being ultimately able to meet their competitors on equal terms, and they are making every effort to secure the early realisation of their hopes.

The Timber Trade.—Though the imports of timber have for the present practically ceased, business in the saw mills and timber yards has improved, the requirements for building purposes being at present more than ordinarily large.

DUNDEE, 18th January, 1888.

Flax and Jute Trades.—The staple industries of the town and district have been fairly active since the opening of the year. The market for raw jute has eased a little. Spinners have adopted a waiting policy, and some small lots afloat have changed hands at a decline of 5s. to 7s. 6d. from the highest point. Telegrams from Calcutta report no material change in the market there for baled jute; but with a falling off in the arrivals of loose jute, and as the owners of the Calcutta mills are large buyers, no material decline in price is anticipated. Jute yarns meet a quieter demand, and prices in some instances have been barely maintained. In jute fabrics the demand has also fallen off a little, and the tendency has been rather against sellers. Sacking is still wanted, and prices are firmly maintained; but the demand for bagging and tarpaulin has not been quite so active, and buyers have if anything the advantage. In flax there has been more doing on the spot for assortment purposes, at about previous rates. On contract there is a fair business passing, and prices are steady. Transactions in tow and codilla are of small extent. Flax and tow yarns are in fair demand, and spinners are inclined to hold for a small advance; but bleachers, so far, are still sellers at the old rates. Orders for linen goods have come in more freely since the holidays, and some good orders from the home trade were placed last week. The foreign demand has also improved, and manufacturers are understood to be well engaged for some time. Sailcloth is steady, but the demand is still limited.

Electric Lighting.—A new carpet factory erected here has just been fitted up with five hundred electric lamps. The dynamo is one of Messrs. Mather & Platt's, and is worked by the engine which drives the looms.

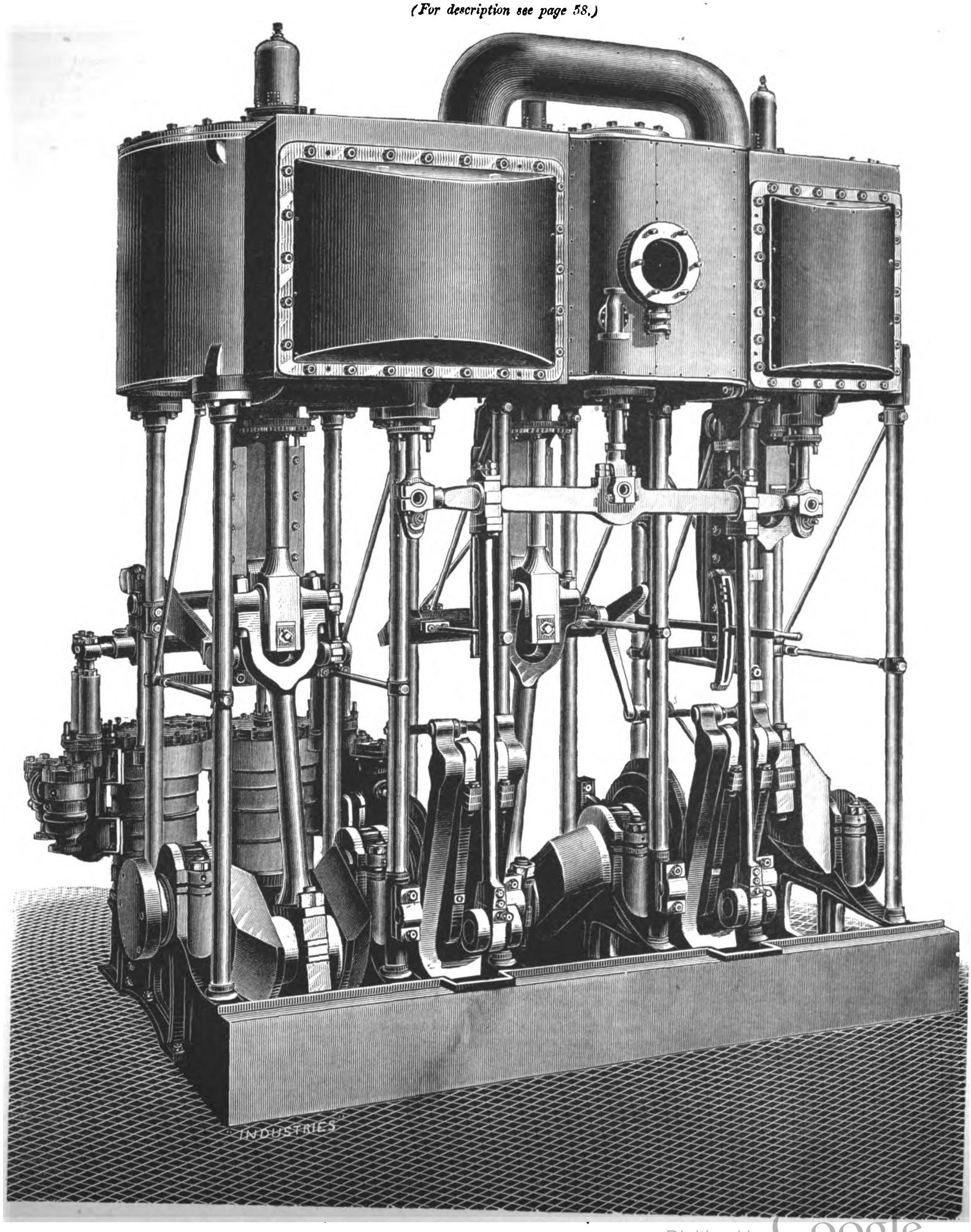
Shipbuilding.—The Dundee Harbour Trustees have accepted an offer from Messrs. Pearce Brothers to build for £6,700 a steel tug fitted with two sets of triple expansion engines, each engine to be of 48 h.p. nominal. The cylinders will be of 12in., 17in., and 30in. diam., and 20in. stroke. Her dimensions will be: Length, 120ft.; breadth, 24ft.; and depth of hold, 10ft. 8in.

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TRIPLE EXPANSION ENGINES
OF THE
GUNBOAT "CERAM,"

CONSTRUCTED BY THE SHIPBUILDING AND ENGINEERING COMPANY, "DE SCHELDE," FLUSHING, FOR THE DUTCH COLONIAL NAVY; MR. W. H. MARTIN, ENGINEER.

(For description see page 58.)



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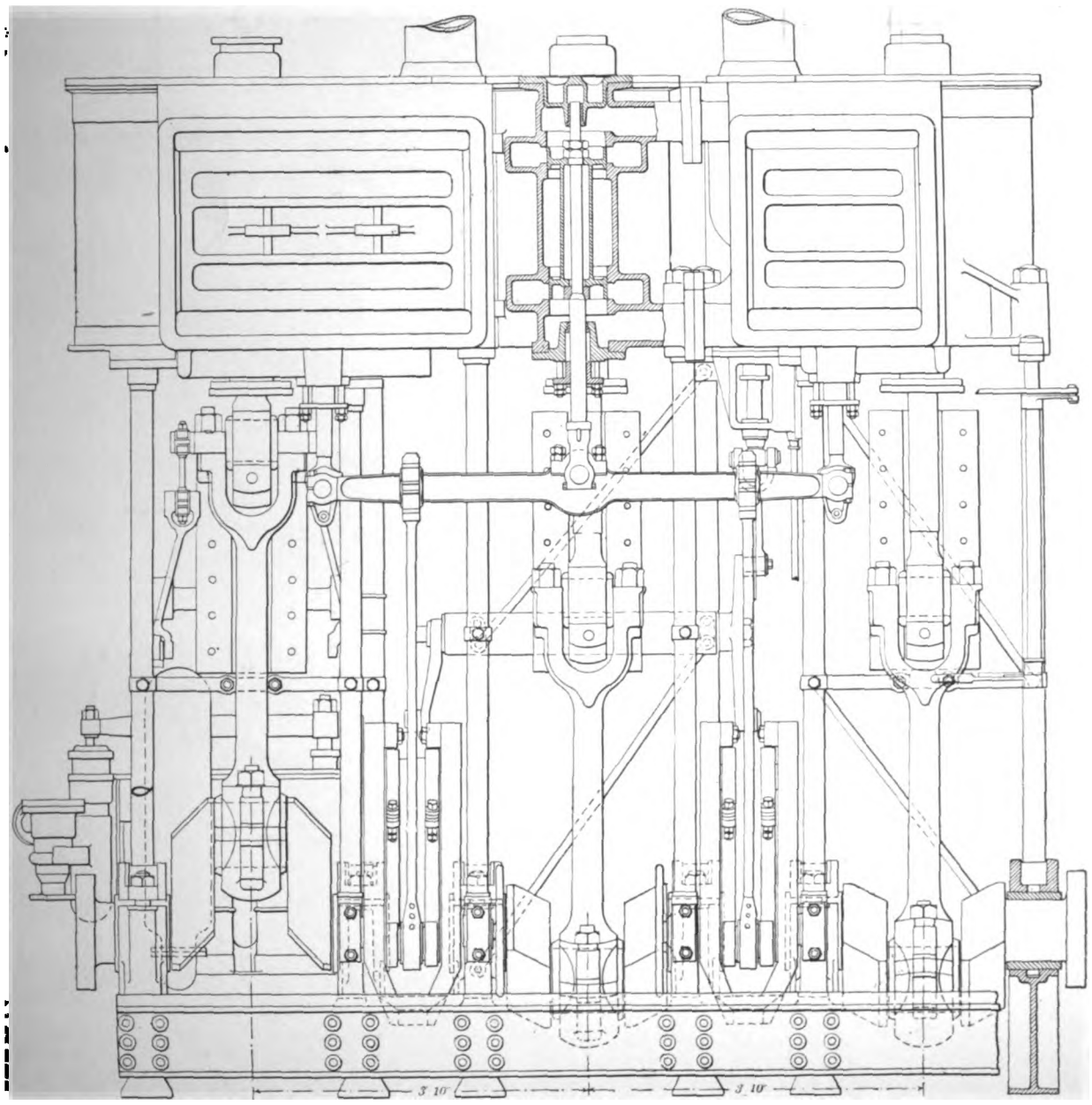


FIG. 1.—FRONT ELEVATION.

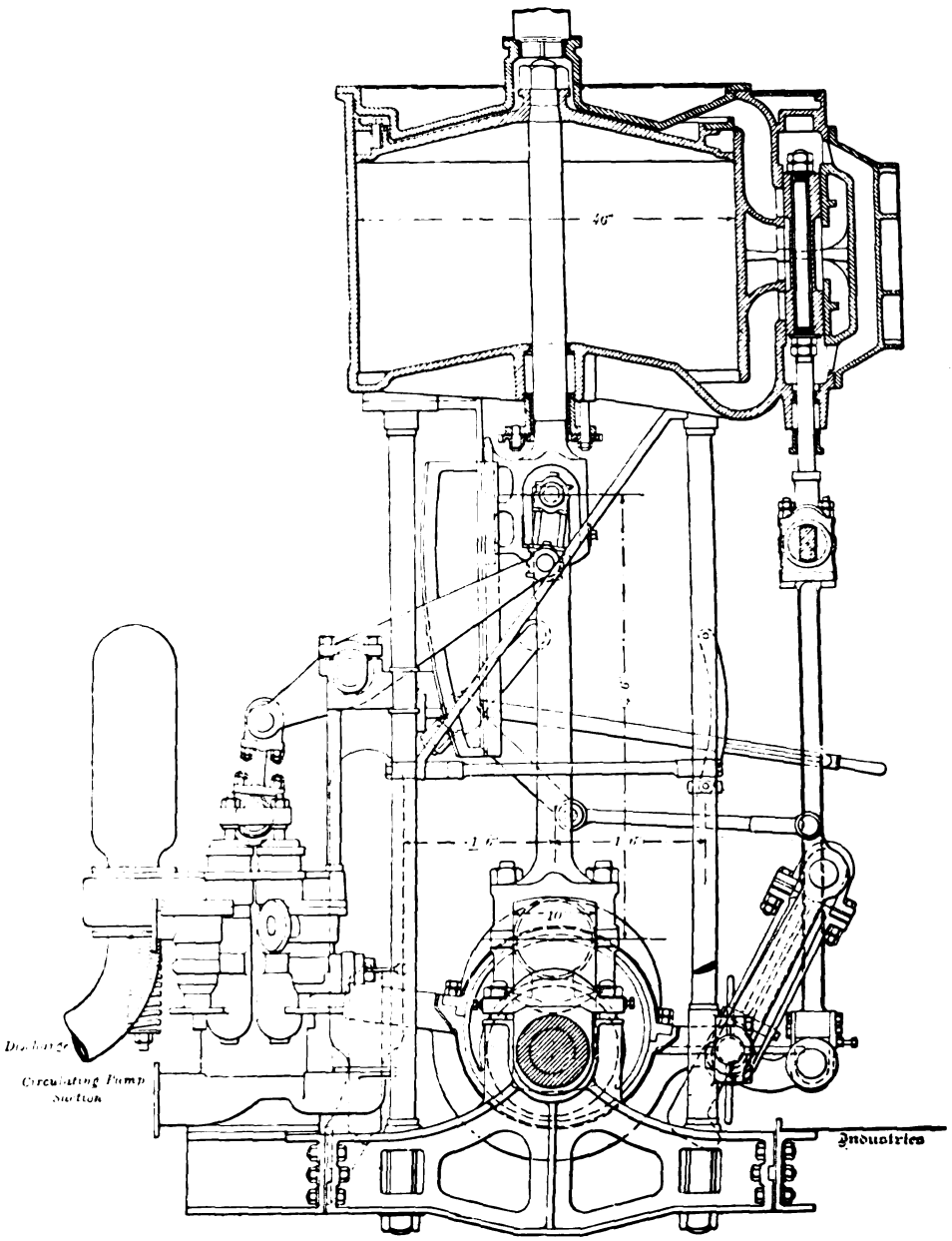


FIG. 2.—END ELEVATION.

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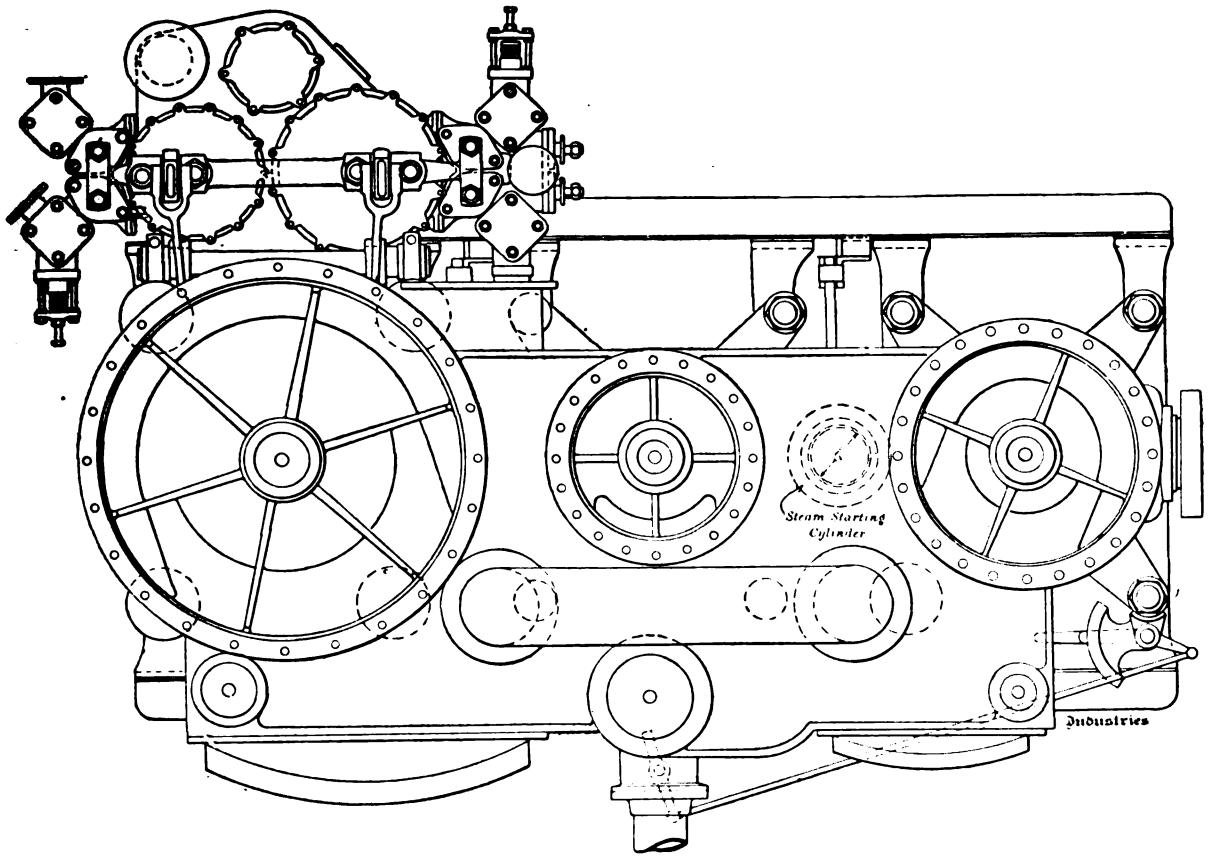


FIG. 3.—PLAN.

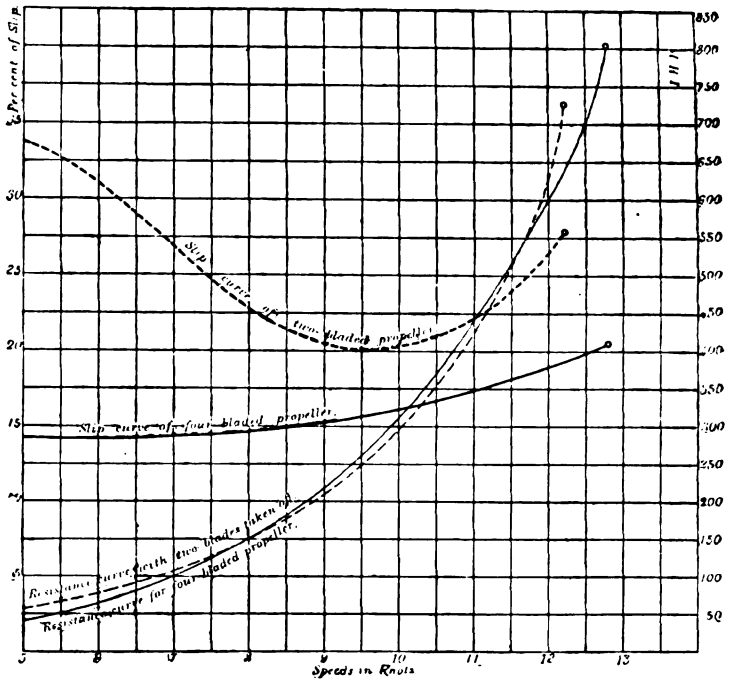


FIG. 4.—SLIP AND RESISTANCE CURVES.

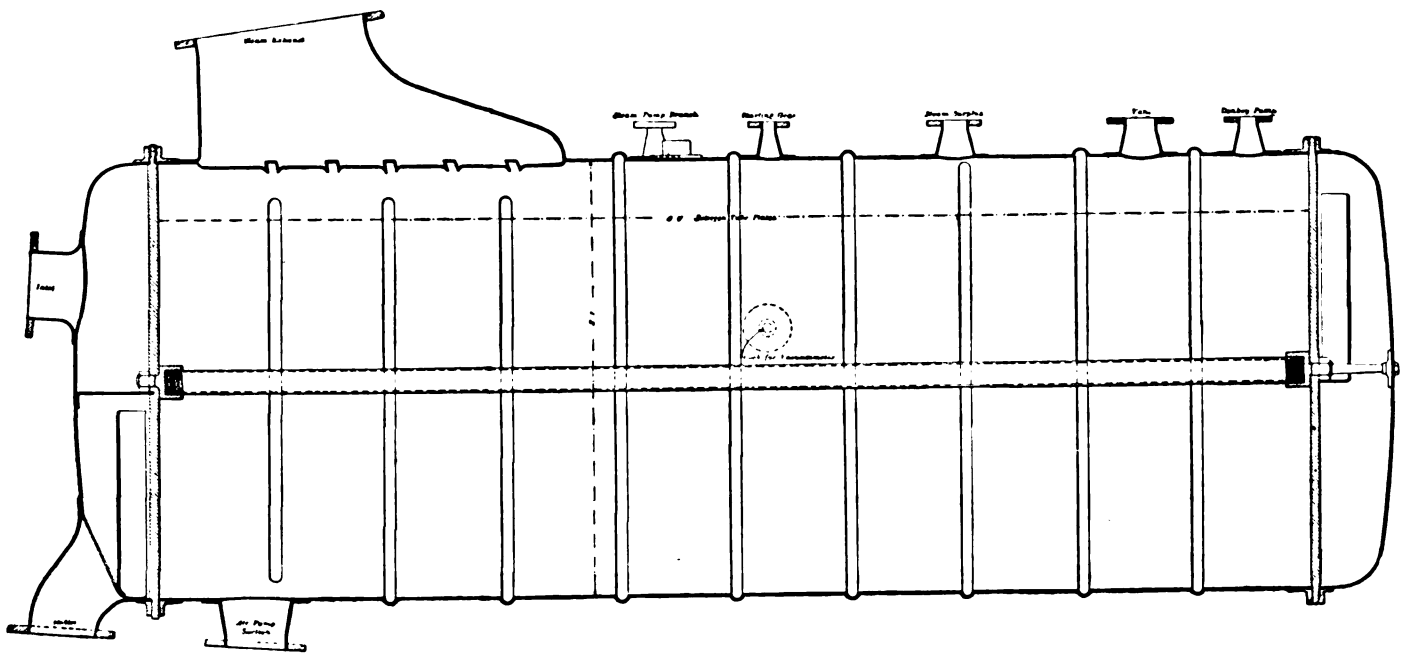


FIG. 5.—LONGITUDINAL SECTION OF CONDENSER.

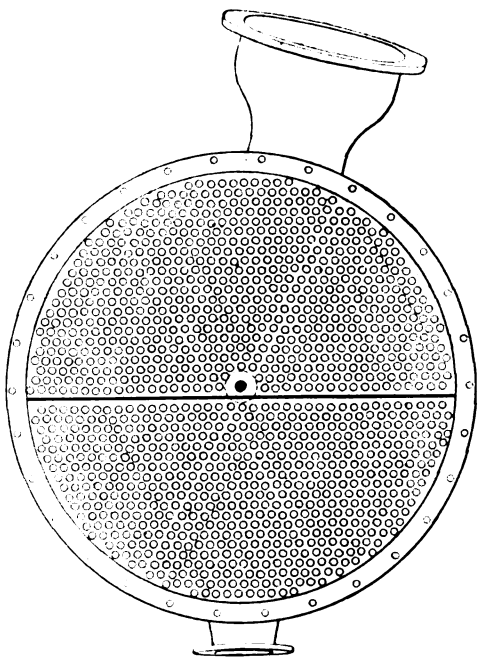


FIG. 6.—END ELEVATION.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62, Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
" " "INDUS, LONDON."
" " "JOURNAL, GLASGOW."
Telephone number: 684, MANCHESTER.
" " 2785, LONDON.

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With a Double-page Supplement showing the
TRIPLE EXPANSION ENGINES OF THE GUNBOAT "CERAM."

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 20TH JANUARY, 1888.

THE INDUSTRIAL IMPORTANCE OF ELECTRICITY.

THE subject chosen by the President of the Society of Telegraph Engineers and Electricians for his inaugural address cannot fail to be highly interesting not only to engineers and electricians, but also to manufacturers of machinery and apparatus required in the practical application of electricity. In this address an attempt has been made for the first time to express in figures the importance of the various trades depending upon the operation of electricity in one form or another. It has often been said that the elaboration of a presidential address for any of our learned societies becomes more difficult from year to year as the available ground becomes to an increasing extent occupied by previous addresses, and considering the large number of able men who have preceded Mr. Graves in the presidential chair of the Society of Telegraph Engineers and Electricians, he had no easy task before him if he would tell the Society something which would be both novel and of practical interest. He has, however, acquitted himself of the task in a manner which leaves nothing to be desired. His address dealt with a subject which is novel in the sense that nobody had previously taken the trouble to investigate it, and which at the same time is of the highest practical importance, because of affecting more or less directly the worldly prospects of his hearers. The President's high official position made it possible for him to obtain information of the number of persons employed in various branches of applied electricity, both in the manufacture of electrical machinery and apparatus, and in the working of industrial enterprises based on the use of such machinery and apparatus. These figures he has now published, and the world is for the first time in a position to form at least an approximate estimate of the industrial importance of applied electricity.

The estimate refers, however, only to those persons who earn their living by the application of electricity in one manner or another, but it does not comprise the far greater number of persons who are indirectly benefited by this agency. If a manufacturer, a merchant, or a private individual sends a telegraphic message, he does so because he expects to derive some benefit from the more rapid means of communication as compared to the sending of a letter or a special messenger. This benefit in some cases cannot be expressed by a monetary standard, but in the majority of cases it is simply a financial benefit, measurable in £. s. d. By use of the telegraph, orders are more promptly executed, time is saved, supplies can be secured in the cheapest markets, and the cost of production reduced, whilst, on the other hand, the value of the manufactured article is enhanced by greater opportunity for effecting a sale which naturally follows the improved facility of communication with various consumers. Thus the operation of the telegraph tends to enhance the amount of wealth produced by human labour, and at the time when the Government took over the telegraphs in this country it was roughly estimated that a sum of 10s. represented the commercial value of each telegraphic message. Since then, telegraphy has enormously expanded, and the commercial value of each message is probably considerably greater than was then estimated. With this aspect of the case, however, the President did not deal. He confined himself to enumerating the benefits accruing to the persons immediately engaged in electrical pursuits. In limiting his investigations to this branch of the subject, he had the advantage of being able to deal with it in a strictly scientific manner, omitting all guess work and conjectures, and including only such facts as could absolutely be substantiated by figures. There can be little doubt that in his anxiety to present to the Society only that which is absolutely reliable, he rather under than over estimated the number of persons directly engaged in electrical pursuits; but the relative proportion between the different numbers of persons engaged in the different branches of electricity is probably correct. The following is a list given by Mr. Graves of persons employed in Great Britain. We have added to each item the percentage of the total, so that the relative importance of the various trades may become apparent:—

Employed in connection with	Number of Persons.	Percentage of Total.
British Land Telegraphs	23,868	56·3
Submarine Cable Companies (mainly British)	6,000	14·2
Telephone Companies	2,500	5·9
Electric Lighting	5,000	11·8
Cable Making and allied businesses	5,000	11·8
	42,368	100

Mr. Graves estimates that the total number of persons employed in land telegraphs throughout the whole world is 180,000; in telephones, 30,000; and in electric lighting, 100,000. Confining ourselves, however, only to the figures for Great Britain, we must remark that the total of 42,368 relates to persons whose whole time is occupied in electrical occupations, the figure being exclusive of those persons who occupy only part of their time in electrical work. On many railways, for instance, the men in the signal cabin have to transmit electrical signals and occasionally whole telegraphic messages; but they have at the same time to attend to their signal levers and to the general working of the traffic. In various engineering works in England which have added an electrical branch to their previous business, the time of many employés is divided between the manufacture of electrical apparatus and that of other machinery. These persons are not included in the returns, and Mr. Graves estimates that if it had been possible to collect data relating to all those who are only partially occupied in electrical pursuits, the grand total of persons dependent for their employment on the various operations directly connected with electricity in these islands would amount to about 100,000, besides a very large addition to the numbers in various trades caused by the consumption of materials they produce. The employment of 100,000 persons means the support of at least 300,000. It is customary to reckon the average family maintained by industrial workers at 4½ to 5; but as in electrical work there is considerable preponderance of young and unmarried people, the average family has been taken as three per worker. On the same basis Mr. Graves estimates that throughout the world there must be about five millions of people who would have to seek for other means of subsistence if electricity and its commercial applications had not been made known to man.

A scrutiny of the figures in the little table given above is very interesting. We find that 56·3 per cent. of the total number of persons deriving their

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subsistence from electrical occupations falls to the British land telegraphs. A material increase in this figure is not likely to occur in future, and it is rather probable that the percentage—if a similar return should be made in ten years' time—will be found lower. The reason is obvious. Telegraphy was the first practicable application of electricity, and has consequently had more time to be developed to its present high degree of perfection than other branches. The present net work of telegraph wires throughout these islands is practically complete, and a large accession of employés cannot be expected to result from the erection of the few new lines which are annually added to our telegraphs. An increase in the number employed might be looked for as a consequence of the more and more extended use of the telegraphs by the public; but the increase will not be very great, since improvements in apparatus are continually being made, whereby the speed of telegraphy and the work done by each operator on each wire are increased. In submarine cables there is for similar reasons no probability of a large increase in the number of persons employed; but when we come to the telephone, electric lighting, and to cable making, it seems highly probable that the absolute numbers, as well as the percentage numbers, of the above table will for some time to come continually increase. The telephone is not as yet used to anything like the extent commensurate with its great utility; and there can be little doubt that as soon as legal restrictions are removed by the lapsing of the various patents, an enormous expansion of telephone business will be the result. In electric lighting an expansion of business is also imminent. Patent rights and monopolies have in this case not had the same baneful influence as in telephones, but legal restrictions of another kind have hitherto hampered the general supply of electricity for lighting purposes; whilst the over speculation in electric light shares some six years ago has had the effect of deterring many from embarking money in this business. Hence the comparatively low number of persons engaged in electric lighting. The condition of this industry is, however, now on the point of a radical and salutary change, and we have little hesitation in predicting that by the end of the current year a fair number of central stations for the supply of electricity will be established throughout England. That the Electric Lighting Act of 1882 must be amended is admitted on all sides, and unless the time of Parliament is blocked by urgent political legislation, the coming session will probably see a new Electric Lighting Act, under which it will be possible for contractors to work, and which will secure capitalists a fair return for their investments. Meanwhile, electrical engineers have not been idle, but have improved the methods of generating currents and the various systems of distribution over long distances to a degree which will render the introduction of a public supply of electricity technically safe and commercially profitable. In estimating the possible increase in the number of persons employed in electric lighting, it must not be forgotten that the figures in the table include also those persons who are now engaged in the manufacture of electromotors and apparatus required for applications of electricity other than lighting. These applications at present form an insignificant part as compared with the lighting industry, but they cannot fail to develop largely within the next few years. As all these trades are dependent upon the production of cable makers, the latter will also find their business expand to a very large degree.

PATENT LITIGATION IN 1887.

MERITORIOUS inventors will be gratified with the retrospect of judicial decisions during the past year. A strong current of sympathy from the Bench in favour of inventors may be observed. This is especially so when the quantity of invention to support a patent claim has been seriously considered. Inventors cannot reasonably object to their Letters Patent being declared invalid where previous publications show their indentical manufacture or process. Previous knowledge often falls short of identity, but shows something very close to it. It not unfrequently happens that a very small detail in construction or variation in a process turns failure into success, and we propose to consider the amount of difference which the Courts have considered sufficient to support a patent during the past year.

To chemical inventors, a case of great importance is that of the Badische Aniline Company *v.* Levinstein (*Industries*, Vol. III., page 146). The invention was for the production of red and brown dyes. It was proved that there had been practically the same reaction with phenol instead of naphthol. The House of Lords decided that this did not destroy the novelty of the invention. In their judgment they referred to Dr. Griess' evidence, viz.: "In 1864, I distinctly state that by the combination of di-azo-benzol and phenol, dye was obtained, and if I had been a little cleverer, analogy would have induced me to prepare this very dye which is now under consideration. But analogy did not lead me to do that. Analogy does not go a long way in chemistry." Again, in Moseley *v.* The Victoria Rubber Company (*Industries*, Vol. II., page 465) the patent was upheld for the production of printed waterproofs. In that case the invention consisted of a combination of four or five processes, each individually old. The combination was new, and the article produced was new.

Turning from processes to mechanical inventions, the inventor will still find room for congratulation. In Wenham *v.* May the patent for the Wenham regenerative gas lamp was called in question. At the date of the patent superheating the gas or the air necessary for combustion, or both, was well known. Nevertheless, Mr. Wenham's improved gas lamp, consisting of an arrangement of parts whereby the heated air is conducted to both sides of the saucer-like frame, was justly considered worthy of patent rights. In Morgan *v.* Windover, the invention was for "improvements in carriages." The most serious allegation against the patent was want of novelty in the patented arrangement, because (1) it consisted in the application of a known article to an analogous and obvious purpose; (2) that purpose was one for which elliptic springs had been previously used; and (3) C springs, as used by the patentee, were mechanical equivalents of elliptic springs. Mr. Justice Kekewich overruled the objection, and held that "the method of application required the exercise of the inventive faculties."

In the action brought by the Haslam Foundry Company *v.* Hall (*Industries*, Vol. III., page 548) the difference between the plaintiff's invention and that of Windhausen of 1869 was a tap. Mr. Justice Stephen held that the insertion in an old set of pipes of a tap for the purpose of withdrawing moisture well known to be condensed there, and also known to be a source of inconvenience if not withdrawn, would form the subject of Letters Patent. The patent was, however, upset on other grounds, which saved Messrs. Hall the necessity of appealing. We would not wish inventors to place too much reliance on this case, but we mention it to show the tendency of the Bench. In Siddell *v.* Vickers the invention was for a mechanical appliance for manipulating forgings. It consisted of the usual wheel and endless chain, in which the forging is supported. On the inside of the wheel there are teeth. To the pin of the wheel there is loosely attached a lever. On the lever there is a pawl which engages in the teeth of the wheel. On raising the lever the wheel moves round, carrying with it the endless chain, which causes the forging to rotate. It was alleged that the Creuzot machine anticipated the invention. In the Creuzot machine the wheel was revolved by toothed wheels and telescopic shafting. The Judge held that Siddell's combination was a new one, and the new tool or appliance was a proper subject for Letters Patent. It might be here noticed that Siddell's appliance was considered simpler than the Creuzot, and improvements in machinery very often take the form of simplification. It often requires more inventive power to reduce the number of parts in a machine than to increase them.

In the following cases there were judgments in favour of the patentees: Proctor *v.* Bennis, Bray *v.* Gardner, Woodward *v.* Sansum & Co., Ellington *v.* Clark, Bunnett, and Co. Patentees' rights in electrical inventions have not had much consideration. The only litigation of note during the past year is perhaps that the Edison & Swan Company have upheld on appeal the very favourable decisions they obtained in the Court below. The time, however, is probably not far distant when the validity of the various dynamo patents will be tested. There have, of course, been cases unfavourable to patentees; they are, however, few in number. In the patent cases of the past year the judges seem to have taken the common sense view of inventions and inventors' rights. Inventors often ask whether some discovery of theirs forms valid subject matter of Letters Patent, but each case must necessarily stand on its own footing. Provided the identical manufacture or process has not been disclosed before, it might be well to test the patentability for themselves by the following considerations: (1) Has the invention increased production or lessened labour, or otherwise effected economy? (2) if so, has the machinery or process, on which it is an improvement, been long before the public? If these questions are answered in the affirmative, allegations "as to analogy," "as to invention being obvious," or being mechanical equivalents, may be disregarded. Results are, of course, a test of utility; but they may be also some test of novelty, and also of patentability. The results must, however, be traced home to and caused by the invention, and not merely have a concurrent history therewith.

COTTON SPINNING LIMITED COMPANIES.

WITHIN the past five months the cotton spinning industry has fortunately taken a turn for the better, and dividends have now become the rule rather than the exception. This satisfactory condition has not altogether been occasioned, as the newspaper reports generally state, by an improvement in the demand and higher prices for the yarn, but is due in a great measure to a gradual decline in the quotations of the raw material. This will be best understood from a consideration of the following statement: In July of last year the average quotation for middling Orleans cotton was 5⅞d. per pound, and for good fair Egyptian 7⅜d. per pound. During the month of December the prices for these cottons were respectively 5⅝d. and 6⅞d. per pound, or a difference in favour of spinners at the present time of ¼d. and ½d. per pound. In a factory using 30,000lb. of Orleans cotton weekly, this would show a saving of about £30 per week, or say £390 per quarter, a sum sufficient in itself to pay a dividend of 5 per cent. on the average modern mill share capital. It will thus be seen that a mill which six months ago could merely pay its way has now a considerable advantage for realising a profit in the purchase of cotton alone, providing that the sale of its product has been maintained at former rates. To determine this point it will be necessary for us to refer to the prices of yarn current at these periods, which may be found in the following table:—

Nos. of yarn.	Prices, July, 1887.	Prices, Dec., 1887.	Increase or Decrease.
32's cop (twist yarn)...	7 13/16d.	8 1/16d.	¼d. increase.
40's „ do. ...	8⅜d.	8⅝d.	¼d. do.
40's „ (weft yarn) ...	8 7/16d.	8 5/16d.	⅛d. decrease.
50's „ do. ...	9¼d.	9d.	¼d. do.

Twist yarns, it will be observed, have risen ¼d., but weft have receded a like amount, so that, speaking generally, prices are unaltered. To improvement in the yarn market, therefore, the present profits of our limited companies must not entirely be attributed. No doubt a brisker demand now exists than was experienced some months ago, but real legitimate means of realising a profit is still extremely meagre. Under the circumstances, therefore, prospective investors in limited company shares should hesitate before purchasing or risking their means, in the belief and hope that the present liberal dividends of 10 and 12 per cent. will be maintained. If cotton advances in price losses will again be the rule, and the advance which has taken place in the share quotations will rapidly be absorbed in a relapse.

In the management of the financial matters of Lancashire "limiteds" there is ample room for reform; under existing rules profits are often declared and dividends paid when really a loss should have been recorded. This fact we explained in a series of articles published in *Industries* during last year, (Vol. II., pages 395, 486, 506); and here again we are presented with another case in point, viz., the reduced price of cotton. If matters were properly adjusted in regard not only to the interests of the company, but also of prospective shareholders, and not for the advantage and profit of mere speculators, every farthing of the profit obtained from the fall in cotton should be placed to a reserve fund. What would be necessary to constitute a rise and fall might be determined in the following manner: An average price for each quality of cotton might be fixed each year by a committee of the Master Cotton Spinners' Association, so that when quotations fell below the stated standard the amount gained would be accounted for to the shareholders in the manner stated, and when an advance took place a sum equal to the difference would be taken from the special reserve fund to assist in maintaining the profit results at an approximate level. In examining the past balance sheets of one or two modern Lancashire companies, a very anomalistic series of results are shown. In one instance we find a concern recording a loss of £40 on the quarter's working, while for the succeeding three months a profit of £980 is stated to have been made. Under circumstances of this kind (which, by the way, are characteristic of the company) we might naturally expect that, after deducting the loss on the previous stocktaking, the directors would have recommended a distribution on a basis similar to the following: £500 say to a reserve fund,

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and the remaining balance of £440 between the shareholders. Instead, however, of acting on this principle, £840 was distributed, and only £100 placed to future credit. This system, although radically bad, and most injurious to the interests of true investors and to the trade, is just what is desired by the speculator. It puts life into the share markets, and causes continuous fluctuations which would otherwise be avoided.

In looking over the published lists of the various companies, it will be observed that as a rule those concerns which have the least amount of share capital called up pay the largest dividends. This is due to the fact that they have all, without exception, large loan accounts on which from 3½ per cent. to 4 per cent. is paid, so that when trade is sufficiently good to admit of larger profits than this being realised in the working, the extra sums are added to the dividends of the shareholders. Other concerns, which have nearly or all of their share capital called up, are less fortunate. Their loan accounts are comparatively small, and as the security is not so great, 6 and even 7 per cent. has to be paid to the loanholders.

Letters to the Editor.

COLLAPSING PRESSURE OF IRON TUBES AND BOILER FLUES.

To the Editor of "Industries."

Sir,—There are probably many old boilers still in existence constructed at the time when exaggerated ideas as to the strength of their flues prevailed. These notions were modified when Sir W. Fairbairn published his formula for the resistance of flues to collapsing; but as this often gives results in excess, as it is incorrect in principle, and as there may be boilers working at pressures that are dangerous, I venture to submit a formula which I consider more accurate.

Let t=thickness of flue plates in sixteenths of an inch.
D=external diameter of flue in feet.

Then P the collapsing pressure in lbs. per square inch=$\frac{16t^2}{D^2}$

when the length of flue is seven times the diameter, or more. When the length is less than seven diameters the flue is stronger than one seven diameters long, in proportion as the length is reduced.

The collapsing pressure in a cold water test might be one-fourth more than that given by the formula, but not in the case of a boiler flue when the plates are heated, and there is an end pressure on the flue owing to its being expanded by the heat more than the shell. The least thickness of the plates, *i.e.*, the thinnest place, should be used as the thickness in the calculation; but if reckoned on the original thickness, it should be remembered that the flues of old boilers may collapse with two-thirds, or even one-half of the pressure given by the formula, depending on the wear and deterioration in quality of the plates, and on other defects. The flues are supposed to be plain, lap jointed and riveted, not flanged or fitted with rings, water pipes or stays.

Yours, &c.,
W. I. Ellis, M.Inst.C.E.

Manchester, 17th January, 1888.

THE FORTH BRIDGE.

The nineteenth quarterly report of inspection by Major-General Hutchinson, R.E., and Major Marindin, R.E., C.M.G., of the works in progress for the construction of the bridge over the River Forth, states that they are informed that the estimate made of the probable progress of the work has been maintained during the last quarter, and no serious interruptions have been caused by the weather; but the night shift has been discontinued for the winter, and the number of workmen employed has consequently been reduced. The greater proportion of the work in erection has been upon the internal viaduct and the top members of the piers and cantilevers, the bottom members having been carried out as far as is necessary for the present.

Temporary Works.

The additions to plant during the past quarter have been confined almost entirely to machines for the purposes of erection. The most important additions are four powerful and specially designed steam cranes, of which six in all will be required, and which, being attached to a frame work of girders forming a platform movable along the top members of the cantilevers, are used for the building out of these top members, and of the struts, and ties, and other portions of the structure within their reach.

Permanent Works.

South Queensferry.—*Main Piers:* That part of the superstructure over the piers which, including the internal viaduct, forms the central portion of the cantilever, is practically complete, the principal work remaining to be done being the riveting of some of the bracing and diagonal struts, and the fixing of the wind fence, and the whole of the flooring of the internal viaduct. On the southern portion of the cantilevers the bottom members are built out for 152ft. and riveted for 90ft., and the first bay of bracing between them is erected. The vertical webs of the booms of the top members, and the bracing between them, are erected for an average distance of 70ft. The first ties are built downwards a distance of 100ft. from the top junctions; the first struts are built to a level of 210ft. above O.D.; and the wind bracing between them is in place for 30ft. beyond the first intersection. The first vertical ties, with their bracing, and the support to the internal viaduct, are erected, and a length of about 100ft. of the girders and bracing of this internal viaduct is in place, and temporarily supported by wire ropes. On the northern portion the bottom members are built out for 160ft. and riveted for 103ft., and the wind bracing between them is erected to 15ft. beyond the second intersection. The vertical webs of the booms of the top members, and the bracing between them, are erected for an average distance of 60ft. The first ties are built down to the junction with the first struts, and the latter stand at a level of 220ft. above O.D., the first bay of the bracing between them being also in place. The first vertical ties, with their bracing, and the support to the internal viaduct, are erected, and a length of about 100ft. of the girders and bracing of this viaduct is in place, and supported temporarily by wire ropes. The riveted work at South Queensferry main pier now amounts to about 4880 tons, showing an addition of 866 tons during the quarter.

Cantilever and Viaduct Piers: The masonry of the cantilever pier has been raised, and now stands at a level of 150·50ft. above O.D. The girder viaduct piers are complete, and the end abutment and piers of the masonry viaduct are built to the level of the springing of the arches, 140·75ft. above O.D.

Inchgarvie.—*Main Piers:* The erection of the junctions at the tops of the vertical columns is in a very forward state. The vertical webs of the bottom booms, and the horizontal and vertical bracing of the top members, are erected, and the riveting of the former is complete. Some lengths of the webs of the top booms are also in place. Nearly the whole of the bracing between the vertical columns is erected and riveted, and the horizontal bracing for staying the columns at mid-height is complete. The internal viaduct over the piers is complete, with the exception of the wind fence and some flooring. On the southern portion of the cantilever, the bottom members are built out for an average distance of 150ft., and riveted for 137ft., and the first bay of bracing between them is in place as far as the intersection. The first struts stand at a level of 118ft. above O.D., and the first vertical ties at a level of 115ft. above O.D., and the girders and bracing of the internal viaduct are in place for about 100ft. On the northern portion, the bottom members are built for 152ft., and riveted for 120ft., and the first bay of the bracing between them is nearly all in place. The erecting platform has been raised to a level of 139ft. above O.D. The first struts stand at a level of 139ft., and the first vertical ties at a level of 155ft. above O.D. The girders and bracing of the internal viaduct are in place for about 100ft. The total amount of riveted steel work at Inchgarvie is 5817 tons, showing an addition of 1105 tons during the quarter.

North Queensferry.—*Main Piers:* The riveting of some of the bracing and diagonal struts, and the fixing of the wind fence on the internal viaduct, comprise practically all the work remaining to be done to complete that part of the superstructure over the piers forming the central portion of the cantilever. On the southern portion the bottom members are built out for 164ft. and riveted for 150ft., and the first bay of the bracing between them is riveted, and half of the second in place. The vertical webs and bracing of the top members are erected for a length of about 70ft. A length of about 150ft. of each of the first ties is built down from the top junctions; the first struts stand at a level of 212ft. above O.D., and the first bay of bracing is fixed. The erection of the first vertical ties, with their bracing, and of the support to the internal viaduct, is complete, and the girders and bracing of this viaduct are in place for a length of about 100ft. On the northern portion the bottom members are built out for 152ft., and riveted for 150ft., and the first bay of the bracing between them is riveted, and half of the second in place. The vertical webs and bracing of the top members are erected for a length of about 100ft. A length of about 95ft. of each of the first ties is built down from the top junctions; the first struts stand at a level of about 212ft. above O.D.; and the first bay of bracing is fixed. The amount of work completed on the first vertical ties, bracing, and internal viaduct is identical with that upon the same parts of the southern portion. The total quantity of riveted steel work at North Queensferry is about 5407 tons, showing an increase of 1112 tons during the quarter.

Cantilever and Viaduct Piers: The masonry of the cantilever pier now stands at an average height of 165ft. above O.D., and that of the viaduct piers and abutments is practically complete.

General Remarks.

Masonry and Concrete: Up to the present date about 566,500 cub. ft. of granite have been delivered, and 562,000 cub. ft. have been set; and about 111,600 cubic yards of rubble masonry and concrete work have been built.

Steel Work: In all about 46,740 tons of steel, an addition of 1578 tons since the date of the last report, have been delivered. The whole of the bottom junctions for bays No. 1 are practically completed in the yard. The fitting of all the bottom junctions for bays No. 2 is in hand, and the whole of the top junctions for bays No. 1 are well advanced. Good progress has been made with the fitting of the internal viaduct for bay No. 2 of the North Queensferry cantilevers, and the work on the bracing of the second bay of all the bottom members is nearly finished. The drilling of all the top members for bays No. 2, and the bottom members for bays No. 4, is nearly complete; that of struts No. 3 and ties No. 5 is about half done; and that of the top members for bays No. 4 is commenced. The whole of the bottom booms and two-thirds of the top booms of the second bays of the internal viaduct are complete. During the quarter the weather on an average was bad for half the time, and from fair to good for the other half. The greatest wind pressures recorded were 11lb. per square foot on the large gauge, and 20lb. on the small gauge, on Inchgarvie, on the 25th November; 24lb. on the small gauge, on the North Queensferry cantilever platform, on the 2nd November; and 32lb. on the small gauge on the top member at South Queensferry, on the 22nd November. The average number of men employed per diem during the quarter has been 3790, and the number employed on the 28th November 3370. The quality of the work continues, so far as we are able to judge, to be excellent. There have been eight fatal accidents among the workmen during the past quarter, two having been killed during a gale of wind by a plank blown for some distance from the North Queensferry pier. It is stated that none of the accidents were due to any failure of plant, such as has caused accidents in previous quarters. Since the last visit of the inspectors very considerable additions had been made to the appliances for the protection of the men employed upon all parts of the structure. It is stated that it is very difficult to persuade many of the men to adopt the most ordinary precautions, and the inspectors mention that they noticed more than one instance of what can only be characterised as foolhardiness, such as should be discountenanced and prevented in every possible way.

Books Received.

The Prospector's Hand Book. By J. W. Anderson, M.A. London: Crosby Lockwood & Son.

L'Electricité: Notions et Applications Usuelles. Par Aug. Michaut. Paris: Georges Carré.

American Chemical Journal. Edited by Ira Remsen. Vol. IX., No. 6.

Transactions of the Institute of Engineers and Shipbuilders in Scotland. Meeting, 22nd November, 1887.

Management of Accumulators and Private Electric Light Installations. A Practical Hand Book. By Sir David Salomons, Bart., M.A., A.I.C.E., M.S.T.E. Third edition, revised and enlarged. London: Whittaker and Co.

Fortschritte der Elektrotechnik. Unter Mitwirkung von Dr. M. Kiliani und Dr. E. Pirani, Herausgegeben von Dr. Karl Strecker. Berlin: Julius Springer.

Flour Manufacture: A Treatise of Milling Science and Practice. Translated from the second enlarged and revised edition, with supplement, by H. H. P. Powles, M.Inst.C.E. London: Crosby Lockwood & Co.

The Yorkshire Illustrated Co-operative Almanac for 1888. Edited and published by Hargreaves Jackson, Middle Ellestones, Greetland, near Halifax.

Examples of Antique Furniture, drawn from the originals by Wm. Sharp Ogden, Architect. Manchester: R. H. Sutton, 25, Princess-street. Part I.

Journal of the Iron and Steel Institute. No. II., 1887. London: E. & F. N. Spon.

A Text Book of Paper Making. By C. F. Cross and E. J. Bevan. London: E. & F. N. Spon.

Reviews.

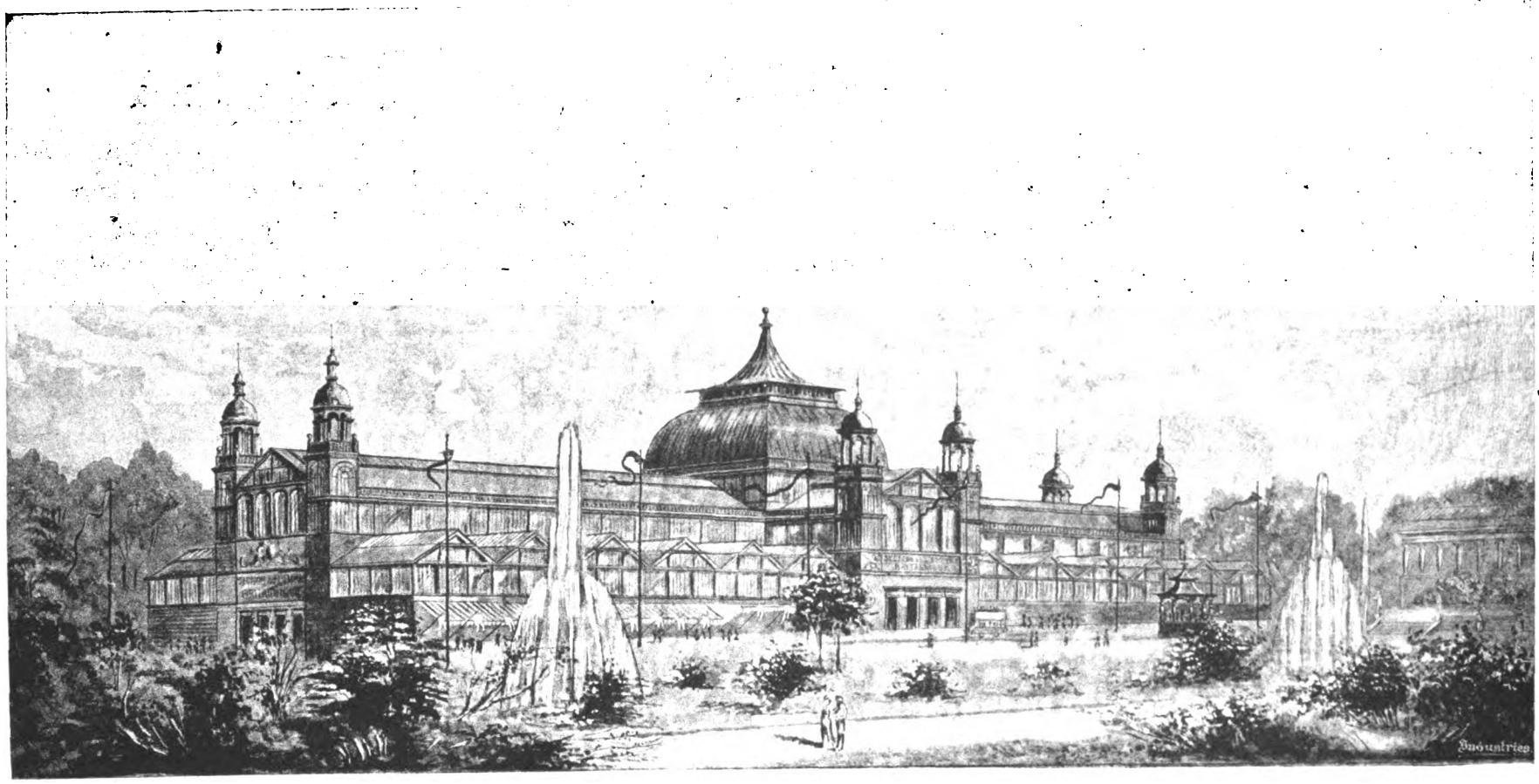
Cours de Construction Navale, professé a l'ecole d' application du Génie Maritime. Par A. Hauser, Sous-Directeur a l'ecole d'application du Génie Maritime. Paris: E. Bernard et Cie. 1886.

We have already given (*Industries*, Vol. I., page 447) a preliminary notice of the course of instruction in marine engineering in "L'ecole d'application du Génie Maritime," in course of publication, and we now wish to direct the attention of our readers to that in naval construction, by M. Hauser, the sub-director of the school. It is without doubt one of the most complete treatises of the kind in existence, consisting as it does of one large volume of 590 pages of text, and another of 340 plates illustrating that text, and although the book is intended chiefly for the use of students in the French dockyards, it is deserving of study by students of naval architecture in this country, especially those connected with the Admiralty. France, Germany, and Italy, among continental countries, are ever ready to appropriate any improvements we make in naval architecture, and our shipbuilders must keep their eyes open as to what is being done by our neighbours. In France the scientific study of naval architecture is of much longer standing than in Britain, and there can be no doubt that we owe many of its most important developments to the researches of French mathematicians and physicists. During the last century, and the beginning of this one, the ships captured from the French served as models for the English Admiralty officials, a practice which ceased only when arrangements had been made in this country for affording those officials a scientific training of a similar nature to that which had long been given in France. The French ships excelled in gracefulness of form, and consequently in speed, while those of Britain were better built and better manned. We owed our victories, however, more to the fighting qualities of our sailors than to the superiority of our ships. Constructive officers had no means of professional instruction, except such as were of a practical nature, until 1811, when the Royal Naval College for the education of apprentices was instituted in Portsmouth dockyard. On another occasion we may trace the development of instruction in scientific naval architecture in Britain; suffice it now to say that the combination of an intelligent knowledge of principles with the superior workmanship of our dockyards, produced excellent results, and the French soon recognised

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THE BRUSSELS EXHIBITION, 1888.

BRITISH EMPIRE SECTION.



the inferiority of their ships in sailing, and the frequency of their sustaining damage as compared with those of the British. In 1832 a commission was appointed by the French Minister of Marine to inquire into the causes of this inferiority, and advantage was taken of the union of squadrons of British and French ships of war in the Downs, to observe their relative performances and the conditions affecting them. A most interesting report followed.

The course of naval construction in the book under consideration is divided into eight parts, viz.: (1) General explanations, (2) Construction in wood, (3) Construction in iron, (4) Launching, repairs, &c., (5) Fittings of the hull, (6) Accommodation on board, (7) Masting, sails, and rigging, (8) A description of the principal types of ships of war. The first two may be passed over without special notice, except perhaps the remark that the second is unnecessarily long for a modern treatise. Wooden ship building in this country and in France has now almost died out, and fifteen chapters form too great a space to give to it in a modern treatise. The part on construction in iron and steel is excellent. Interesting historical details are given of the introduction of these materials for ship building, and their advantages and disadvantages are duly noted. Some points, however, are not so complete as they might be, but we suppose that these are given in the lectures in the school of which this book presents an outline. A very short *résumé* is given of the rules of Lloyd's Registry and the Bureau Veritas, and occasional reference is made to their application; but as the author treats chiefly of ships of war, sufficient details are not given to make his remarks of much use to builders of merchant ships, although the methods of construction of ships of war are very fully explained. The chapter on riveting is very complete and valuable, and enters fully into the practice both in France and England, as well as the calculations for the various proportions, and the author strongly advocates the use of mechanical methods when possible, while that on plating and armour contains a vast amount of useful information. The part relating to the use of steel might have been made more complete by the incorporation of the results of some of the experiments which have been made in this country and in France. This section is concluded by chapters on composite construction, on water tight compartments, and on ventilation, which, however, are somewhat fragmentary in their nature. The section on launching and appliances for the repair of ships will be read with interest by British ship builders, as it contains descriptions of methods which seem to be peculiar to France, and of the apparatus employed, while the accounts of the different kinds of docks, basins, &c., will be found useful, although we must admit that some parts are a little antiquated. We need not enter into details of the sections relating to the fittings of the hull, the accommodation on board, and masting, sails, and rigging; they are all very complete, and deserve careful study from Admiralty officials, as they give much information which is not generally available.

The eighth and concluding section on the principal types of ships of war is the one which will be read with most interest by non-professionals, and possibly also by statesmen, as it gives in a very small space a *résumé* of the navies of the chief powers, special attention, of course, being paid to that of France. It begins by stating the constitution and programme of the latter, and its chief functions in times of peace and war. In time of peace, it has for its object to support diplomatic demands by military demonstrations, to protect and keep the colonies in relation with the mother country, to assure the safety of the merchant navy and to repress all acts of piracy, and, lastly, in foreign countries it ought to intervene to cause the rights of French citizens to be respected. In time of war, the fleet is intended to overcome and reduce the enemy; in the case of offensive action, an attack is made upon the fortified places in the territory of the enemy, by bombardment, and, if necessary, by disembarking an army corps. If, on the other hand, the enemy do not wait for the attack, and bring their fleet to the assailants, it is necessary to have ships analogous to those of a besieging fleet, but endowed with greater mobility. Should the enemy be victorious, and carry the theatre of war to the shores of the assailants, it is necessary to defend them, in addition to the fortifications situated upon the most important points on the land, by coast-guard ships and by torpedoes. Lastly, a large number of small ships are required for various purposes, such as acting as coast police, for the protection of fishermen, and the service of the arsenals. Subject to these uses the French fleet has been arranged in classes, and descriptions of examples of each of those are given by the author, and a comparison made with similar ships in foreign navies, which will no doubt be carefully studied by our Admiralty officials and others interested in the subject. On the whole we think the book a valuable production. It covers a very wide field, and cannot, of course, enter into full details of all the subjects mentioned, nor, perhaps, is it intended that it should do so, being rather an outline of the course professed in the school; but we must say it is one of the most complete outlines in existence, and its concluding sentence may be quoted, to show the sentiments which are engrafted in the young French engineers. It says: "L'ingénieur ne pourra donc que chercher à satisfaire à des nécessites toujours changeantes, à des programmes sans cesse modifiés par les progrès de l'art militaire, les perfectionnements industriels, les transformations politiques. Chaque jour, il devra fournir l'instrument de combat nécessaire au marin, qui lui en suggère les principales données, souvent difficiles à concilier. C'est ainsi qu'il pourra, pour sa part, 'contribuer à la gloire des armes de la France, et soutenir l'honneur du pavillon.'"

THE BRUSSELS EXHIBITION, 1888.

BRITISH EMPIRE SECTION.

We have already, in our impression for the 4th November last, given a bird's-eye view and general plan of this Exhibition, and we now are enabled, through the courtesy of the architects, Messrs. Maxwell and Tuke, Princess-street, Manchester, to give above a general view of the main building, which will contain the exhibits belonging to the British Empire Section. The entire area allotted to the whole exhibition comprises about 316,000 square metres, and of this space 20,000 square metres have been set apart for the British section. The building we now illustrate is being constructed under the superintendence and direction of Messrs. Maxwell & Tuke, and Mr. Byron, an English contractor, and will, to a great extent, consist of part of the buildings erected for the late Royal Jubilee Exhibition held at Manchester last year. The nave will be identical with the nave of that exhibition, and will be about 500m. long, with a transept and towers forming the central entrance. The building will be connected by a gallery with the main building of the general exhibition, but in all other respects it will be a complete exhibition in itself. As we have before stated, the general management of the British section has been entrusted to the manager of the late Manchester Exhibition, Mr. S. Lee Bapty, who has been appointed with the sanction of the Belgian Government and the Chief Commissioner of the British section. Judging from the success which followed his management at Manchester, we have good reason to anticipate a favourable result for the British Empire Section at the forthcoming Brussels Exhibition.

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SWINTON'S SYSTEM OF DIRECT TELEPHONIC EXCHANGE.

Up to the present, whenever the number of telephones connected to the circuit exceeded two or three, it has been usual to make the connection by means of a central exchange, from which radiate the wires to the subscribers, and for town telephony this no doubt is the only practical system; but when telephonic communication is required within the limits of a building, or even those of a works, the central exchange system does not offer sufficient advantages to compensate for the cost of keeping an attendant at the exchange, and to provide for such cases Mr. Swinton has devised a very ingenious system of intercommunication between a limited number of instruments



Fig. 2.

without making use of an exchange centre at all. In this case each instrument or station (we must not say subscriber, for virtually the instruments are all in the service of the same concern) can call up any of the other stations without interfering with the rest, notwithstanding the fact that at the same time conversation may be going on between two other stations on the circuit. We had last week an opportunity of testing this system in a warehouse in London, where six instruments are fitted in various floors and offices. In this case the telephones have been installed in lieu of speaking tubes. It is evident that to produce intercommunication between six speaking tube stations, there would be required fifteen separate tubes, whereas the communication between six telephone stations requires only eight separate wires. These wires are bunched together into a small and flexible cable, thus occupying very much less space than fifteen speaking tubes. The time for a call is not longer with the telephone than with the speaking tube, whilst the clearness of speech is very much greater. The arrangement of the circuit will be understood from our illustration (Fig. 1), whilst Fig. 2 shows the instrument at each station. It consists of an ordinary Swinton telephone, with the addition of a switch box below. When the telephone receiver hangs on the switch hook, as in our illustration, the call bell is in circuit with the two contacts of the jack plug, which is usually inserted into the hole at the extreme left of the switch box, and in this condition the instrument is ready to be called up by any other station on the circuit, as will presently be explained. When the telephone receiver is taken off the hook, it is automatically switched into circuit and the call bell switched out of circuit in the usual way. The front of the switch box is fitted with plug holes distinctly lettered with the names of the different telephone stations comprised in the system.

SWINTON'S DIRECT TELEPHONIC EXCHANGE.

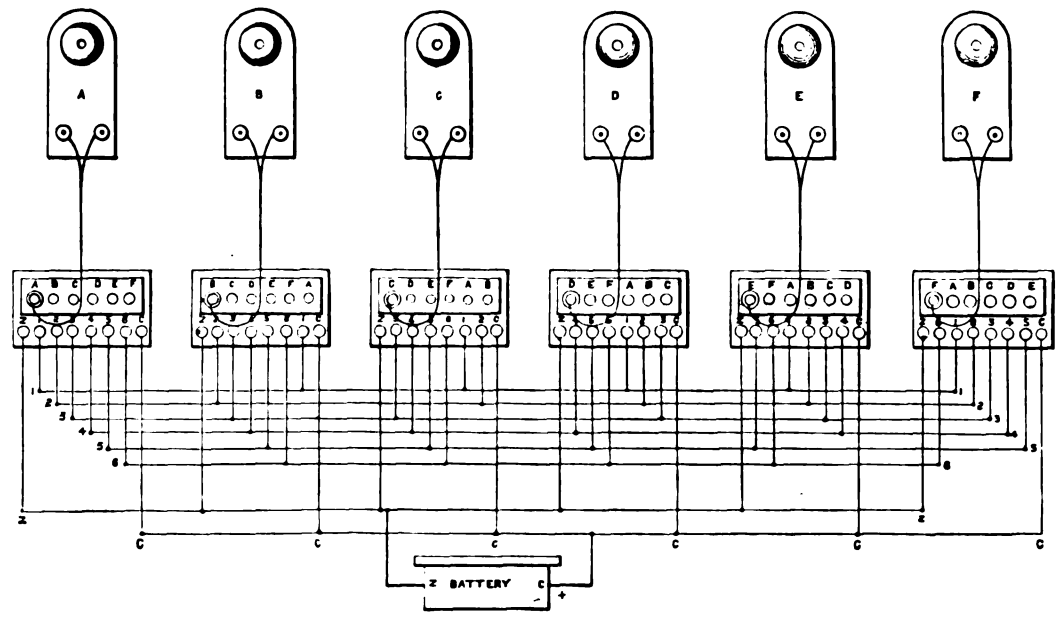


Fig. 1.

In connection with the terminals of the telephone is a flexible cord terminating in the jack plug already mentioned, which simply consists of two metal strips separated by a piece of insulation. This can be inserted into any of the holes in the switch box for calling up the station indicated by the letter on the box. Referring to Fig. 1, it will be seen that there is only one battery (in the warehouse we inspected, where there are six stations, the battery consists of eight Leclanché cells, No. 2), and all the switch boxes are coupled in parallel, the terminals for the battery connection being marked Z and C. The other connections between the stations are clearly shown on the diagram.

To explain the working of the system, let us assume that A wishes to call up C. He would first take off his telephone from the hook, then draw out the plug from A and insert it into the hole marked C, by which means the call bell of C would begin to ring, the ringing of the bell being notified to A by a loud rattling noise in his own telephone receiver, due to the current from the battery being rendered intermittent by the contact breaker of the bell at C. Upon C removing his receiver from the hook the noise ceases, and A knows that he can talk to C, and *vice versâ*. The current now goes from the positive pole of the battery through the receiver and transmitter of C, through its plug C, to line No. 3 into the plug C of the instrument A, then through its receiver and transmitter and back by Z to the negative pole of the battery. When the conversation is completed A must replace his plug in the A hole of his switch box, so that other stations may be able to call him up if required. It is evident from an inspection of the diagram that any two stations may communicate with each other, irrespective of communication going on between any other two stations; but if B tries to call up A or C whilst these two are in communication, the absence of the rattling noise in his own receiver intimates to him that the line is engaged. This prevents the interruption of conversation, and any possibility of confusion. If any station does not wish to be called up, as might be the case where the instrument is fixed in the principal's room, who only requires to initiate communication with the other stations, but not to be called up himself, all he has to do is to omit inserting the plug A in the first hole of the switch board. All these instruments are worked with a direct battery current, and have no induction coils; but for long distances Mr. Swinton has just brought out a modification of his original instrument, in which induction currents are employed; but instead of using a separate induction coil to each transmitter, he uses the receiver of each instrument as the induction coil for the transmitter of the same instrument. The telephone receiver contains a soft iron core, which becomes magnetised by the battery current traversing the primary coil as soon as the receiver is taken off the hook. On the same core is a fine wire coil connected to the line. The transmitter is in series with the primary coil of the receiver, and the induced current of the secondary coil goes to actuate the receiver of the other station. These instruments are made by the Equitable Telephone Association, Limited, of 75, Queen Victoria-street, E.C.

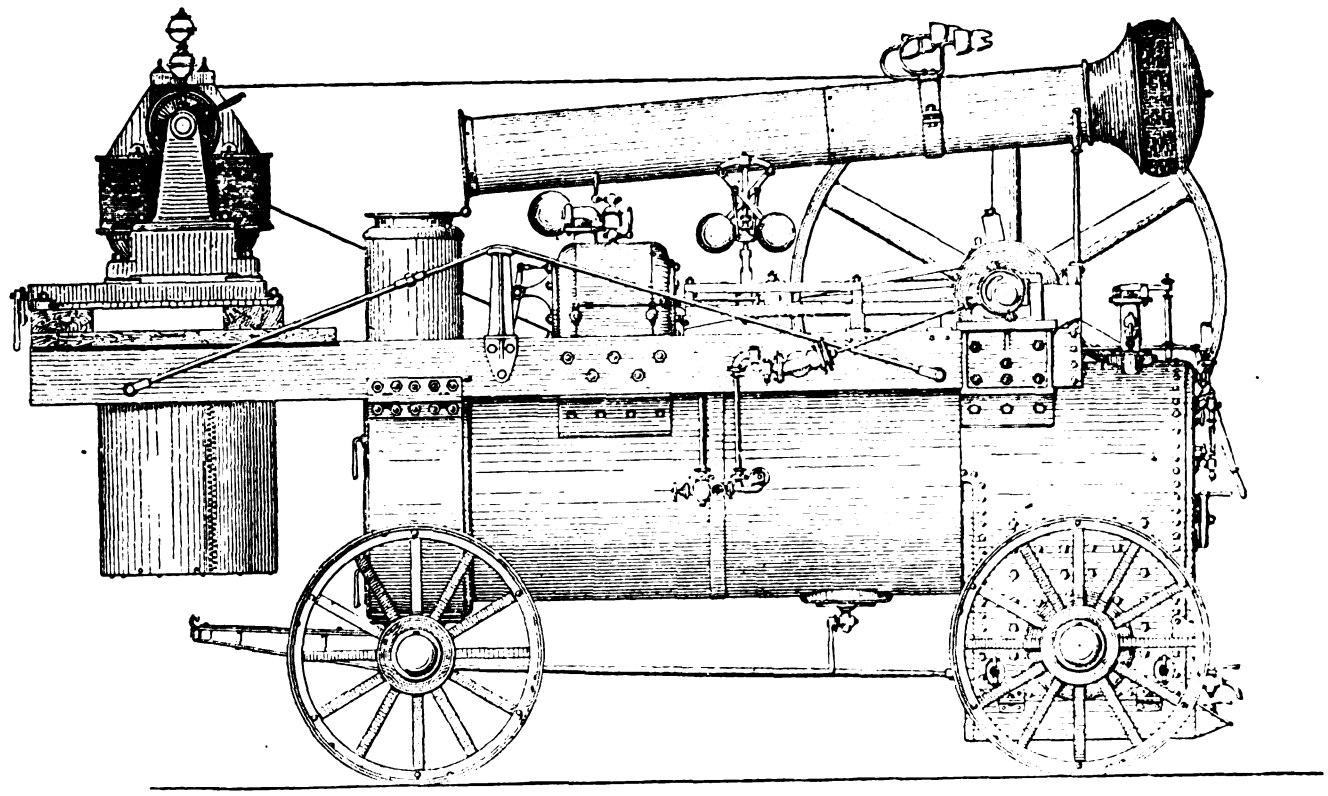
PORTABLE ELECTRIC LIGHT PLANT.

A few weeks ago our Vienna correspondent referred to some successful trials with a portable electric light plant on the North-Western Railway of Austria. The details of this plant, which has been constructed by Messrs. Siemens & Halske, of Vienna, have now been communicated by Herr Friedrich Bechtold to the Journal of the Vienna Society of Electricians, from which we reproduce the illustrations on the next page. It consists of a portable engine, on which is mounted a dynamo, and of one van containing all the accessories. The railway company stipulated that the vehicles should be adapted for travelling over common roads, and that an apparatus should be supplied by which they could be loaded or unloaded from railway trucks on either side. This apparatus consists of an inclined frame placed at one end of the truck, and a winch placed at the other end. The vehicle (engine or van) is drawn up on to the track, or let down from it by means of the winch and a rope. The company also stipulated that the dynamo should be able to supply eight 9 ampère arc lamps, and six 16 c.p. glow lamps simultaneously, and that the arc lamps should be burned in parallel series of two, and the incandescent lamps all in series; this condition being imposed so as to have the lamps as nearly as possible independent of each other. The engine is an ordinary portable engine of 12 effective horse power, running at 175 revolutions per minute, and driving the dynamo direct from the fly wheel by a belt. The engine is placed on the top of the boiler in the usual way, and on a prolongation of its frame, consisting of two stout oak beams, is fixed the dynamo, a sliding bed and screw serving to tighten the belt. The cylindrical casing below the dynamo is a water butt, which is detached and placed by the side of the engine when the latter is at work. A light roof, supported on iron poles, is fixed over the engine so as to keep the dynamo from getting wet in bad weather. This roof is carried on the top of the van when travelling. To protect the dynamo from the heat of the chimney the lower part of it is surrounded by an asbestos mantle. The dynamo is compound wound for 110 volts, and a maximum output of 50 ampères, the speed being 1100 revolutions per minute. The total weight of the engine and dynamo in travelling condition is 6 tons 6cwt. The cart weighs with all accessories 3 tons 16cwt., and contains the following: On the roof there are eight bamboo masts 21ft. long for the support of the arc lamps, and thirty bamboo rods 18ft. long for the support of the cables. To each side of the cart is attached one half of a telescopic ladder 20ft. long. The other tackle required is stowed away in the interior of the cart, as shown in our illustration, and consists of eight arc lamps occupying the central space, and of which only one is shown; eight reels of insulated cables, six containing 380 yards each, and two 540 yards each; a switch board for five circuits, with current and potential indicators and rheostats; six glow lamps with fittings, a number of double bell insulators, brackets, couplings, reserve carbons, reserve brushes, a vice, a complete set of lineman's tools, a small set of engineer's tools, several coils of wire, two water buckets, and three coal baskets. Under the seat

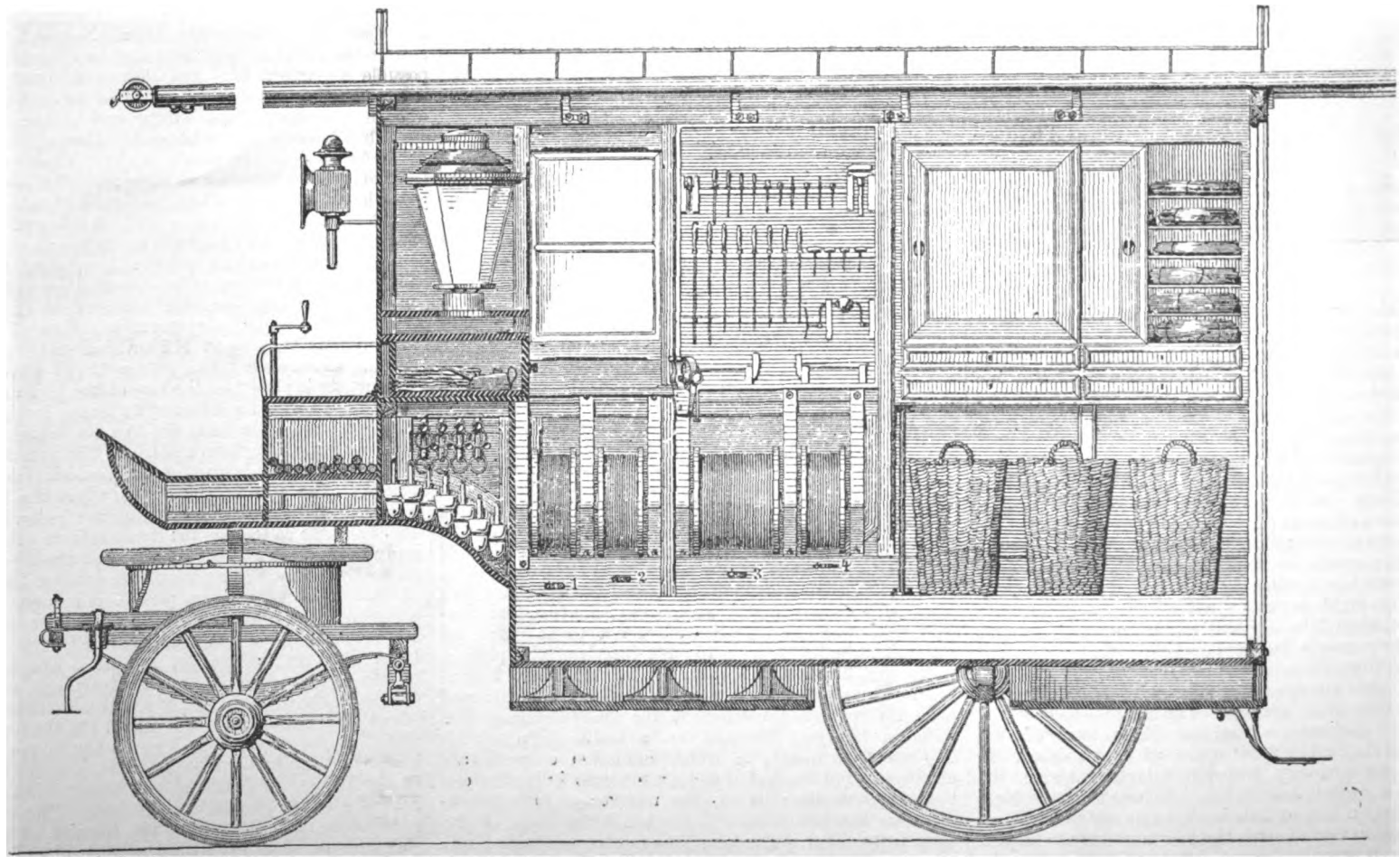
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PORTABLE ELECTRIC LIGHT PLANT.

Constructed by Messrs. Siemens & Halske, Electrical Engineers, Vienna.



Portable Engine and Dynamo.



Section of Van containing Necessary Appliances.

of the driver are stowed away the cast iron foundation plates and sockets for the masts of the arc lamps, and a number of wedge-shaped steel spikes to serve as earth anchors for the guy ropes of the masts. All the circuits are numbered, so that no mistake can be made in the connection between the lamps, cables, the dynamo, and the switch board. On the first trial of this plant, the time occupied from unloading until the whole of the five circuits were in working order was nine hours, and the work was performed by twelve unskilled labourers. On a second trial, when only two arc lights and the six glow lamps were used, the work was performed within five hours by six labourers. This plant will probably have an extended use, especially as its management can be entrusted to unskilled labour.

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THE BERNSTEIN SYSTEM OF ELECTRIC LIGHTING.

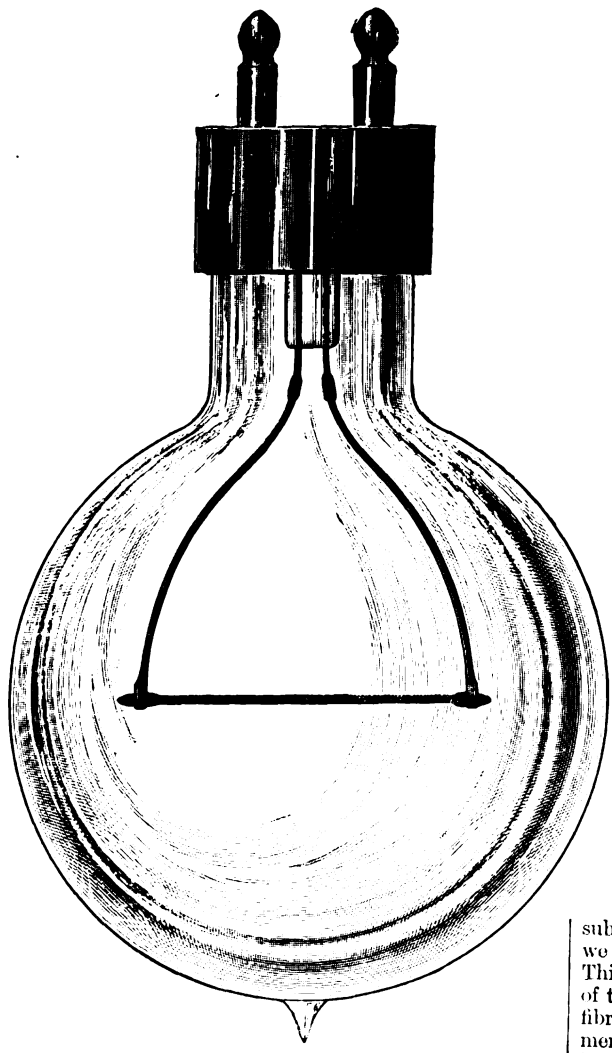


FIG. 1.

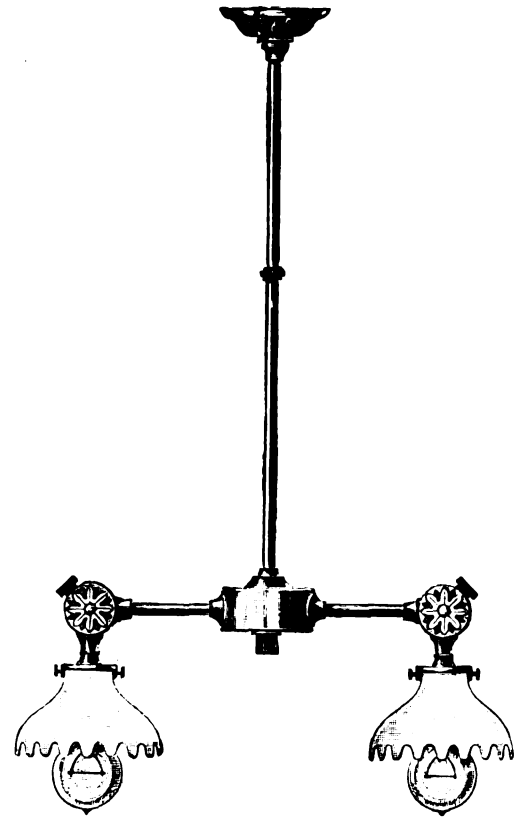


FIG. 2.

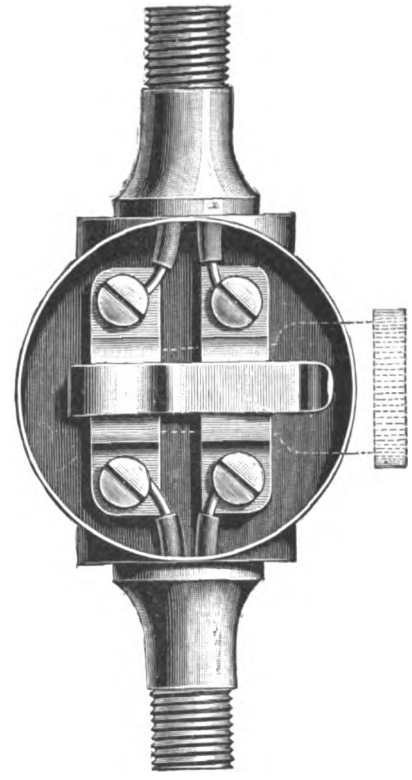


FIG. 3.

THE BERNSTEIN SYSTEM OF ELECTRIC LIGHTING.

MR. BERNSTEIN has for some years been advocating the series system of electric lighting by glow lamps of low resistance, and a number of installations, especially in factories and mills, has been fitted up on this plan. As early as 1883 Mr. Bernstein showed his system at the Vienna Exhibition, but since then he has made considerable improvements in its various details. In principle, the series system has some advantages over the parallel system. In the former it is possible to employ comparatively thick filaments in the lamps, and the result is greater economy than with high resistance lamps. Why thick filaments should admit of being worked at a higher efficiency than thin filaments, and yet last quite as long, has not yet been satisfactorily explained; but it is nevertheless generally admitted to be a fact. On the other hand, if we work both filaments at the same efficiency, the life of the stout filament will be longer than that of the thin filament. Another advantage of the series system is the possibility of keeping the light emitted by each lamp absolutely constant, notwithstanding variations in the total number of lamps supplied from the circuit. In parallel distribution this condition can only be obtained approximately, since the conductors must have a certain resistance, and the loss of potential must, to a certain extent, vary with variations in the consumption of current. In the series system, on the other hand, as long as we keep the current absolutely constant, the light emitted by each lamp must also be constant, whatever the resistance of the leads may be. To provide against the extinction of all the lamps in case of the breakage of one, Mr. Bernstein devised, about two and a half years ago, an electromagnetic arrangement to be added to each lamp, which automatically shifts the current from the lamp to a by-pass in case of the lamp failing; and it is interesting to note that at the last meeting of the Berlin Society of Electricians, Mr. William Siemens brought the subject of series glow lighting before the Society, and showed, as the latest practice of Messrs. Siemens & Halske, an electromagnetic device in principle similar to that of Mr. Bernstein. The latter gentleman, however, very shortly after designing it, abandoned this magnetic by-pass, and substituted a very simple and ingenious fusible plug, which we described in our impression of the 7th January, 1887. This plug is inserted as a shunt to the lamp, and consists of two conducting portions, insulated from each other by fibre strips, and a small quantity of a mixture of oxide of mercury and powdered carbon or graphite. This mixture is a very bad conductor when the e.m.f. is only that occurring between the terminals of the lamp; but upon the lamp failing, the e.m.f. rises to a sufficient degree to electrolyse the paste of oxide of mercury and graphite, forming metallic mercury, and thus establishing the by-pass. To insure greater safety of contact, the centre piece of the plug, which formerly was fixed, has now been provided with a spring, as shown in Fig. 4. When the paste is reduced, and thus shrinks, the spring causes the centre piece to follow into the cup of the lower portion of the plug, making the contact perfect. The plug boxes have also been improved over last year's pattern, and are illustrated in Figs. 3 and 6. In the style shown in Fig. 3 the plug box forms a part of the bracket to which the

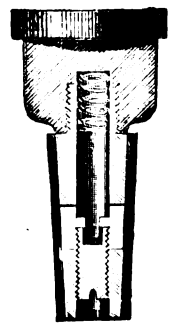


FIG. 4.

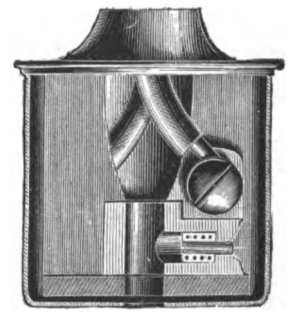


FIG. 5.

lamp is attached, the ends being screwed to the usual gas thread employed in such fittings. The wires pass through the interior of the tube, and are attached to two metal strips, across which rests a metal spring when the plug is not inserted. In this condition, therefore, the plug box simply short circuits the main leads. When the plug is inserted the insulating part at its upper end raises the spring out of contact with one of the strips, and thus forces the current to pass through the lamp. Should, however, the lamp break, or the plug be inserted when the attendant has forgotten to place a lamp in the fitting, the whole potential difference of the dynamo will, for the moment, come between the lower and upper portion of the plug, electrolysing the plate, and thus short circuiting the mains. Should the plug be withdrawn before a new lamp is fitted no danger to the circuit or to the attendant can arise, because the top spring simply comes down and again short circuits the connections, so that in this most recent design Mr. Bernstein has provided for all possible contingencies. The plug box, shown in Fig. 6, is intended for use on the mains, as they are encased in wooden bearings on the wall, and the illustration is so clear that no further description is required.

Coming now to the lamp (Fig. 1), it will be noticed that Mr. Bernstein has abandoned the two-pole type which he originally employed, and now introduces both

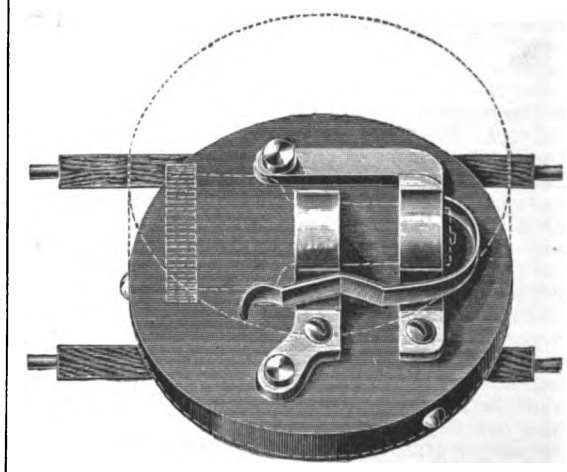


FIG. 6.

wires at the same end of the globe. The filament is a straight rod of carbon attached to the ends of two copper strips, as shown in our illustration. The leading in wires are of platinum fused into the glass, and connected with two stout brass terminals, shaped as shown. The lamp holder (Fig. 5) has been specially designed to carry the large current of 10 ampères without heating of contacts. The brass terminals of the lamp fit into corresponding holes in gun metal contact pieces supported on fibre, and the terminals are locked in position by means of cross pieces pushed into the nick of each terminal by a spring. One of these terminals is shown in section in our illustration. With this improvement in the construction of the lamp the latter is rendered more easily applicable to decorative fittings; and on a recent visit to the Bernstein Company's works in Commercial Road, London, S.W., we

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saw a large number of very handsome and artistic fittings adapted for the Bernstein lamp. We select for illustration in Fig. 2 one of these, being a two-light pendant. The mains are brought down inside the pendant into a circular box in which is situated the switch; from there they pass through the horizontal arms and plug boxes at the corners down to the lamps. The switch has four poles, and consists of an insulated base, on which are fixed four metal segments of a circle. Two of these, side by side, are connected to the mains, and the other two to the lamp wires. Connection is made between these segments by means of two phosphor-bronze springs attached to the face of a second insulating disc, to which is also fixed the switch handle. In one position the springs establish connection between the main wires and lamp wires, and when turned through 90° one spring short circuits the main wires, whilst the other short circuits the lamp wires. The switch is absolutely sparkless, as can readily be gathered from the above description of the connections; and it has this further advantage, that when the current is switched off the lamp, both lamp wires are completely disconnected from the main wires, and any part of the lamp wires, or of the fitting, may be touched when adding or repairing a fitting without danger, even if a leak to earth should exist on the main circuit.

Mr. Bernstein proposes to use his system not only for isolated plants but also for central station lighting. The dynamos employed would all be designed to give a current of 10 ampères, at a maximum pressure of from 1000 to 2000 volts. Each dynamo is to be driven by belt from its own steam engine, and constancy of current would be insured by electric regulators, varying the speed of the engine in accordance with the number of lamps in circuit. Under these conditions the e.m.f. will be very nearly proportional to the speed of the engine, and as the current is constant, an ordinary speed counter on the engine shaft could be used to show the number of Board of Trade units supplied by the dynamo within any given time. The street mains would consist of No. 10 wires or equivalent cables, insulated from each other, and a number of these would be drawn into iron pipes laid underground along the streets. Each circuit would be tapped by house wires, and supply current to such a number of lamps in series as corresponds to the maximum pressure available at the station.

THE WELSH GOLD FIELD.

At a meeting of the Geologists' Association, held at University College, London, the 6th inst., a paper on the above subject was read by Mr. T. A. Readwin. The first referred to the history of the gold field, which had been known to geologists for nearly fifty years. While previously it had yielded to the ancient Britons the metal for the ornaments they so extravagantly used, its fame may also have been one of the inducements to the Roman invasion, as the invaders certainly mined gold in the neighbourhood. In the seventeenth century still more important operations were carried on by Thomas Bushell, who rented the mines from Charles I., and erected a mint at Aberystwyth. One of the £3 pieces then coined was exhibited. Between 1631 and 1645 gold to the value of quite two millions of our money was obtained. The author then summarised the literature of the subject since a paper read by Dean before the British Association, in 1844, again called attention to the matter. Amongst these were papers by Calvert, Sir A. Ramsay, J. A. Phillips, Sir W. W. Smyth, Forbes, Ansted, and a series by Mr. Readwin. The gold field which is now attracting especial attention occupies from 50 to 60 square miles of the mountainous district of Merionethshire, on the north bank of the river Mawddach. Its geology has been well described by Sir A. Ramsay (*Quarterly Journal of Geological Soc., Vol. X.*), who has shown that it consists of slates and flags—the Lingula flags—resting upon the Aberystwyth grits, the whole penetrated by many quartz veins and dykes. The gold mainly occurs in the veins near the junction of the Lingula flags and the underlying grits, especially in the neighbourhood of the greenstone dykes. It occurs associated with other minerals, such as ores of copper, silver, lead, and zinc, with mispickel, micà, barytes, witherik, and sometimes traces of platinum. There are hundreds of such lodes, from a few inches to 46ft. in thickness, all more or less auriferous. He had himself had over 1600 assays made, including some by Johnson, Matthey, & Co., and only 14 gave no trace of gold; 140 gave under 3dwts. of gold per ton, 48 gave 3dwts. and under 5dwts., 133 gave from 5dwts. to 10dwts., 64 from 10dwts. to 3oz., 40 from 10oz. to 20oz., 22 from 20oz. to 50oz., 15 from 50oz. to 100oz., 11 from 100oz. to 200oz., 2 from 500oz. to 1000oz., 1 between 1000oz. and 2000oz., 3 between 2000oz. and 5000oz., 5 between 5000oz. and 10,000oz., and finally one gave between 10,000oz. and 20,000oz. He had experimented on the Gwynfynydd lode stuff, and between 1882 and 1884 had extracted 44oz. 10½dwts. of gold from 53¼ tons of the ore by 22 assays; of these 3 yielded under 5dwts. of gold to the ton, 6 between 5dwts. and 10dwts., 6 between 10dwts. and 1oz., 1 between 2oz. and 3oz., 1 between 5oz. and 10oz., 2 between 10oz. and 20oz., 3 between 50oz. and 100oz., 1 yielded 22,000oz., and one as much as 35,840oz. per ton. He had, however, made further assays of the ore from this mine, with a total result of 113½oz. of gold from 72 tons, obtained by 78 distinct trials, being at the rate of 1oz. 11dwts. 13gr. to the ton. He enumerated twenty Welsh mines that had yielded gold, including the Cwmeisen, Dolfrwynog, Tyddyn, Gwladys, Glasdyr, and the Vigra and Clogau. From the last alone 16,468oz. 18dwts. 3gr. of gold had been obtained, and sold mostly to the Bank of England for £62,849. 0s. 6d., one-twelfth of which went to the Crown as royalty. In conclusion, Mr. Readwin regretted the exaggerated anticipations now current as to the future of this gold field, and expressed the caution that not more than half an ounce—or at most 1oz.—of gold to the ton should be expected; he had published that opinion twenty years ago, and still adhered to it. He entertained most sanguine hopes, however, that the district would become a valuable and prosperous mining centre.

A discussion followed, in which Dr. Hyde Clarke, Mr. Topley, Dr. Hicks, and others took part. Professor Blake and Dr. Edwin Ball urged caution in dealing with the subject, the latter pointing out that the gold occurs there in pockets, a condition most unfavourable to profitable mining. A vote of thanks to the author closed the proceedings.

THE COPPER "BOOM" AND COPPER MINING.

We have already directed attention to the crippling effects of the present prices of copper on those industries which consume the metal largely, and expressed an opinion unfavourable to the "ring" of speculators who have brought such prices about by that indefensible method of dealing known as "cornering." It is being urged with some warmth by certain journals that there is another side to the question, that there are producers as well as consumers, and that the former deserve as much consideration as the latter. Doubtless there is some truth in this contention; and if the language in which it is couched did not imply that the present rates are necessary to the well being of the copper mining industry, we should have nothing to say against it. But it requires considerable power of self control to follow patiently the course of an argument tending to show that the rise from £39. 15s. to £85 a ton in less than two months is justifiable and generally beneficial to industry. No doubt the low level of £40 was remunerative only to those mines which could produce cheaply; but it is an undeniable fact that such mines exist, and that their output was sufficient for the contracted consumption of a few years back. It is, moreover, equally undeniable that these low prices led to a largely increased consumption of copper. This larger consumption was beneficial to producers and consumers alike. All that was needed, then, was a sufficient rise in price to enable the best of the more costly mines to add their production to meet the constantly growing demand, without seriously restricting the use of the metal. This much probably will be readily admitted. The differences of opinion come when we attempt to fix a limit to the rise. But there should be little divergence at this point. The problem is simple enough, and its solution is obvious. It is well known that plenty of copper may be produced remuneratively, from the mines now being worked, at £50 a ton. This is a fair price for copper, sufficient for the producer, without being burdensome to the consumer. At £80, copper becomes useless for many purposes. It is thus abundantly clear that present prices, and even a considerably lower level, must lead to a very serious restriction of its use. This effect will begin to operate at once, and that alone would suffice to bring back the price to £50 in a little time. But the high profits now obtainable will lead, on the other hand, to a greatly increased production. Every mine will be worked to its utmost capacity, and what is of more serious consequence, numerous properties, which in the ordinary circumstances of trade cannot be profitably worked at all, will be again set in operation. We need no prescient intelligence to show us that in a very short time the market must be glutted with copper, and that instead of the profitable £50, the metal will be a drug at £40. Where, then, will be the benefit accruing to the copper mining industry from the better conditions of trade generally and the upward movement initiated by the syndicate? Had the latter been content with a rise of 20 per cent., genuine shareholders of copper mines might have had something to be thankful for, even to that self seeking body of speculators. As it is, they are preparing for themselves another long period of adversity as a set-off to a spurt of at best a few months' duration.

SMOKE ABATEMENT.*

The author said it was not his intention to bring forward any new method of treatment, but rather to lay before the members a few of the evils caused by black smoke, the Acts of Parliament in force in the city of Glasgow and neighbourhood for the suppression of the smoke nuisance, the methods of carrying out the provisions of these Acts, and shortly to mention a few of the methods which had been advocated for the total abolition of smoke in our towns and cities. To show that the smoke nuisance was not confined to the present day, he quoted from the author of "Sylvia," who in 1661 describes coal smoke as the cause of every evil and the herald of the approaching destruction of London, and the contrast was noted and commented upon during the time that Newcastle was blockaded owing to the wars of that period, so that coal could not be sent to London. The unpleasant sensations experienced during fogs, with their effect on the healthy and robust as well as those who were ailing, together with their destructive effect on the numerous telegraph and telephone wires, and also on the insulators, were touched upon. Stress was laid upon the fact that, in addition to the black, sooty particles which make everything dirty, the sulphurous acid gas sent out from the chimneys of furnaces does a great deal of the damage said to be due to the soot, and Professor Freytag was quoted to show that more than ·003 volume per cent. of sulphurous acid in the air would do damage to vegetation. The author stated that from the analyses of twenty-two samples of coal of this district (kindly given by Dr. Wm. Wallace) the average amount of sulphur was ·658 per cent., and supposing that account were taken of all the dross and triping, &c., used for fuel, containing say ·9 per cent. of sulphur, this would mean that 9 tons of sulphur were given off in the form of sulphurous acid gas from every 1000 tons of coal burned. As near as the author can judge, about 9000 tons of coal are burned in Glasgow per day for all purposes. To show the value of analysing the smoke, the author quoted the following examples from Professor Ferd. Fischer, of Hanover: In the case of what might be called good firing there was a loss of 14 per cent. of the total heating power, while a case of bad firing showed a loss of 35 per cent. of the heating value of the fuel. Some cases tested gave results showing that 60 per cent. of the total heating power was going to waste, which, after overhauling the boiler seating and flues, and regulating the draught, was reduced to 7 per cent. loss of the heating value of the coal.

The following Acts of Parliament are in force for abating the smoke nuisance, the first and third being applicable to the whole of Scotland, while the second is purely for the city of Glasgow. "An Act for the Abatement of the Nuisance Arising from the Smoke of Furnaces in Scotland, dated 25th August, 1857," which enacts that "all furnaces shall in all cases be constructed or altered so as to consume or burn the smoke arising from such furnace," "provided always that the words 'consume or burn the smoke' shall not be held in all cases to mean 'consume or burn all the smoke,'" and the necessary powers and penalties for the carrying out of the Act are detailed. "The Public Health (Scotland) Act, 1867," in which it is enacted that "any fire place or furnace which does not as far as practicable consume the smoke arising from the combustible matter used in such fire place or furnace;" and "any chimney (not being the chimney of a private dwelling house) sending forth smoke so as to be injurious to health," the necessary powers and penalties shall be enforced. "The City of Glasgow Police Act, 1866," states that "every person who so uses, or causes, permits, or suffers to be used, any furnace or fire therein (except a household fire) as that smoke issues therefrom, unless he proves that he has used the best practicable means for preventing smoke, and has carefully attended to and managed the said furnace or fire so as to prevent as far as possible the smoke therefrom," shall be subjected to penalties which are clearly stated. To carry out the provisions of this Act, the city is divided into districts, each under a superintendent directly responsible to the Chief Constable. A certain number of smoke observations require to be made every week, and for this purpose each superintendent details a sergeant and constable for duty. Each observation lasts one hour, during which the constables must not lose sight of the top of the chimney, and must not be in sight of each other. After taking an observation, they leave a note of the fact with the owner of the works. The report to the Chief Constable states that the chimney in question emitted during the hour of observation so many minutes black or dense smoke, so many minutes light grey or whitish smoke, and so many minutes no smoke. It is held that dense or black smoke may be any colour so long as one cannot see through it, and in prosecutions under the Act this is the meaning attached to the term "black smoke." The Chief Constable hands the worst of these reports to the Police Procurator Fiscal, who in turn cites the worst offenders to appear and show cause why they have not abated the nuisance complained of. In no case is the Procurator Fiscal bound to prove more than that black smoke issued from the chimney, irrespective of the duration of such emission. It lies with the defender to show that such emission was unavoidable, and that he had done all in his power to abate it. At the same time, the use of bad coal will not be taken as a sufficient reason unless there be other factors showing that the said use of bad coal was unavoidable by the defender at the time of complaint.

In face of these Acts it might be asked why the nuisance still existed, and the answer is that they are only optional, and not compulsory; and the author stated that his experience of the working of these Acts gave rise to a good deal of feeling among manufacturers, which finds expression in a variety of ways which do not tend to the abatement of the smoke nuisance. He advocated that each town, county, or district should appoint an inspector, capable of dealing with the subject from the practical and scientific points of view, with power to visit any works at any time without notice, in order to judge of the best thing to be done in each case, and to have the power of instituting prosecutions where necessary; and his belief is that

*Abstract of paper read at the Graduate Section of the Institution of Engineers and Shipbuilders in Scotland, on the 6th December, 1887, by Mr. George C. Thomson.

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this would meet with the approval of everyone concerned, and also of the public; and in support of his views he quoted the following from the report of the Chief Inspector under the Alkali Act: "I am not a little pleased to be able to add that, although there are more than three hundred manure works (including Scotland), all this change has been brought about without a single prosecution." The author is sanguine enough to believe that the same thing might be effected in the matter of the smoke nuisance, or at the very worst with but a very small percentage of the present prosecutions. He also believes that at no distant date all furnaces and chimeys may be brought under the working of the Alkali Act, or else of a special act, and inspectors may be appointed to deal with the smoke nuisance alone.

After explaining the process of combustion, and the loss arising from incomplete combustion, the author showed that with care in the construction and working of furnaces and their flues, and in the case of boilers that where there was sufficient power, there would be no smoke. After touching upon the principal mechanical contrivances designed and in use for smoke prevention, he passed on to consider the use of gas as fuel, and mentioning the Siemens and Wilson producers as well known, referred to the Brookes producer as being new and self cleaning, while the iron work was protected by a water jacket. It is a modification of the Wilson producer, but has not been long enough before the public to judge of its merits. The gas producer of Mr. Ludwig Mond claims to retain almost all the sulphur, and recover about half the nitrogen present, which is about three to four times more than that obtained hitherto by the distillation of coal in gas works or coke ovens, and the gas from it is smokeless. The principal novelty is the introduction of a larger quantity of steam or watery vapour, so regulated that the temperature of the producer is kept lower than usual, the heat not being allowed to exceed that indicated by dull redness, and the gas is equal to that produced under the older systems. Should it prove a general success the health of our towns would be greatly benefited, and one great source of damage to plant life done away with. The employment of forced blast for boiler furnaces, and the introduction of coal dust or powder for fuel, and furnaces for burning the same, such as that of M. Michel Perret, were briefly touched upon and described. From the foregoing it was evident that smoke could be consumed with advantage to everyone concerned, and the author trusted that the day was not far distant when the eyes and hearts of the weary toilers in our great industrial hives might be gladdened by the sight of flowers growing in our squares and gardens as luxuriantly as in the fresh country air, and that fogs might be done away with; but to enable this to come to pass an explicit and compulsory act was necessary.

Notes.

COTTON MILLS IN FRANCE.

Although both England and the United States have shown great progress in the cotton spinning industry, France does not make much headway. The quantity manufactured in the last named country remains stationary at about 110,000 tons, as does also the import of cotton yarn at about 130,000 tons. The American Consul at Rouen states that old fashioned spinning mills abound, and cannot possibly prove profitable with their antiquated machinery; newly erected mills have given a certain vitality to the trade, but are insufficient to control it. The reason for this is that they require a large outlay of capital, and doubts exist whether they will be able to compete for a length of time against foreign mills.

TRADE WITH PORTUGAL.

Owing to the delay which takes place in the publication of Portuguese statistics on foreign trade, the figures relating to the year 1885 are only now available; but late though they are, they contain some facts worthy of notice, for it is seen that the tendency of British commerce is to remain stationary, while that of other nations, and notably of Germany, is increasing. The imports from Great Britain were highest in 1873, when they amounted to £4,461,000, or about 59 per cent. of the total. Since then there has been a diminution in our trade, and in 1885 the British imports amounted to only £3,489,000, or 42 per cent. of the total. On the other hand the German trade, which in 1870 was only of the value of about £60,000, has risen to £833,000 in 1885. This success on the part of Germany is attributed to the cheapness of the goods and the activity of German agents in finding a market for them. The trade of Belgium is also increasing, the articles mainly concerned being woollen goods and metal.

ITALIAN IMPORTS.

The British Consul at Venice, in reporting on the trade of that port during 1886, attributes the falling off in the imports of silk and woollen yarns and manufactures to the augmented production of these goods in Italy. Owing to the low price of cotton in 1886, and to the establishment of some cotton mills in the Venetian provinces, the imports of cotton increased. It is stated that British exporters have to encounter, in all the markets of Venetia, the energetic competition of the German and French manufacturers, who are taking the trade out of our hands. The causes assigned for this are that the goods thrown on the markets by the German and French manufacturers, although of much inferior quality, bear the appearance of being as good as the English, and are sold at a much cheaper rate; that the said manufacturers, by means of active commercial travellers, are accurately informed of the wants of buyers, and are prompt to adapt their supply to the nature of the demand; and finally, that they generally furnish goods in a liberal way at three or six months' credit. British goods, however, still enjoy a very high reputation for their workmanship and lasting qualities, and would be given the preference by the buyer, but for the great difference of price.

AMERICAN BOUNTIES ON SHIPPING.

Among the Bills introduced in the United States Congress before adjourning for the holidays, there was one providing for the payment of bounties to American ships. Whilst there is but little likelihood of its passing during the present session, our American correspondent states that each year there are more representatives in favour of the idea. The present scheme proposes that the following bounties per gross ton shall be paid on all iron and steel vessels built in the United States and registered, after 1st July, 1888: Vessels under 1000 tons, $10 (£2) per ton; from 1000 to 2000 tons, $15 (£3) per ton; 2000 tons to 3000 tons, $20 (£4) per ton; and vessels over 3000 tons, $25 (£5) per ton; provided the vessels are built according to plans approved by the Navy Department, and subject to Government purchase for purposes of war within twenty-five years.

TEXTILES IN PERSIA.

In reporting on the trade of Tabreez for the financial year 1886-87, Consul-General Abbott says that the importation of coloured calicoes from Russia has not increased with the rapidity which was anticipated, and that even in the province of Khorasan, where it was believed they would become greatly in vogue, Russian prints are comparatively scarce, decided preference being given to Manchester goods. Grey and white calicoes and other piece goods, and 24 yard prints, were in fair demand; but prints of a superior quality did not prove remunerative. German and Austrian cloth found a ready sale at good prices, and some descriptions of French and Belgian cloths—"draps fins" and "draps de fantasie"—are beginning to gain a footing in the market. An Austrian merchant from Vienna has opened a store at Tabreez for the sale of clothing, haberdashery, and fancy goods; but no serious competition with the English import trade, as regards coloured and plain cottons, has yet set in from the Russian side. The Consul believes we shall be well able to hold our own if we combine superior cloth, good printing, and durable colours, with the designs best suited to the Persian taste.

PETROLEUM IN EGYPT

Information has occasionally reached this country with respect to petroleum discoveries in Egypt; but it has not been very definite. Some particulars are now given in a United States consular report, in which it is stated that petroleum was found on the Red Sea coast in 1885 at a depth of 150ft.; but that the flow ceased after a few days. It was then determined to make a geological survey of the district, and Mr. Mitchell, an American, who had charge of this, reported after an inspection of four months that there existed an extended field charged with petroleum. Dr. Tweddle, also an American, has a contract with the Egyptian Government to direct and superintend investigation. He was allowed £30,000 with which to buy boring apparatus and other necessary material for prospecting, and has had a large force at work at Gebel-el-Zeit, boring a number of holes, none of which, however, have reached a greater depth than those previously sunk by the Government. As yet, petroleum has not been struck in any of the holes, and the Consul considers it probable that oil will only be struck at a much greater depth. Very large sums of money have been spent—sums far in excess of what was first proposed and agreed upon—and the prospecting progresses very slowly.

AMERICAN SHIPPING CONVENTION.

A convention of the American Shipping and Industrial League was to be held in Washington from the 16th to the 19th inst. The League was instituted about two years ago for the purpose of promoting the development and distribution of the products of American labour by the extension of the merchant marine of the United States, and to establish thereby more intimate commercial intercourse with other countries by frequent and direct mail service. Most, if not all, shipbuilders and shipowners throughout the States belong to this organisation, and nearly all important industries are in sympathy with it. The principal railroad companies have decided to slightly reduce the fares of delegates to the convention. The League has been divided into the five following departments, in order that the work might extend throughout the entire country: The North Atlantic Coast, the South Atlantic Coast, the Gulf Coast, the Pacific Coast, and the Lake Shore and Mississippi Valley. These departments have held local conventions during the past year. The President of the League is the Hon. Joseph Wheeler, of Alabama, and in the circular calling the convention together he states that the object of the meeting is to consider the best means of protecting the native shipping industry, and to save the country from paying annually to foreign shipping companies the sum of £30,000,000.

MR. KRUPP AT SHEFFIELD.

According to *The Times* of Saturday last, Mr. F. A. Krupp, the head of the great Prussian arsenal at Essen, visited the works of Messrs. John Brown & Co., Limited, Sheffield, on the 12th inst. Mr. Krupp, who was accompanied by one of his staff, Mr. F. Asthöver, and by his London agent, Mr. Alfred Longsdon, was conducted through the works by Mr. J. D. Ellis, the chairman of the company. The special object of the visit was to witness the action of the gigantic hydraulic forging press, lately added to the plant of the Atlas Works. This press, which is believed to be the most powerful and efficient forging tool at present in existence, nominally exerts a total force of 4000 tons, but its actual full power is considerably greater. Three large furnaces, each capable of heating an ingot of 100 tons, prepare the work for the massive machine, and two travelling cranes, each capable of lifting 150 tons with ease, convey the forgings from the furnace to the press, and manipulate them as required. One man, who stands at the floor level in a cage suspended from the crane, and travelling with it, has under his hand four valves, by which he lifts, lowers, advances, retires, moves sideways, or revolves the forging on its own axis. A second man works the lever which governs the strokes of the press, and by observing an index in front of him regulates with the utmost nicety the distance from the anvil at which the top tool is to cease its advance. A forge master and several furnace men are also required to superintend and to feed the apparatus; but its working is entirely under the control of the two men referred to. Mr. Krupp was so thoroughly satisfied with the machine that he ordered one precisely like it for his own works from Mr. Walker, of Messrs. Tannett, Walker, & Co., the makers of the press, who was present during the proceedings. At Essen the forgings are all done by hammers, which are still used in Sheffield for several kinds of forgings. Mr. Krupp also witnessed several other processes of steel manufacture.

THE MINERAL RESOURCES OF BOSNIA.

Previous to the occupation and administration of Bosnia by Austria-Hungary, which took place in the year 1878, the iron industry of the former country was well developed, and sufficed not only for home requirements, but a large amount of manufactured articles, especially scythes, was also exported to neighbouring countries. The change of Government, however, the laying down of the railway line Brod-Sarajewo, and the formation of numerous highways, facilitated the importation into Bosnia of cheaper manufactured iron, to the detriment of the native product. The Bosnian iron industry has therefore considerably declined. When Austria first occupied Bosnia, the Ministry in Vienna devoted some attention to the development of the iron industry in that country. Investigations and borings under Government supervision were made, with partly successful results, and this led to the foundation, in 1881, of the Bosnia Company. This company carried on the work already begun by the Government, and found a fair amount of chrome and manganese ore. In January, 1886, the Austrian Government took over the administration of the Bosnia Company, and commissioned Herr Bruno Walter, formerly director of the company, to draw up a report on the condition of the mineral resources of Bosnia. This report, which has now been published by the Government for Bosnia and Herzegovina in a book entitled "Beitrag zur Kenntniss der Erzlagerstätten Bosniens," gives a fair account of the mineral deposits of the country, amongst which are the following: Spathose iron, red and brown iron ore, specular iron ore, iron and copper pyrites, manganese ore, gold and silver, antimonite grey copper, galena, and chrome ore. Bosnia is very rich in ironstone, which is found in the extreme north-western districts and in the south. Manganese ore suitable for the manufacture of ferro-manganese is found near Cevljanovic. Silver mining was formerly carried on in the district of Srebrenica, but was discontinued when the Turks took possession of the country. Well informed mining engineers are of opinion that there exists a large amount of silver ore in the district still untouched, and state that they expect this branch of trade will again flourish. Quicksilver is not found in any great quantity, but a fair amount of chrome ore exists in the valleys of Dubostica, Tribija, and Krijava.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

6th January, 1888.

228. Holland, W. — Mechanism for stopping engines.
229. Shaw, J., & others — Apparatus for polishing steel wire.
231. Kitson, J., & others — Machinery for making healds for looms.
235. Smith, J. — Spinning machinery.
248. O'Brien, J. O. — Rock boring machinery (*Bomet*).
252. Green, W. R. — Hydraulic lifts.
254. O'Neill, W. P. — Hydraulic tramway locomotive.
261. Wickham, W. R. — Breech loading fire arms.
262. Rush, J. T. — Boot sewing machines.
270. Priestman & Priestman — Hydrocarbon engines.
273. Williams, T. — Machines for cutting plastic substances.
277. Gubbins & Bayley — Machines for making horse nails.
278. Cayley & Courtman — Projectiles.
280. Williamson, G. B. — Apparatus for splicing wire (*Hughes*).

7th January, 1888.

281. Rogers, J. E. — Compressed air motors.
301. Ramsay, J. — Apparatus for washing coal.
311. Trelease, E. H. — Air pumps.
315. Hewett, R. W. — Furnaces.
321. Hassel, W. — Atmospheric hammer.

9th January, 1888.

335. Eves, J. V. — Spinning frames.
339. Falconer, R. — Furnace tube cleaner.
340. Taylor, F. D. — Anchors.
344. Niven, J. — Anchors.
350. Parks, E. F., & others — Shrinking heated wheel tyres.
351. Hitt, T. — Anchoring vessels.
352. Drake, G. — Appliances for raising sunken ships.
357. Scott, L. K. — Carriages for machine guns.
361. Sellner, L. — Condensers.

10th January, 1888.

367. Royston, E. R. — Steam engines.
374. Willis, J. — Steam wheels as motive power to propel ships.
376. Dixon & Gradwell — Spinning machinery.
385. Bolton, J. — Sewing machines.
387. Burgess, H., & others — Shuttles and weft carrying bobbins.
400. Lake, H. H. — Sewing machines (*Tucker*).
401. Harvey, H. A. — Low steel.
403. Sanday, W. — Circular saw.
406. Graepel, H. — Pulverising ores.
407. Tomson, W. H. — Freezing machines.
414. Kingdon, G., & others — Quadruple expansion engines.
415. Bowker & Williams — Looms.
418. Darby, J. H. — Manufacture of steel or iron.
419. Edwards & Smith — Gas engines.
426. Haddan, R. — Sewing machines (*Hensel*).
427. Griffiths, G. — Rag engine.
428. Allday & Allday — Forge bellows.

11th January, 1888.

430. Ashworth, H. — Mules.
431. Keymer, H. J. C. — Improvements in motors.
439. Cotton & Cotton — Machines for looped fabrics.
442. Taylor & Taylor — Flues of boilers.
443. Biertumpfel & Biertumpfel — Candle moulding machines.
445. Sims, T. P. — Machine for making scorifiers, cupels, and crucibles.
456. Huese, F. A., & others — Apparatus for printing.
458. Smith, J. — Warp looms.
461. Hett, C. L. — Turbine governors.
464. Allen, J. — Propulsion of lifeboats.
466. Tempest-Radford and Morton — Manufacture of pile fabrics.
467. Cornely, E. — Embroidering machines.
474. Scott, T. W. — Vessels propelled by screws.
478. Westerman, J. A. — Endless traction railways.

12th January, 1888.

484. Pemberton, W., and others — Looms.
486. Ireland, J. — Railway chairs.
497. Lister, H. — Weaving pile fabrics.
498. Edmondson & Edmondson — Printing, embossing, and shading textile fabrics.
508. Parkinson, G. S. — Aërial propulsion.
512. Sington, T. — Gas engines.
513. Boyd, D. — Projectile.
517. Pickering, G. F. — Calculating machines.
519. Redfern, G. F. — Thrashing machines (*Damanion*).
520. Verini, G. F. — Chimneys.
523. Orcel, A. — Furnaces.
529. Johnson, J. Y. — Mercurial air pumps (*Doerr and Mace*).

ELECTRICITY.

6th January, 1888.

224. Böhm, E. — Electric incandescent lamps.
225. Abbott & Douglas — Electric battery for miners' lamps.
227. Lewis, J. S. — Telephonic apparatus.
242. Davies, J. H. — Electrical measuring instruments.
249. Roe, J. T. — Electric meters.

7th January, 1888.

293. Parker, T. — Dynamo-electric machines.
295. Parker & Rees — Electric meter.
296. Parker, T. — Switches for electric circuits.
302. Parker, T. — Electric meter.

9th January, 1888.

366. Abel, C. D. — Electric arc lamps (*Siemens and Halske*).

10th January, 1888.

396 & 424. Lorrain, J. G. — Continuous currents of electricity.
416. Tucker, J. H. — Electrical measuring instruments.

11th January, 1888.

472. Webster, W. — Treating sewage by electrolysis.

12th January, 1888.

506. Dorman & Smith — Incandescent electric lamps.
507. Berg, E. — Controlling signal telegraph.
531. Edmunds, H. — Generation, distribution, and control of electricity.

CHEMISTRY.

6th January, 1888.

245. Stead, W. H. — Manufacture of gums.

7th January, 1888.

305. Wylde, J. R., & others — Chlorate of potash.
314. Ducat, F. A. — Discolouring and disodourising product.

9th January, 1888.

353. Levi, S. J. — Photographic lamps.
356. Hart & Bishop — Lights for photographic purposes.

10th January, 1888.

370. Emmens, S. H. — Explosives.
377. Park, J. — Chromium.
390. Andreoli, E. H. M. — Halogens.
405. Perry, E. W. — Photographic sensitive films.
421. Lewis & Phillips — Refractory ores.

12th January, 1888.

487. Orr, A. — Nitro-cellulose.
524. Farmer, E. H. — Photographic printing.
530. Arnold, J. — Deodorising sewage.

MISCELLANEOUS.

6th January, 1888.

223. Wilkins, T. — Knife cleaning machines.
226. Williams, J. — Valve gearing.
230. Thompson, J. — Stoves.
233. Coles, R. W. — Manufacture of type.
237. Thomson, G. — Oil feeding for the bearings of shafts.
238. Roberts, A. — Equilibrium valve.
239. Reid, F. T., & others — Safety gas burner.
243. Sunyé & Blumberg — Nails.
250. Hughes & Letts — Locking the nuts on fish plates.
253. McInnes & Morriss — Machine counters.
256. Sawer, J. C. — High pressure tap.
258. Heckford & Stanley — Lock and latch.
259. Stanley, W. F. — Explosives, and apparatus connected therewith for producing instantaneous light for photographing.
263. Lock, C. — Couplings for railway vehicles.
264. Redfern, G. F. — Apparatus for drying substances (*Raty & Lambert*).
265. Redfern, G. F. — Grinding substances (*Raty and Lambert*).
275. Abel, C. D. — Brake mechanism (*Westinghouse*).

7th January, 1888.

282. Enright, J. — Gas lighting.
287. Clarke, A. — "Sorting tools" for dressing pottery ware.
288. Simmons & Cravos — "Hanks" for fastening ships' sails.
291. Allan & McBlain — Die for punching holes in iron and steel plates.
292. Fonseca, J. H. da — Railway signalling.
298. Bates, J. — Velocipedes.
299. Roby, G. — Oil lamps.
304. Boult, A. J. — Means for distributing oil upon the surface of water (*Meissel*).
306. Heard, T. H. — Railway buffers.
309. Hollands, S. H. — Fans for forced draught.
310. Martin, S. — Velocipedes.
316. Stevens, J. S. — Reefing schooner main sails (*Stevens*).
317. Powell, D. — Centre board countervail.
319. Mallett, C. S., & others — Vacuum gauges.
320. Palfroy, A. — Sails for yachts.
322. Simpson, W. S. — Glass bottles.
325. Comings, W. R. — Tubes.
326. Blanchard, M. H. — Terra-cotta fire proof construction.
329. Morland & Morland — Dyeing woollen skins.

9th January, 1888.

332. Key, J. T. — Corrugated steel scoops.
336. McKay, J. B. — Machinery for dyeing yarns.
338. Briddon, G. — Dust collectors.
341. Gorton, W. S. — Vertical bar fencing.
342. Considere, E. — Safety guards for the front of tram engines.
346. Thame, J. R. — Barrels manufactured from paper.
355. Vigouroux & Drivet — Tubes.
358. Schulhof, J. — Boxes for packing cartridges.
359. Rose, G. — Spray lamps.
360. Darling, J. — Couplings for railway carriages.
365. Price, J. — Ventilating tanks for carrying petroleum.

10th January, 1888.

371. Jones, J. — Apparatus for treating malt.
372. Gibbs, W. — Lead glazing.
375. Woodhead, M., & others — Velocipedes.
379. Pullinger, T. C. — Velocipedes.
381. Romain, H. — Draught preventer.
383. Pearce & Besson — Methods of holding plate glass while roughing, smoothing, or polishing.
384. Inman, H. — Trimming machines.
386. Thompson, W. P. — Wood planing tools (*Brown*).
391. Vine, J. W., & others — Lubricating and moistening rags.
394. Wilholft, F. — Vulcanised soft rubber.
395. Taylor, T. H. — Lubricants.
402. Lake, H. H. — Dyeing textile materials (*Weldon*).
404. Sanday, W. — Vices.
408. Laidman, J. H. — Stern posts.
411. Shannon & Bennison — Edging articles of textile fabric.
412. Ambjorn, P. (Comte de Sparre) — Cartridges.
413. Norris, J. — Beer engines.
417. Darby, J. H. — Burning lime.
425. Haddan, R. — Knife cleaning machines (*Hensel*).

11th January, 1888.

433. Taylor, R. — Facing nuts.
436. Thomas, A. — Swing bucket for unloading ships.
440. Barbour & Combe — Applying liquid to yarns whilst being twisted.
444. Hall, J. — Grate backs.
448. Brown, C. — Atmospheric stove.
453. Urquhart, R. J. — Fluid meters.
454. Cutler, S. — Telescopic gas holders.
457. Forsaith, T. — Hand saw.
459. Andrews, S., & others — Axles for tram cars.
460. Statham & Chudleigh — Stereotype plates.
462. Fletcher, R. G. — Velocipedes.
465. Digby, E. J. T. — Substitute for leather.
468. Haworth, E. — Weavers' shuttle tongues.
476. Cobbe, J. — Reflecting gas or other artificial light.

12th January, 1888.

481. Riddell, W. M. — Drying textile fabrics.
483. Reynolds & Reynolds — Ships' compasses.
491. Stokes & Stokes — Cooking oven.
492. Palmer, R. W. — Hansom cabs.
493. Palmer, R. W. — Rubber tyred wheels.
494. Hilton, J. — Fire proofing mills.
495. Cooper & Cooper — Roofing felt.
496. Cooper & Cooper — Manufacture of "wood wool."
509. Simpson, J. C. — Duplex action blind.
510. Gorton, J. P. — Screw driver.
511. Howorth, J. — Ventilators.
518. Asbury, C. — Lamps.
527. Gray, A. — Ships' davits (*Wicks*).
528. Simpson, W. S. — Screw ferrule.
532. Imray, H. — Gas lighting apparatus for railway trains (*Picard*).

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

14th January, 1888.

401. Fryer, R. McC. — Improvements in ships.
501. Ewens, P. — Furnaces.
527. Vavasseur, J. — Mounting for a rapid-firing gun.
840. Day, St. J. V. — Apparatus for drying grain (*Swan*).
1266. Adam, G. — Gas engines.
1739. Lorenz, W. — Breech loading guns.
1990. Redfern, G. F. — Harbours, piers, and breakwaters (*Saunders*).
3153. Lapworth, W. — Weaving elastic or corded fabrics.
3274. Stitt, J. C. — Generation of steam.
3285. Stuart, G. — Sight bars of guns.
3444. Wilson, E. — Machine for working leather.
3463. Eddington & Steevenson — Traction engine.
3464. Eddington & Steevenson — Traction engines, &c.
3473. Holzle & Spranger — Platen printing presses.
3484. Stevenson, H., & others — Spinning machinery.
3504. Hinks & Dorman — Boot sewing machinery.
3518. Brogan & Malloch — Method of producing rippled patterns upon plate glass.
3539. Tongue, J. G. — Feed water taps (*Creamer*).
3593. Foord, W. S. — Printing machines.
3601. Keats & Keats — Cutting presses.
3618. Bradford, T. — Washing machines.
3633. Butler, H. — Looms.
3634. Archer, C. F. — Hydraulic lifts.
3663. Wetter, J. — Stitching or binding machinery (*Stamm*).
3674. Newton, A. V. — Recoil of guns (*Nobel*).
3680. Ludbrook, H. E. — Machine for cleaning vegetable fibres.
3733. Moncrieff, A. — Mounting guns.

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3771. Arnold, J. J..... Tidal trap for scouring rivers and channels.
3800. Brougham, F. J. ..... Apparatus for cleansing clothing (*Desjardines*).
3905. Illingworth & Illingworth ..... Combing machinery.
3988. Donaldson, W..... Fluid pressure motors.
4002. Hattersley & Hall ... Derrick cranes.
4069. Dawson & Adams..... Machines for ruling lines on paper.
4324. Nicholson, C. J. ..... Railway and tramway wheels.
4967. Sowden, A. ..... Looms.
6278. Harrison, G. H. ..... Steering screw steamers.
6295. Kohler & Lachman .... Sewing machines.
6460. Clark, A. M..... Harrow and pulveriser (*Rothchild*).
6645. Hockey, J..... Hay making machines.
6746. Maertens, E. ..... Spinning machines.
9243. Rothery & Warburton Tramway rails and sleepers.
11673. Kennedy & Kennedy... Machine for wrought metal tubes.
12423. Mathewson, A. W..... Winding and twisting yarn.
15131. Pilkington, F..... Preventing girders from buckling
15214. Boult, A. J. ..... Saw hammering mechanism (*Gowen*).
15566. Gordon, G. W..... Machine for pulping coffee (*Lang*).
15804. Cockcroft, T. M..... Sewing machinery.
15906. Thompson, W. P..... Brick machines (*Duval & Blunt*).
15961. Ambler, A..... Trap twisting frames.
16077. McCoy, J. S..... Machine for making smooth surfaces on stone.
16232. Jones & Quilter..... Hydraulic machinery.
16274. Mauser, P..... Breech loading fire arms.
16514. Furnival, T., & others. Guillotine cutting machines.
16743. Freeland & Bradley... Double trees for agricultural machines.
16813. Evans, G. F. ..... Mechanism for transmitting motion.
16837. Vaughan, G. E..... Machines for bagging chaff (*Andrews & Beaven*).
16841. Hurst, H. P..... Cartridges, projectiles, and wipers for guns.
16883. Molesworth-Hepworth, E. N..... Weaving.
16903. Panhard & Levassor .. Steam generators.
16930. Thompson, W. P..... Construction of floors and roofs (*Gocht*).
16942. Lendrum & Dytch ..... Stockinette frames.
16955. Bower, T., & others..... Apparatus for cutting coal.
16958. Whitley, C. ..... Machine for winding lace.
16975. Blackman, A. L. ..... Canal locks.
17040. Humphreys, J. C..... Machines for planing lumber.
17082. Crossley & Healey..... Carding and preparing silk, tow, and flax.
17120. Allison, H. J. ..... Sewing machines (*Harris Button Hole Attachment Co.*).

ELECTRICITY.

14th January, 1888.

1904. Kapp, G., & others ..... Transformers.
2130. Jehl, F..... Electrical inductors.
2134. Schanschieff, A..... Miners' safety lamps and galvanic batteries.
3560. Warburton, E. C..... Electric lamps.
3611. Forbes, G..... Laying electrical conductors underground.
3782. Edwards, E..... Electric telegraphs (*Kunhardt*).
3783. Edwards, E..... Morse keys (*Cassalette & Kunhardt*).
3785. Beckingsale, E. W..... Electrical conductors.
3917. Wittenberg, C. ..... Telephones.
9725. Thompson, W. P..... Dynamo-electric machines (*Westinghouse*).
14260. Drew, S. C. ..... Telephonic circuits.
15588. Johnson, J. Y..... Dynamo-electric machines (*Rechniewski*).
16558. Wright, A..... Regulating electric currents.

CHEMISTRY.

14th January, 1888.

2297-8. Brin & Brin..... Saccharine and sacchariferous matters.
2741. Gittins, C. E..... Softening of water.
3994. Lake, H. H. ..... Colouring matters (*Leonhardt and Co.*).
4271. Walker, A. ..... Yeast.
5109. Hauff, J..... Sulphio-cyanides of aluminium, iron, and chromium.
9313. Mann, A..... Alloys of aluminium.
13955. Fiske, S..... Treatment of sugar cane.
15459. Forel, S. ..... Colouring matters.

MISCELLANEOUS.

14th January, 1888.

315. Hardingham, G. G. M... Iron cement (*Grouvelle*).
341. Timmis, J. M. ..... Feeding oil into vessels.
618. Chatwood & Chatwood Locks and latches.
1727. Gandy, M..... Belts for driving machinery.
2026. Tate & Killip..... Governors.
2092. Brode, L. A..... Utilising the waste of coal.
2699. Norcombe, E. S., & others Manufacture of paper bags.
2853. Crowe & Stone ..... Metal corners for cardboard boxes.
2864. Kay, R. D..... Valves for inflating life belts.
3070. Marlin & Taylor ..... Padlocks.
3169. Watson, L..... Apparatus for scalding and refrigerating milk.
3177. Lee & Wiggins..... Velocipedes.
3291. Howard & Bousfield Manufacture of gas.
3443. Wilson, E. ..... Disintegrator.
3458. Sage, F..... Indicators.
3487. Morison & Purser..... Hydrocarbon lamps.
3515. Blogg, S. D..... Locking nuts.
3516. Sturmey, W..... Gate locks.
3520. Cockburn, J. ..... Apparatus for discharging water jets.
3540. Tongue, J. G. ..... Safety razor (*Kampfe & others*).
3543. Wallwork & Wells ... Gas burners.
3554. Fraser, J..... Lucifer matches.
3561. Birch, A. ..... Dyeing, bleaching, and otherwise treating fabrics.
3600. Keats, A. ..... Manufacture of boots.
3607. Linley & Biggs ..... Velocipedes.
3654. Goodwin & How ..... Lock nut.
3667. Hocking, F. ..... Production of fresh water from salt water.
3681. Chartres, A. H..... Cut-off gear for fluid pressure engines.
3715. Longmore & Watson... Treatment of fibrous plants.
3742. Herdman, G. A. ..... Improvements in felts.
3772. Morrison, W. H..... Trimming lamp wicks.
3793. Imray, J. ..... Refrigerating apparatus (*La Compagnie Générale pour la Production du Froid Procedes, E. Fixary*).
3841. Cumming, J., & others Apparatus for heating water.
3944. Oldham, T. ..... Steam generator flues.
3968. Shave, W..... Velocipedes.
4561. Gamble, J. ..... Retaining the lubricant on vertical spindles.
4844. Rössler & Reinhard... Screw conveyors.
4954. Crane, F. ..... Method of japanning, lacquering, or coating various articles.
5337. Bang & Ruffin ..... Purifying crude spirit.
5366. Farini, G. A..... Ammunition for rifles.
7066. Butterworth, W. ..... Drip cups for shaft bearings.
7244. Stanley, W. F. ..... Heat conductors.
7381. Dudley & Hamilton ... Concrete and artificial stone mantel pieces.
7687. Calvert & Hunt ..... Shuttle guards for looms.
7808. Sunter, L. E. ..... Screws and screw drivers.
9756. Mills, G. A. ..... Ammunition for fire arms.
9784. Gotendorf, J. N. ..... Covered buttons and apparatus therefor.
9968. Cook, P. ..... Glazed water proof paper canisters.
10744. Eyre & Spottiswoode Parallel ruler.
11564. Watson, H. ..... Washing plunger.
12011. Nunn, W. ..... Candle lamps.
12721. Webber, W. T. ..... Carriage lamps.
12780. Weston, T. R. ..... Method of obtaining type plates.
13176. Waterfield, T. B. ..... Guard for tram cars.
14123. Johnson, J. ..... Chuck.
14157. Lake, H. H. ..... Manufacture of knitted stockings (*Esty & Busiel*).
15027. Schapiro, A. ..... Paper files with receiving wires.
15432. Grunhut, J. ..... Dyeing.
15604. Redmond, F. ..... Machine for cleaning windows.
15950. Fahrig, E. ..... Gas burners.
16299. Gradenwitz & Taenzer Pressure gauges.
16332. Spengler, F. ..... Locks.
16391. Lake, W. R. ..... Automatically extinguishing fires (*Dyer*).
16549. Imray, H. ..... Pitch chains (*Jeffrey*).
16817. Cole & Cole ..... Gas governors.
16904. Groth, L. A. ..... Safety lamps for miners.
16912. Lavender, H. P..... Safety apparatus for hoists.
16931. Gowland, J. ..... Chimney tops applicable as ventilators.
16943. Seymour, W. T. ..... Lids of sheet metal cans.
16965. Nicholls, S. ..... Syphon water waste preventers.
17000. Goulden, W. ..... Velocipedes.
17020. Dallas, J. D. ..... Burglar alarms.
17025. Mills, B. J. B. ..... Brakes for vehicles (*Roberjot*).
17041. Martin, T. ..... Gate latch.
17069. Taylor & Whitfield... Ventilating of mines.
17106. Grunhut, J. ..... Dyeing cotton in aniline black.
17121. Lister, J. T. ..... Sash locks.
17158. Lake, H. H. ..... Purifying feed water (*Daniels*).
17162. Salcher & Schwertschlag..... Metallic plates for lithographic purposes.
17163. Sundgren, C. A. ..... Shafts of carriages.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 7th October, 1887, inclusive.)

Year 1883.

4663. Clark, A. M. ..... Hot blast stoves (*Algea*).
4664. Ellis, W. T. G..... Checking arrival and departure of employés.
4665. Brewer, E. G. ..... Repeating fire arms (*Werner and another*).
4667. Thompson, N. ..... Unions for pipes, hose, &c.
4669. George, E., & others ... Telephonic apparatus.
4671. Serrell, H. ..... Alarm bells for bicycles.
4674. Leoni, S. ..... Gas cooking ovens.
4678. Atwood, J. F. ..... Attaching buttons to fabrics.
4680. Hetherington, J. M.... Ring spinning frames.
4682. Darwin, H. ..... Theodolites, &c.
4683. Coxeter, S. J., & another Electromotors.
4685. Boult, A. J. ..... Cartridge shells (*Ring & others*).
4687. Stuart, M. ..... Packing cases.
4690. Nawrocki, G. W. von... Ironing boards (*Hess*).
4693. Needham, G. H. ..... Breech loading fire arms.
4700. McDevitt, J..... Sewing machines.
4705. Brown, R., & others ... Definite photographs.
4709. Bivort, E..... A railway switch.
4710. Shaw, A. R. ..... Telephonic, &c., apparatus.
4712. Pieper, C..... Sewing machines (*Gritzner*).
4725. Byrnes, F..... Aërial transit.
4728. Henderson, A. C. ..... Voltaic batteries (*Bassett*).
4732. Atkinson, J. E. ..... Transporting and exposing photographic plates.
4736. Phillips, D..... Carriages.
4738. Sharples, G. B. ..... Bleaching fibrous materials.
4740. Schmiers, L. ..... Dampening apparatus for lithographic presses.
4741. Lampe, O..... Trace hooks.
4746. Boult, A. J. ..... Raising water from wells (*Yeagley*).
4747. Sutton, J. W. ..... Burning gas mixed with hydrocarbon vapour.
4749. Lake, W. R. ..... Extracting essential oil from hops (*Breithaupt*).
4751. Wise, W. L. ..... Pyrometers (*Boulier*).
4752. Reed, C. H. ..... Chains, &c.
4753. Donald, J..... Washing machines.
4754. Jenkin, F..... Driving gear.
4758. Beveridge, J. ..... Treatment of ores.
4759. Sands, H. ..... Saw sharpening machinery.
4760. Wirth, F. ..... Producing warmth (*Honigmann*).
4764. Lake, W. R. ..... Packing of pistons (*Bell*).

Year 1882.

4707. Vaughan, G. E., & ano. Bicycle stand, &c.
4774. Bull, H. C. ..... Boiler for generating steam.
4778. Strangways, H. B. T... Telephones.

Year 1881.

4262. Verdin, R. ..... Transhipping coal, &c.
4265. Westmacott, P. G. B... Rotary valves.
4304. Aylesbury, H..... Dynamo machines.
4356. Fraser, A. G., & others. Shelling grains, &c.
4363. Haddan, H. J. ..... Knitting machines (*Universal Knitting Machine Co.*).

Year 1880.

3975. Fawcett, J. A..... Fermented liquors, &c.
3979. Smith, W. ..... Stoves.
3992. Scott, D. ..... Piled fabrics.
4005. Brewer, E. G. ..... Dynamo-electric machines (*Cance*).
4036. Haddan, H. J..... Sewing machines (*Keith*).
4044. Corliss, G. F. ..... Steam engines (*Corliss*).
4065. Lightfoot, T. B..... Refrigerating apparatus.
4070. Edwards, G. M..... Tie and core metal (*Hyatt*).

Year 1879.

4041. Pilkington, W. W..... Grinding glass.
4045. Haddan, H. J. ..... Indicators for steam engines (*Crosby*).

Year 1878.

3861. Lockwood, H. ..... Waterproofing structures.
3868. Alexander, E. P..... Corkscrews (*Clough*).
3902. Lake, W. R. ..... Spindles, &c. (*Rabbeth*).

Year 1877.

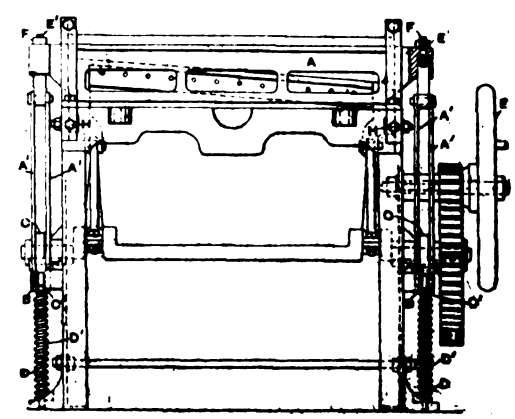
3697. Kennan, T..... Iron bar fences, &c.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Shearing Sheet Metal.—*D. Smith, Jun., Wolverhampton.*—The sheet of metal to be sheared is gripped by a bar and held firmly in its position as determined by means of the shearing gauges. The mechanism employed will be understood by reference to the accompanying diagram, which represents a

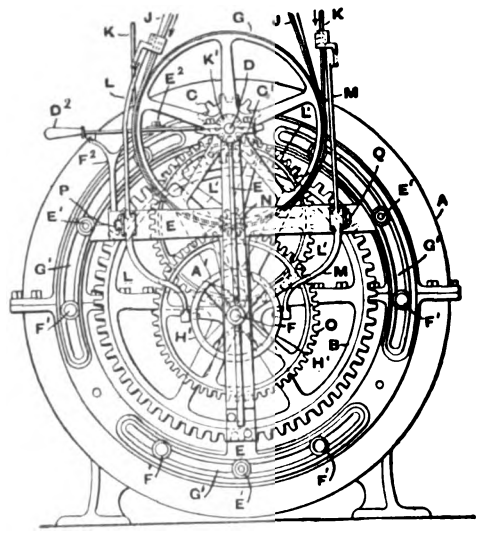


front view of the machine. A is the grip bar, which is carried immediately in the front of the shear arm; and A^1 A^1 are straps or links connected to the bar A by means of pins E^1, whose lower ends are connected to the side levers B. These levers are fulcrumed at their ends furthest away in the diagram, and their nearest ends are boxed out to carry the rollers C^1. The cams C C are keyed to the crank shaft, and spiral springs D round the rods D^1 bear up against the levers B. The sheet to be sheared is adjusted in position against suitable gauges, and motion is imparted to the shaft and the cams by means of the wheel E. The cams depress the levers B, and cause the grip bars to grasp the sheet. When the cams revolve off the rollers, the springs D force up the levers B, and consequently the grip

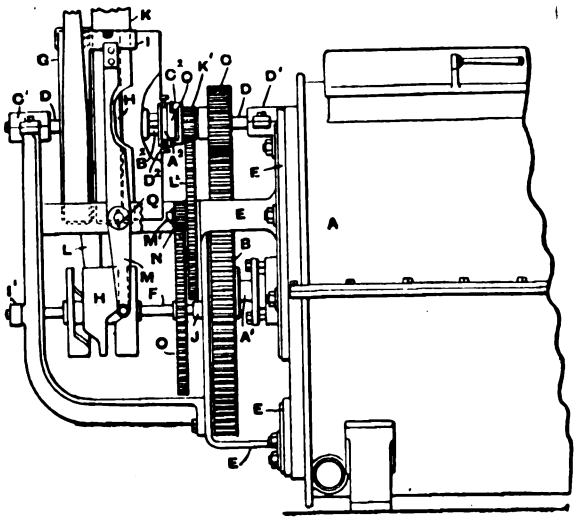
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bar A. The pins E¹ are provided with shoulders, in order that they may be adjusted for different thicknesses of sheet metal. By means of the grip bar acting in combination with the shear blades, the sheet may be readily edged. The guides carrying the shear arm and grip bar are set back by means of the pins H¹, through a distance not less than the thickness of the sheets to be edged, and thus as the shear arm descends it edges down the sheet at right angles to its plane. The grip bar, pressing close on the edge of the sheet, insures the desired straightness. The inventor makes five claims for these improvements described.—No. 1940. February 8th, 1887. 8*d*.

Reversing Belt Gear.—*A. H. Reed.* (*H. E. Smith, New York, U.S.A.*)—This invention is a device for imparting reverse motions to a shaft by means of belt gearing. In the example illustrated in the figures, the apparatus is attached to a cylindrical washing machine, but the mechanism is nevertheless applicable to any other machine. A represents a frame or casing in which is journalled the shaft A¹. This shaft has



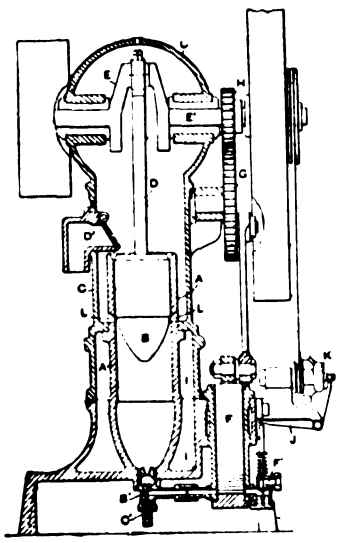
rotary motion from the driving shaft D imparted to it through the toothed gearing B C. Three pulleys G H I are mounted on the shaft D, G and I being loose and H fixed thereon. Two belts J and K, the former twisted and the latter straight, connect these pulleys with the line shaft, and according as one or the other works on the fixed pulley, the rotation of the shaft D takes place in one direction or the other. The train of wheels K¹ N O impart the rotation of the shaft D to the shaft F. The latter shaft carries a cam H¹, which works the levers L and M. The belts J and K are thus moved in a lateral direction off one pulley and on to another, and the object of the invention is



attained. The cam is so formed that first one lever and then the other is moved, and the reversing of the motion is not effected too suddenly. A clutch is provided on the shaft D, so that the reversing mechanism may be thrown out of gear at any time. The inventor makes three claims for these combinations.—No. 106. January 4th, 1887. 8*d*.

Rock Boring Apparatus.—*J. Thom, Riccarton, Ayr.*—This invention has for its object the reducing of the cost of diamond drills for rock boring purposes, and the shortening of the operations to be carried out in its use. The machine is mounted on wheels, and its frame carries a horizontal shaft provided with fast and loose pulleys, over which the driving belt travels. This shaft also carries at its sides a pair of spur pinions of different diameters, one of which is in gear with a corresponding spur wheel on the shaft of a chain barrel. The pinions and cog wheels are of different sizes, according to the speed at which the chain barrel requires to be driven when winding up the boring rods and drill. At the central part of the shaft is a bevelled wheel, which gears with a pinion on the inner end of a horizontal shaft situated at right angles to the other. The outer end of this shaft is provided with another bevelled wheel, which gears into a bevelled pinion. This latter pinion drives the shaft to which the boring rods are coupled. The latter shaft and its connections are pivoted at the inner end, and are capable of being moved sideways upon a quadrant, so that they may be shifted out of the central position when it is desired to lift the boring rods and drill by the chain barrel and chain. To prevent too much weight from acting on the diamond drill when the hole becomes deep, a provision is made for counterpoising the weight of the rods, which consists of a second chain barrel, one portion of which is of larger diameter than the other. The chain is caught by a hook attached to another chain, which is wound round the smaller portion of the second chain barrel, and a counterpoise is suspended from a chain upon the larger portion of the barrel. In order to release the rods when a piece of rock chokes the bore hole, a shaft is provided with handles which are caused to operate on the suspension chain, whereby the rods may be moved upwards or downwards in the hole until the obstruction to their revolution is removed. The inventor makes three claims for these arrangements and combinations, together with the counterpoising apparatus.—No. 94. January 4th, 1887. 11*d*.

Internal Combustion Heat Engines.—*H. H. Hosack, Liverpool.*—According to this invention, the air and the fuel are introduced separately into the cylinder, in order that no premature combustions shall take place. The annexed diagram represents a vertical sectional elevation of an engine designed according to the suggested improvements. The cylinder A has a water jacket I. A casing C incloses the connecting rod D and the crank E, and constitutes an air chamber having an air inlet valve D¹. The gas pump F is worked by the spur wheel G H. The exhaust valve is worked by a bell crank lever, which is operated by a cam projection on the spur wheel G, and the ignition valve is of the heated tube type worked by another cam on the spur wheel G. The gas pump F is provided with a suction valve F¹ and a delivery valve B¹. The valve F¹ is an ordinary lift valve, and serves to govern the supply of gas. When the engine runs above its normal speed, the lever J keeps the valve F¹ open, and so upon the compression stroke of the pump the gas is forced back into the gas main, and not into the cylinder. The delivery valve B¹ is kept upon its seat by a spring C¹, which is of sufficient strength to prevent any gas entering the cylinder from the pump until it is compressed to a certain atmosphere. The pump may be arranged to inject all the gas into the cylinder, so as to render the charge

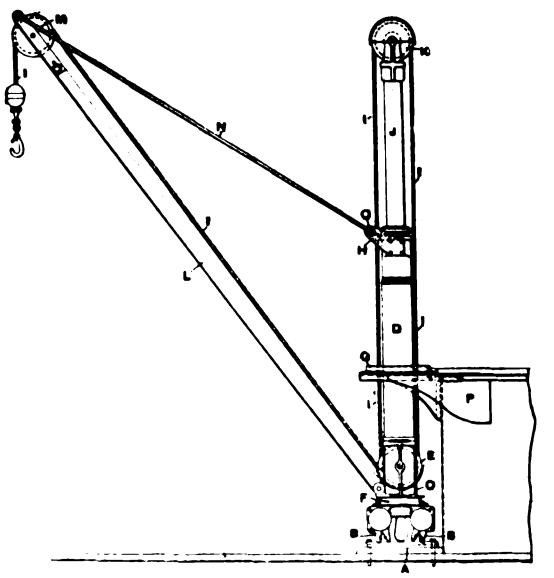


combustible just before the compression stroke of the piston is terminated. During the compression stroke air is introduced through the valve D¹. In the succeeding out stroke the charge is ignited and the piston is urged outwards, at the same time compressing the air in the reservoir C. Just before its termination, some part of the products of combustion escapes through the opening of the exhaust valve, and when the piston has reached its extreme position, the ports L are opened, and the compressed air from C rushes through into the cylinder and expels a large portion of the remaining products of combustion. The whole space of the cylinder is thus occupied by pure air, and the more perfect absence of products of combustion thus insured enables the inventor to obtain a more complete combustion, and hence a more effective stroke. The inventor claims the method of expulsion of the gaseous products, the cycle of operations, the mode of supply of fuel, and the construction of the engine.—No. 888. January 20th, 1887. 11*d*.

Looms.—*E. Woodhouse & J. J. Grimshaw, Leeds.*—The object of this invention is to provide means for reversing the warp beam without disarranging the let-off motion. The drums on the ends of the beams, round which the weighted cords are wound, are connected to the beam by a pawl and ratchet mechanism, in such a manner that the beam is free to be turned back without actuating the drums. The inventor claims the improvements in let-off motions for the before mentioned object, and the combination with a warp beam of a ratchet wheel rigidly fixed to the beam, and a loose drum mounted on the beam having a pawl adapted to engage with the wheel.—No. 2091. February 10th, 1887. 8*d*.

Carding Engines.—*J. McQueen, Manchester.*—This invention consists of improvements in the method of grinding the flats from the face which rests on the elastic bend. A bracket is attached to the engine framing, and carries a horizontal shaft, to whose inner end is fixed a wheel gearing into the snugs on the flats. This wheel is formed so that the part which comes into contact with the snug is held up by a spring. On the other end of the shaft is fixed a bevel, which gears into another on an upright shaft; on the upper end of the latter shaft a wheel is secured, which has projections on its under side to suit the angle and width of the flats. The motion of the flats is transmitted to the last named wheel from the elastic wheel which is driven by the flats. The elastic wheel lifts the flats up against the projections on the under side of the wheel, and brings the points of the wire on the flats into line when passing under the grinding roller, thus making all the flats alike in the relation of the working parts to the points of the wire. In another form of the invention, an endless chain is placed above the flats, each link of which corresponds to the end of the flats in width and angle. By the action of the elastic wheel, the flats are lifted up against the links of the chain, which are held in line by a straight piece fixed inside of the chain. The inventor makes two claims.—No. 3050. February 28th, 1887. 8*d*.

Ship Cranes.—*W. Shapton, London.*—The inventor has designed this hydraulic crane with a view to keeping it entirely above the deck line. The bottom of the post is stepped on the deck, and the upper part is supported by a collar or bracket from a deck house or from a mast. The tie rods of the jib are secured to the post above this collar, and the jib itself is attached to the pillar between this collar and the footstep. The lifting chain passes through this collar, and the slewing cylinders are fixed upon the deck at the foot of the crane. The appended diagram represents an elevation of a crane constructed according to this principle. A is the footstep fixed to the deck, and C is the post of the crane, which consists chiefly of the main



hydraulic cylinder D. The ends of the slewing cylinders are shown just above the footstep, and F is a drum on the crane post which receives the slewing chain. The apparatus used for slewing the crane consists of chains fixed to the cylinders at B, and passing over pulleys on the ends of the rams which work in these cylinders. The ram J supports a pulley K at its summit, and the chain I being attached to the foot of the crane passes over the pulley K, under the sheave E and over M, which is placed at the extremity of the jib L. The tie rods N attached to the jib head are connected with the lug heads H by means of the bar O. These parts and their joints are made in such a manner that the tie rods can be easily taken off when the crane is not in use. P is the bracket which serves as the upper support of the mechanism, and in the drawing takes the form of a collar surrounding the cylinders. The post is hereby held steadily, but is nevertheless free to turn round together with all its gearing. The inventor makes four claims for this crane.—No. 1807. February 4th, 1887. 8*d*.

Boiler Flues.—*D. Adamson, Dukinfield, Cheshire.*—This invention relates to improvements in the manufacture of tubes and shells of boilers, and its chief object is to construct and arrange a machine which will in one operation flange a solid tube at both ends, and simultaneously roll out of the solid metal one or more rings. A pair of rollers are placed horizontally; one of them is provided with grooves on its periphery, and is supported in the main frame of the machine, and is made adjustable by means of suitable mechanism; the other roll, which is not adjustable, is of comparatively small diameter, with a flange at each end, and grooves corresponding to those of the other roll. The non-adjustable roll is supported at one end in a strong bracket securely bolted to the housing, and this bracket carries an arm which extends to the opposite side of the machine, where it has secured to it a pedestal for supporting the other end of the non-adjustable roll. The arm, pedestal, and the other parts are arranged to permit of solid tubes being readily placed between and removed from the rolls, thus dispensing with the hinged journal commonly employed in such machines. In operation the adjustable roll is moved back far enough to allow the heated solid tube to be passed over the non-adjustable roll and its fixing, and up to a stop. The adjustable roll is then moved quickly forward so as to press the tube between the two rolls, which as they revolve flange the ends and simultaneously form the rings on the tube. The inventor makes five claims for the combinations and improvements.—No. 535. January 13th, 1887. 11*d*.

Furnace Doors.—*A. W. Robertson, West Ham, Essex.*—The improved furnace door is constructed of a sheet of metal, preferably steel, provided with apertures for the admission of air. The bottom edge of this plate is turned over so as to carry a pin or axle, the ends of which are carried in bearings formed in a piece of angle iron which surrounds the furnace mouth. A flame or baffle plate is attached to the door at a suitable distance from it, and is also furnished with air admission holes. The door is held in its closed position by means of a weighted lever latch mounted between two lugs on the furnace front. Suitable springs may be attached to the door to ease the fall. Claims: (1) The construction of the hinge by bending over one of the edges of the door so as to envelope a pin or axle, the ends of which are mounted as described; (2) the application of springs to ease the fall; and (3) the general construction and arrangement described.—No. 13027. September 26th, 1887. 6*d*.

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SPINNING MACHINES.—*S. Tweedale, Accrington.*—This invention involves an improvement in the construction of the step and bolster bearings for spindles, described in Letters Patent No. 2095 of 1881. Instead of the spiral springs and nuts as before used, the inventor now employs a collar, so made as to fit closely to the inside of the bolster carrier. This closeness of fit serves to support the spindle in an upright position when at rest. A part of this collar is made into a shell by boring or cutting away part of the metal between the outside and the centre; and a number of grooves are cut through this shell part for the purpose of rendering it elastic, thus allowing the lever end of the bolster tube to have a limited amount of lateral motion. After the insertion of the bolster tube in the base, a brass cap is forced on the top of the base in order to prevent the tube being lifted out of its position. The inventor makes one claim for the improvement described.—No. 1737. February 3rd, 1887. 8*d.*

WINCHES.—*M. Archer, Gateshead.*—The frames of the winch are formed in the ordinary shape, and are made of cast iron plate or angle iron. Instead of the usual drum, the inventor employs a series of externally convex iron bars. Their convexity is of such a degree that the exterior curved surfaces of the bars are parts of the surface of a cylinder whose axis coincides with the axis of the bars. These bars are carried between wrought or cast iron plate ends, in one of which they are riveted, while they are allowed to slide through holes in the other end. These ends of the drum are both secured to the shaft with which they revolve, and the length of the barrel may thus be adjusted at will. In order to hold the pinion of the winch in or out of gear, a sliding block is formed which slides upon the top cross stay of the frames forming the body of the winch. The block is secured in either of two positions by means of a tongue piece fitted into it, which may be dropped into one of two notches in the cross stay. The block has two lugs upon it, between which the pinion of the winch is placed, and the driving spindle runs through both the lugs and the pinion, so that the position of the sliding block determines the position of the pinion. The inventor claims the method of altering the length of the barrel, and the method of holding the pinion in or out of gear, as described.—No. 1842. February 5th, 1887. 8*d.*

PNEUMATIC HAMMERS.—*G. Glossop, Sheffield.*—These improvements relate to pneumatic hammers, and consist in the application of a brake by means of which the action of the tup may be stopped or retarded. A brake block is let in the inside face of the standard, and is moved outwards against the tup by the horizontal action of a wedge, which is fitted in a recess between the brake block and the standard. The wedge may be operated by any suitable mechanical arrangement, such as a treadle or hand lever. Claim: In pneumatic hammers the combination with the tup of a suitable brake by means of which the tup may be retarded or stopped substantially as described.—No. 1706. February 3rd, 1887. 8*d.*

ROLLING SEAMLESS TUBES.—*W. P. Thompson, Liverpool.* (*C. Kellog, Buffalo, New York.*)—These improvements are applicable to a form of rolling mills described in Letters Patent No. 2844 of 1883. The object is to provide means of adjusting both the rolls in the vertical and horizontal pair simultaneously, to furnish means for maintaining the free end of the mandrel in proper position, to allow of adjustment of the rolls supporting the material operated on, and to supply means of preventing the bending of the mandrel during the process of rolling. The inventor makes thirteen claims for the combinations of parts employed.—No. 14042. September 6th, 1887. 8*d.*

ELECTRICITY.

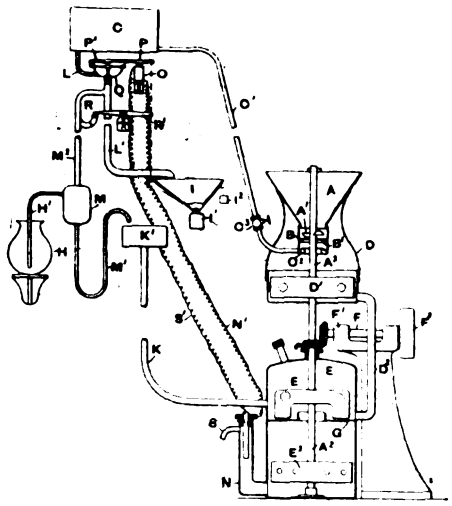
SECONDARY BATTERIES.—*C. D. Abel, London.* (*A. Dun & F. Hasslacher, Frankfort-on-the-Main.*)—The object of this invention is to provide an accumulator whose durability is less limited than of those at present in use. The negative plate consists of retort carbon, or of a metal which is insoluble in caustic alkali, such as copper, iron, aluminium, &c. The depolarising substance is a metallic oxide, also insoluble in caustic alkali, for example, oxides of silver, copper, manganese, nickel, cobalt, or bismuth, all of which bodies can pass to a higher state of oxidisation. Carbon powder may be mixed with the depolarising substance in order to increase its effectiveness. When mixed with water the depolarising agent is formed into a plastic mass, and in that state is applied in thick layers to the surfaces of the negative electrode. The prepared electrode is wrapped in a covering of asbestos, or other tissue, which will allow the exciting liquid to penetrate it. The positive electrode consists of a plate of carbon, or metal insoluble in caustic alkali, copper being used by preference. The exciting liquid is a more or less concentrated solution of zinc oxide or lead oxide in caustic alkaline lye. The negative and positive electrodes are arranged alternately, and are respectively connected to a common pole. In order to prevent the action of atmospheric carbonic acid upon the exciting liquid, this should be covered with a layer of paraffin oil, or the vessel may be hermetically closed with solid paraffin or gypsum. This cover is provided with an opening closed by a ball valve, permitting the escape of the gases given off, and serving for the introduction of water to make good the quantity converted into gases during the changing operations. The inventors make one claim for the battery as described.—No. 1862. February 5th, 1887. 6*d.*

CHEMISTRY.

PURIFICATION OF COLOURING MATTERS.—*R. Reid, Glasgow.*—This invention relates to improvements in the method of separating fine solid insoluble matter or grit from alizarine, starch, and other solutions used in the operations of calico printing. The inventor effects this separation by passing the alizarine or other article through silk cloth, of the kind known as silk bolting cloth, such as has been used in flower bolting machines. The result of this treatment is that the grit is separated effectually, and the doctors' streaks in calico printing are prevented.—No. 3304. March 4th, 1887. 4*d.*

METHYLENE BLUE.—*O. Imray, London.* (*Farbwerke vormals Lucius & Brüning, Hoechst-am-Main, Germany.*)—The chlorzinc contained in ordinary methylene blue of commerce has an unsatisfactory effect on textile fabrics. In order to obviate this disadvantage, the zinc is to be precipitated from the solution by means of alkalis, or sulphides, oxalates, or phosphates of alkalis, and by the addition of common salt, or by re-crystallisation the dissolved colouring matter is to be separated from the filtrate. The inventor makes one claim for this improvement.—No. 2985. February 25th, 1887. 4*d.*

APPARATUS FOR GENERATING CARBONIC ACID.—*J. Mangnall, Manchester.*—The method and apparatus here invented are shown in the accompanying diagram. The basic carbonate is introduced into the chamber B, through the perforated bottom of which it falls into the vessel D, after having been mixed with a supply of water from the reservoir C. The powder is thoroughly dissolved by the stirring action of the rotating arm D^1, which is fixed to the shaft A^2. The pulley F^2 supplies the motive power to this shaft by means of the bevel gearing shown



in the diagram. The carbonate enters the vessel E through the pipe D^2, and the acid by means of the pipe K. The cistern C empties itself periodically down the pipes L L^1 into the vessel I, which can cant on its fulcrum I^1. The suction action caused by the fall is employed to exhaust the air within the receiver M, which is connected by the trapped pipe H^1 with the acid supply H, and likewise has a pipe M^1 leading to the vessel K^1, and thence by the pipe K to the generator E. The acid will flow up the pipe H^1 and the vessel M through the syphon M^1 and into the generator E. The regulation of the supply of acid is effected in the following manner, while the carbonate supply is not interfered with: The waste pipe N is made of copper, and has an insulated zinc stopper S. These two pieces of metal act as a battery when there is a preponderance of acid in the liquid contained in the vessel N. The current thus generated is communicated to the magnet O, which attracts the armature P, and thereby the supply valve Q will be closed, the air valve R opened, the vacuum in M destroyed, and the flow of acid to the generator stopped, while the carbonate supply is not interfered with. The excess of acid is thus neutralised. The inventor makes five claims: For the method of preparing the gas, for the mode of supplying the acid, for the regulation of the quantity of acid, and for the construction and combination of the parts of the apparatus.—No. 1832. February 5th, 1887. 8*d.*

PHOTOGRAPHIC IMAGE ON GELATINE SURFACE.—*H. Sutton, Ballarat, Victoria.*—This invention is designed for the purpose of automatically converting a photographic image on a gelatine surface into a relief or intaglio printing surface, which will show the half tones of light and shade. The inventor takes an ordinary sensitised gelatine plate bearing a photograph broken up by any pattern or grain, and immerses it in warm water until the gelatine has swelled to a certain extent. The plate is afterwards cleansed of any free water remaining on its surface, and it is subjected to a gradually increasing heat until all the water has been driven off. Those parts of the gelatine which are unaffected by the action of light, and which are freely absorbent of water, melt and are drawn by capillary attraction under the unmelted portions, thus forcing up the latter into relief. The inventor makes one claim for the process described.—No. 15722. November 16th, 1887. 4*d.*

MISCELLANEOUS.

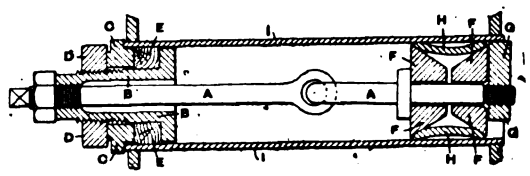
FIRE EXTINGUISHING SPRINKLERS.—*F. Grinnell, Providence, Rhode Island, U.S.A.*—This invention relates to systems of fire extinguishers in which the distributing pipes are filled with air under a low pressure, while the water is held in check by a valve of suitable construction under the control of the light air pressure. Certain combinations are introduced by this invention whereby the air pressure in the pipes is made to act in direct opposition to the water, thus doing away with all intervening mechanism heretofore employed. A valve and valve casing are placed between the air pipe and the water pipe, and a device is arranged for opening the ports that form the valve chamber to the two pipes. The inventor makes thirteen claims.—No. 1512. January 31st, 1887. 1*s.* 1*d.*

FRICTION CLUTCHES.—*J. Marshall, Gainsborough.*—This invention applies more particularly to the coupling of two shafts in line. On the end of one shaft is fixed a disc with a flange, upon the internal side of which bear the coupling devices carried by the other shaft. The other shaft has fixed to its end a circular box with a number of radial divisions, which accommodate the coupling devices. These devices consist of an outward portion and a stem, which can slide outwards and inwards in a boss. Each boss acts as a guide for the stem, whilst the sides of the upper parts of the divisions act as guides for the outward portion of the coupling device. Each coupling device is internally screwed, and another screw engages with it which abuts against the inner side or bottom of the division. The screws are provided with levers in order to turn them, and are connected by links with a collar sliding on the shaft, and operated by a forked lever. When the collar is thus slid in one direction, the levers are all operated so as to give a movement of equal extent of partial rotation to all the screws, and they consequently cause the coupling devices to move outwards, and bear on the portion of the adjacent shaft. In order to allow for the adjustment of the levers on the screws, for the purpose of taking up wear, the engagement is effected by a series of ribs and grooves round the interior of the hole in the lever, through which the neck of the screw passes, and also in the neck of the screw. The inventor claims the employment in friction clutches of screw spindles as described, the means of adjustment, and the general construction of the clutch.—No. 1805. February 4th, 1887. 8*d.*

FIRE EXTINGUISHERS.—*D. Spence, Glasgow.*—This invention involves a new arrangement and construction of portable chemical fire extinguishers. The exterior vessel is made of sheet iron, and is preferably about 2½ft. high, and may be of various diameters, from 4in. to 12in. A screwed cap is at the upper end, through which is introduced the alkaline carbonate solution, and a tight sealed bottle containing the acid is inserted in the midst of the liquid. In the upper hollow part of the metal vessel is fixed a central ring, secured to two or more radial metallic supports projecting from the interior surface of the vessel. One of the supports is of the form of a screwed spindle, and is intended to be worked from the outside. The vessel of acid is supported within the central ring, which has several sharp studs on its inner surface to help in cracking the glass when pressure is exerted by the spindles. A screwed stuffing box is formed on the outside of the vessel to keep the neck of the spindle pressure tight. The outer end of the spindle is provided with a handle, and a slight lateral inward traverse is sufficient to crack the bottle and allow the acid to escape. A hinged forked arm is attached to the exterior of the vessel to inclose the handle and to prevent its being accidentally burned when not required. A vertical tube projects down from the upper part, and is used for the discharge of the gas given off. The inventor claims the combination of the ring and its accessory fittings with the general construction of the apparatus.—No. 2229. February 12th, 1887. 8*d.*

YARN SIZING APPARATUS.—*J. S. Sutcliffe & J. S. Smith, Bacup, Lancashire.*—The object of this invention is to obtain greater uniformity of sizing in yarn sizing machines. For this purpose the squeezing rollers are driven by means of two cone pulleys, and the speed of the rollers is altered by moving the driving belt along the pulleys. When heavy warps are passing through the machine the speed is reduced, but is increased on the passage of light warps. Two claims are made for the improvements described.—No. 1640. February 2nd, 1887. 8*d.*

STOPPER FOR BURST TUBES.—*H. T. B. Sanderson, South Shields.*—This apparatus is designed for the stopping of tubes which have been burst by external pressure, and consists of a wrought iron rod provided with stoppers at either end. The front end stopper is constructed of a screwed ferrule B, which has a collar at one end, and also of a loose washer C and a nut



D. Between the washer and collar is placed an india-rubber washer E. The back end stopper consists of two loose eccentric cones F and an eccentric nut G. Between these two parts is placed the india-rubber washer H. The two end stoppers are placed into the front end of the tube, leaving the rod A projecting out of the tube. The front stopper is then made steam tight by screwing up the nut D. The other stopper is then pushed into the tube to its proper position, and is made steam tight by screwing on the square at the front end of the rod. The objects aimed at by this invention are: To arrange operations so that the front end stopper may be made steam tight before the back end stopper is allowed to pass the fracture, and to use the front end stopper as a stuffing box for the rod until that stopper is made steam tight. The inventor makes four claims.—No. 2341. February 15th, 1887. 6*d.*

AXLE BOXES.—*A. J. Boult, London.* (*F. B. H. Bouter, Chicago, U.S.A.*)—This invention has for its object the prevention of waste of the lubricating oil. At one end of the box is an opening through which the cotton waste is introduced to the axle. At the other end of the box is the opening for the reception of the axle. The wall through which the latter opening is cut is divided transversely to the axle by a channel, which extends all round the opening. In this channel rests the sand board. In order to prevent the escape of oil through the opening in the wall and sand board, a screw is inserted through a specially tapped hole in the upper portion of the wall of the axle box. The screw is hollow, and is threaded externally, and terminates above in a closed square end, suitable for grasping with a wrench. A stem fits closely into the open end of the tube and rests with its inner end against a coiled spring, while its outer end protrudes a short distance from the tube. The tube and stem are so placed in the shell of the axle box that the outer end of the stem presses gently against the upper side of the axle, and so prevents the escape of oil. As the stem is made of soft metal, its friction does not cause any grooving of the axle, but only tends to impart to the stem a concave surface, evenly fitting with that of the axle. The inventor makes eight claims.—No. 13756. October 11th, 1887. 8*d.*

LACE MACHINES.—*A. W. Smith, Nottingham.*—The object of this invention is to provide means for regulating the tension on the beams containing yarn. A clip is formed by bending a strip of metal, of suitable dimensions, into the form of a circle, to fit the beam collar. An extension, or loop, is made opposite the two free ends of the metal strip, and the two ends are turned parallel to each other, and are provided with holes through which passes a screw bolt. A winged nut prevents the clip from cutting the beam collar, and the clip is lined with leather to insure a regular amount of friction. The clip is placed on the

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beam collar with the loop over a pin, secured to the beam bearing, and the requisite amount of tension is obtained by means of the screw. The inventor makes two claims.—No. 12968. September 24th, 1887. 6*d*.

Tension Pulleys for Spinning Machines.—*J. Wilson, Shipley, Yorkshire.*—In order to simplify the construction of pulleys, a tinned plated is placed between a pair of dies, fitted to an ordinary screw or hydraulic press. The press, when operated, blocks the plate to the configuration of the dies, and forms a flange on the circumference. The opposite side of the pulley is made in a similar manner, with a sheet of metal of less diameter than before, so that a flange of only one-eighth of an inch is formed on it. The two plates are placed together and the axle secured thereto, and the flanges on the side plates forming the circumference are soldered together. The inventor makes two claims.—No. 755. January 18th, 1887. 6*d*.

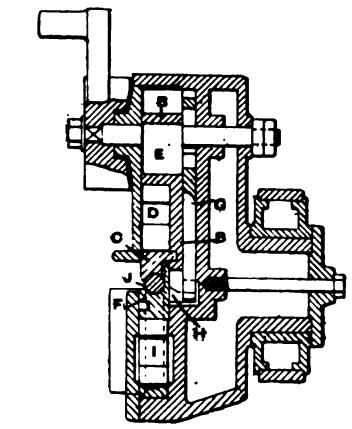
Railway Brakes.—*G. A. Boyden, Baltimore, Maryland, U.S.A.*—The improved brake is applied by the pressure of springs, and is released and controlled by the pressure of a compressed fluid supplied from the locomotive through a train pipe. On each carriage, and in communication with the train pipe, is mounted an expansible chamber preferably formed of a metal box or drum containing a flexible diaphragm. It may, however, be formed of a cylinder containing a piston. On one side of the diaphragm and pressing against it are a number of suitable springs, and the compressed fluid is admitted on the other side. The diaphragm also carries the rod by means of which the brakes are applied. The brakes are first applied by means of a hand wheel fitted on the car, and after that are under the control of the engineer. In case of a coupling pipe breaking, or the train parting, the brakes are applied at once. Nine claims are made for the improvements described.—No. 15175. November 8th, 1887. 8*d*.

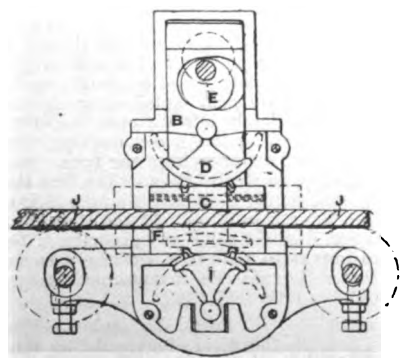
Machine Tool Holder.—*D. S. Seymour, Hartford, Connecticut, U.S.A.*—The stock of the tool holder is slotted at one end, and is furnished on one side with two diagonal grooves extending across the slot. The interior of the eye bolt is shaped so as to correspond with the diagonal grooves. The eye bolt is placed in the slot in the stock, and the tool is passed through the eye and placed in either of the grooves, thus inclining one way or the other according as it is desired to use it for right or left hand work. The eye bolt is then screwed up and the tool is secured. One claim is made for the combination of the parts described—No. 14122. October 18th, 1887. 6*d*.

Filter Presses.—*E. A. Cowper, London.*—In a filter press constructed according to this invention, thin plates, preferably of mild steel, are employed, and great rigidity and stiffness is imparted to them by making them of a slightly domed or conical form. The plates are cut or punched from rolled sheets, and are shaped by being pressed between dies in a hydraulic press, or by other known means. It is preferred to form the plates with flat portions at their edges where the joints are made. Claim: The construction and use for a filter press of steel or wrought iron plates domed, conical, or conoidal, substantially as set forth.—No. 15238. November 8th, 1887. 4*d*.

GERMAN PATENT ABSTRACTS.

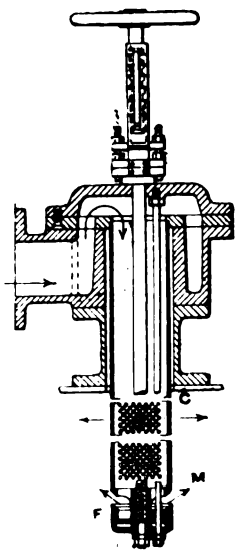
Coupling Apparatus.—*Adolph Bleichert & Co., Leipsic-Gohlis.*—This invention relates to the connection between cars and driving ropes. By turning the eccentric E, and thereby actuating the slide B, the jaws C and F are pressed against the rope J; by means of the two toothed segments D and I, the





pressure of C and F is automatically regulated according to the power transmitted by the rope. When the coupling is disconnected, the jaws C and F are brought back to their place by D and I, returning to their normal position. A sliding bar L, actuated by cams on the shaft of the eccentric, locks the jaws C and F by means of the catches H.—No. 41441. February 27th, 1887.

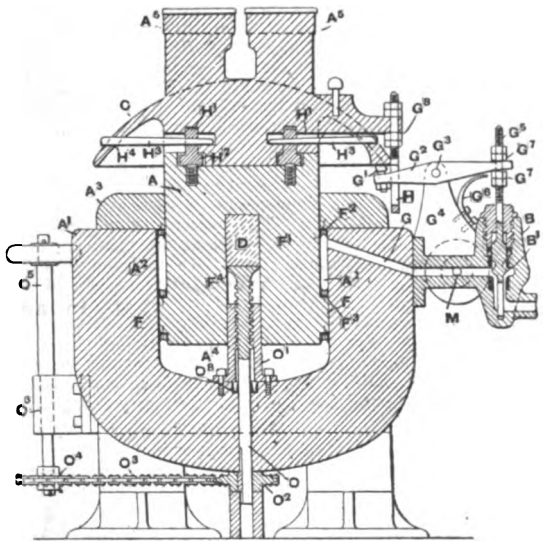
Condensers.—*Ernst Spandau, Magdeburg.*—This invention relates to an improvement of the roses used for condensers. The piston F is lowered by means of a screw as the perforations



in the rose C get choked up. When F arrives at its lowest position, that is, when all the perforations have become useless, the water is discharged through M in the shape of a bell.—No. 41464. June 1st, 1887.

UNITED STATES PATENT ABSTRACTS.

Brick Machine.—*S. E. McGregory, St. Louis, Ohio.*—This invention introduces several improvements into the construction of a machine described in McGregory and Koch's Patent No. 332814. Some of these will be understood by reference to the annexed diagram, which represents a section of the lower hydraulic cylinder. The plunger A of the press is made to work

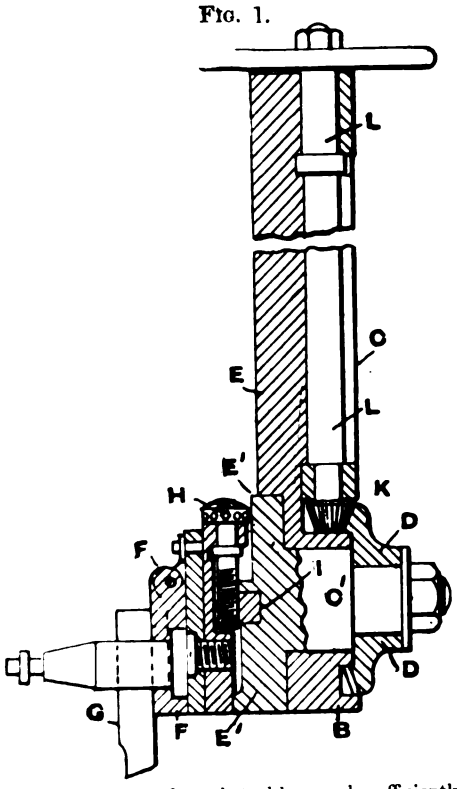


in the cylinder A^1; instead of relying on gravity to restore the plunger to its original position after the stroke, an arrangement is devised for accelerating its downward movement. For this purpose the upper part of the plunger is narrowed, leaving an annular space A^2 between it and the cylinder. Water is caused to enter this space through the tube G, and its action on the part F of the plunger accelerates the downward motion. The ring A^3 confines the water and concentrates the hydraulic force. The movement of the plunger serves to open and close the exhaust valve B^1 for the chamber A^2. The valve chamber B is attached to the cylinder A^2, and the water is admitted and exhausted from the same passage G. The dust protector C, before it reaches its lowest position, strikes the set screw G^1. By means of the lever G^2 and spring G^6 the valve B^1 is unseated, and it remains so until the loop H in its upward motion engages the lever G^3. The inner end of the lever is then drawn upward, and the valve B^1 is seated; at the end of its stroke the inlet valve opens by the action of a lever and admits the water through the side pipe M. The water pressure holds B^1 seated until it is unseated in the next stroke. Provision is made for cushioning by placing a spring D in the chamber F^4. The screw O supports the spring, and also serves to regulate the length of the stroke, as it can be adjusted vertically by the mechanism O^2 O^3 O^4 O^5. There are also improvements in the mould frame, in the mode of holding the moulds, and in the means of opening the exhaust valve for the lower chamber of the hydraulic cylinder, and other variations in the construction of the machine. The inventor makes forty-one claims for the improvements and their combinations.—No. 362102, dated 3rd May, 1887.

Lamps.—*B. J. M. Menge, Cincinnati, Ohio.*—The body of the lamp, which is enveloped by a cylindrical glass case, consists of two main parts, the reservoir for the oil and the apparatus for regulating the wick. The intention of the inventor is to make use of vegetable combustible matter, and in order to heat the oil before its access to the wick, the reservoir is placed at the upper part of the case, and the heated gases from the flame are made to pass up a flue which penetrates the reservoir. Two tubes support this reservoir, one of them allowing the oil to flow down to feed the lamp, and the other to admit the air necessary for combustion. The lower part of the reservoir partakes of a conical shape, thus acting as a reflector for the light. The apparatus for controlling the wick consists of a main spring, a balance wheel, and a train of wheels, which operate intermittently a trimming device and a wick-raising mechanism. The trimmer is composed of two independently pivoted limbs, each having inclined cutting faces, in order that the wick crust shall be thrown off laterally when their operation is completed. By these means the wick is snuffed and raised at the same time automatically. The inventor makes nineteen claims for the details of these improvements, together with their several combinations.—No. 373083, dated 15th November, 1887.

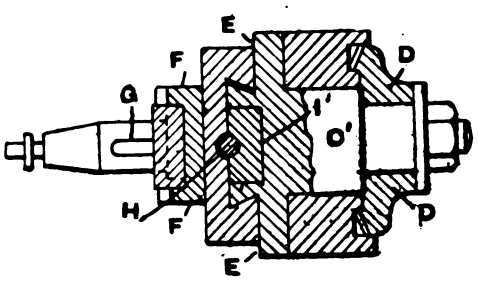
Planing Curved Surfaces.—*C. F. Geyer, Aurora, Illinois.*—The invention consists of a cutting tool intended more particularly for the planing out of the driving boxes of locomotives. The tool is applied to an ordinary planing machine, having the usual bed, cross head, and automatic feed. The Figs. 1 and 2 represent a vertical and transverse section of the tool-holding

Fig. 1.



bar respectively. E is a forged steel bar made sufficiently heavy and strong to withstand a considerable strain. At its lower end is a circular enlargement B, and at its rear a groove C. Concentric with the enlargement B is a shaft C^1, upon which is mounted a gear wheel D and a face plate E^1. The front part of this plate is shown in Fig. 2, and is of a dovetailed shape in cross section. The plate serves as a vertical guide for the tool carrier F, which holds the tool G. The tool carrier is made vertically adjustable upon the dovetailed projection by means of the screw H, which works within a half nut I set into the face plate E^1. The gear wheel D is driven by the pinion K upon the end of the shaft L, which rests within the groove at the rear of the bar E. The shaft L, and with it the gears which give rotation to the

Fig 2

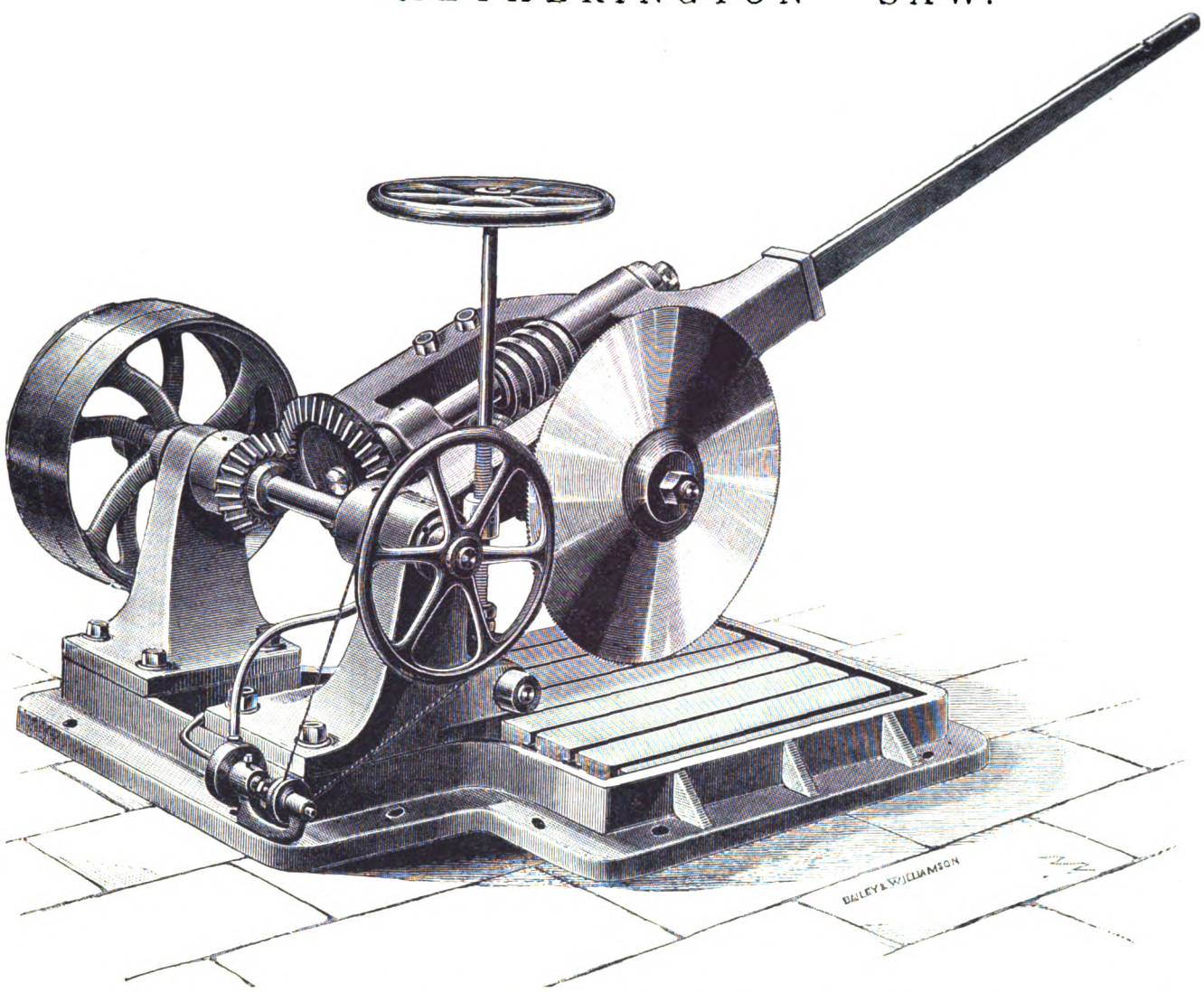


face plate E^1, may be driven by hand or by ordinary feed gear wheels, and the bar E may be given a lateral movement on the cross head by the usual means. An important advantage connected with this device is that several boxes may be operated upon at one time, and thus greater accuracy is secured, and the boxes may be used interchangeably. The inventor makes four claims for these combinations.—No. 373586, dated 22nd November, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE "HETHERINGTON" SAW.



THE "HETHERINGTON" SAW.

Our illustration represents an improved machine for sawing iron or steel bars of various sections while cold, constructed by Messrs. Hetherington & Co., engineers, Manchester. This machine is fitted with a saw 22in. diam., and it will cut round or square bars up to 5in., and channel sections up to 12in. by 6in. As will be seen, it is constructed with a planed bed plate, in which are T slots for bolting down the work, and surrounding this is a trough into which flows the soap and water used for lubricating. The saw itself is fastened to a steel spindle carried in two bearings, which are attached to the two sides of an oscillating frame. To the saw spindle is fastened between the bearings a gun metal worm wheel, into which gears a steel worm cut out of the solid and forming part of the spindle carried by bearings arranged longitudinally in the frame. The power is transmitted by means of a belt working upon fast and loose pulleys, which are carried on a cross shaft supported by two curved standards bolted to the bed plate. By means of bevel wheels, clearly shown in the illustration, the motion of the cross shaft is communicated to the worm. The inner bosses of the standards are turned so as to form trunnions, on which the saw frame is pivoted. The feed motion is effected by means of a hand lever, to which, if desired, a weight can be attached; but, on commencing, the frame is lowered by the vertical screwed spindle, on the end of which is a hand wheel. When the saw comes in contact with the work, this screw is run back sufficiently to free the frame, lock nuts being arranged to act as a stop when the saw has gone through the bar or channel section. The saw is thus prevented from cutting through the bed plate, and its range of movement limited. The lubricant is supplied by a small centrifugal pump driven from a grooved pulley on the end of the driving shaft, so that while the saw is running a plentiful and continuous stream is thrown upon it. When it is necessary to sharpen the saw, a small emery wheel can be attached so as to treat each tooth, being driven from a groove formed on the outer edge of the loose pulley, while the saw is held by a pawl, which enables it to be moved forward a tooth at a time. It will be seen that the machine is very complete, and that provision has been made for all contingencies. All the bearings are long, and ample strength is given to every part of the machine. We understand that the makers have now a large number of these machines in use under all conditions of work, and that, as the cost is reasonable, it is taking the place of other machines designed for the same class of work. It will be seen that the rate of traverse of the saw is variable, being greater where a small amount of metal has to be cut, and slower where a large area is being treated. It is claimed that in this way the saws are able to maintain a higher average speed with less damage than in the older style of machine. The circumferential velocity recommended by the makers for cutting iron or steel is 50ft. per minute, and at this speed a girder of H section 12in. by 6in., with a thickness of $\frac{11}{16}$in., may be cut in ten minutes; a similar section, but only 9½in. by 3½in., and $\frac{7}{16}$in. thick, occupying only four minutes to cut.

UNIVERSITY EXTENSION AND TECHNICAL EDUCATION.

By Henry Dyer, C.E., M.A.

I.

What is usually understood by the "University Extension Scheme" had its origin about fifteen years ago mainly through the efforts of Professor Stuart, of Cambridge, and the lecturers were as a rule graduates of that University. Naturally, therefore, the subjects selected by them for the popular classes were those which had been included in their own curriculum of study, and were thus for the most part of a literary or purely scientific nature. On the other hand, by "Technical Education" people generally understand instruction, which is chiefly of a practical nature, relating to the trades or industries of the country, and the two educational movements which are known by the above mentioned names have to a large extent been kept entirely distinct. This is not only unnecessary, but it is altogether a mistake. The education of the country must be looked upon as a whole, and its various parts made to work in harmony with each other, and not as separate, and to a certain extent antagonistic units. In his recent paper on the "University Education of the People" (*Contemporary Review*, November, 1887), Professor Garnett expressed the opinion that the relation of the university colleges to technical education constitutes an important question which will very soon demand serious attention, and he briefly indicated some of the steps which ought to be taken to enable local colleges to meet the demands of the district in which they are situated, not only for general, but also to a large extent for technical or industrial education. In this article I shall attempt some further details, and to give my proposals more definite shape, I shall suppose that they apply chiefly to the district with which I am best acquainted, viz., the West of Scotland, of which Glasgow may be looked upon as the centre. This district includes educational institutions and industries of all kinds, and if unlimited means were at our disposal might soon have a very perfect scheme of education in every department. Whatever applies to it will therefore apply to all other districts in the country, simply by omitting those parts which are not represented in those districts. The other day Professor Huxley said that he did not believe that the man lives at the present time who is competent to organise a final system of technical education of any kind, as all attempts made in that direction must for many years to come be experimental, and that we must get to success through a series of blunders. If this be true of technical education taken by itself, it must be true to a much greater extent of attempts to arrange a system which would also include general education. At the most, all that can be done for a start is to sketch in brief outline the plan of operations intended to lead up to an ideal system of education, and to leave the details to be filled up by those whose local knowledge enables them to judge fairly of the wants of the different districts.

Before we can form an adequate idea of what University Extension should mean, we must have a more complete conception of the functions of a university than that usually held. If that meaning has been more restricted than it ought to have been, it was not because the man who was the chief inspirer of the work had limited notions regarding it, but simply because the men and means at his disposal were not sufficient to fully carry them out. At the opening of University College, Dundee, a few years ago, Professor Stuart said: "This college is part of that great new educational movement which is just beginning to feel its way, so to speak, into life. Like the ancient University movement of eight hundred years ago,

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NOTES ON SCREWING APPLIANCES.

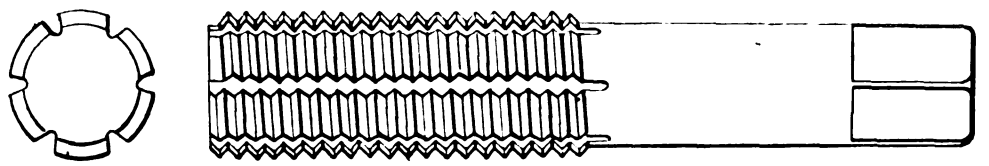


FIG. 1.—PLUG SIZE MASTER TAP FOR CUTTING DIES IN ORDINARY SCREW STOCKS.

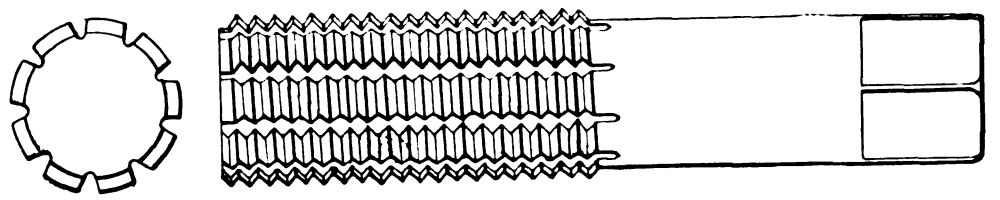


FIG. 2.—MASTER TAP FOR CUTTING DIES IN GUIDE SCREW STOCKS.

it is arising, not in any one nation alone, but simultaneously throughout Europe. It is a part of the great forward, onward movement of men's minds, a step in modern civilisation; and all such steps are common to the nations. It is the gaining of one other part of human life to a thoughtfully ordered scientific whole, it is another mountain top still further to the west, touched with the slowly rising sun of human progress. And it has this inestimable characteristic, that it descends right through the masses of the whole people. This movement, in which your college has consciously taken part, is a movement in keeping with the time. These are democratic days—the days of privilege are numbered. Whatever is done must be done for the people, not for the few; and the new demand for a new scientifically ordered education comes from the great body of the people, and not only from the cultured few. It arises in great towns; it must be met in these great towns. It has all the characteristics of the new life of the age. So here, then, we must raise into existence a new class of education, a new scientifically ordered system of thought, a new faculty—the faculty of applied science—which shall not necessarily follow on any of the old lines, but shall shape its existence and its form by the answer to the all important question, What do the people need?"

If educational authorities had been in the habit of asking themselves this question, we should not now require to consider the necessity of re-organising all our teaching institutions. It is a sad commentary on our whole system of education when we reflect on the fact that improvement in those institutions has as a rule been forced upon them from without, and that the men who ought to have led public opinion were content to allow the great stream of national progress to flow past, and leave the institutions under their charge undisturbed in their sluggishness.

What do the people need? Certainly not a curriculum three hundred years old, which, however well suited to train priests, doctors, and lawyers of that period, does not at all meet the wants of the present day. They need to be trained as men and citizens, and the highest institutions should therefore not only be able to afford them a good liberal education, but also whatever professional training was necessary. In its higher departments, at any rate, what goes by the name of technical education is exactly the same in kind as the older education of doctors (the only one which has kept up approximately with the times), and should be given by the same class of institutions. Students of medicine attend lectures on scientific subjects and on their applications to human anatomy, physiology and surgery; they work experiments in laboratories, and make drawings of the various subjects they study, and they obtain the more practical part of their knowledge in hospitals and private practice. What is wanted by engineers and manufacturers is exactly of the same nature, viz., a knowledge of the principles of mathematical and physical science and their applications to industrial problems, the ability to put on paper the results of their calculations and study, supplemented by experimental work in laboratories. Like the doctors, the practical part of their training should be obtained outside the College walls under the conditions of everyday life, and not with the artificial surroundings of a toy workshop or manufactory.

Professor Garnett, in his paper, points out a distinction which is very often forgotten, and shows wherein lies the difference between a technical school and a trade school. He says (*Contemporary Review*, November, 1887, page 651): "In a trade school students learn precisely what they would learn in a workshop. Such schools exist in France and America and elsewhere; and in the trades which require comparatively little skill and inexpensive plant, there are many examples in connection with refuges, reformatories, and similar institutions in this country. The technical school is intended, not to take the place of the workshop, but to supplement its teaching. In the workshop the apprentice is taught to imitate; in the technical school he should be taught to think. In the workshop he learns methods; in the technical school he should be taught the corresponding reasons. In the workshop he performs the same operation repeatedly and under the same conditions until he acquires manual dexterity. In the technical school, if he repeat an operation, he varies the conditions so as to acquire practical knowledge, and be prepared for any emergency that may arise." The majority of those who talk and write about technical education never get beyond the idea of a certain amount of manual training, combined with the minimum of scientific knowledge required to enable the students to understand the operations they perform, and in its strictly etymological sense this meaning may be correct, but it shows the absurdity of allowing oneself to be bound by words instead of looking at the facts of the case. It might be an advantage if we abolished the use of the term "technical education" altogether, and included the higher and scientific parts of it in the ordinary institutions for general and professional education, and relegated the practical parts to trades schools. On the Continent, and in the United States of America, a considerable number of trades schools have been inaugurated; but as a rule they are kept quite distinct from what are usually called technical institutions. In the latter country there has been a considerable amount of discussion on the subject, and the following extract shows how the question is viewed by different types of educationists: "The phrase 'industrial education' may have and has acquired two entirely distinct meanings. As understood by one party, it means the kind of education that is intended to foster industrial skill, and to fit the pupil, while at school, for the industrial pursuits of later life. Perhaps the majority of those who insist on the importance of industrial education in public schools, and who are urging its adoption, use the phrase in this sense. But there is a totally different sense in which the phrase 'industrial education' may be understood; not that education shall be made subservient to industrial success, but that the acquisition of industrial skill shall be a means of promoting the general education of the pupil; that the education of the hand shall be a means of more efficaciously educating the brain. It is in this latter sense, in which labour is regarded as a means of mental development, that industrial education is understood by the most enlightened of its advocates. They are well aware that to introduce a trade into the school is to degrade the school; that to take away from the young the time that should be dedicated to the elements of general culture, and devote it to training them in a special aptitude, however useful later on, is to impair the humanity of the child. They desire nothing of this sort, and they ask that a workshop be connected with every school for no other reason than that for which a chemical laboratory is connected with every college. There are thus two antagonistic parties whose watchword 'industrial education' has alike become. The one seeks to make the mass of mankind more machine-like than they already are, though with the proviso that they shall be made more perfect machines, more skilful to increase wealth, and to feed the channels of the manufacturers' profits. The other party, standing at the opposite pole of thought, seeks rather to elevate the masses, to more completely develop the humanity of the young, and looks upon technical and art education in the school as a novel and admirable means for achieving this result."—Prof. Felix Adler, *Princeton Review*, March, 1883.

(To be continued.)

NOTES ON SCREWING APPLIANCES.

I.

TAPS.—There are few tools so universally employed as screw taps; they are to be found in many varieties in the workshops of every engineer, and in fact in every workshop or mill where metals are manipulated or machinery used. Yet although their present form is based on the results of long experience, it is by no means an uncommon occurrence to find taps of such mechanically bad design as to necessitate the expenditure of an unnecessarily large amount of power in the very simple operation of, say, tapping a hole. Nothing appears easier than to do this and to do it properly, and indeed so easy is it that the very qualities essential to a really good tap are frequently lost sight of even by some firms with whom the making of taps is a specialty, and they are often completely ignored by a few old fashioned engineering works who year after year make their own taps in a very roundabout and clumsy way, although taps of much better design and capable of doing more work can be bought at less than half of what the "home made" taps have cost. Originally, taps were made by screwing a rod and then filing three or four flats on it to form the cutting edges. The angles of the cutting edges were thus necessarily obtuse, and the action of the tap was one of scraping and abrasion. Taps of this kind are still to be found in use, owing either to ignorance or indifference on the part of those who use them, as the force required to use them is very excessive, and the work done by them cannot be of the best. The qualities essential to a good tap are rather more numerous than would appear at first sight, and may be summed up as follows: (1) It must be of the length that has been found most convenient for general work, and as tap makers are all agreed on this dimension, no remarks are necessary; (2) the diameter of the screwed part must be such that the hole tapped by it is large enough to allow a bolt of standard size to enter easily, and to do this the tap must be from $\frac{2}{1000}$in. to $\frac{5}{1000}$in. larger than the gauge; (3) the tap must cut a thread with the least possible expenditure of power, and in such a way that the surface of the thread is smooth and not, as often appears when bad taps are used, rough and torn; both these conditions are dependent on the condition of the cutting edge, and on the form and size of groove; the former is also dependent on the way the thread of the tap is "backed off," but this will be fully discussed later on under the head of grooving. (4) The tap must be capable of withdrawal with a very much smaller force than that required to tap the hole. This may appear to some as an unnecessary condition, since it is generally considered that the tap can never need anything like the same force to withdraw it as to cut the thread, but nevertheless such is sometimes the fact. The fault is in the size and form of the grooves, and not unfrequently in the backing off, and will be considered under those heads.

There are, as every engineering reader well knows, several kinds of taps, viz., working taps, machine taps, plug and full sized master taps, gas and gas master taps, fine and square thread, boiler stay taps, &c. The best proportions of all but stay taps have been settled by long experience, and there is very little variation in the dimensions now adopted by all the best English makers, and given in the accompanying tables.

SCREW THREADS.—Until about 1840 almost every engineering establishment in the country had its own rules for the proportions of screw threads, which gave rise to considerable inconvenience in the provision for repairs, and rendered them expensive and imperfect, owing to the fact that it was not at all an easy matter to measure accurately the pitches of threads on the bolts requiring renewal, and thus repairs were imperfect and many bolts weakened by having badly fitting nuts if the latter were used again. Great waste was occasioned when old nuts had to be replaced by new ones fitting the new bolts accurately. Sir Joseph Whitworth was the first to recognise the importance of this difficulty, and to take steps to reduce the various practices of engineers to one common standard; and after a few years, as is well known, his rules for threads became the only recognised standard for this country. The conditions of a properly formed thread are power, strength, and durability, and their essential requisites are pitch, depth, and form; the power required for closing two pieces of mechanism together determines the pitch, which, for a given diameter of bolt, determines the angle of the inclined plane of the thread round the surface of the bolt. The form determines the direction in which the force acts, and durability depends chiefly on the depth of thread. A square thread has the advantage as regards power, because the resultant of the force applied is in the direction of the axis, but it is weaker than a V thread of the same pitch. A fine thread gains in power, but loses in strength, and an increased depth of thread obviously weakens the bolt; hence it is apparent that any thread made to fulfil one condition is defective as regards the other two conditions, and a mean must be

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made so as to give the greatest satisfaction as regards the three conditions of a good thread taken collectively. It is a matter which cannot be calculated, but is acquired by experience, and Whitworth in forming his scale collected all the best forms of other engineers, and taking a mean of them produced what is now universally known as the "Whitworth thread," and used to the almost total exclusion of every other form except in America, which has a system of its own. It is important to remark that the proportion of pitch to diameter varies with nearly every size of bolt; but the angle is in all cases 55°, and the top and bottom of the thread is rounded off to one-sixth of the depth, in order to preserve the thread as much as possible from injury, so that the actual depth of thread is ·64 of the pitch. The American system of screw threads differs from ours in the fact that the angle of thread is 60°, the top and bottom being cut down flat to one-sixth the depth. The pitch of threads is the same as our own with the exception of ½in., 1⅝in., and 1¾in. bolts, which have 13, 5½, and 5 threads per inch respectively.

Working Taps.—These are made in sets of three, viz., taper, second, and plug; each being made of convenient length. The taper tap is turned taper from the point to the sixth thread from the top, and the diameter at the point is the diameter at bottom of thread; thus there are six full threads at the top and no thread at all at the extreme point of the taper tap; it is backed off by the file on the taper part only. The taper of the taper tap should not be more than to the bottom of the thread, or it is liable to be used in holes which are too small, at the risk of breaking the tap. It is also of importance to avoid excessive backing off, especially if the backing off is done by the chaser as in some cases, as the tap is liable to "wobble" in the hole and tap it too large, and also to wedge fast the cuttings when being drawn out. The second tap is rounded off from the point (where the diameter is the same as that of the taper tap) to the sixth thread from the point, the remainder of the screwed part having a full thread, and the taper part only is backed off by the file. The plug tap has a full thread down to the point, and is not backed off at all.

Table I.

Giving the best Dimensions for Working Taps.

Size of Tap.	Number of Threads per in.	Diameter at Bottom of Thread.	Diameter of Neck.	Diameter at Bottom of Grooves.	Total Length.	Length of Screwing.	Size of Square.	Length of Square.
in.		in.	in.	in.	in.	in.	in.	in.
¼	20	·1859	·25	·1406	2·5	1·35	¼	·375
5/16	18	·2413	·2388	·1757	2·75	1·5	5/16	·4375
⅜	16	·2949	·2924	·2109	3	1·65	⅜	·5
7/16	14	·3460	·341	·246	3·25	1·8	7/16	·5625
½	12	·2932	·3882	·2812	3·5	1·95	½	·5625
½	12	·4557	·4507	....	3·75	2·1	½	·625
9/16	11	·5085	·5035	·3515	4	2·25	9/16	·6875
9/16	11	·5710	·566	....	4·25	2·4	9/16	·6875
⅝	10	·6219	·6144	·4218	4·5	2·55	⅝	·75
⅝	10	·6844	·6769	....	4·75	2·7	⅝	·75
¾	9	·7327	·7252	·4921	5	2·85	¾	·8125
¾	9	·7957	·7877	....	5·25	3	¾	·8125
1	8	·8399	·8324	·5625	5·5	3·15	1	·875
1¼	7	·942	·9345	·6328	6·25	3·375	1¼	1·0
1¼	7	1·067	1·0595	·7031	7	3·875	1¼	1·0625
1½	6	1·1615	1·1515	·7734	7·75	4·375	1½	1·125
1½	6	1·2865	1·2765	·8437	8·5	4·875	1½	1·1875
1¾	5	1·3688	1·3588	·9140	9·25	5·375	1¾	1·25
1¾	5	1·4938	1·4838	·9843	10	5·875	1¾	1·3125
1¾	4½	1·5904	1·5804	1·0546	10·75	6·375	1¾	1·375
2	4½	1·7154	1·7054	1·125	11·5	6·875	1¾	1·4375
2¼	4½	1·8404	1·8254	1·1953	12·25	7·375	1¾	1·5
2¼	4	1·9298	1·9148	1·2656	13	7·875	1⅞	1·5625
2¼	4	2·0548	2·0398	1·3359	13·75	8·375	1⅞	1·625
2¼	4	2·1798	2·1648	1·4062	14·5	8·875	1⅞	1·6875
2½	4	2·3048	2·2875	1·4765	15·25	9·375	1⅞	1·75
2½	3½	2·384	2·3665	1·5468	16	9·875	1⅞	1·8125
2¾	3½	2·509	2·4915	1·6171	16·75	10·375	1⅞	1·875
3	3½	2·634	2·6165	1·6874	17·5	10·875	1⅞	2

Machine Taps.—These taps are used almost exclusively for nut tapping machines. There is only one of each size instead of three, as in the the case of working taps, and when in use the tap is passed right through the nut. The screwed part has until recently been made much longer than for working taps, but of late the best firms have reduced the length considerably. The old fashioned machine tap is screwed parallel and tapered the same as a taper working tap, but with those having a reduced length of screwing the thread is screwed taper from the point to the sixth thread from the top and then parallel; the object of the taper screwing is to equalise the strain on the machine; the diameter at the point of the new tap is the diameter at bottom of thread as given in the table, and the thread is then cut to half its depth at the point by a chaser on a taper screw cutting lathe, and the thread backed off by a file in the usual way for taper taps. The effect of this alteration has been to equalise the wear and increase the life of the tap, and to diminish the time required for tapping a nut.

NOTES ON SCREWING APPLIANCES.

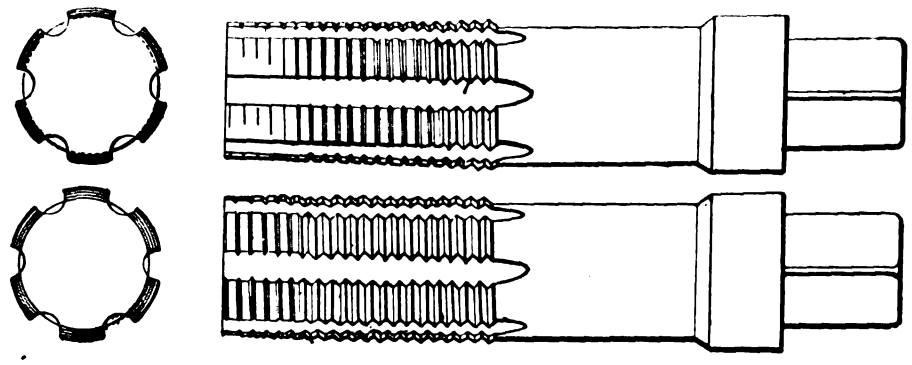


Fig. 3.—Working Taps—Taper and Plug for Iron Gas Piping.

Table II.

Giving the best Dimensions of Machine Taps, "old pattern." The only alteration in this table for "new pattern" taps is the length of screwing, which is the same as for Working Taps, the total length being the same as given below.

Diameter of Tap.	Number of Threads per in.	Diameter at Bottom of Thread.	Diameter of Neck.	Diameter at Bottom of Grooves.	Total Length.	Length of Screwing.	Size of Square.	Length of Square.
in.		in.	in.	in.	in.	in.	in.	in.
¼	20	·1859	·1406	·1406	3·8	1·8	¼	·5
5/16	18	·2413	·2388	·1757	4·2	2·05	5/16	·5625
⅜	16	·2949	·2924	·2019	4·6	2·3	⅜	·625
7/16	14	·3460	·3410	·216	5	2·55	7/16	·6875
½	12	·3032	·3882	·2812	5·4	2·8	½	·75
½	12	·4557	·4507	....	5·8	3·05	½	·8125
9/16	11	·5085	·5035	·3515	6·2	3·3	9/16	·875
9/16	11	·5710	·5660	....	6·6	3·55	9/16	·9375
⅝	10	·6219	·6144	·4218	7	3·8	⅝	1
⅝	10	·6844	·6769	....	7·4	4·05	⅝	1·0625
¾	9	·7327	·7252	·4921	7·8	4·3	¾	1·125
¾	9	·7957	·7877	....	8·2	4·55	¾	1·1875
1	8	·8399	·8324	·5625	8·6	4·8	1	1·25
1¼	7	·9420	·9345	·6328	9·75	5·5	1¼	1·3125
1¼	7	1·067	1·0595	·7031	10·5	6	1¼	1·375
1½	6	1·1615	1·1515	·7734	11·25	6·5	1½	1·4375
1½	6	1·2865	1·2765	·8437	12	7	1½	1·5
1¾	5	1·3688	1·3588	·9140	12·75	7·5	1¾	1·5625
1¾	5	1·4938	1·4838	·9843	13·5	8	1¾	1·625
1¾	4½	1·5904	1·5804	1·0546	14·25	8·5	1¾	1·6875
2	4½	1·7154	1·7054	1·125	15	9	1¾	1·75
2¼	4½	1·8404	1·8254	1·1953	15·75	9·5	1¾	1·8125
2¼	4	1·9298	1·9148	1·2656	16·5	10	1⅞	1·875
2¼	4	2·0548	2·0398	1·3359	17·25	10·5	1⅞	1·9375
2¼	4	2·1798	2·1648	1·4062	18	11	1⅞	2
2½	4	2·3048	2·2875	1·4765	18·75	11·5	1⅞	2·0625
2½	3½	2·3840	2·3665	1·5468	19·5	12	1⅞	2·125
2¾	3½	2·5090	2·4915	1·6171	20·25	12·5	1⅞	2·1875
3	3½	2·6340	2·1650	1·6874	21	13	1⅞	2·25

Plug Master Taps.—Only one tap of this kind is supplied for each size, and that, as its name denotes, is not used for roughing out, but simply for finishing the thread. Plug masters are used for finishing the thread in solid dies, such as are used for screw stocks and screwing machines, and also as a "hob" for finishing the threads on "chasers" used with screw cutting and hand lathes. The thread is parallel from top to bottom, and is not backed off at all. The grooves are more numerous and smaller than for working and machine taps, so that they may be used for re-cutting solid dies, where it is evident that if the top grooves were wide and few in number they would be constantly interfering with the grooves in the die, and a round hole of accurate size could not be tapped. It would also be inconvenient if not impracticable to cut a chaser on a hob with wide grooves, and indeed the taps have so little work to do that wide grooves are quite unnecessary.

Full Master Taps.—As in the case of plug master taps, only one of each size of full master taps is made, and these are similar in every respect to the plug masters. The diameter of a full master is, however, exactly twice the depth of the thread greater than the size marked on the tap; for instance, a 1in. full master is 1in. diam. at the bottom of the thread. They are used for cutting the threads of dies in guide screw stocks, and in the die box of most screwing machines. The object of using this tap in the first case is to have the points of the thread on the dies at the proper inclination for tracing a thread of accurate pitch on the bolt, and it is obvious that if any other size of tap than the full master were used, the inclination of the thread to the axis traced on the bolt would be either too great or too small, and a thread of incorrect pitch would be cut in the first part of the operation. To see this point clearly, it is only necessary to remember that for any given number of threads to the inch the pitch is quicker and the inclination of the thread greater at the bottom than at the top of the thread, as shown by the diagram Fig. 4, on the next page.

Table III.

Giving the best Dimensions for Plug Master Taps.

Size of Tap.	Number of Threads per in.	Diameter at Top of Thread.	Diameter at Bottom of Thread.	Diameter of Neck.	Diameter at Bottom of Grooves.	Number of Grooves	Total Length.	Length of Screwing	Size of Square.	Length of Square.
in.		in.	in.	in.	in.		in.	in.	in.	in.
¼	20	·25	·1859	·1834	·1609	5	2·5	1·2	¼	·35
5/16	18	·3125	·2413	·2388	·2163	5	2·6875	1·3	5/16	·4
⅜	16	·375	·2949	·2924	·2699	5	2·875	1·4	⅜	·45
7/16	14	·4375	·346	·341	·3191	5	3·0625	1·5	7/16	·5
½	12	·5	·3932	·3882	·3682	6	3·25	1·6	½	·55
½	12	·5625	·4557	·4507	·4307	6	3·4375	1·7	½	·6
9/16	11	·625	·5085	·5035	·4835	6	3·625	1·8	9/16	·65
9/16	11	·6875	·571	·566	·546	6	3·8125	1·9	9/16	·7
⅝	10	·75	·6219	·6144	·5969	6	4	2	⅝	·75
⅝	10	·8125	·6844	·6769	·6594	6	4·1875	2·1	⅝	·8
¾	9	·875	·7327	·7252	·7077	9	4·375	2·2	¾	·85
¾	9	·9375	·7952	·7877	·7702	9	4·5625	2·3	¾	·9
1	8	1	·8399	·8324	·8149	9	4·75	2·4	1	·95
1¼	7	1·125	·942	·9345	·8920	9	5·15	2·5	1¼	1·05
1¼	7	1·25	1·067	1·0595	1·017	9	5·5	2·6875	1¼	1·1
1½	6	1·375	1·1615	1·1515	1·1115	9	5·85	2·875	1½	1·15
1½	6	1·5	1·2865	1·2765	1·2365	12	6·2	3·0625	1½	1·2
1¾	5	1·625	1·3688	1·3588	1·3188	12	6·55	3·25	1¾	1·25
1¾	5	1·75	1·4938	1·4838	1·4438	12	6·9	3·4375	1¾	1·3
1¾	4½	1·875	1·5904	1·5804	1·5401	12	7·25	3·625	1¾	1·35
2	4½	2	1·7154	1·7054	1·6654	12	7·6	3·8125	1¾	1·4
2¼	4½	2·125	1·8404	1·8254	1·7654	12	7·95	4	1¾	1·45
2¼	4	2·25	1·9298	1·9148	1·8548	12	8·3	4·1875	1⅞	1·5
2¼	4	2·375	2·0548	2·0398	1·9798	15	8·65	4·375	1⅞	1·55
2¼	4	2·5	2·1798	2·1648	2·1048	15	9	4·5625	1⅞	1·6
2½	4	2·625	2·3048	2·2875	2·2298	15	9·35	4·75	1⅞	1·65
2½	3½	2·75	2·384	2·3665	2·3090	15	9·7	4·9375	1⅞	1·7
2¾	3½	2·875	2·509	2·4915	2·434	15	10·05	5·125	1⅞	1·75
3	3½	3	2·634	2·6165	2·559	15	10·4	5·3125	1⅞	1·8

Table IV.

Giving the best Dimensions for Full Master Taps.

Size of Tap.	Number of Threads per in.	Diameter at Bottom of Thread.	Diameter at Top of Thread.	Diameter of Neck.	Diameter at Bottom of Grooves.	Number of Grooves	Total Length.	Length of Screwing	Size of Square.	Length of Square.
in.		in.	in.	in.	in.		in.	in.	in.	in.
¼	20	·25	·3141	·2475	·225	5	2·5	1·2	¼	·35
5/16	18	·3125	·3837	·31	·2875	5	2·6875	1·3	5/16	·4
⅜	16	·375	·4451	·3725	·35	5	2·875	1·4	⅜	·45
7/16	14	·4375	·5309	·4325	·4125	6	3·0625	1·5	7/16	·5
½	12	·5	·6068	·495	·475	6	3·25	1·6	½	·55
½	12	·5625	·6693	·5575	·5375	6	3·4375	1·7	½	·6
9/16	11	·625	·7415	·62	·6	6	3·625	1·8	9/16	·65
9/16	11	·6875	·804	·6825	·6625	6	3·8125	1·9	9/16	·7
⅝	10	·75	·8781	·7425	·725	6	4	2	⅝	·75
⅝	10	·8125	·9406	·805	·7875	9	4·1875	2·1	⅝	·8
¾	9	·875	1·0173	·8675	·85	9	4·375	2·2	¾	·85
¾	9	·9375	1·0798	·93	·9125	9	4·5625	2·3	¾	·9
1	8	1	1·1701	·9025	·975	9	4·75	2·4	1	·95
1¼	7	1·125	1·308	1·1175	1·075	9	5·15	2·5	1¼	1·05
1¼	7	1·25	1·433	1·235	1·2	9	5·5	2·6875	1¼	1·1
1½	6	1·375	1·5885	1·365	1·325	12	5·85	2·875	1½	1·15
1½	6	1·5	1·7135	1·49	1·45	12	6·2	3·0625	1½	1·2
1¾	5	1·625	1·8812	1·615	1·575	12	6·55	3·25	1¾	1·25
1¾	5	1·75	2·0062	1·74	1·7	12	6·9	3·4375	1¾	1·3
1¾	4½	1·875	2·1596	1·865	1·825	12	7·25	3·625	1¾	1·35
2	4½	2	2·2846	1·99	1·95	12	7·6	3·8125	1¾	1·4
2¼	4½	2·125	2·4096	2·11	2·05	15	7·95	4	1¾	1·45
2¼	4	2·25	2·5702	2·235	2·175	15	8·3	4·1875	1⅞	1·5
2¼	4	2·375	2·6952	2·36	2·3	15	8·65	4·375	1⅞	1·55
2¼	4	2·5	2·8202	2·485	2·425	15	9	4·5625	2	1·6
2½	4	2·625	2·9452	2·6075	2·55	15	9·35	4·75	2	1·65
2¾	3½	2·75	3·1116	2·7325	2·675	15	9·7	4·9375	2	1·7
2¾	3½	2·875	3·241	2·8575	2·8	15	10·05	5·125	2	1·75
3	3½	3	3·336	2·9825	2·925	15	10·4	5·3125	2	1·8

In Fig. 4, let A B represent the circumference of a common tap, say 1in. diam. at the top of the thread, and B C the pitch of that thread, therefore A C is the inclination of the top of the thread to the axis of the bolt. The circumference at the bottom of the thread is A D (only 2·637in.), and A E the inclination of the bottom

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LOGGING IN CANADA.

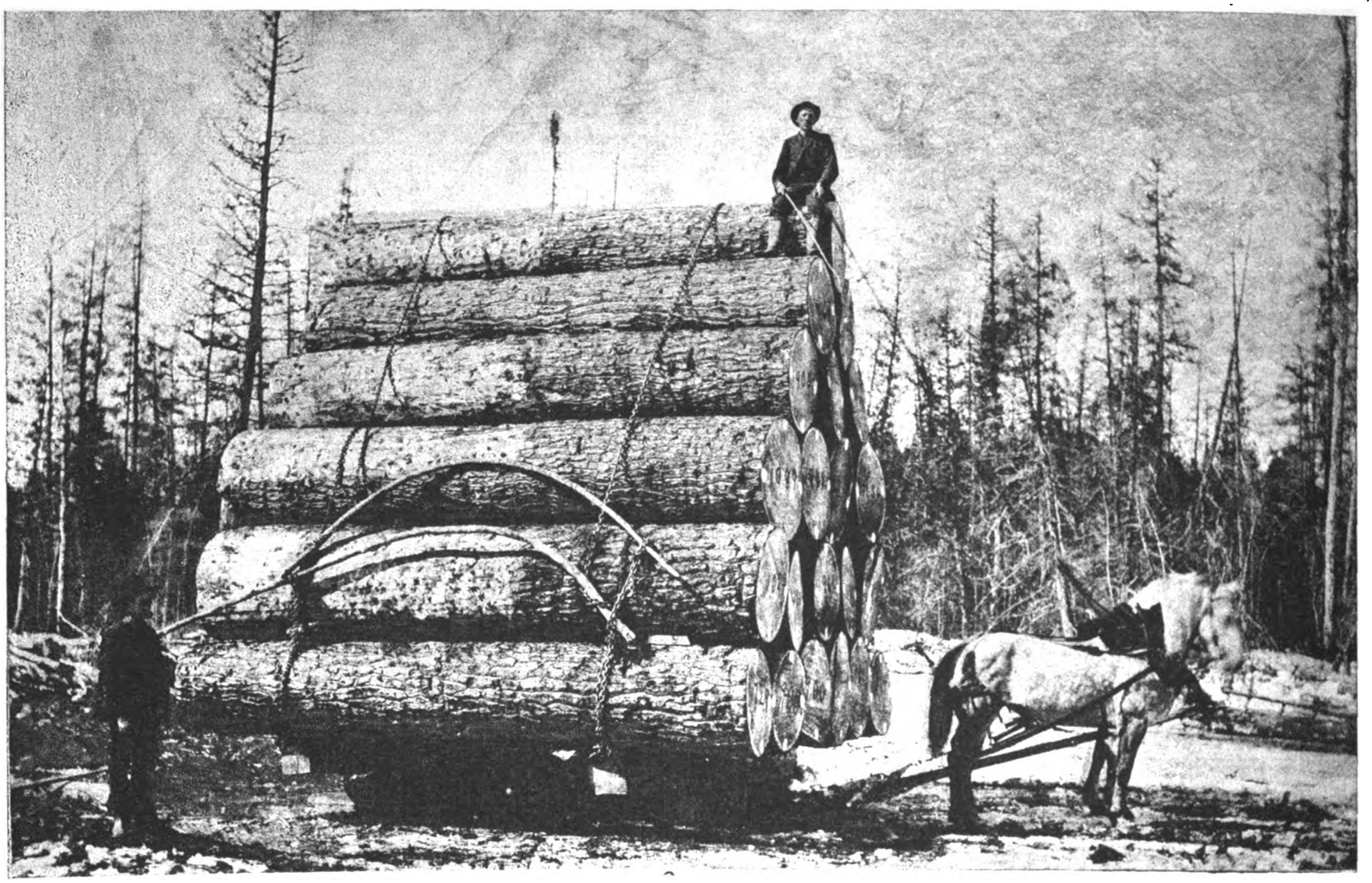


FIG. 5.—A LOADED SLEIGH.

of the thread to the axis. This being the case, it is manifest that if the dies of a guide screw stock were cut by a plug master, A E would represent the inclination of the thread traced on the surface of a 1in. bolt at the beginning of the operation, and therefore the pitch of that thread would be ·149in. As the thread is cut deeper in the bolt its pitch would be gradually reduced to ·125in., the resulting thread being slightly imperfect,



FIG. 4.

although on an ordinary bolt no defect might be observed from this cause. The question of cutting the dies of a screwing machine with a full master tap will be referred to at a later stage.

GAS TAPS.—These taps are used for iron pipe couplings and for roughing out the solid dies for screwing iron pipes. The diameter at the top of thread is twice the thickness of the pipe greater than the standard size marked on the tap, that is, equal to the outside diameter of a gas pipe the bore of which is the size marked on the tap. Two taps of each size are used; these are called taper and plug, but they really correspond to the taper and second of ordinary taps as regards the backing off; the grooves are more numerous than in ordinary taps, but their form should be the same.

(To be continued.)

NEW CORLISS ENGINE.—A modification of the Corliss engine has been lately built by a firm in Elmira, New York. The valves are arranged on the Corliss plan, but the governor is what is known as a shaft governor, and as the motion is all positive, releasing gear and dash pots are not necessary. The engine, which is very economical, is for high speeds, and the regulation is very good.

LOGGING IN CANADA.

III.

(Continued from page 55.)

THE conveyance of the logs from the "roll-ways" to the river is comparatively straightforward work. For rapidly as these forest thoroughfares are constructed, they are nevertheless easy to traverse, as the frozen snow affords a firm and smooth surface for the sleighs to travel over. These roughly constructed vehicles are loaded with as much timber as a pair of horses can conveniently draw, and sometimes rather more; the amount being regulated by the length of the journey to the river. Towards the end of the season, a great deal of rivalry exists between the different teamsters, as to who can successfully convey the largest load in one journey with his pair of horses, and Fig. 5, taken from a photograph, gives an idea of the extent to which these sleighs are laden when a competition of this sort is on. The aggregate quantity of timber in this case amounted to 10,270ft. inch board measurement. The part of the frozen river selected for depositing the logs upon presents a unique appearance when the time approaches for the thaw to set in (which is about the month of April). The vast accumulation of timber, to one who sees it for the first time, is astounding, enabling him to appreciate, in a manner that would otherwise be impossible, the extent of the work which has been done during the previous five or six months by the industrious gangs of woodmen scattered about in the neighbourhood. He sees a space, which is in reality the width of the river, completely covered with logs piled up between two banks, and reaching, perhaps, as far as the eye can see in either direction—the river itself being entirely hidden from view. As the logs arrive they are rolled on to the ice, and stacked one above the other until they attain the height of the banks (sometimes 40ft. or 50ft.) on either side of the stream. These "log jams," as they are called, often contain as many as from three to four hundred thousand logs, and have been known to extend over a length of two miles. The illustration (Fig. 6) represents a "jam" of considerable proportions, and although the timber is not piled to anything like the above mentioned height, in this case the estimated amount contained in it is over 21,000,000ft. The river has to be dammed above the "log jam" in order to collect a sufficient head of water to displace the mass of timber below it; for the stream is never strong enough to effect this without artificial assistance, and even were it otherwise it would be policy to force the stream as much as possible, as the work of the wood is thus much more quickly carried out. So that, although these dams are very expensive, and sometimes difficult to build, it is found more economical to construct them, than to incur any delay in the log driving.

When the thaw has fairly set in, the ice given way, and a sufficient head of water has accumulated above the dam, the sluice gates are opened, and the flood forces its way through the piled up logs, carrying some of them with it in its onward course, and loosening up the whole structure. At the same time a large staff of "log drivers," armed with peaveys and canthooks, are stationed in suitable positions for the purpose of further detaching the logs from the main body, and setting them floating down the stream. This work is fraught with great danger, as it is next to impossible to calculate with nicety to what extent the logs will help themselves, and consequently it not unfrequently happens that men are standing on the top of a pile, when suddenly, being undermined by the stream, it will collapse, and crush them to death, or severely injure them. In fact, all through the "wood butcher's" trade (as the American vernacular has it) accidents are very numerous; so much so, that the lumberman's hospital is an important feature in the logging industry, and it is satisfactory to learn that in America a movement has recently been set on foot with a view to connecting hospitals in different districts, so that a yearly ticket, which hitherto would only have admitted the holder to the local hospital, becomes available for any other belonging to the association. The

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LOGGING IN CANADA.



FIG. 6.—A LOG JAM.

advantage of such a system to the loggers, who are liable to be constantly on the move, is apparent. Already we hear that seventy hospitals have joined the association, situated at intervals right across the Continent, from the Atlantic to the Pacific.

To return, however, to the subject of log driving, the principal tools used for this are the "peavey," the landing hook, and the pike pole, illustrated in Fig. 7 by A, B, and C respectively. The first two of these, it will be seen, are variations of the canthook, the flat surface at the end of which is replaced in the case of the peavey by a sharp spike, for the purpose of getting a better hold; and with the landing hook by a sort of chisel edge, which bites the rough surface of the log as it is being drawn in. The pike poles are about 10ft. long, and mainly used for guiding the floating logs.

In the case of a large jam, it becomes necessary to repeat the floods, or "freshets," as they are usually styled, a great number of times before the logs are all started; and although good management and skill on the part of the men is a necessary feature in effecting the rapid disintegration of a log jam, luck has also a great deal to do with it. As soon as the jam is broken up, the log drivers follow the timber along the banks of the river, with a view to preventing the logs from forming another jam on their own account, which they would most assuredly do if those which got stopped in the windings of the river and caught against obstacles were not promptly set going again by the men. To do this, it is often necessary to get into the middle of the stream, the men walking along the intervening logs as they travel down. This feat requires a considerable amount of skill, and it is wonderful to watch the ease with which a man accustomed to this mode of journeying on the water, can get along. It is no unusual thing to see one of these men balancing himself on a round log as it is floating down the stream, and steering his course with the aid of a pike pole, with every appearance of being quite at ease, and without fear of being turned over. The spiked boots which the men wear materially assist them to maintain a firm footing.

The period of log driving is a time by no means devoid of anxiety to the proprietor. The state of the river being very dependent on climatic influences, it is important for him to have favourable weather. A dry season will cause several weeks' delay in the arrival of the logs, and until they arrive the saw mills must be kept shut. In some cases it becomes impossible to convey the logs at all,

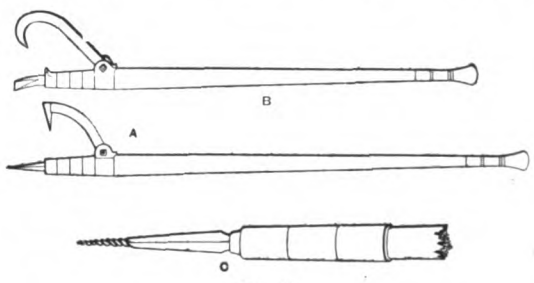


FIG. 7.

under which circumstances the financial losses are very heavy indeed. When the river is low and sluggish, the exertions of the log drivers do not suffice to keep the timber on the move without constructing fresh dams behind the logs from time to time as they go down. The distance between these dams varies naturally very much according to the nature of the stream. Under unfavourable circumstances, it may be necessary to make them every two or three miles, and when it is borne in mind that the length of a drive is sometimes as much as one hundred miles, the delay and expense of damming is apparent. With reasonable luck and good management, it is possible to move 1,000,000ft. (board measure) of logs at each freshet. According to the number of logs in a stream, the number of hands employed in driving varies; but the "crews," as a rule, consist of from 50 to 150 men. Their wages run from $\$1\frac{1}{2}$ to $\$2$ a day—in addition to which their food is found—which, although higher than those of the forest hands, are by no means excessive, as the labour of log driving is no less arduous and decidedly more dangerous than log making. A hundred mile log drive under favourable circumstances, might cost about 50 or 60 cents per 1000ft.; but this, of course, is subject to considerable variations, for reasons above explained. The timber is so rapidly receding before the inroads of the axe, that every year the length of the log drives increases considerably, as it is necessary to go farther up the country to fell. Naturally enough the Canadian lumberman follows up the courses of the best waterways on his "limit," and so far he has been able to get timber within practical sleighing distance of a suitable river, the province of Ontario being one of the best watered districts in the world; but there must come a time when he will have to follow the lead of his American neighbours, who, having pushed their operations so far, are often obliged to look for their timber now in parts of the country where there are no streams in the vicinity, and who consequently are obliged to construct railways expressly for log traffic, which system, though expensive, insures a very regular delivery, and saves a great deal of time.

(To be continued.)

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 24th January, 1888.

The Iron Market.—The tone of the iron market is strong, and the aspect of affairs generally encouraging. The demand steadily increases, and prices are very firm all round. All works are now well provided with orders. The latest reports received from the provinces are characterised by a cheerful tone. It is admitted everywhere that the situation daily grows stronger, and that the outlook for the current year is far brighter than seemed possible at the beginning of December. At a meeting of the rolled wire manufacturers held during the week, the terms of the proposed syndicate were signed. The association is to remain in existence three years. The wire nail makers have also held a meeting to fix a scale of prices. In anticipation of a considerable advance in these classes of goods, a large amount of buying has taken place this week. The scarcity of pig iron in Belgium has occasioned great activity in the Longwy district, from which Belgian manufacturers are now drawing large supplies of crude iron.

The Metal Market.—The expected reaction seems to have set in. There is little genuine business in copper, consumers refraining from buying more than the quantity absolutely necessary to enable them to continue their operations from day to day, and speculators have apparently exhausted their means of forcing up and maintaining prices. A heavy fall has to be chronicled this week, Chili bars being now quoted fully £5 a ton lower. The reaction can hardly fail to involve tin, which is far above its true value in the market. It is difficult to understand how it has held its position so long, for the abnormal prices now current cannot be justified by the state of the stocks in hand. These, including the quantity afloat, amounted at the end of the year, for England, Holland, and America, to 15,576 tons, against 14,595 at the end of November, and against 12,236 tons on 31st December, 1886. Lead is quiet. Spelter is still in strong demand for consumption. Prices remain unaltered.

Distribution of Motive Power by Compressed Air.—M. Victor Popp is making good progress with his system of distributing compressed air for motive power purposes. The works for compressing the air in the Rue St. Fargeau, at Ménilmontant, are of considerable magnitude. They cover an area of 15,000 square metres, of which an extent of 2000 metres is roofed over. There are already fixed and in operation seven steam engines of 400 h.p. and two of 100 h.p. each, a total of 3000 h.p. The conduits have already been laid over the whole area comprised between the line of the Boulevards and the Rue de Rivoli. These are sometimes laid in trenches cut for the purpose, and sometimes in the sewers. The total length of pipes laid was, at the end of last December, a little over thirty miles. This source of power is used for working electric light machinery in a large number of establishments, among which may be mentioned the Café Americain, the Café de Paris, the Café Anglais, the offices of the *Figaro*, and the Jardin d'Hiver.

The Universal Exhibition.—As it is still commonly believed that exhibitors at the Exposition Universelle will have to pay a rent for the space occupied by their goods, the authorities have publicly announced, for the third time, that no such charge will be made. Exhibitors will have to pay their share, that is, proportionally to the space they occupy, of the costs of the installation, and the decoration and care taking of the building. The chief director has determined the general types of the installation for each group, which, while allowing a wide scope for variations in the decorations, will entail on the exhibitors much less expense than they were called upon to bear in 1878. The Eiffel Tower, the erection of which is being pushed on without intermission night and day, Sundays and week days alike, has now reached a height of 50 metres, where the first floor, to be used as a restaurant, is being constructed.

Prize for Pottery.—The Société Industrielle of Amiens has offered a prize of money and a gold medal to any French potter who shall succeed in making earthenware sewage pipes of a quality equal to those manufactured by Doulton & Co., of London.

BERLIN, 23rd January, 1888.

The Iron Market.—The policy of syndicating trades to obtain excessively high prices does not seem to be an unmixed blessing to the German iron trade, and voices are raised here and there in condemnation of an artificial state of things under which exporters are beginning to lose their business. As matters at present stand, finished iron makers and merchants find it very difficult to execute orders for export, since the high prices of crude iron, brought about by the syndication of the trade, are almost prohibitory. It seems likely that only those makers of finished iron will be able to compete against England and Belgium in neutral markets, who are at the same time producers of crude iron. Meanwhile the powerful weapon of the iron masters is now being turned against them. The owners of limestone quarries in the Westphalian district have formed a syndicate for the purpose of artificially forcing up the price of limestone required by the blast furnaces, the contemplated rise being in some cases as much as 80 per cent. above the present ruling price. This is strongly, though illogically, resented by the iron masters of the district, who threaten to boycott these quarries, and get their supply of limestone at whatever sacrifice in the shape of freight from other parts of Germany, until they can themselves open out new quarries in their district. The boiler explosion at the Friedenshütte is still the topic of controversy, opinions being divided as to its cause. At a recent meeting of the Silesian Boiler Insurance Society it was given out that the origin of the explosion was not, properly speaking, in the boilers at all, but that the boilers were first damaged by an explosion of the blast furnace gases, and then burst by the steam pressure inside. The Society is now trying to put pressure on the Government, in order to induce them to pass a law under which the use of blast furnace gases for boiler firing should be either prohibited or restricted. As this would be very injurious to the iron industry generally, the Verein Deutscher Eisenhüttenleute (a society composed mainly of mining and iron works engineers) intend to oppose at their next meeting the views advanced by the Silesian Boiler Insurance Society, and so prevent the passing of any law which might interfere with the present blast furnace practice.

Textiles.—Although considerable business is now being done in linen goods, reports from Saxony characterise the present position of flax spinners and weavers as by no means flourishing. The prices of linen goods of medium and better qualities are depressed, and the demand is much smaller than for the coarser kinds, resulting in a displacement of this industry which is prejudicial to the manufacturers, who have hitherto mostly produced the better kind of goods. The evil is aggravated by the fact that the Russian flax crop of last year was insufficient, and therefore prices ruled rather higher than usual. As a consequence, even large spinners are at present not able to make anything like the profit they were accustomed to. Efforts are now being made to render the trade independent of the supply of Russian flax, and several agriculturists are now trying to revive the culture of flax in Saxony, which in previous years was very flourishing. In the Rhine districts the textile business is improving, and although there is little doing in woollen cloths, worsteds are in good demand. Plush and upholstery goods are also brisk, and a good trade is being done in silk and half silk piece goods; velvets, however, are rather dull. Brussels and other carpets are in fair demand, at remunerative prices. A good trade is also being done in fabrics containing india-rubber, with the exception of elastic sides for boots, in which English competition is almost forcing the home article out of the market.

Electric Lighting in Germany.—According to the presidential address of Dr. von Stephan at the Berlin Society of Electricians, there are at present in use throughout Germany 15,000 arc lamps and 170,000 glow lamps, supplied with current from about 4000 dynamos. Dr. von Stephan estimates that an arc lamp requires on an average ¾ h.p. and a glow lamp ⅛ h.p. On this basis the total horse power employed in electric lighting throughout Germany amounts to 30,000 h.p. The Berlin gas works have also recently collected statistics regarding the extent to which the electric light is introduced in this town. It appears that 1554 arc lamps, 22,363 glow lamps, and 333 dynamos are installed. The town authorities are now negotiating for a new contract with the Electricity Supply Works, under which the cost of installation for glow lamps would be diminished by 18 per cent., and that for arc lights by 27 per cent., as compared with the prices at present charged, whilst the company undertake to pay a fine in case of failure or delay in putting up an installation. When the installation is put up to the order of the town authorities a fine of £2. 10s. for every day's delay will be imposed, whilst for non-delivery of current to private consumers within four weeks after the installation is put up the fine is £1 per day. The old market in this town was one of the first places lighted by arc lamps, but the installation has not proved very successful. The lamps were grouped in parallel series of two, and in some cases the conductor was iron wire. The buildings are very scattered, and supervision was not easy, consequently breakdowns were of frequent occurrence. Now that the municipality have determined to erect new markets in the various suburbs of this town, they propose to light these by gas. It is, however, likely that better counsels will prevail, and that the Corporation will adopt arc lamp installations where the lamps are in single parallel, and the potential is maintained at 65 volts.

VIENNA, 23rd January, 1888.

The Iron Market.—Owing to continual interruptions of traffic, due to snowstorms and the inclement weather, very little business has taken place in the iron market, and it has been impossible for the syndicated works to fix their prices for the current quarter. It is hoped that a settlement may be come to during the present week, at prices slightly higher than those ruling before Christmas. Business in the western part of the empire might be described as rather languid during the past week, whilst in Hungary the market was absolutely depressed. This is to a certain extent due to the want of decision displayed by Hungarian iron masters in the syndicate movement. Their deliberations are kept private, and dealers are therefore loath to enter into large transactions before they know what policy will be pursued by producers. A very important contract has just been concluded, under the sanction of the Minister of Commerce, between the Government railways and the Austrian syndicate of rail makers, under which the whole requirements of the State lines for rails during the next five years have been secured at the price of 96fl. per net ton, or say about £7. 10s. per ton, which is the lowest price on record. The contract stipulates for a further reduction of prices if Glasgow warrants should drop below a certain limit, whereas no increase of price will be allowed, however high Glasgow warrants may rise. The total quantity of rails estimated for renewals and extension of lines, during the next five years, is a little over 100,000 tons, and that of fish plates, bolts, and other accessories, about 10,000 tons.

The Defective Boilers at the Vienna Installation.—Now that all the hubbub about the failure at the Vienna Opera has subsided, and the financial responsibility has been settled in the right quarter, it is possible to survey the situation impartially. English readers are hardly able to conceive the amount of vehement vituperation which in a case like this is poured forth day after day in the columns of our newspapers, whilst at the same time the editors refuse to admit any letter written by an incriminated person in vindication of his own rights, or even as a mere statement of facts. The boilers for the installation were originally designed for Mr. Crompton by Mr. Wilson Hartnell, of Leeds, and would have been built in England had it not been for the intervention of our Minister, Count Taaffe, who imposed the condition that they should be built in Austria. They were consequently ordered from the Witkowitz Works, financed by the Rothschilds; and notwithstanding that the specification was drawn up in the most stringent manner, the work was done with complete disregard of the specification. Immediately upon delivery leaks began to show, and Mr. Crompton refused to accept these boilers. The makers patched them up for a time, but without permanent success. The boilers were then removed, and temporary locomotive boilers were put in, the time occupied by the change being only nine days. Since then the installation has been running without a hitch, and so far the difficulties are over; but then came the sequel as to who was to blame. It was first proposed to settle the case by arbitration, the arbitrators to consider preliminary evidence; but by some mischance they gave judgment without having examined the evidence, or looked into the workmanship of the boilers. When, subsequently, the evidence was laid before them, they withdrew their decision, and the Witkowitz Company, which had in the meantime taken the case into court in order to compel Mr. Crompton to pay for the boilers, withdrew it suddenly when the evidence of experts was brought forward. Messrs. Wilson Hartnell, MacGregor, Longridge, Professor Kennedy, and some Austrian engineers examined one of the boilers, which had been cut open for the purpose, and it was due to the opinion of these gentlemen, condemning the workmanship as utterly bad, that the Witkowitz Company proceeded to withdraw their claim, and to agree to take back their defective boilers, making no charge for them; to pay for the labour and freight in replacing them by new ones, to pay the Opera fine, which amounted to upwards of £3,000, and the professional expenses of the witnesses. The total cost of the failure to the Witkowitz Company is probably upwards of £10,000.

The Vienna Electrical Laboratory.—The programme of this undertaking has just been issued by the Directors of the Technological Museum, of which the laboratory forms a recently added section. The work will be superintended by Herr Carl Schlenk, and is to embrace experimental investigations of dynamos as regards output, power consumed, efficiency, and other matters; investigations and reports on executed installations for lighting, power, or chemical purposes, photometry of arc and glow lamps, calibration of measuring instruments, and investigations of primary and secondary batteries. A tariff has been fixed for the work, which will presumably be required very frequently. Thus for testing a dynamo the charge will be from £1. 4s. to £4, according to size of machine; for testing a glow lamp, 16s. to £1. 4s.; arc lamp, £1. 4s. to £1. 12s.; calibration of instruments, 5s. to £1. 12s. Members of the Museum obtain a discount of 25 per cent. off these charges. Where the work is of special nature or for outside work the charge is to be agreed upon beforehand. These fees are levied primarily with the object of covering working expenses. Any surplus is to be equally divided between the exchequer of the Museum and the staff of the laboratory.

BRUSSELS, 24th January, 1888.

The Coal Market.—Coke and coal for industrial purposes continue firm, with a tendency to rise. The demand for coke is greater than the supply. At Charleroi dross is quoted at 3s. 9d. to 4s.; small coal at 4s. 7d. to 5s. 9d.; cobbles at 13s. 7d. to 15s. 2d.; and unscreened household coal at 8s. 5d. to 10s. Owing to several blast furnaces in the Mons district having been re-lighted, fuel for metallurgical purposes is scarcer than before. The stocks of coal in hand are very much smaller than at the same period of 1887 and 1886. At Liège the situation is similar, and the prospects of the trade promising.

The Metal Market.—Some of the rolling mills and engineering works are now less busy. A fall has taken place in the price of certain metals, and tin is quoted at £158 to £160; copper ingots at £84; spelter at £22; and lead at £15. 12s. Luxemburg pig is quoted at 37s. 9d. free on rail. The Athus works decline to contract at 36s. for the second quarter of the year. Foundry pig is firm at 38s. 4d. to 39s. 2d. for No. 5. In view of the general

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tendency of iron in Europe to advance, we may expect a rise here soon. The second tenders for the purchase of Rumelange blast furnaces have resulted in the Liège Crédit Général and the Bank of Liège acquiring one half, and the Bank of Brussels the other half, for the total sum of £132,222. The statement which has been made here that Krupp will manufacture a portion of the projectiles ordered by the Belgian Government at Charleroi, is a mere rumour, and is not based upon any tangible facts.

Glass Works.—The market has been very quiet for some time; fewer orders are received, and stocks are large. At the last meeting of the glass makers' committee, it was decided to maintain the prices fixed by the convention.

The Brussels Exhibition of 1888.—Progress is being made abroad with a view to participation in this exhibition. France will take part in it officially, and a committee has been appointed, of which the Minister of Commerce is president, and M. Bergé vice-president; Messrs. Casalonga and Estor-Mortier are the agents general. From Manchester, various buildings are being sent from the late exhibition for the British section. Collections of minerals and chemicals are being made in Germany, and there will also be sent from that country wines, beers, and spirits. The Belgian Government reserves a large space for home manufacturers and merchants, to whom room will be given at half the official rate. The buildings are still in a backward state.

The Lighting of the Town.—An important change has been made in the organisation of the management of the lighting of the town, M. Aerts, manager of the gas works, having been appointed surveyor of public lighting and gas mains in place of M. Wybauw, who takes charge of the electric lighting, clocks, and telephones. At present the electric light installation of the town only comprises the generating station at the gas works, from which the Theatre de la Monnaie, the Grand Place, and the Theatre du Parc are supplied. It is, however, probable that the municipality will favour a project of erecting an electric light station in the centre of the town, which would serve the principal restaurants, cafés, and some public buildings. Negotiations to this effect have been commenced with the Société Industrielle of Brussels.

DÜSSELDORF, 23rd January, 1888.

The Iron Market.—The relative calm which characterised the iron market in the first two weeks of the year must have been wholly due to the influence of the holiday and stock taking season, for it has given place to the same degree of activity as prevailed down to the last week of 1887. This being the case, it is not surprising that prices again show a rising tendency all round. This tendency is strengthened by favourable accounts received from the Silesian district and from abroad. Pig iron is in strong demand, forge pig being particularly sought after. Despite the recent large advance and the protests of the finished iron makers, the prices of crude iron have a decided tendency upwards, a circumstance which points to a further advance in finished produce. The effect of these high and constantly rising prices on the foreign trade is becoming very marked; imports are increasing and exports rapidly diminishing. It is surprising that under such conditions the home demand should remain brisk. The blast furnace owners' union, having made arrangements for controlling the action of the merchants, has the market now entirely in its own hands. This state of things is giving rise to some misgiving on the part of consumers. The only serious check on native producers is the import trade, which at the present high rates in the home markets is likely to afford healthy competition. The few rolled iron works which have remained outside the syndicate are now underselling the latter, and as it has been determined that the Lorraine works will not join, the competition in this direction is likely to increase. With firmly fixed rates for crude iron, all this must tend to injure the position of the finished iron and steel manufacturers. Business in bars is not very active, the foreign demand having fallen off heavily. Few transactions take place for delivery later than the end of the first quarter. Common plates and boiler plates are in strong demand. Hoops are less eagerly bought, but full prices are paid.

The Iron Industry and the Transport Question.—The question of developing the means of transport and reducing the cost of carriage is one which greatly agitates the iron industry of Western Germany at the present time. An important meeting of all the iron masters of this locality has been called for the 5th February, to consider "the future of the Rhenish-Westphalian blast furnace industry relatively to the question of ore supply." This industry is growing more and more dependent upon the *minette* ores of Lorraine, and it is contended by the blast furnace owners that their future prosperity, if not their very existence, demands a great reduction of the railway charges and the canalisation of the Moselle. The matter is of such weighty importance for the iron industry of this locality, that the meeting, which will certainly be largely attended, is awaited with some anxiety.

Flax and Yarn Markets.—Flax spinners have found but small cause for satisfaction in the business of 1887. The demand for the fine and medium numbers was generally languid, and the margin for profit dwindled away. The year closed, however, in greater activity, and the prospects have continued to improve since. The flax markets have in consequence acquired more life. Generally business is animated and prices are firm, with a rising tendency in some directions. The future of the home grown flax trade is attracting earnest attention. The partial failure of the crop in Russia of late years, and the growing ill will which shows itself in a war of tariffs between Russia and Germany, have stimulated the culture of flax in Saxony, and this movement in favour of the home trade is likely to grow. Of the imports of flax into Germany, which amounted in the first eleven months of the last year to 873,912cwt., 767,856cwt. were derived from Russia. For flax yarns there is a fairly brisk demand. The business in cotton yarns has improved within the last week. Spinners, who have plenty of orders in hand, are again firm in their demands, refusing to make the smallest concession to buyers. The tone of the market is strong and hopeful.

LILLE, 24th January, 1888.

Flax and Yarn Markets.—The market for flax offers no new features. There is still a strong and steady demand for home grown produce, at the full prices asked by sellers. Russian, too, continues to be largely dealt in, and prices are very firm. Business in yarns is fairly animated. The home demand steadily grows, and as transactions on foreign account are numerous, spinners are able to obtain more remunerative prices for their goods. Jute yarns find ready buyers, at steadily rising prices. The exports of linen and jute yarns from the port of Dunkirk in the month of December were unusually large.

The Iron Market.—Week by week the tone of the iron market grows stronger, and the outlook for the present year more encouraging. Manufacturers have determined to follow the example of their German rivals, and combine to force up prices to a remunerative level. In this determination they exhibit perfect and complete unanimity, a circumstance which has brought consumers into the market in anticipation of higher rates. Current quotations are £5. 8s. for merchant bars; but £5. 12s. will probably have to be paid before the end of next week. Some important orders from Paris have been lost to this district by underbidding on the part of manufacturers in the centre; but as there is plenty of work in hand, the circumstance has not occasioned much disquiet. Evidence of the activity prevailing in the crude iron producing district of the Meurthe-et-Moselle is afforded by the extraordinary demand for blast furnace coke. In ordinary times, the greater part of this fuel is derived from this locality; but our coke manufacturers are now unable to meet the demand, and the blast furnace owners are compelled to buy largely in Belgium.

The Sugar Bounties Question.—The commotion raised by the London Conference on the sugar bounties question has subsided, the belief having become general that the proposals of the British Government will not be accepted. It is hard to see how the French Government can, in the face of the angry protests from growers and manufacturers, and the pressure which is being brought to bear upon them, do otherwise than reject these proposals.

The Glass Industry.—The glass industry in the North of France is in a fairly prosperous state, though the low prices now prevailing are beginning to provoke complaints. There are in this district seventeen coal furnaces, eight gas furnaces, and two open hearth furnaces, both of which latter are at Aniche.

Light Trains.—By a decree of the Minister of Public Works the Western Railway Company are authorised to run "light trains," that is, trains composed of not more than six carriages, to stop at any point between stations to take up and set down passengers without luggage.

AMSTERDAM, 24th January, 1888.

The Canal from Rotterdam to the North Sea.—In connection with this subject the Minister for Public Works at the Hague has informed the Dutch Legislature that he is working on the basis of an estimated total expenditure framed by his predecessor in office. The late Minister estimated that £1,250,000 more would be required to allow of the largest vessels passing through the canal to Rotterdam. £584,000 have already been expended since 1884, leaving £666,000 still to be spent on the work.

Telegraphic Communication with the Dutch West Indies.—The negotiations of the Government with the Pedro Seduengo American Telegraph and Cable Company of New York are now so far advanced that it is almost certain that both Dutch Guiana and Curaçao will be in possession of double telegraphic communication with Europe and Holland before the year is out. The above company has an exclusive Brazilian concession for land cables on the coasts of the empire from America. The company proposes to lay cables from Visca in Brazil to Paramaribo, the capital of Dutch Guiana or Surinam, and thence to Willemstad, Curaçao, provided Holland gives an annual subsidy for twenty years. The Dutch Government has agreed to do this. At Curaçao the above cables will connect with others, which the French Compagnie Télégraphique des Antilles is now laying to Hayti and Cuba.

NEW YORK, 14th January, 1888.

Railways.—The Central Traffic Association have reduced the rates of freight on iron and steel to places west of Pittsburg, much to the surprise of manufacturers, who were in expectation of an increase of 10 per cent. There was last year an increase of 1910 in the number of men employed by the New York Central Company, the total amounting to 20,170, who received £2,324,124 in wages and salaries. The company's coal tonnage increased by 762,912 tons, or over 25 per cent. The strike of the Reading Railroad employés has extended to the miners, and there are now nearly 50,000 idle men in the Schuylkill region. There is but little traffic on the Reading Road, and if the strike is not soon terminated many manufacturing concerns will have to shut down for lack of coal. The burning of coal dirt in the Wooten engines of the Reading Railroad is to be abandoned. It has been found to be one of the most expensive features of the road's equipment, and the present management of the road has decided to substitute standard boilers as soon as the Wooten boilers are worn out. Several have already been converted in the Reading shops. The first train that crossed the International Bridge at Sault Ste Marie consisted of 102 cars of flour loaded at Minneapolis for New York and Boston.

Bridges.—The contract for building the water spans of the Grand Avenue Bridge at St. Louis over the Mississippi, has been awarded to the King Iron Bridge and Manufacturing Company for £28,800. The approaches, which have already been erected, are 205ft. and 224ft. long, and the part which has just been contracted for consists of a central span of 400ft., and two anchor spans of 150ft. each, making the bridge 1129ft. long, including approaches. The entire cost of the bridge will be about £100,000.—Work has already begun on a bridge across the Hudson River, below West Point, which will form one of the most important links in the through system of roads from North to South. The approaches are being rapidly pushed forward.—The report of the Trustees of the New York and Brooklyn Bridge for the year ending December 1st, show the number of passengers carried in the cars to be 27,940,313, and the number of foot passengers 2,664,413, making a total of 30,604,726.

Glass Works.—A strike has taken place in the table ware departments of nineteen glass factories in different parts of the country, a large number of men being idle in consequence.

The Navy.—It is probable that Messrs. Herreshoffs will get the contract for a torpedo boat authorised by Congress. The design is for a boat of 130ft. length, having a beam of 15ft., and drawing 5½ft. of water aft and 2ft. forward. It is to be fitted with twin screws and triple expansion engines. The speed contracted for is 22 knots, with a bounty of £300 for each quarter knot from 22 to 23, and £400 for each quarter knot over 23. If the speed falls below 22 knots the penalty is £800, and the boat is to be rejected if the speed falls below 20 knots. The vote is for £20,000, and the contract price is £18,740. Messrs. Herreshoffs believe that the speed of the boat will be 24 knots.

PHILADELPHIA, 14th January, 1888.

Filtering Water for Cities.—There has been erected in Atlanta, Georgia, an apparatus designed to filter the water supply of the city. The plant consists of twelve cylindrical vessels, 13ft. diam. and 10ft. high. The water in passing into each filter is divided into two streams, the smaller of which is passed over alum. The streams again unite, and the alum causes the impurities in the water to become flaky, and the subsequent passing through coarse sand removes them. The quantity of alum taken up per gallon of water can be regulated by suitable valves governing the flow of water within certain limits; but the amount used is almost infinitesimal, and can have no bad effects on the user. A test of this plant showed that the daily capacity is 4,216,000 gallons, and the water became as clear and sparkling as spring water. The city of Paterson, New Jersey, is fitted with the same kind of plant, and it is also in use in many paper manufactories.

The Susquehanna Coal Company.—This company in their last report give the following particulars as to the cost of a ton of coal produced by them. The account is in cents, and is divided into two parts, the first covering all the expenses in the mine proper, and the second outside expenses:—

Inside Expenses:	Cents. per ton.	
Air and gangways	4·42	
Cars, slope, and drift	1·19	
Cross headings and chutes	4·13	
Exhaustion of land	7·04	
Mining coal	47·38	
Repairs, &c.	36·11	
Timber and props	7·75	
Total inside expenses		108·02
Outside Expenses:		
Insurance	0·38	
Legal expenses	·05	
Live stock	1·08	
Office	·13	
Preparing coal	11·71	
Repairs, general	5·37	
Royalties	2·01	
Stable expenses	3·99	
Stationery and printing	·18	
Stock coal expenses	·40	
Superintendence and clerks	1·65	
Taxes	1·18	
Total outside expenses		28·13
Total mining expenses		136·15

In the case of this particular company royalties are very low, as in some instances they are as high as 50 cents per ton, and the other expenses vary very much in different collieries from those given above. The cost of $1·36, or say 5s. 6d. per ton, is considered very satisfactory for the company.

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NOTES ON FOUNDRY WORK.

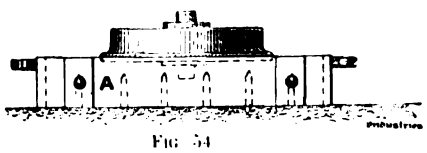


Fig. 54

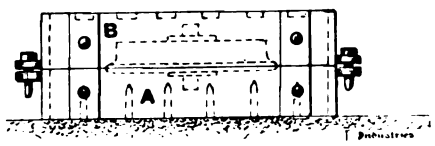


Fig. 55

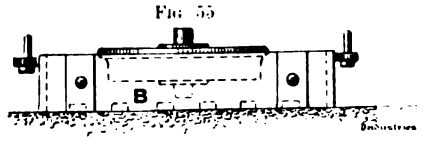


Fig. 56

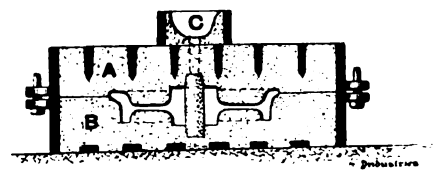


Fig. 57

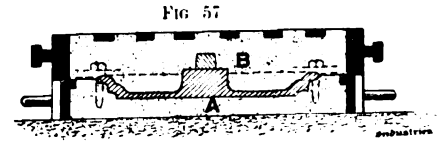


Fig. 58.

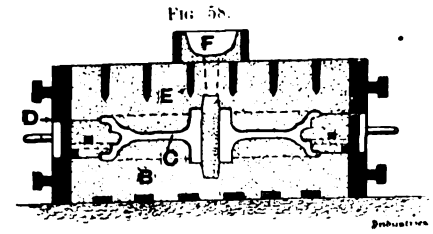


Fig. 59

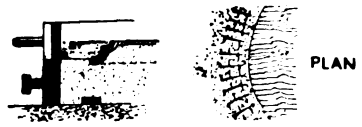


Fig 60

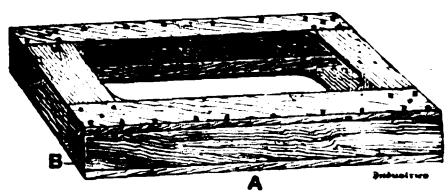


Fig. 61

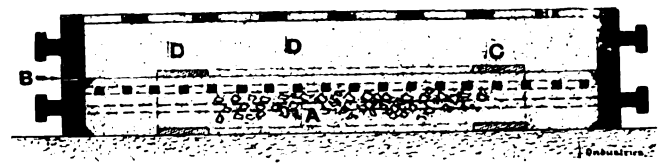


Fig 62

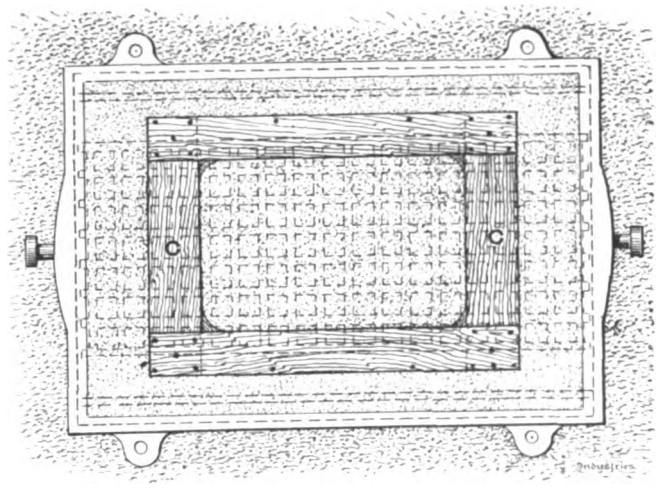


Fig 63

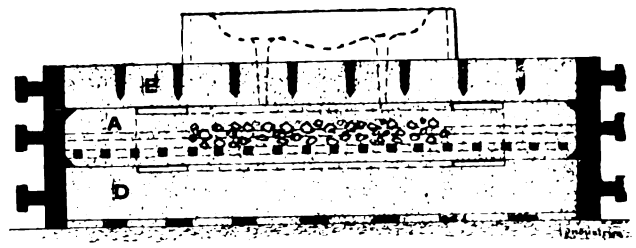


Fig 64



Fig 65

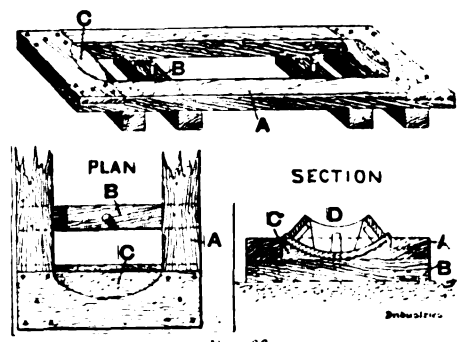


Fig 66

NOTES ON FOUNDRY WORK.

By the Author of "Pattern Making."

(Continued from Vol. III., page 615.)

XI.

Turning Over.—This is, of course, the reverse of bedding in, and is the method adopted in the best work when not of too bulky dimensions. Still, like bedding in, the matter is usually one of the custom of the shop—men who are accustomed to work by one method preferring that to the other. Turning over is easier, and with good flasks is safer, than bedding in; and but for the large number of flasks required, would doubtless be adopted even more than it already is. There is less risk of unequal ramming in turning over than in bedding in, and less risk also of the casting becoming strained by the pressure of metal. In many cases bedding in is impracticable, as in long columns and similar castings, which are poured upright, and in small castings made in quantity and several moulded in a box. Each method of moulding is therefore especially adapted for certain classes of work. As I have given several illustrations of bedding in, I will now give three typical cases of turning over. A two parted flask, viz., cope and drag, are required in any case for turning over, and often there are three or more parts, and one or more middles, in addition to the cope and drag. Turning over then simply implies that the whole of the mould is contained within flasks, no portion being in the sand floor, and that the flasks are rolled over for the ramming of opposite faces. Hence we require no coke bed, for the air is all brought away at the joints of the flasks, at the bottom face of the drag, and at the top of the cope. Both the top and bottom faces of the mould are therefore rammed up on the pattern faces, and vented directly to those faces, and there is no tucking in, except under side angles and recesses. And, unlike bedded in moulds which can only be skin dried, turned over moulds can when desired be made in dry sand, and dried in the stove.

Take as a very simple illustration the trolly wheel (Fig. 54). First, the sand is roughly shovelled into flask A, trod down with the feet, and strickled off level with the top edge. On this sand the wheel is laid, and rapped down with the mallet until the central part of the rim, where the diameter is greatest, is about level with the box edge, as shown in the illustration. Then the sand is sleeked round that edge with the trowel, parting sand strewn over the joint, and the drag box B (Fig. 55) put on, and rammed up in a manner rather different from that which is adopted with a cope, inasmuch as no lifters are required. The flat bars being wide, the rammer has to be used diagonally as well as vertically between them. The surface, right to the face of the pattern, is then vented. The boxes being already cottared, are now turned over together, and laid with the flat bars downwards on a loosely rammed bed, levelled with the shovel only, parting sand intervening, and given two or three twists sideways to make a good bedding of the surfaces in contact. The vent wire is passed horizontally several times between the bottom face of the flask and the sand bed, to form a communication between the edges of the flask and the vents which run to the face of the pattern. The cope flask, or that into which the pattern was first bedded, is now lifted off and the sand knocked out, leaving the drag as in Fig. 56. A fresh layer of parting sand is strewn over the top joint face of the drag, and the cope put over again, then liftered, rammed up in the usual way, and vented; a runner pin being stuck on the central boss, and rammed beside the central core. The cope is then lifted, the pattern drawn, the moulds cleaned, cored, and blacked, and cottared or weighted. When cast, the boss is fed through the runner C (Fig. 57), which figure shows a section of the mould, all ready for casting.

As an illustration of a mould made in a three parted box, the sheave wheel (Figs. 58, 59, and 60) may be taken. Fig. 58 shows the first position of one half the wheel pattern, the box A being simply a bedding for the wheel, as in Fig. 54, while the drag B is rammed and vented over it, similarly to the drag in Fig. 55. When drag B is turned over on its bed (Fig. 59), A is taken away, and the sand knocked out, the top joint face of B is sleeked over, and strewn with parting sand. The middle part C is rodded, as shown, similarly to the middles which were shown in Fig. 17 (Vol. III., page 162). Clay water is swabbed over the middle placed on the drag, and partially rammed up, that is, about level with the joint face of the lower half of the pattern. To support the ring of sand which overhangs and forms the narrow groove of the pulley, nails of 3in. or 4in. in length are pushed down into the sand, as shown in Fig. 60, fulfilling therefore the same purpose as the larger rods in cores, and in cods of green sand. Then the top half of the pattern is put on, a weight laid above to keep it steady, and the remainder of the sand in the middle part rammed up to the top joint, that is, to the middle line of the flange D in Fig. 59. This, of course, may not happen to coincide with the top joint of the box; but when it does not thus coincide it is necessary to slope the face of the sand joint from the joint of the flask to the middle line of the pattern flange. This joint also is smoothed and strewn with parting sand, and lastly the cope E is put on, liftered, and rammed Then the boxes are separated for the cleaning of the mould, showing the impressions in the drag and cope precisely alike, and the middle as a ring of sand. Fig. 59 illustrates the mould in section, complete and ready for pouring; F indicating the pouring basin and runner.

The frame (Fig. 61) affords an example of turning over of a different style than those just noted. We have cope, drag, and middle; but the mode of making is not quite the same. There are masses of sand overhanging the metal spaces on each side of the central hole, which cannot be carried safely by any amount of rodding. A core would be suitable and safe, but would double the work in the pattern shop, and be therefore too costly, unless several similar castings were required. Hence a grid to carry the green sand middle is the alternative. There being no core, therefore it is necessary, in order that the pattern shall deliver itself, that one plate A (Fig. 61) shall be loosely dowelled to the sides B; and with the pattern thus made, we proceed with the moulding.

To commence then, the middle flask A (Fig. 62), rodded at the sides, is laid on the sand floor, roughly levelled with a shovel. On the bottom sand, the back of the pattern, or that which is afterwards to come in the top, is laid. Some facing sand is thrown within and around the pattern, and black sand above this again, until a considerable portion of the sides, say one-half or two-thirds, is rammed up. A central body of ashes is placed in, and then the grid. Since this has to rest upon the internal fillet of the middle part, it must at this stage, since the flasks are upside down, be screwed or wedged temporarily up to the fillet. A bar is therefore put through the eye of the grid, and by its means the latter is pulled up close to the fillet, as it appears in Fig. 62. The remaining sand is now rammed all over, both between and above the grid, and outside the pattern, and is finally strickled off level with those upper edges of the ribs upon which the loose plate is dowelled, that is, upon the joint B in Fig. 62. All the sand inside the pattern is vented to the central ashes, and to the hole in the centre. The outside is vented to the face B, just strickled.

The clamp, which held the grid securely during ramming up, is now removed, the loose framed plate (Fig. 61, A; Fig. 62, C) is placed on by means of its dowels. Fig. 63 shows a plan view of the mould at this stage. Some parting sand is strewn over the face, and the drag part (Fig. 62, D) put on, cottared, rammed up, and vented all over with say $\frac{3}{16}$in. vents, about 1in. apart. The flasks are ready now to be turned over, and so a thickness of parting sand is strewn over the top of the drag D, and this prevents sticking of the surfaces in opposition. The drag being turned over (Fig. 64, D), the sand around the now upper edges of the pattern is consolidated with the rammer and the hands before the cope E is put on. This is liftered and rammed. Then

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the cope, the middle, and the pattern are separately lifted away from the drag, and all the parts cleaned and blacked ready for the final closing. Fig. 64 shows the mould complete with its pouring basin. Two main runners are provided, each of which, on reaching the level of the top of the mould, branches off into two or three broad thin ingates, which carry the metal in quickly without chilling, and without leaving large runners to be cut off afterwards.

In connection with this subject there is to be noted the use of "turnover boards," variously termed also "bottom boards," and "joint boards." Fig. 65 shows a plain bottom board. Upon its face the joint of a half pattern, or the face of a flat pattern, is placed. Over the pattern so laid the flask is set and rammed up, and being then turned over, the board is taken away, leaving a true joint face of sand to receive the other half of the pattern if a pipe or column, or the cope face if a flat pattern. Then, obviously this principle is capable of almost indefinite modification and extension, since the face of the board need not be a true surface all over, but only in those portions on which the joint edges of the flask abut. Other portions of the board may be cut to the irregular outlines of patterns, having edges whose corresponding sand partings are not in the plane of the board, but are either above or below. Moreover, the board may be either cut down or blocked up with sloping faces corresponding with the intended sloping sand joints of a more or less irregular character, and so save the moulder the trouble of cutting and sleeking his joints at every repetition of moulding—an important consideration in work often repeated. Fig. 66 affords an example of this modification of the turnover board. It is one used for ramming up the inside face of the pattern of a corner tank plate upon. It consists of a stout frame A, formed of four pieces halved together, and resting on the two cross bars B B. The pattern lies upon these, and dowels standing up therefrom, and fitting into corresponding holes in the tank plate, prevent it from shifting sideways. The inner longitudinal edges of the frame coincide with the chipping edges of the pattern section (Fig. 66). The inner transverse edges of the frame form the outlines of the sand points, being hollowed down (C C) to the curve of the plate, and chamfered back to allow of a free lift. The pattern D being laid on the frame, as shown in section, the drag is put on and rammed up. Being turned over, and the cope rammed and removed, the screws which hold the side flanges to the plate are of necessity withdrawn, owing to their radial position, which would prevent their withdrawal along with the plate. The plate is then lifted, the flanges following afterwards singly, leaving the mould free to receive the cores for the bolt holes.

Then again, in machine and plate moulding, further modifications occur, the flasks not coming together at all until the cope and drag are both rammed. There is very much involved in this subject of joint boards, but having explained their principle and purpose, I leave them for the present, but hope to refer to them again, in connection with the subject of plate and machine moulding. Other examples of turning over will also arise in connection with subjects of a special character.

(To be continued.)

Notices of Meetings.

THIS WEEK.

Society of Arts.—Friday, 27th January, 8 p.m. Indian section. Paper to be read on "The Public Health in India," by Mr. Justice Cunningham.

Royal Institution of Great Britain.—Saturday, 28th January, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

Physical Society.—Saturday, 28th January, 3 p.m. Papers to be read on "The Effect of Magnetisation on the Thermo-Electric Properties of Bismuth," by Mr. Herbert Tomlinson; On "The Influence of Magnetism and Temperature on the Electrical Resistance of Bismuth and its alloys with lead and tin," by Mr. E. van Aubel; and on "A Water Dropping Influence Machine," and on "The Price of the Factor of Safety in Lightning Rods," by Professor S. P. Thompson.

NEXT WEEK.

Society of Arts.—Monday, 30th January, 8 p.m. Cantor lecture on "Yeast, its Morphology and Culture," by Mr. A. Gordon Salamon, F.I.C., F.C.S.—Tuesday, 31st January, 8 p.m. Applied Art Section. Paper to be read on "The Monumental Use of Bronze," by Mr. J. Starkie Gardner, F.G.S.—Wednesday, 1st February, 8 p.m. Ordinary meeting. Paper to be read on "The Sweating System, or the Functions of the Middleman in Relation to Labour," by Mr. D. F. Schloss.

Institution of Civil Engineers.—Tuesday, 31st January, 8 p.m. Ordinary meeting. Discussion on Sir Bradford Leslie's (K.C.I.E., M.Inst.C.E.) paper on "The Erection of the 'Jubilee' Bridge carrying the East Indian Railway over the river Hooghly, at Hooghly." Paper to be read (time permitting) on "The Alexandra Dock, Hull," by A. C. Hurtzig, M.Inst.C.E.

Civil and Mechanical Engineers' Society.—Wednesday, 1st February. Paper to be read on "The Use of Ammonia as a Refrigerating Agent," by Mr. F. B. Lightfoot, M.Inst. C.E., M.Inst.M.E.

Institute of Patent Agents.—Wednesday, 1st February, 7 p.m. To resume the discussion on Mr. O. Imray's and Mr. E. Carpmael's papers. To read, and if time permit, to discuss a paper "On the International Convention as it affects the Granting of Patents of Invention," by Mr. A. M. Clark, Fel.Inst.P.A.

Institution of Mechanical Engineers.—Thursday, 2nd, and Friday, 3rd February, 7-30 p.m. Forty-first annual general meeting, annual report of Council, and election of office bearers. Discussion to be resumed on "Irrigating Machinery on the Pacific Coast," by Mr. John Richards. The following papers will be read and discussed as far as time permits: "On the Position and Prospects of Electricity as applied to Engineering," by Mr. William Geipel; and "Third Report of the Research Committee on Friction: Experiments on the Friction of a Collar Bearing."

Architectural Association.—Friday, 3rd February, 7-30 p.m. Ordinary meeting. Paper to be read by Mr. R. P. Spiers.

Geologists' Association.—Friday, 3rd February, 7-30 p.m. Annual meeting.

Royal Institution of Great Britain.—Friday, 3rd February, 9 p.m. Lecture on "Ancient Microscopes," by Mr. Frank Crisp.—Saturday, 4th February. Lecture on "Experimental Optics," by Lord Rayleigh.

PRICES CURRENT, 26th January.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3	32/-	Cash
Scotch Warrants, m/n	41 0½	"
Hematite Warrants, m/n	43 6	"
Stocks in Stores. Scotch	942,750—Dec. for week,	32 Tons
Middlesbro'	346,733—Inc. "	542 "
Hematite	212,644—Inc. "	570 "

Exclusive of stocks in makers' yards.

Market quiet.

	No. 1.		No. 3.		
Coltness	52 6	.....	44 6	f.o.b.	Glasgow.
Gartsherrie	47 9	.....	44 6	"	"
Dalmellington	43 6	.....	41/-	"	Ardrossan
Eglinton	42 3	.....	40 3	"	"
Glengarnock	47/-	.....	41 6	"	"
*Derbyshire	—	.....	38/-	f.o.t.	Works.
*Lincolnshire	—	.....	33 6	"	"
*Lancashire	—	.....	38 6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.		Best.	
	£ s. d.		£ s. d.	
Middlesbro' Bars	4 15 0	.....	5 5 0	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 5 0	.....	5 15 0	Manch'r.
" Angles	5 15 0	.....	6 5 0	"
Crown Sheets	6 15 0	.....	7 0 0	"
" Hoops	5 10 0	.....	5 12 6	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 15 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53 6	43 6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£20	10	0	to	£20	15	0
Copper: British Cakes and Ingots	80	0	0	"	81	0	0
" Chili Bars	74	0	0	"	——		
" Manufactured (strong)	90	0	0	"	——		
Lead: Common Pig	15	2	6	"	15	5	0
" English Sheet	16	2	6	"	16	5	0
Tin: Straits	166	10	0	"	——		
" Australian	167	10	0	"	——		
" English Ingots	150	0	0	"	155	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper has been irregular all week, fluctuating from £79 to £74. There is very little actual business doing. It is said that the French Syndicate has nearly concluded arrangements for two or three years with several of the largest producers of raw copper, and this will regulate the price on a higher level. In the meantime trade in all branches of the copper industries remains exceedingly dull.

Tin remains firm, but lower prices are quoted for forward delivery.

Lead is lower, Spanish lead having fallen to £14. 7s. 6d.

Spelter is a little lower, owing to the re-sale of a large lot which had been bought speculatively. The market has again recovered as stocks are small, and all the producers well sold forward.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	29	0	0
" Ceylon	"	24	10	0
Cottonseed	"	20	10	0
Cod	"	19	0	0
Lard	"	41	0	0
Linseed	"	19	0	0
Palm, Lagos	"	22	0	0
Rapeseed: English	"	26	0	0
Seal: Pale	"	23	10	0
" Brown	"	18	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	8¼
" Spirit	"	0	0	7¾

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	8	—	.....		
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6¾	—	0	1	7
Alum: Lump (powder 10/- ex.)	ton	4	15	0	—	4	17	6
Ammonia: Carbonate	lb.	0	0	3¼	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	13	0	0	—	.....		
" Liquor	lb.	0	0	3¼	—	.....		
Bleaching Powder	ton	7	10	0	—	.....		
Bisulphide of Carbon	"	13	0	0	—	.....		
Borax	"	28	0	0	—	.....		
Benzole (90%)	gal.	0	3	9	—	0	4	0
" (50 90%)	"	0	2	9	—	0	2	10
Copper Sulphate	ton	22	0	0	—	23	0	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	10	0	—	25	10	0
" White Sugar	"	28	0	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	6¼	—	.....		
" Prussiate (Yellow)	"	0	0	7⅜	—	.....		
" Sulphate (Basis 90%)	ton	9	0	0	—	.....		
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	7	0	0	—	.....		
" " " 60%)	"	6	0	0	—	.....		
" " (Cream, 60%)	"	5	18	0	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	3	—	0	1	4
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

Erratum.—We regret that in the description of the British Empire Section of the Brussels Exhibition, given on page 66 of our last week's issue, an error occurred in referring to the official position of Mr. S. Lee Bapty. We think it well to correct this by stating that Mr. Bapty is Commissioner-General of the British Section, to which position he was appointed with the sanction of the Belgian Government.

We have received a copy of the first number of the *Locomotive Engineer*, a new American monthly journal devoted to the interests of drivers, firemen, and those employed in keeping locomotive engines in order. The journal is illustrated, and contains a large number of short, but very readable articles of practical interest, evidently written by men who have had experience in the round house, repairing shop, and on the road. The illustrations, which are well executed, refer mostly to tools required in the repairing shop. Science, either pure or applied, finds no room in this journal, but the articles are characterised by sound common sense. Amongst the matters treated we may specially mention articles on car heating, the setting of locomotive tyres, the practice of the round house, and a strong denouncement of the absurd claims now put forward by the Swinerton Locomotive Company for their flat driving wheels. The style of the articles is more peculiarly American than that of other American journals of a more scientific character, but nevertheless pleasant and fresh, and the printing is very good. We wish our contemporary every success.

Liverpool Engineering Society.—The opening meeting of the present session of this Society was held at the Royal Institution, Colquitt-street, on Wednesday; Mr. Charles H. Darbishire, Assoc.M.Inst.C.E., president, in the chair. Upon taking the chair the President delivered a short address to the meeting. Mr. A. W. Brightmore, M.Sc., then read a paper entitled "Some Recent Experiments on Iron and Steel and Riveted Joints." Mr. Brightmore reviewed the important series of experiments carried out at the instance of the Prussian Government by Wöhler and Bauschinger. He showed how these experiments pointed to the conclusion that, when the nature of the stresses in the members of any structure is subject to continual reversal, the maximum load consistent with the permanency of that structure is not more than one-third of what may with perfect safety be borne when the nature and amount of the stresses remain constant. Proceeding then to riveted joints, he dwelt upon the principles that guide their design, and concluded by demonstrating the advantages of machine over hand riveted joints.

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HOME INDUSTRIES.

MANCHESTER, 26TH JANUARY, 1888.

THE ENGINEERING TRADE.—Now that business has settled down after the holidays, it is found that there is not much more work being actually placed with stationary engine builders. Generally speaking, they are only moderately employed, although there are one or two exceptions to this rule. Some good orders are in course of execution for India, and others are in the market for the same country; but on home account the orders which are talked about are neither many nor large. Millwrights are also a little better than they were, and in most cases could readily find occupation for more men. It is a hopeful sign that the trades unions have not so many members out of employment, which would indicate a general increase of work. Machine tool makers are as a rule fairly employed, but an increase of work is hardly to be looked for by them until the general industries of the country have improved. Locomotive builders are still short of orders, although there is a little more inquiry. Boiler makers continue well supplied with orders, and are almost without exception likely to be so for some time. The abolition of the old system of punching, and the more general application of scientific principles of construction in this branch, have led to a large increase in the amount of work put upon a boiler, with the result that the workmen engaged are mostly in full work. Machine makers are still busy, and it is gratifying to note that this is the case in almost all departments. Card room and ring spinning machinery is, perhaps, most in demand; but, speaking broadly, there is no lack of employment among machine builders. It is stated that Mr. Samuel Brooks is adding to his specialty of ring spinning frames the manufacture of carding engines and roving frames, having taken up the construction of a recently patented carding machine. Hydraulic engineers are badly off for orders, and have in addition to contend against a low range of prices. Within the past few years larger cylinders have been adopted in the type of baling press used in Manchester, a bore of 18in. being now usually adopted, and this has led to the substitution of steel cylinders for the iron ones formerly employed.

THE IRON TRADE.—The lower prices ruling in the Glasgow and Middlesbrough markets for pig iron are somewhat checking business here, but, except in the case of second hand parcels, there is no actual business being transacted at these lower rates. Makers, who are generally well sold at higher prices than those at present ruling, profess to believe in the probability of an advance, and are consequently very firm in their quotations. Local irons are being quoted at an average price of 40s. per ton, and hematite makers decline to sell at anything under the rates of a few weeks back, that is, about 55s. per ton delivered. Bar iron is also very firmly held, and has advanced in price, common bars being now quoted £5. 5s. per ton, although they can be bought at a lower rate than this. There is a fair call for steel boiler plates, which, along with all steel goods, maintain the advances recently noticed.

RIVER POLLUTION.—This subject, which, in view of the construction of the Manchester Ship Canal, is of great importance to this district, was considered at a conference, held in the Town Hall, on the 24th inst., and presided over by Lord Egerton of Tatton. Representatives from sixteen town councils, forty-eight local boards, and ten rural sanitary authorities were present, and resolutions were passed expressing the opinion that the time had arrived when the matter should be dealt with, and pledging the bodies represented to inform the chairman by the 25th of March next what practical steps were being taken by them towards this end. It was stated that the watershed of the Mersey embraced 606 square miles, and that of the Irwell 175,000 acres, the population affected being about 1,700,000. Various corporations have expended sums of money on this question, and it appears to be likely that a united effort will now be made to solve the difficulties of the question.

LONDON, 26TH JANUARY, 1888.

THE MONEY MARKET.—There is no great demand for money at present, even the rush for Bass debentures, which has been the only excitement of the past week, failing to harden rates at all. The stock markets are also exceedingly dull. The movements have been convulsive and without real interest or importance. At the close of last week the quietness of the stock markets was attributed to no particular cause, but with the beginning of this week the approach of the settlement, which began yesterday, was taken as a sufficient explanation of the idleness of the Exchange. British funds have been drooping a little, and foreign stocks are decidedly dull. There has been no great movement in home railways, with the exception of an occasional jump up or down in the southern Railways, as the phases of the struggle with Sir Edward Watkin have seemed favourable or otherwise to the prospects of a union between the southern lines. The one feature of the week has been the issue of the Bass debentures, which have been subscribed many times over at premiums ranging from 11 to 13, the issue price being 107.

COMPANIES.—Since our last report the following new companies have been registered: Alboline Oil and Varnish Company, Limited, with a capital of £25,000; Ducker Portable House Company, Limited, with a capital of £200,000; Colonial and Foreign Mining Syndicate, Limited, with a capital of £10,000; London and De Kaap Exploration Syndicate, Limited, South Africa, with a capital of £12,500; Roartey's Luck Mining and Developing Syndicate, Limited, South Africa, with a capital of £50,000; English Piano Manufacturing Company, Limited, with a capital of £15,000; Johns' Bottling and Stopper Company, Limited, with a capital of £100,000; Flameless Explosives Company, Limited, with a capital of £150,000; the Lane End Works, Limited, with a capital of £100,000, to acquire the Lane End and Oldfield Collieries and Brick Works, Staffordshire; Andalusia Iron, Coal, and Steel Works Company, Limited, with a capital of £1,200,000; the Great Grimsby Coal Supply Company, Limited, with a capital of £2,000; the Salterforth Water Company, Limited, with a capital of £1,000; Samson, Teale, & Co., Limited, with a capital of £10,000, to manufacture cycle and sewing machine fittings; Bass, Ratcliff, & Gretton, Limited, with a capital of £2,720,000; the Eastern Counties and British Farmers' Condensed Milk Company, Limited, with a capital of £100,000; Williams & Robinson, Limited, with a capital of £200,000; and Brain's Patent Tanning Company, Limited, with a capital of £25,000.

PRODUCE.—The rates both for cane and beetroot sugar have fallen owing to the operations of speculators, though no change has been reported in the prospects of supply which caused the recent rise. Should prices on the whole be maintained, there is a chance of the large sugar works at Silvertown being re-opened. The tendency of the coffee market is to decline.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 15th January, amounted to £1,059,289 on 15,830½ miles, as compared with £1,041,816 in the corresponding period of 1887, when the mileage was 15,706¾ miles. An increase is thus shown in the mileage of 123¾ miles, or 0·7 per cent., and in the receipts of 1·6 per cent.

THE NAVY.—The gunnery trials made at Portsmouth with the "Mersey" show that the arrangement of the circular shields adopted results in difficulties in working the guns. A modification will therefore probably be made. A new type of swift powerful sloop, to be built at Sheerness, has been designed by Mr. W. H. White, and will be the largest vessel of the class in the navy. She will have a displacement of 1580 tons and will be 220ft. long between perpendiculars, and 233ft. long over all, with a breadth of 35ft. She will be built of steel, and be fitted with torpedo tubes. She will be unarmoured, but the vital parts will be protected by a steel deck. The death is announced of Mr. W. B. Robinson, late chief naval constructor at Portsmouth Dockyard.

ELECTRIC LIGHTING.—Messrs. W. H. Smith & Son intend to instal the electric light in their extensive premises in the Strand. The wiring in connection with the same has been put into the hands of Messrs. Woodhouse & Rawson.

DRAINAGE.—As a result of the visit paid by the Margate Corporation to the sewage works at Friern Barnett, which we reported in Vol. III., page 664, the Drainage Committee of the Margate Town Council has recommended the board to employ Mr. Baldwin Latham to advise them generally as to the drainage of the town, and to submit a plan with estimate of cost.

COMMERCIAL EXAMINATIONS.—The Council of the Society of Arts have had for some little time under consideration the question of modifying or enlarging the system of commercial examinations, which have now for many years been carried on by the Society, in view of the recent demand for improved commercial education. At present, examinations are held in subjects covering pretty much the same ground as that defined in the new scheme of the Oxford and Cambridge local examinations; but certificates are awarded in single subjects, not on the general result of the examination. For some years the experiment of awarding general commercial certificates, instead of the separate certificates, was tried; but was found less satisfactory to the candidates generally. No decision has yet been come to respecting a change in the system; but it is probable that the system of separate certificates will be continued, and that it may be supplemented by the issue of general commercial certificates. The Society has already received a promise of £100 for a travelling scholarship from the Clothworkers' Company, and further assistance is requested of the same kind. The object of these travelling scholarships is, of course, to enable the holder to acquire that practical knowledge of foreign countries which can only be attained by actual residence abroad.

BRUSSELS EXHIBITION.—A meeting convened by Mr. S. Lee Bapty, Commissioner-General for the British Empire in connection with the Brussels International Exhibition, was held at the Mansion House on Tuesday, to promote the interests of the above Exhibition.

GLASGOW, 26TH JANUARY, 1888.

UDSTON COLLIERY EXPLOSION.—Mr. Ralph Moore, H.M. Inspector of Mines, has now issued his report on this explosion. He considers that it was a dust explosion, and recommends that shot firing in dry and dusty mines ought to be prohibited. He points out that the new Mines Bill permits shot firing in dusty mines under certain conditions, but he fears that these will be neglected and explosions must result.

SHIPPING.—Pig iron shipments show an excess of 30 per cent. over the corresponding figures of last year, and coal shipments an increase of 20 per cent. Freights outwards are still advancing. For the Mediterranean trade ships have been very scarce, and freights have in some cases been higher than they have been for some years.

TRADE SYNDICATES.—Negotiations have been in progress for bringing about an understanding between the American and the Scotch mineral oil companies, with the object of maintaining prices. A representative of the Standard Oil Company has been in Glasgow conducting the negotiations. Rumour has it that a number of the chief coal mining companies in the Glasgow district are about to consolidate themselves. The method of syndicated trade which has found favour on the Continent seems to be likely to take definite root in this country.

SHIPBUILDING.—A few more contracts have been placed within the past week. Messrs. A. & J. Inglis have booked an order for a yacht of 300 tons; and have laid the keels of the two 4000 ton steamers they are building for the British-India Steam Navigation.

THE FORTH BRIDGE.—A mischievous rumour, having its origin apparently in Stock Exchange operations, was current in the leading Stock Exchanges on Saturday, to the effect that mechanical difficulties had caused cessation of operations at the Forth Bridge. The rumour condescended to details, so far as to allege that one of the caissons had begun to slip. No one, of course, who had seen the structure would imagine that such a disaster could have occurred. Yet the rumour obtained so much credence that a fall of 30s. took place in North British Railway Stock. We are authorised to give the most unqualified contradiction to the statement. The work on the bridge has been progressing with a rapidity even greater than had been anticipated.

AGRICULTURAL EDUCATION.—Professor Wallace, of Edinburgh University, has issued a proposal for the development of agricultural education in Scotland. He urges the increasing of educational institutions rather than the establishment of experimental farms.

(From our own Correspondents.)

LIVERPOOL, 25TH JANUARY, 1888.

THE NEW ST. HELENS RAILWAY.—Arrangements have been made for the public cutting of the first sod of the St. Helens and Wigan Junction Railway, by the Right Hon. the Earl of Derby, K.G., on Saturday next, the 28th inst. During the proceedings Lord Derby will receive a unique present in the form of a solid silver model of a loaded waggon, measuring 10in. by 7in., every detail of construction being made to scale. The proposed line will be 18 miles long, commencing at Lowton, on the Wigan Junction Railway, where there is already a station, and terminating at Fazakerley, on the Southport Branch of the Cheshire Lines, a portion of the route being identical with that in the original scheme of George Stephenson for the Manchester and Liverpool Railway, abandoned on account of the opposition of a former Earl of Derby. After leaving Lowton, the line will pass through Haydock Park—where there will be a platform station for accommodation during racing and coursing meetings—Haydock, Parr, St. Helens, Denton's Green, Loughborough Road, Croxteth, and Fazakerley, at which places stations will be built. The chairman of the directors is Mr. R. Seton-Kerr, M.P.; the engineers are Sir Douglas Fox and Sir Charles Metcalfe; the contractors are Messrs. S. W. Pilling & Co., of Manchester, who have undertaken to construct the line in about two years. The capital of the company is £550,000.

SHEFFIELD, 25TH JANUARY, 1888.

THE HEAVY BRANCHES.—Iron and steel have been selling with tolerable briskness at about the same rates as last week; but local makers are not just now embarrassed by press of orders, and some manufacturers go so far as to say that the revival in trade is not by any means general. At the rolling mills, however, operations are more satisfactory, and the makers of railway material are on the whole busy, particularly on tyres, axles, and springs. Heavy machinery is in better demand, and one or two engineering firms—old established concerns like Messrs. Davy Brothers—are doing a steady trade. At nearly all the large works employment is fairly plentiful; and for edged tools and cutlery the market continues to yield good orders, considering the limited time travellers have been out since Christmas. The small-pox epidemic is now kept well in check by the authorities, and business men need have no fear in visiting the town.

LEEDS, 25TH JANUARY, 1888.

TEXTILES.—There is little fault to find with trade in the textile branches. Nearly all styles are selling well, but the largest purchases are of thick material for next winter's use. Woollens are still taking the fancy of buyers.

IRON AND STEEL.—In the heavy industries of Leeds there is a great deal of activity. The Bessemer output at Aireside promises well, and the market for manufactured iron is improving. Some extensive orders have recently been placed with Messrs. Kitson & Son, Messrs. Tannett, Walker, & Co., and one or two other large firms; and men are finding more employment than they did in the first quarter of last year. Nearly all the engineering firms are doing well; and for roofing, fencing, and other material

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the demand is encouraging. Material for shipbuilding is more eagerly inquired for, and lately there have been a number of quotations passing for railway work abroad.

Coal.—In West Yorkshire the coal trade is brisk, but prices keep low, and there is little prospect of owners, even if they were inclined, being enabled to give the men an advance.

NORTH STAFFORDSHIRE, 25th January, 1888.

The Pottery Industry.—As has been repeatedly affirmed before here, prices of both china and earthenware have of late years been so low as to leave little or no margin of profit. With a view to remedy this condition of things, the Longton China Manufacturers' Association was recently formed, and on Monday last a large and representative meeting of earthenware manufacturers from all parts of the district was held at Stoke, to discuss the adoption of a similar policy to that pursued by the Longton Association. After a long discussion the following resolution was passed, with only one dissentient: "That this meeting, having heard the scheme of the Longton China Manufacturers' Association, believes that such scheme would form the basis of an agreement which would be advantageous to the whole body of earthenware manufacturers in this district." A working committee was appointed, including the principal firms and manufacturers in the Potteries Mining Institute. A meeting of the local institute was held on Monday last for the further consideration of the proposed special rules for North Staffordshire. The rules drafted by the joint committee of colliery proprietors and colliery managers, which had been appointed to consider this matter, were adopted after much discussion. It may be noted that the new provisions of the Coal Mines' Regulation Act, 1887, are acting very detrimentally to the interests of colliery proprietors in this district, the men in many cases absolutely refusing to comply with them except at a considerable advance in price. At one colliery, where an advance has been refused by the management, a strike is reported. It is calculated that the Act will add at least 3d. per ton to the cost of raising coal.

BIRMINGHAM, 25th January, 1888.

The Iron and Metal Trades.—The fall in the price of copper, consequent upon the syndicate becoming sellers, has had an adverse influence upon the iron market. The effect is felt, not in diminished price, but in a temporary lack of orders. At present there seems every probability that the syndicate will hold its own and maintain copper at something like £75; and if this proves to be the case, doubtless the lull in the iron trade will pass away. Stocks are becoming low, and dealers will in many cases be compelled to order on this account. The galvanisers are still busy, and one or two good roofing orders will keep them engaged for some time. Marked bars are £7, and unmarked ditto £5 to £6. Galvaniser's singles are £6. 5s. to £6. 10s., and doubles £6. 15s. to £7. In general hardwares there is fair activity, but scarcely so much as before Christmas. The Merchandise Marks Act, which recently came into operation, has helped somewhat to slacken business. Much uncertainty exists regarding the working of this Act in cases where a number of parts of one article are made by separate manufacturers, the so-called maker being merely a putter together of the pieces. It is much to be desired that test cases under the Act should be heard so as to clear up doubts. The agricultural colonies in the southern hemisphere appear to be in a fair state of prosperity judging from their demand for railway appliances; spades, shovels, hoes, and other cultivating tools are also in good request, and building requisites are in active demand. Trade in cheap brass founding is still checked by the price of copper; but in the higher and artistic branches, where the cost of raw material is of less moment, an increased activity is manifested, particularly as regards exports.

Cable Tram Cars.—The lines are now complete, and preliminary runs have been made with the new cars. Beyond a little temporary difficulty with the gripper, there has been no hitch; but the shopkeepers and others along the route are complaining of the ceaseless rumbling and grinding sound caused by the pulleys.

LEICESTER, 25th January, 1888.

Wool Spinning and Yarn Trades.—There has up to the present not been a very noticeable increase in trade, and although there is more doing than at the time of last report, business is still quiet. The tone of the trade has to a marked extent flattened, and the somewhat bright anticipations have not been fulfilled. Prices remain practically unaltered; country dealers and growers still ask late rates, and decline to deal on any other basis. But as spinnners are not operating staplers decline to deal, and at present the market generally is a waiting one. Should this continue it is probable that raw material will decline in price. The sales in London at the end of the month will largely influence the course of business. Spinners as a rule are fairly busy, and the year has opened somewhat hopefully; but orders drag considerably, and the uncertainty of prices increases this tendency. Yarn merchants are now busier, and are booking a few season orders, principally in cashmeres; but there is much room for improvement.

Hosiery Trade.—Business has not expanded to the extent which was anticipated, and is scarcely up to the average of the last year or two; yet orders are coming more freely to hand. The plain hosiery department is moderately employed, and spring samples are now out, and a few orders are already placed for them.

Boot and Shoe Trade.—There is a manifest improvement in this important industry; travellers are now well on their journeys, and orders have come more freely, and though the lines booked generally are not very heavy, they have sufficed to give fuller employment to the workpeople. Several large houses are now working full time. As a rule buyers, both wholesale and retail, are extremely cautious in purchasing. The tone of trade as a whole may be considered fairly cheerful, and there are anticipations of better trade in the next two months.

SOUTH WALES, 25th January, 1888.

The Coal Market.—There is an increased demand for all kinds of steam coal, best qualities selling as high as 9s. to 9s. 3d. The house coal collieries are also busy. Furnace coke is quoted at 14s. 9d. and foundry quality at 17s. per ton. The anthracite collieries in the Swansea Valley are directing their attention to the demand for anthracite "nuts," which has now existed for some considerable time. Two collieries have put up machinery for breaking up their coal, which has to be in pieces about the size of an egg, for facilitating its use in house stoves; but the accumulation of "smalls," which is inseparably connected with the process, is said to be a difficulty in the way of its general adoption, unless the demand very much increases.

The Tin Plate Market.—The sustained advance in the price of tin, and the unwillingness of buyers of tin plates to pay the necessarily enhanced values, have compelled manufacturers to make some attempts at concerted action amongst themselves. Although the formation of a syndicate by the whole trade is not an easy matter to effect, there is no doubt that the agitation stiffened prices whilst it lasted. Few things, however, could show so well of what heterogeneous elements the body of manufacturers is composed as the fact that no agreement seems possible even at so critical a period. As a consequence prices have again fallen, and some few makers appear to be entirely at the mercy of their buyers. 14s. to 14s. 3d. is the price now quoted for cokes. This trade, which, as regards the carrying, used not long ago to be almost a monopoly of Liverpool, the plates being sent there by rail, has now completely changed its character, and steamers like the "Montana," which recently left Swansea with 3000 tons, do the trade direct with the United States.

The Tin Syndicate.—This combination seems to have lost none of its original vigour. All the tin offering is being bought, a lot of 200 tons to arrive shortly having been taken at the highest figure ruling, viz., £166. 10s. per ton.

BARROW-IN-FURNESS, 25th January, 1888.

Iron and Steel.—The hematite iron trade remains very quiet, although makers are firm. Speculative sales have principally been made, and only a few legitimate sales between makers and consumers have taken place during the week. Prices are slightly higher, mixed numbers of Bessemer iron being sold at 45s. per ton net f.o.b., and forge and foundry samples at 44s. 3d. to 44s. 6d. Stocks in makers' hands are small. It is anticipated that the iron trade will revert to a more active position by reason of the facts that makers are busy and well sold forward, and that all the branches of trade which use Bessemer and ordinary hematite qualities of pig iron are busily employed and likely to require fuller deliveries during the season. It is believed that the present depressed tone is caused mainly by the influence of the Scotch pig iron market, and it is certainly a fact that the business done during the past few days has been mainly on speculative account, and not actual transactions between producers and consumers. The steel trade is quiet in rails, but prices are firm at from £4 to £4. 5s. per ton net f.o.b., according to section. Ship plates are in strong demand, and are firm at £7. 5s. per ton, while angles are in full inquiry at £6. 10s.; blooms are again in better request, and billets and slabs are in good demand, while wire and hoops are an improving trade. There is, in fact, every indication of a considerable industrial activity in the steel trade during the year, and this will doubtless have a similar effect on the iron trade.

MIDDLESBROUGH, 25th January, 1888.

Pig Iron.—The market remains steady at the price mentioned last week, viz., 32s. 3d. per ton for No. 3 G.M.B., although chance lots may be had at 32s. These are merchants' prices. Makers ask more—33s., and even 34s., per ton, but practically they have little to dispose of. The opinion is almost unanimous, however, that prices are bound to advance, and the tendency in that direction is felt already. Warrants are quoted at 32s. 3d. per ton cash. Hematite is at 44s., mixed numbers.

Shipments of Pig Iron.—The shipments of pig iron for this month so far are far ahead of those over the same period in January of last year, being 46,260 tons up to the 23rd instant, as compared with 26,914 tons, and the excess is not confined to any one quarter of consumption, but is spread over all. The preponderance of increase in export is to Scotland, and especially to other parts of England and Wales, the latter being as 13,440 tons to 2450 tons.

Manufactured Iron and Steel.—The finished iron trade still maintains its activity, and the increased prices are unaltered. There are orders placed which will take a considerable time to complete. The finished steel trade is scarcely so busy as it was, and prices are hardly maintained. The North-Eastern Steel Works have not yet finished repairs. The lock-out, if under the circumstances it can fairly be considered one, is practically settled by the agreement of both parties to abide by the decision of an independent arbitrator in all cases of dispute.

Salt.—This trade is very quiet just now, and the increasing competition has materially toned down prices. All varieties of salt are prepared, from that fitted for domestic use to that adapted for manure. The bulk is disposed of in chemical manufactures. There is not so much of it shipped at this season of the year.

NEWCASTLE, 25th January, 1888.

Chemicals.—Though the prices of chemicals have not shown much inclination to advance lately, the demand for certain products which come largely into general use, such as bleaching powder, soda, soda crystals, caustic soda, and alkali, keeps fairly good. The output of these commodities is large, while stocks do not show much tendency to accumulate. The Newcastle Chemical Company contemplate largely extending the manufacture of caustic soda, and will commence at an early date to erect new works for this purpose. This extension will not cause any curtailment of production in the other branches of the chemical industry now carried on at the company's works. The Jarrow Chemical Company's establishment at Felling is very busy at present, especially in the manufacture of bleaching powder and alkali. The same description, however, does not apply to the company's works at South Shields, which for some time past have been rather slack. Messrs. Henderson's factory, Haworth Shore, is one of the busiest on the Tyne, the principal products being soda and bleaching powder. Messrs. Tennant's factory, Hebburn, is busy in the same branches, but some other establishments are not so favourably placed, and in one instance an early discontinuance of operations is anticipated.

Copper.—The Tharsis Copper Company are now doing a brisk business both at their Howdon factory, where the initial processes of the manufacture are carried on, and at their Hebburn establishment, where the metal undergoes the refining stages, and is finally turned out in its marketable form. There is a large demand on home account for the commodity commonly known as "blue billy," and considerable quantities are daily shipped to Middlesbrough and other centres of the iron and steel trades. The same commodity, after undergoing a special process of manufacture, finds a ready market in America, the quantity sent away since the beginning of the year being considerably over 3000 tons.

Lead.—In the different branches of the lead manufacture business is somewhat dull, but a hopeful feeling exists with reference to the future, and in the general revival of trade, which is now slowly but surely making itself felt, it is believed that this locally important industry must soon participate. The lead factory at St. Anthony's is already well employed, both in the sheet and red lead branches. At this establishment a special quality of lead is produced for exportation to China, and in this department considerable activity exists just now. The white lead department connected with this establishment has been for some time inoperative.

Colour Works.—Messrs. Shaw & Co.'s colour works, New Besswell, are exceedingly busy, the whole of the product being absorbed by American demand. The paint works at Stepney and Bill Quay are also very brisk, the demand from home and foreign sources being well maintained.

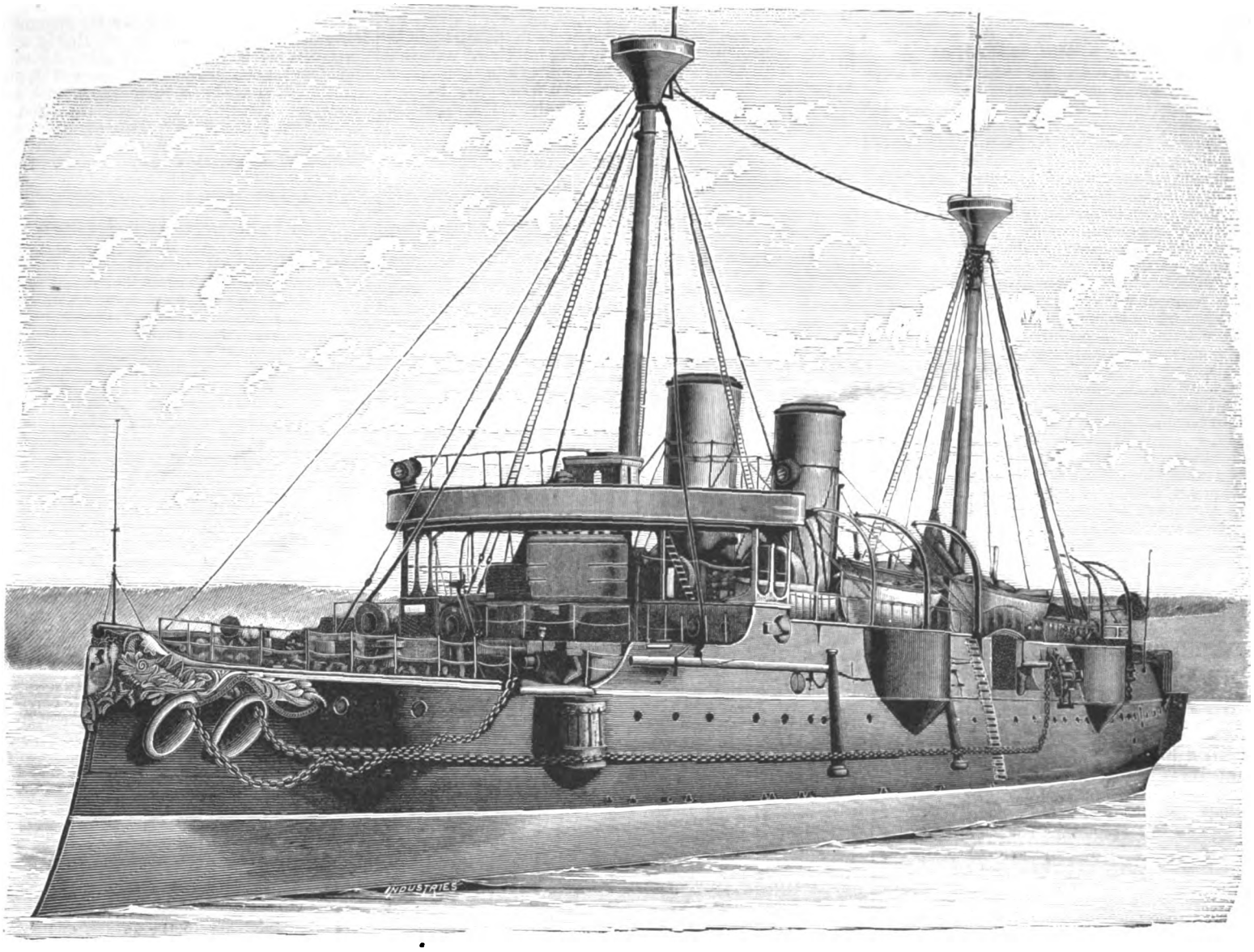
Shipping Notes.—Messrs. R. Stephenson & Co. have received from the Trinity House an order to build two large composite light ships, which will be laid down immediately at their Hebburn yard. The firm have orders for several steel steamers of a large class, two of which are now in early stages of construction. A moderate sized cruiser, which is understood to have been ordered by the Roumanian Government, was recently launched from the yard of Messrs. Armstrong, Mitchell, & Co., of Elswick. It is now receiving the engines and boilers at Messrs. Hawthorn and Leslie's works, St. Peter's.

BELFAST, 25th January, 1888.

General Trade.—All branches of industry are well employed at present, but there is not much unusual activity, and the number of hands employed continues to be under the average. Engineers and boiler makers are busier than they have been for some time, and several firms hold good orders for large sized land boilers. Felt makers are principally engaged on foreign orders. Aerated water manufacturers are doing well, and considerable quantities of the commodity have been exported during the winter months. Contractors and house builders find no lack of employment. The Durham-street Weaving Company (Belfast) opened their new concern on the 11th inst. They intend keeping 500 looms at work. Messrs. Stapley and Smith, of London, who already employ about 3000 hands in and around Londonderry and Strabane, have opened a new shirt and underclothing factory at the latter town. This firm has done much to bring this industry to its present position in the North of Ireland.

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THE SPANISH CRUISER "REINA REGENTE."



THE PADDLE ENGINES OF THE S.S. "QUEEN VICTORIA."

We illustrate, on our two-page supplement this week, the engines of the paddle steamer "Queen Victoria," which, together with her sister ship the "Prince of Wales," was recently built by the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow, to the order of the Isle of Man, Liverpool, and Manchester Steamship Company, Limited, for their line between Liverpool and the Isle of Man. The engines are of the compound direct acting type, indicating upwards of 7000 h.p., and have two cylinders placed one above the other, as seen in the illustration; the high pressure cylinder being nearly horizontal, whilst the low pressure is placed in a diagonal position beneath it, the space between the two forming a receiver for the steam exhausted from the high pressure cylinder. The two pistons, having each a stroke of 6ft. 6in., actuate two cranks placed at suitable angles. The low pressure cylinder alone is steam jacketed. Both the high and low pressure cylinders are fitted with ordinary slide valves worked by double eccentrics and link motion, and reversed by means of one of Messrs. Brown Brothers' steam and hydraulic reversing engines. All the working parts of the engines are of steel throughout, and the castings, with the exception of the cylinders and condenser, are also of steel. To further reduce the weight of the engines, the paddle shafts, crank pins, and reversing shaft are made hollow. The air pump is worked by a bell crank driven by a link from the connecting rod of the low pressure engine, and the bilge pumps, which stand on the sole plate, are worked by a lever attached to one end of the air pump rocking shaft. Separate donkey pumps on the Worthington principle are used for feeding the boilers; the water is circulated through the condenser by one of Messrs. Allen's centrifugal pumping engines. The engines are supplied with steam, at a working pressure of 110lb. per square inch, by four double ended steel boilers, one pair of boilers being forward and the other aft of the engines. The engine and boiler spaces are separated by coal bunkers. Each boiler has six of Fox's patent corrugated furnaces, making in all twenty-four furnaces. Air is supplied to the furnaces by Laing's patent system of forced draught. In this case four fans of 6ft. diam. are used—one on the top of each boiler—which draw the hot air rising from the stokehold, and force it through casings over the boiler uptakes down the ends of the boilers to the furnaces, thus thoroughly ventilating the stokehold, and at the same time supplying the furnaces with hot air. On the trial trip last June on the Clyde the "Queen Victoria" attained the average speed of 21 knots during six runs, or 24·2 miles per hour, with the engines making forty-five revolutions per minute. Her sister ship, the "Prince of Wales," however, shortly afterwards beat her, by going at the high speed of 24¼ knots per hour during a short run, and averaging 22·6 knots, or 26 miles per hour, during a six hours' run. We hope to publish further illustrations of these engines in a future issue.

THE SPANISH CRUISER "REINA REGENTE."

We give above an illustration of this interesting vessel, which has now passed out of the hands of her builders, Messrs. J. & G. Thomson, Clydebank, and is lying in the Clyde, off Greenock, ready for sea. A description of the ship was given in our columns at the time it was launched (see *Industries*, Vol. II., page 220); but as the vessel has since completed her speed trials, the following particulars may be of interest. The most striking feature is the high speed which has been attained in a heavily armed seagoing ship, with moderate dimensions and displacement. The speed of the ship under forced draught for a continuous run of four hours was 20·7 knots, while with natural draught it was found that a speed of 18½ to 19 knots could be easily maintained. The consumption trials indicate that it will be possible to steam at a speed of ten knots per hour for a distance of over 13,000 knots with the full coal supply of 1200 tons. These results have been attained by the adoption in this vessel of all the latest improvements which have been made in the construction of war ships, and especially in their propelling machinery. Among these may be mentioned the employment of twin screws, forced draught, triple expansion engines with a high boiler pressure, and the free use of wrought and cast steel both in the machinery and hull. In order to attain a maximum of protection with a minimum of weight and cost, the thick armoured sides, which have been adopted until lately in vessels of this class, have been replaced by an arched steel deck, extending for the whole length of the ship below the water line, and varying in thickness from 2in. to 4¾in. On the top of this deck arrangements are made for stowing a large supply of coal in numerous water tight compartments. The armament consists of four 21-ton breech loading guns, six 2½-ton guns, and a numerous armament of machine and quick-firing guns, four of which will be mounted in the military tops. There are also five torpedo tubes in different parts of the ship for discharging torpedoes on the Schwartzkopf system. While the offensive and defensive powers of the ship are thus of a most formidable nature, the ordinary equipment has been by no means sacrificed. There is a large complement of boats, including three propelled by steam, and capable of carrying quick-firing guns, and a considerable number of men; and powerful hoisting machinery is supplied for putting the heaviest of these boats into the water at short notice. The complement of men and officers is about 400 all told, and the entire main deck is devoted to their accommodation. Some interest attaches to the manœuvring trials of the "Reina Regente" as being the first large vessel that has been fitted with the balanced rudder, which has been patented by Messrs. Thomson. These trials were made last autumn in the Firth of Clyde, in the same manner as that in use by our own Admiralty, and the results showed that the vessel was capable of making a complete circle in three minutes when steaming ahead at a speed of 18 knots, the diameter of the circle being less than 3½ times the length of the ship.

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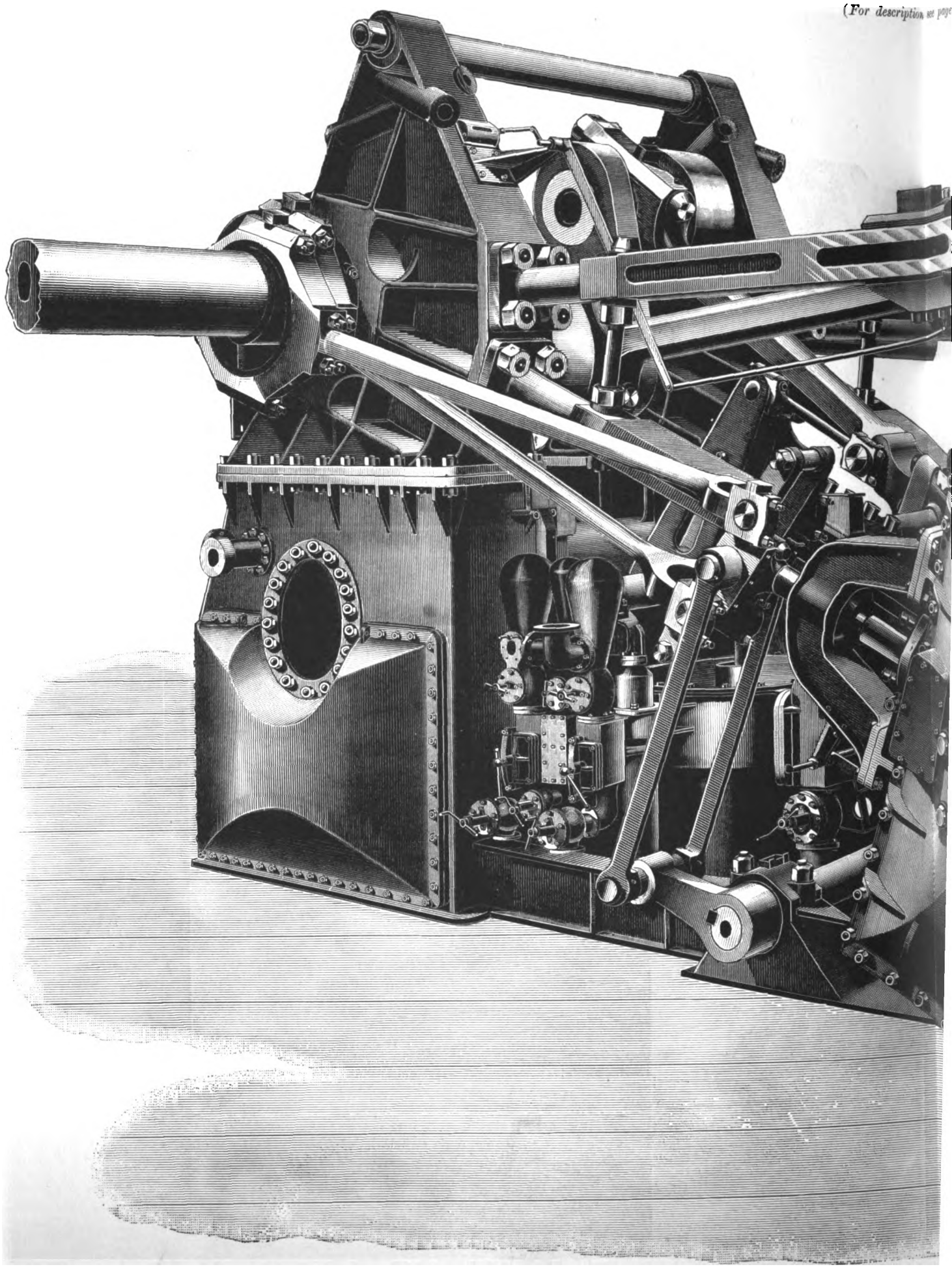
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COMPOUND PADDLE ENGINES OF

CONSTRUCTED FOR THE ISLE OF MAN SERVICE BY THE FAIRFIELD S

DIAMETER OF CYLINDERS: HIGH PRESSURE, 61IN.; LOW

(For description, see page



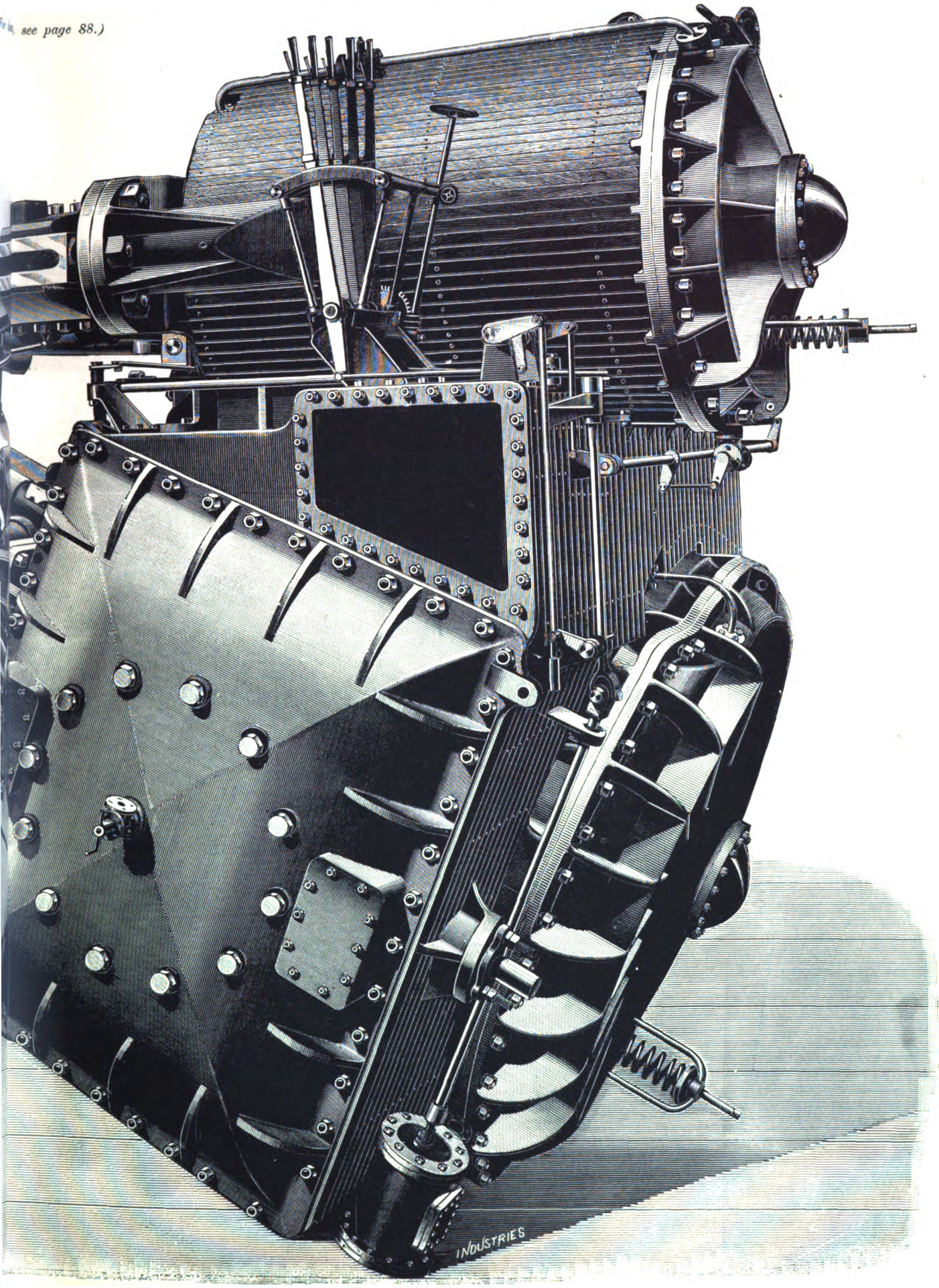
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OF THE S.S. "QUEEN VICTORIA."

D SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GLASGOW.

; LOW PRESSURE, 112IN. STROKE, 6FT. 6IN.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62, Ludgate Hill, E.C. (Watkins & Osmond.)
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With Index and Extra Supplement, consisting of Double-page Engraving, showing the
COMPOUND PADDLE ENGINES OF THE S.S. "QUEEN VICTORIA."

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 27TH JANUARY, 1888.

CHANGES IN THE CRUDE IRON INDUSTRY.

THE removal of the Dowlais Iron Works to Cardiff is one of the first visible effects of important changes which are taking place in the iron industry. By transporting their works from inland sites to the sea coast, manufacturers place themselves under new economical conditions. The very idea of such a change shocks our sense of what we have, from habit, come to regard as the fitness of things. The carrying of the idea into action so disturbs our judgment, by upsetting preconceived notions of what is natural and necessary, that we look on in bewilderment when some one, more far-seeing and enterprising than the rest, breaks away from old associations, and, like the Dowlais firm, casting prejudices aside, enters boldly on a new path. Hence it arises that the event which has stirred South Wales, and which has become the chief theme of conversation wherever a direct interest is felt in the manufacture of iron, is regarded with mingled feelings of astonishment, admiration, and misgiving. The reason alleged for this migration of works is the burdensome character of the railway charges. But these charges, which have not gone on constantly rising, would not be more and more grievously felt, nor would it be practically possible to evade them by such radical measures as those adopted by the Dowlais firm, and contemplated by others, if the economical and commercial conditions under which the works were originally founded had not materially changed. Here we touch upon the root of the matter. The progress of science, marvellously rapid in these latter days, has brought in new methods of iron manufacture. Old processes have undergone modification, fresh products have been arrived at, and the costs of production have been so diminished in certain directions that their distribution is no longer the same. The conditions and circumstances of trade have also greatly changed within the last two or three decades. Industry, which was formerly concentrated chiefly in these islands, has spread, till now we have to meet a formidable competition wherever we carry on an important trade. Easy and quick international communications, constantly diminishing freights, a more systematic conduct of commercial affairs, competition which gives grave importance to small matters, the spread of technical education; these and numerous other influences have combined to render the trade which we carry on to-day an essentially different thing from that of even a quarter of a century ago. In these altered circumstances manufacturing works situated on the sea coast may possess advantages over their inland rivals which may give them the preference, not only in the foreign but also in many of the home markets. Whether or not advantages shall accrue to the sea-side works is a question involving consideration of the particular conditions to which the industry there to be carried on is subject.

The location and grouping of existing blast furnaces, and consequently of finished iron and steel works, have been determined by conditions prevailing in the past, but which have mostly passed away. In times when two tons of coke was consumed in extracting one ton of pig iron from the ore, it was a matter of economical necessity to carry on smelting operations in the neighbourhood of the coal mines. It must, doubtless, always remain true, or so long, at least, as solid fuel is used in the blast furnace, that those localities in which abundant and readily accessible ores exist alongside rich coal seams, will produce iron most cheaply. But the difference between the past and present in this respect is that whereas formerly only such localities could be chosen as suitable seats of the iron smelting industry, now the choice is much less narrowly restricted. True, ore was often conveyed to these works from distant sources; but all ore so dealt with was of a rich character, and was used for a special purpose in conjunction with native ore. There is no instance of coal being conveyed long distances to the furnaces, none, at least, on a large and practical scale. It thus frequently happened that pig iron for export was subjected to the cost of a long land carriage, and though this charge was heavy, and our export trade in crude iron was very large, there was no remedy as long as the process of smelting required a large proportion of coal. For these reasons, many abundant deposits of ore, containing a fairly high percentage of iron, have been left neglected, even when on the sea coast and within easy reach of commodious ports, if they lie remote from seams of suitable coal. These are the principle characteristic features of a situation that has begun to pass away. Urged on by the necessity born of keen competition, manufacturers have sought to reduce the consumption of fuel, and, guided by a constantly widening knowledge, they have achieved no small success in that direction. By the middle of the decade beginning with 1860, the consumption of coke in the blast furnaces had been reduced, for ordinary qualities of ore, to 1·25 tons per ton of pig made. Since that date further progress has been made. The latest American practice, which seems to keep slightly ahead of our own, brings the quantity down to 0·8 ton. It is, moreover, to be remarked as a circumstance not without influence on the events we are considering, that greater knowledge and more efficient means of coking have enabled us to utilise for metallurgical purposes classes of coal formerly held to be worthless for coke manufacture. A little reflection on these facts is sufficient to reveal the wide significance of the changes which have taken place. To go no farther back than the period included between 1860 and 1870 for a comparison, it is quite another thing to transport from the collieries to the blast furnaces 80 tons of coke, instead of 125 tons, for every 100 tons of pig iron made. There is no reason to believe that the lowest limit has yet been reached, so that we may, without straining probabilities, contemplate a future, even in the present century, in which 75 tons of coke will be the standard for ordinary practice. Under these new conditions it is easy to understand that the proprietors of the Dowlais works will find it more advantageous to bring their fuel rather than their iron down to Cardiff. On the coast they will be in the best position for the export of their produce, either coastwise or to foreign parts, and for the reception of the foreign ore which they find it necessary, or desirable, to use. Here we have the key to the position. When we have recovered from the surprise which the announcement of this new departure has occasioned, we shall recognise the wisdom of the step, and find encouragement in the knowledge that our manufacturers are alive to the needs of the times, and sufficiently enterprising to give effect to the judgment they form concerning the requirements of the situation.

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The question has a wider bearing than that we have hitherto assigned to it. The migration of our large inland works to the sea coast is certainly a matter of high importance to the prosperity of our iron industry; but the movement will not stop there, and its further development is likely to shape our destiny in the industrial world in a yet higher degree. The conditions now prevailing invite the transference of British energy and British capital to foreign shores. This movement is, indeed, in progress now; but it has not yet involved, except in an incidental way, the blast furnace industry. And yet the fairest prospects are in this direction. The opportunity will assuredly not be neglected by the foreigner. What we may expect is to be seen in the line of action adopted by the Italians. These enterprising people, though placed at a serious disadvantage by nature in depriving them of coal, have determined to establish a great iron industry. Already surprising progress has been made. What this progress has been is partly indicated by the fact that our export of coal and coke to Italian ports increased from 2,354,103 tons in 1884 to 3,186,854 tons in 1887. Hitherto the Italians have directed their attention chiefly to the development of the finished iron and steel branch of the industry, importing most of their crude iron from England—55,749 tons in 1885, 69,175 tons in 1886, and 122,994 tons in 1887. But they have at the same time done something towards the utilisation of their own abundant and rich deposits of ore. There are blast furnaces in operation working on native ores with imported English made coke, and the results having been found satisfactory, projects are being formed and preparations made to gradually extend the system. Much of the Italian ore is rich in iron and of remarkable purity. The Elba ores are well known. But there are others of good quality in abundance, and within easy reach of the sea ports. Now, if we assume the cost of manufacture on the spot to be the same as in this country, it will be manifestly more advantageous to import 75, or even 80, tons of coke than 100 tons of pig iron from England. But labour is cheaper in Italy than here, so that the advantage would be made greater on this account. These facts are being pressed upon the attention of the Italian Government, who may be expected to protect this young crude iron industry by imposing, before the present century is out, a heavy duty on foreign pig iron. We cite this example as the most striking out of many that might be adduced. It is sufficient to indicate the probable course of events. Others will suggest themselves to our readers. The department of the Meurthe-et-Moselle in France is a case in point. That locality, which is the principal pig iron making centre in France, has no coal. The whole of the coke consumed in the blast furnaces is imported partly from Belgium and partly from the department of the Nord. Under the conditions of iron manufacture prevailing a quarter of a century ago, the Meurthe-et-Moselle, rich as it is in excellent ores, could hardly have competed successfully with its neighbours, which have received their smaller endowment of ore along with the coal necessary to reduce it. The future has probably in store for us many examples of this sort, and we are made to think of these by the reports which reach us from across the Atlantic of 5510 tons of pig being made with a consumption of 4425 tons of coke, and by the announcement from South Wales relating to the migration of the great Dowlais Iron Works.

THE PANAMA CANAL.

The position of the French Government in the Panama Canal question becomes increasingly difficult as the chances of making the canal on the original plans, and within the stipulated period, are gradually vanishing. When, under M. de Freycinet's administration, M. Rousseau, the chief engineer of roads and bridges in France, was dispatched as one of a commission to investigate the progress made in Panama, French investors naturally expected to receive straightforward advice as to the wisdom or otherwise of putting money into the undertaking; but M. Rousseau's report was not by any means conclusive. It contained, on the one hand, an abundant glorification of the great French canal maker as to his moral character and general ability; and, on the other, an assertion that the undertaking would prove impracticable unless the original plans were considerably modified. When French investors, belonging generally to the middle and poorer classes, have sunk sixteen millions sterling in an undertaking, no Minister would dare to advise the abandonment of the scheme, and so the Panama Canal went on swallowing successive loans, not, indeed, with the sanction, but at any rate under the tolerance, of the Government. At the present moment more money is again required, and this time M. de Lesseps actually proposes that the French Government should assist in procuring it for him by bringing in a bill to authorise a lottery. The reason he gives for raising money by such means is his anxiety to secure to Frenchmen the glory and substantial reward of having supplied the whole of the capital required for the canal; but his request has not been received in this patriotic spirit by the Government, both M. Tirard and M. Rouvier flatly refusing to lend State aid to such a lottery. The bill for sanctioning the lottery will, therefore, have to be brought in by a private member, and considering the great personal influence of M. de Lesseps, and the fact that amongst the constituents of almost every member there are many who would suffer certain and immediate loss by the abandonment of the canal, it seems likely that the bill will pass.

It is interesting to note that simultaneously with this new attempt to raise money, M. de Lesseps has virtually abandoned his original scheme for a low level inter-oceanic canal without locks. It is announced by M. Max de Nansouty, in the *Genie Civil*, that the change of plans was adopted in consequence of the representations made by M. Eiffel, who came to the rescue with an offer to construct the necessary locks, in order to avoid the gigantic earth works which would otherwise be required in cutting through the central range of hills. Only by this means will it be possible to get the magic streak of water between the two oceans within the stipulated time, and M. de Lesseps knows only too well that on the moral effect of this feat the financial success of the whole undertaking depends. The total length of the canal is about forty-six miles, and according to M. Eiffel's plan there will be the following locks: The first of 26ft. lift at the fourteenth mile from Colon, the second of the same lift at the twenty-third mile, and two of 36ft. lift at the twenty-seventh and twenty-ninth miles respectively. By means of these four locks a height of 124ft. above the sea level will be reached in the eastern portion of the canal. In the western or Pacific portion there are to be three locks of 36ft. each, and one of 26ft.; but it is possible that to reduce the amount of cutting on the watershed one more lock may be found necessary, making the difference of level between the Atlantic and the highest point in the canal 160ft. All the locks but this last one will be supplied by gravitation from rivers; but for the highest lock steam pumps will be necessary, the total power being estimated at 3600 h.p. The locks will have a minimum width of 59ft. at the entrance, and will be 590ft. long. M. de Nansouty calculates that with a speed of six miles an hour in the straight reaches of the canal and 2½ miles in the bends, a vessel will pass from one sea to the other in 17½ hours, and that ten vessels will be able to pass through daily. Under these conditions the total annual capacity of the canal would slightly exceed nine million tons of traffic. Since this figure is in excess of the traffic originally estimated by the Panama Canal Congress (7,500,000 tons), it is difficult to see why the Eiffel scheme should be considered by M. de Lesseps as only provisional; but in the article already quoted we are told that the canal with locks is only intended to establish communication as quickly as possible, and that the original scheme of a low level canal without locks will be carried out as soon as the provisional canal is in working order.

GLASS BOTTLE MAKING BY MACHINERY.

In the closing weeks of last year we were thrown into a happy frame of mind, as a fitting preparation to the festive season of Christmas, by an announcement loudly trumpeted forth by the daily press and more feebly echoed by some of the weekly technical journals, to the effect that a British inventor had triumphed over difficulties which none of his predecessors had been able to cope with, and had thereby rendered British manufacturers, if not exactly able to "lick all creation," at least competent to hold their own against their Continental rivals in the glass bottle making industry. The discovery of this bright prospect in one of our industries was made by a party of upwards of thirty newspaper representatives "of all sorts," who, at the invitation of Messrs. Sykes, Macvay, and Co., travelled from London to Castleford, Yorkshire, on the 16th of last month. In the week following, newspaper articles dealing with the glass bottle trade abounded, and this exertion has been kept up, for in *The Times* of Wednesday last there appeared a description of this invention. The public were led to believe—that is, that portion of the public which is in the habit of taking its opinions ready made from the newspapers—that a complete revolution in the bottle making industry was about to take place, that the cost of labour was to be reduced from 3s. 6d. to 3d. a gross, that in consequence of this enormous reduction we should be relieved from the oppressive competition of the foreigner, that the life of a glass blower was to be prolonged to the allotted span of three score and ten years, and that, in a word, an age of prosperity for the British bottle maker was about to dawn above everything we could ask for or imagine. When blessings pour down in this April shower sort of way, we are apt to suspect that things are not what they seem. It may be that there has been no exageration in this case; but we must confess to a feeling of apprehension that the prospect is too good to be true. This apprehension becomes, unhappily, greater as we look more closely into the facts which have been set forth for our delectation by the newspaper reporters aforesaid. Some of them will scarcely bear a near inspection; others change their aspect under examination.

We have no desire to depreciate Mr. Ashley's invention, which may possess all the merits claimed for it. Doubtless it is regarded as a practical and efficient machine by those who have taken it in hand, and it is not unlikely that it has a great future before it. But seeing that it has scarcely passed beyond the stage of a working model, we cannot but view as premature all practical conclusions arrived at concerning it. A large number of patents has been taken out in past years, both in this country and abroad, for machines to do the same work. For some reason or other these have not come into use. We are told by some of the newspaper representatives that the Castleford machine differs from these only in the mechanism for moulding the neck. Now, on this point, a high authority on glass bottle making assures us that a moulded neck can never equal in strength one made in the usual way. The glass which is put by hand round the neck to form a strengthening band acquires, as it is drawn out, a kind of grain or fibrous structure, which gives it a greatly increased resisting power in the direction of its length, and thus forms a hoop of sufficient strength to withstand the pressure of the cork.

But passing this by as a matter of detail, there remain some objections to the views enumerated in the articles resulting from the trip to Castleford. It is calmly assumed, as if the matter were beyond the possibility of doubt, that this machine will practically give a monopoly of the trade to those who obtain a license to use it. But when, as in this case, an inventor has been preceded, accompanied, and followed in the same field by so many competitors, and the records of the Patent Office are crowded with specifications, it is hard to see what claims can be made that shall be wide enough to keep every workable machine in the hands of the owners of Mr. Ashley's patents. Another unjustifiable assumption is that the manufacture of bottles by this machine involves no more than its erection at existing works. The trades unions have already set their faces rigidly against the introduction of such machinery, and those who know the glass trade will be aware that only by the erection of new works and the employment of a fresh set of men, outside the control of the unions, can mechanical manufacture be successfully established in this country. Any change of this character must, therefore, be slowly effected, and under conditions which will largely checkmate the advantages afforded by the new system.

But it is when dealing with the commercial side of the question that we find ourselves most at variance with the statements so confidently put forward. Take, for example, the evidence adduced to show the importance of the trade which, it is alleged, is to be recovered by adopting this machine. "We are importing," so runs the statement, "16,000 gross of glass bottles a day from the Continent." In another place we are told that the Continent, in this case, means Germany and Belgium. This then is the trade which we are to win back by means of the Ashley machine. Let us see how these figures will bear close inspection. Assuming that the 16,000 gross is an average for the 310 working days only, the imports for the year must amount to 4,960,000 gross, or more than 700,000,000 bottles. It is to be borne in mind that Messrs. Sykes, Macvay, & Co. are described as makers of wine, beer, spirits, and aerated water bottles, and pickle jars, and that all the remarks made appear to have reference to those classes of bottles. In these circumstances we may presume the 16,000 gross to consist chiefly of such ware. Now the works of Messrs. Sykes, Macvay, & Co. are said to be amongst the largest and best equipped in the kingdom; they give employment to 300 hands, and their daily output of bottles is 420 gross. We are further informed that these hands are unable, by reason of the exhausting character of the

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labour, to work more than five days a week. Basing a simple calculation upon these data, we learn that to manufacture 714 million bottles said to be annually imported from the Continent, forty-five such works as those of the Castleford firm, or their equivalent, employing 13,500 hands, must be kept going full time. This is a startling revelation, and it is moreover of a character to suggest doubts. Proceeding a step further, these doubts are resolved into absolute disbelief when we compare the results of our calculation with the records of the import trade in glass contained in Board of Trade returns. We there find that the "Unenumerated Manufactures of Glass," under which description bottles are included, imported in the year 1887 amounted to 746,153cwt. These goods consist chiefly of bottles; but the total, it is to be observed, falls short of three-quarters of a million cwt. The weight of ordinary wine, beer, and spirit bottles is about 230lb. per gross, that of half bottles and aerated water bottles about 150lb., and pickle jars average about the same as the aerated water bottles. We should not be far wrong if we assumed 200lb. as the average weight of all the imported bottles of these classes. But to keep on the safe side, we will take 180lb. Multiplying by this average, we find the weight of the 714 millions of bottles to be about eight million cwt., a quantity nearly eleven times greater than that given in the Board of Trade returns. Turning now to the official statistics of the importing countries, we learn that the quantity of glass bottles shipped from Germany to Great Britain in 1887 amounted, in round numbers, to 123,000cwt. It is probable that this quantity was swollen by a considerable proportion of the same class of goods sent from Hamburg and Bremen; but the total consignments did not exceed 690,000cwt., and of course only a part of this quantity came to England. The Belgian Customs returns show that the exports of bottles to England were last year under 300,000cwt. It is clear then from these facts that if the statement in question is in any sense true, it must have reference to such small ware as medicine and scent bottles, of which, by the way, it may be remarked that we are ourselves large manufacturers. But granting the possibility of making up the numbers in this way, the disparity in the figures cannot be explained away in this manner. The weight of common medicine bottles—those that are most largely used—is about 45lb. per gross. Now, if the 16,000 gross said to be imported daily were made up wholly of these bottles—which, of course, is not the case—the total quantity would amount in the year to two million cwt., a quantity greater by some 337,000cwt. than that of all the glass goods of every sort imported in 1887.

Leaving it to the authors of these large statements to explain away on other grounds the difficulty which to us is insuperable, we readily admit that the import trade in bottles is of sufficient importance to be worthy of an effort for its recovery. But assuming that the Castleford machine is about to be generally adopted in this country, will the result be, as predicted, to at once crush out this import trade? We think not. What is to prevent the foreigner from adopting mechanical manufacture in his turn? If there is but little hope of creating a monopoly at home, there is still less of controlling the industry abroad. In nearly all Continental countries where inventions are protected by patents, a manufacturer can compel the inventor to grant a license to use the machine on reasonable royalty. But in a case like the present, in which the task of avoiding the patentee's claim is easy, a different course would probably be followed. Anyhow, the foreign manufacturer would keep pace with his British rival, and the conditions of the trade would, in their international features, remain unchanged. It is admitted that the glass bottle trade has gone to Germany and Belgium, because labour is cheaper in those countries than in our own. Probably, then, there is but one means of recovering this trade, viz., by equalising the rates of wages. When the British trades unions have seen fit to level down to the Continental point, or when the foreign trades combinations have succeeded in levelling up to the British rates, which, of course, would be preferable, then—and not till then—these large imports will disappear from the Board of Trade returns.

THE PARIS ELECTRICAL LABORATORY.

While our own Electrical Standards Committee, instituted by the Society of Telegraph Engineers and Electricians, is apparantly unable to get together the funds necessary for the establishment of a laboratory where electrical instruments could be officially tested in a manner similar to that adopted at Kew for thermometers and watches, French electricians have progressed much better in this respect, the reason evidently being their command of a considerable fund which was left over from the Paris Electrical Exhibition of 1881. As the electrical laboratory in Paris will shortly be opened, a brief sketch of its history may be interesting to our readers. The Paris Exhibition was not only scientifically and technically, but also financially, a great success, and at the close of it the general commissioner, M. G. Berger, was able to hand over to the Minister of Posts and Telegraphs the sum of £12,000, to be used eventually as a fund for the establishment of some kind of electrical laboratory. For a time the matter remained in abeyance, there being no public body of sufficiently strong position to initiate a work of such importance. But after the establishment of the International Society of Electricians in 1883, with M. G. Berger as its first president, this Society instituted a committee to report on the ways and means for establishing the laboratory, whilst the president took the necessary steps at the Ministry of Posts and Telegraphs in order to have the fund transferred to the control of the Society. In due course, the secretary of the committee, M. E. Sartiaux, published a report containing particulars of various other electrical laboratories, and based upon this report the Society definitely resolved to carry out the project for which the fund was originally intended. In this task they were well supported by private manufacturers, the Brothers Menier, for instance, giving them, rent free, land and buildings at No. 20, Rue Rouelle, in the Quartier de Grenelle; whilst a steam engine, a gas engine, and some electric machines and apparatus were lent free of charge by the respective makers. The buildings required some slight alterations, which were carried out under the superintendence of M. Dutreuil, the architect to the International Society of Electricians, but otherwise very little money was needed to complete the internal fittings of the laboratory. In consequence of this economy the greater portion of the fund is still intact, and the interest will be used to provide the working expenses. The Society, now under the presidency of M. Mascart, has appointed M. de Nerville as general director of the laboratory. This gentleman is a telegraph engineer, and is well known in France for the work he did there years ago in connection with MM. Mascart and Benoist in making a determination of the legal ohm. The programme of the laboratory is a fairly wide one. It is proposed that facility should be given to private individuals and manufacturers of electrical machinery for making researches which they could not carry on at their own laboratories or works. It is also proposed to standardise electrical measuring instruments, and to supply with each instrument which has been tested a certificate showing its limits of error; also to test electrical machinery generally, and to institute researches which the International Society of Electricians might deem of sufficient general utility.

Letters to the Editor.

A NEW DEPARTURE IN WELDING.

To the Editor of "Industries."

Sir,—With reference to Mr. Fletcher's letter, published in several of your contemporaries, it may interest him and your readers to know that for years past we have, in the manufacture of Fox's patent corrugated boiler furnaces, been welding Siemens mild steel plates from $\frac{1}{4}$in. to $\frac{3}{4}$in. in thickness with ordinary gas and air, using a form of blow pipe jet. The aggregate of our welding during the past year would be represented by some 20,000 lineal feet, the tubes being from 2ft. to 5ft. in diameter, and made to work at pressures up to 200lb. per square inch. The amount of oxide formed is dependent upon the relative amounts of gas and air employed, an oxidising flame producing more and a reducing flame less. The surfaces of our tubes are perfectly clean and free from scale, which shows an absence of oxide.

Yours, &c.,
W. L. Wildy, Engineer.

Leeds Forge, Leeds, 24th January, 1888.

TRANSMISSION OF POWER.

To the Editor of "Industries."

Sir,—I must demur to your statement on page 40 that the experiments between Kriegstetten and Solothurn, in Switzerland, "have shown that about 75 per cent. of the power at the generating station is actually available at the motor station, the distance over which the transmission takes place being close upon five miles." The power at the generating station is said to have been about 40 h.p., and the dynamo was big enough to absorb the whole of this. Only 50 per cent. of the power available was therefore delivered. What was measured was the power expended on the armature of the generator, and that given out by the motor when both were working together, and these were in the ratio 100:75. We ought to know the power expended on the generator when the motor was replaced by an equivalent resistance, and when it was free from the reaction of the back e.m.f. The ratio $\frac{\text{power delivered}}{\text{power available}}$ is a very different thing to $\frac{\text{power delivered}}{\text{power expended}}$. The power available is usually measured when the motor is out of circuit, the power expended when the motor is in circuit. This does not appear to have been done in Solothurn, and is a blot on those otherwise admirable experiments.

Yours, &c.,
W. H. Preece.

G.P.O., London, 18th January, 1888.

BELGIAN FOUNDRY PRACTICE.

To the Editor of "Industries."

Sir,—In Mr. Dixon's presidential address, printed in your issue of the 20th inst., there is a statement to the effect that in a certain Belgian workshop moulds are made without patterns, the drawings being sent direct into the foundry. If any of your readers can give detailed information on this very exceptional workshop practice, it would be both novel and interesting to a large number of technical men.

Yours, &c.,
The Author of "Pattern Making."

25th January, 1888.

THE BOARD OF TRADE INSPECTORS AND GREEN'S ECONOMISERS.

To the Editor of "Industries."

Sir,—In the report of a preliminary inquiry (No. 242) under the Boiler Explosions Act, 1882, upon an explosion of a Green's economiser at Junction Mill, Chadderton, Lancashire, I find the following expression of opinion given by Mr. William H. Woodthorpe, who it appears made the inquiry in question, viz., "the working of these *so-called* economisers (the italics are mine) should be attended to with great care, as only by so doing will disastrous explosions be avoided; and it would be well if the nature of the material from which these apparatus are constructed were fully understood by those interested." He then goes on to say in reference to these "*so-called economisers*" that "in this mill five boilers are employed, but four only are used at one time. Under these circumstances I am inclined to think there is little need for an economiser being fitted, as by easily working all the boilers at once the owners would effect a substantial saving." These statements are supplemented by the following "observations" among others by his chief, Mr. Thomas W. Traill: "Cast iron, it is hoped, is getting to be regarded as an unsuitable material of which to make such apparatus. I have before expressed my opinion on this point, and I regard such structures as described in this report to be a constant source of danger."

I presume that before Messrs. Traill and Woodthorpe decided to publish such statements they must have had at least some facts and foundation to rest them upon. As the document is public property, and they are public servants, it seems to me there is no impropriety in my inviting these gentlemen to give the reasons for the faith that is in them on this subject; and I shall be glad to know: First, why does Mr. Woodthorpe describe Green's economiser as a "so-called economiser?" That expression—if it means anything—would indicate that it is only so in name and not in fact. If he has sufficient evidence to support that statement it should be at once made public, as steam users have for the last thirty years had implicit reliance upon this apparatus producing an economy of from 15 to 25 per cent. of the total fuel burnt under their boilers, according to the circumstances of each case. Many thousands of such apparatus are in use, and an enormous sum has been expended upon them. Similar apparatus are every day being applied, all of which outlay might be saved if Mr. Woodthorpe be correct. He gives in the case of the Junction Mill, Chadderton, a suggestion: Four boilers only, he states, are usually worked, and an economiser, and to discontinue using the economiser and to use in its stead a fifth boiler, or, to use his own words, "By easily working all the boilers at once the owners would effect a substantial saving." I would here just ask what would be the further saving effected by putting down and using a sixth, or say a seventh boiler, and so on? That is to say, where does the saving produced by adding boiler room stop? Will Mr. Woodthorpe supply the formula for calculating this point. In another part of Mr. Woodthorpe's report, speaking of the heat to which the pipes were exposed, he says: "I would estimate the temperature of the pipe to have been about 560°F." By this, I presume, we may fairly assume that the escaping gases were at a temperature of at least 560°. If so, then experience shows that a saving of from 20 to 25 per cent. would be produced by fixing a Green's economiser; but if putting in another boiler instead will "effect a substantial saving" even upon that result, engineers who are not connected with the Board of Trade have, it would appear, still much to learn, and also to unlearn.

It would be most interesting to know on what basis Mr. Woodthorpe's opinions on this most important matter rest, and if he can substantiate his statements, he will confer a great boon not only upon steam users, but also upon the great body of engineers who have for so many years been recommending and erecting these "so-called economisers."

Further, "these structures"—by which I suppose is meant Green's economisers—are in the opinion of Mr. Thomas W. Traill, "a constant source of danger," and can only be prevented from "disastrous explosion" by being "attended to with great care." Might I ask Mr. Woodthorpe whether it would not be well to give us a list of the explosions which have already occurred to "these structures," and the proportion they hold to the number of economisers at work? Is it not, sir, a fact within your own knowledge, that economisers receive little or no attention, are seldom or never inspected, and in fact, are not the whole of the conditions laid down by Mr. Woodthorpe totally neglected? And yet, with the exception of a few cases, little trouble is found to be given by "these structures," either from the nature of the "material" used, or the manner in which they are designed. So little risk is experienced or thought of in relation to them that it is only within the last few years that insurance companies have canvassed for their insurance, and I very much question whether even the largest insurance company has one hundred insured, amongst the 23,000 boilers under its charge.

It appears to me, so far as evidence is obtainable by ordinary persons, that Messrs. Traill and Woodthorpe have grossly misrepresented the risk accruing from "such structures," and that they have needlessly raised a feeling of serious alarm in the minds of a very large number of steam users. If Messrs. Traill and Woodthorpe can confirm their statements much good may result; but if, on the other hand, they have no solid grounds for their action, much mischief has been done by raising feelings of doubt and dread with regard to one of the greatest improvements in steam engineering of the present generation.

Yours, &c.,
Manchester, 21st January, 1888. Economiser.

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TRIPLE EXPANSION ENGINES FOR TEXTILE FACTORIES.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Replying to the inquiry of your correspondent "H." in your issue of the 13th inst., as to "whether any makers have as yet applied the system of triple expansion to stationary engines for textile factories," I beg to state that, so far as my knowledge goes, the first occasion on which such an application was made was in January, 1868 (just twenty years ago), at Messrs. Day, Nephew, & Son, Calder Wharfe Mill, Dewsbury. Triple expansion engines were then made in conformity with the patents of my father, Mr. J. S. Crosland, of Manchester, and to his designs and drawings. They consisted of two low pressure cylinders of 28in. diam., and two intermediate cylinders 18½in. diam., all having a stroke of 5ft., and two high pressure cylinders 14½in. diam., each having a stroke of 2ft. 6in. The engines ran forty revolutions per minute. From the annexed diagrams, taken 2nd September, 1870, by the Boiler Insurance and Steam Power Company, Manchester, it will be seen that with a pressure of 135lb. per square inch in the boiler at the time of indicating, an average pressure of 71lb. was maintained in the high pressure cylinder, 26·1lb. in the intermediate, and 6·4lb. in the low pressure cylinder of No. 1 engine, and of 71·4lb., 26·4lb., and 5·97lb. in the corresponding cylinders of No. 2 engine, developing altogether 410 i.h.p., and that for a weekly consumption of 24⅓ tons of coal, or at the rate of 1·85lb. of fuel per i.h.p. per hour.

Diagrams taken from the Triple Expansion Engines belonging to Messrs. Day, Nephew, & Sons, Calder Wharfe Mill, Dewsbury. September 2nd, 1870.

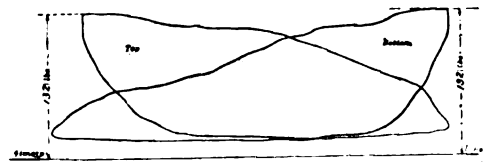


DIAGRAM OF HIGH PRESSURE CYLINDERS—Diam. 14½in., Stroke 2ft. 6in.

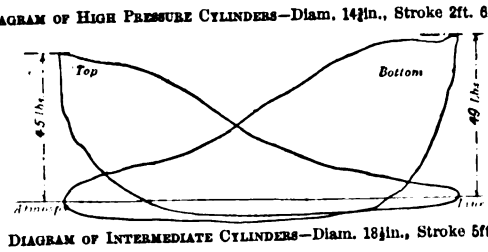


DIAGRAM OF INTERMEDIATE CYLINDERS—Diam. 18½in., Stroke 5ft.

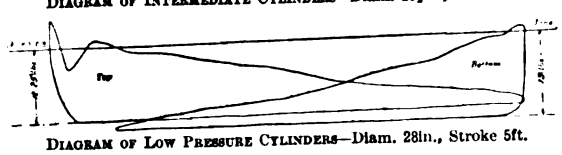


DIAGRAM OF LOW PRESSURE CYLINDERS—Diam. 28in., Stroke 5ft.

Steam for these engines was supplied from two boilers, modifications of the elephant or French type. The size of the fire grate of each boiler was 4ft. by 4ft. 6in., giving a total fire grate area of 36 sq. ft. The evaporative power of these boilers did not exceed 6lb. of water per lb. of fuel consumed, and the result attained of 1·85lb. of fuel only per i.h.p. per hour, shows clearly the extremely economical results obtained by these engines. An examination of the diagrams given herewith will show the very small weight of steam used per i.h.p. Had boilers of the marine type or of the multitubular class been employed, and an evaporation of from 9lb. to 10lb. of water obtained, the result would have equalled anything that has so far been done either on land or afloat.

Diagrams taken from the Triple Expansion Engine belonging to Mr. Thomas Ashworth, Cleator Mill, Carnforth. July 11th, 1872.

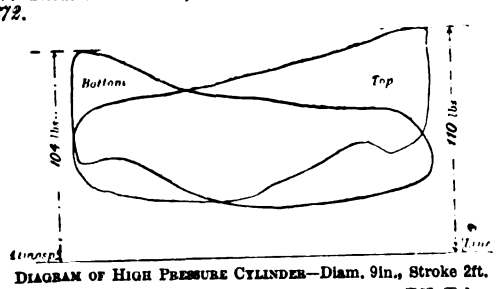


DIAGRAM OF HIGH PRESSURE CYLINDER—Diam. 9in., Stroke 2ft.

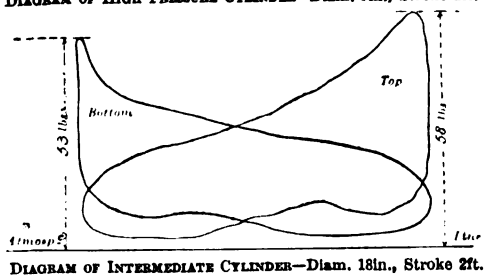


DIAGRAM OF INTERMEDIATE CYLINDER—Diam. 18in., Stroke 2ft.

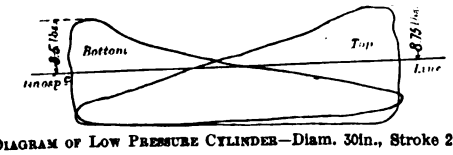
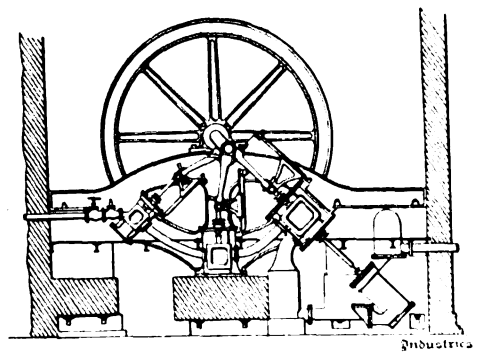


DIAGRAM OF LOW PRESSURE CYLINDER—Diam. 30in., Stroke 2ft.

In the year 1870 the Fairbairn Engineering Company, Limited, Manchester, constructed and set to work a triple expansion engine from the patented designs of my father, at the Cleator Mill, Carnforth, belonging to Mr. Thomas Ainsworth. The high pressure cylinder in this instance was 9in. diam., intermediate 18in., and the low pressure cylinder 30in., each cylinder having a stroke of 2ft., and the engine ran sixty-six revolutions per minute. All the three cylinders, and also the connecting pipes between the cylinders of this engine, were steam jacketed, and supplied with steam direct from the boiler. From the diagrams taken 11th July, 1872, also by the Boiler Insurance and Steam Power Company, it will be seen that the average pressure in the high pressure cylinder was 50lb., that in the intermediate cylinder 25·25lb., and that in the low pressure cylinder 11lb. The feed water was used entirely cold. The total power developed by the three cylinders was 138 i.h.p., and the coal consumption 2·2lb. per i.h.p. per hour. Steam for this engine was supplied by two of Sir William Fairbairn's patent boilers, at a pressure of 150lb. Each of these boilers consisted of three shells 3ft. 9in. diam. and 22ft. in length; the upper shell being placed above two lower ones, and used for a steam and water reserve, the lower shells having one internal flue each, 2ft. 9in. diam. The evaporative power of this boiler would not be great, and probably did not exceed 6lb. or 6½lb. of water per lb. of fuel The same remarks as to the excessive cost of producing steam and the further economy which might have been produced by more economical boilers for this engine apply as in the case of Messrs. Day, Nephew, & Son. So thoroughly satisfactory in every respect was the working of this engine, that Mr. Ainsworth ordered and had fixed alongside a duplicate engine, in the year 1872.



CROSLAND'S TRIPLE EXPANSION ENGINE. 1868.

Having regard to the great interest now taken in high steam pressures and triple expansion engines—especially by marine engineers—and to the claims made for their introduction into general practice, it may be interesting here to remark that my father had previously laid his designs for the triple expansive working of steam engines, and using high pressures of 150lb. and upwards, before Sir William Fairbairn; and so thoroughly did he agree and concur with my father's views, that he made arrangements with him for the sole right of making his triple expansion engines under his patents. Sir William was making arrangements for starting this work when his failing health and subsequent death put an end to the further prosecution of the scheme. The principle of triple expansion, the use of pressures from 150lb. and upwards, and my father's general designs, had his full approval, and he would but for his death have been instrumental in bringing them forward and giving them the prominence they deserved, in which case your correspondent "H" would probably not have required to make his inquiry, as the system would have been as well known and appreciated for stationary purposes as it now is for marine engines. Marine engineers have, I believe, and as I have shown, simply followed, and have not originated or led to this change in engineering practice, as "H" appears to think; and in proof of this I send you the above illustration showing one design of my father's engines. A description of a similar engine was given by your contemporary *Engineering*, page 392, 3rd June, 1870, and on page 394 of the same issue there is a good illustration. A full description of the Fairbairn boiler can be found in the same journal, commencing at page 298 in the issue for 3rd May, 1872.

Yours, &c.,

J. F. L. CROSLAND.

Manchester, 17th January, 1888.

TO THE EDITOR OF "INDUSTRIES."

SIR,—In reply to your correspondent "H.," whose letter appeared in your issue of the 13th inst., we beg to state that we are now manufacturing triple expansion engines for electric lighting purposes. If you will kindly publish this reply to "H." we shall deem it a favour.

Yours, &c.,

MARSHALL & Co.

Keighley, Yorkshire, 20th January, 1888.

Reviews.

THE BRITISH COLONIES AND THEIR RESOURCES. By James Bonwick, F.R.G.S. London: SAMPSON LOW, MARSTON, SEARLE, & RIVINGTON. 1886.

This book was written in view of the recent Colonial and Indian Exhibition, not only for the purpose of directing attention to the contents of that Exhibition, but also for creating a wider interest to the heritage of the people of these British Isles in distant places. It is a very useful contribution to what has recently been called commercial geography, and it contains notices of British Colonies in Asia, British Colonies in Africa, British Colonies in America, and British Colonies in Australasia, and special attention has been devoted to those least known to the general public. As the author remarks, traders of every sort, manufacturers and merchants, are interested in a knowledge of the resources and requirements of our own possessions. Politicians can no longer afford to pass by Colonial topics, as the prosperity of the British Islands is now indissolubly associated with the welfare of our dependencies, upon the sound principle that trade follows the flag. A closer connection of all parts of the British Empire with its three hundred millions of people is much to be desired, since the world's true progress will be thereby so extended and hastened. Such a connection can only be brought about by the collection and distribution of correct information regarding the various parts, and books of the class we are noticing will be extremely useful for these purposes.

TRANSACTIONS OF THE NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS. Vol. III. Edited by the Secretary. Newcastle-upon-Tyne, 1887.

We are much pleased to find that the third volume of the Transactions of the North-East Coast Institution of Engineers and Shipbuilders maintains the high standard of the two previous volumes. The papers are excellent in quality, and the discussions add much to their interest and value, while the volume is well got up both as regards printing and illustrations. We are sorry, however, to observe that the Institution has spent more money upon it than was warranted by the ordinary revenue. We trust, however, that arrangements will be made for increasing that revenue, and that the members will not allow the quality of their Transactions to deteriorate. The volume under consideration begins with a list of the publications received in exchange for the Transactions, and a summary of their contents which will be exceedingly useful to the members. One of the greatest wants of the present day is a convenient system of reference to the work done in the different departments of pure and applied science. An immense amount of energy is spent on work which is practically buried, and if the results of that work were more generally available much time and money would be saved. The inaugural address of the President, Mr. Doxford, was noticed in almost all the scientific journals at the time of its delivery, and afforded material for a considerable amount of discussion, which we need not now renew. The paper by Messrs. Nichol and Gravell on "The Use and Transport of Liquid Fuel" will be useful not only to engineers but also to merchants who require to study the commercial aspects of the questions involved, while that by Mr. Mudd on the "Plan and Construction of Marine Engine Works" is a very good study of the conditions which are of importance in all such works, rather than those which are rendered expedient in particular works owing to local circumstances. The elaborate paper by Mr. Foster on "The Principle of Work" in relation to the strength of structures, and the fallacy of "The Accepted Theory" of the strength of hollow shafting drew out a long and interesting discussion. We have not space even to summarise these, but we may say that although some points of Mr. Foster's paper were shown open to dispute, still it contains a large amount of experimental duty of much interest and considerable importance, while the discussion brought out some interesting points. Mr. Gannaway's "Notes on the Launching of Vessels" contain the results of much observation, and introduced a good discussion. That on "Technical Education for Engineers and Shipbuilders," by Mr. Ivan Mavor, has a melancholy interest on account of the premature death of its author by the explosion on board the petroleum steamer "Petriana." We have reproduced this paper in these columns, and we will only say that it gave evidence that its talented author was as well qualified to discuss educational matters as to superintend the practical operations of shipbuilding. The most important paper, however, in the volume is that by Mr. Blechynden on "The Reaction and Efficiency of the Screw Propeller." In it the question of the screw's reaction and efficiency is examined almost wholly from an experimental point of view, and an endeavour is made to bring forward in the light of practical experiment such facts bearing on the subjects as, in the opinion of the author, are insufficiently appreciated. The paper is neither intended as a treatise on screw propulsion nor as an explanation of the method of designing a screw, but is addressed to engineers who are acquainted with the general facts of the case, and gives facts bearing on some of the phenomena involved, with the intention of leading to a clearer appreciation of the working of a screw in water, and we commend it to the study of marine engineers. The last paper is by Mr. J. P. Hall, on "Compound *v.* Triple Expansion Engines, from a Ship Owner's Point of View," and contains a large amount of information of great value not only to the ship owner, but also to the marine engineer. An appendix to the volume gives the programme of the visit of the Institution of Naval Architects to Newcastle, and a short account of the Mining, Engineering, and Industrial Exhibition, which has recently closed. Taken as a whole, we have seldom read a volume of Transactions with so much pleasure as the one which we have now briefly noticed.

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SIR WILLIAM THOMSON'S ELECTRICAL MEASURING INSTRUMENTS.

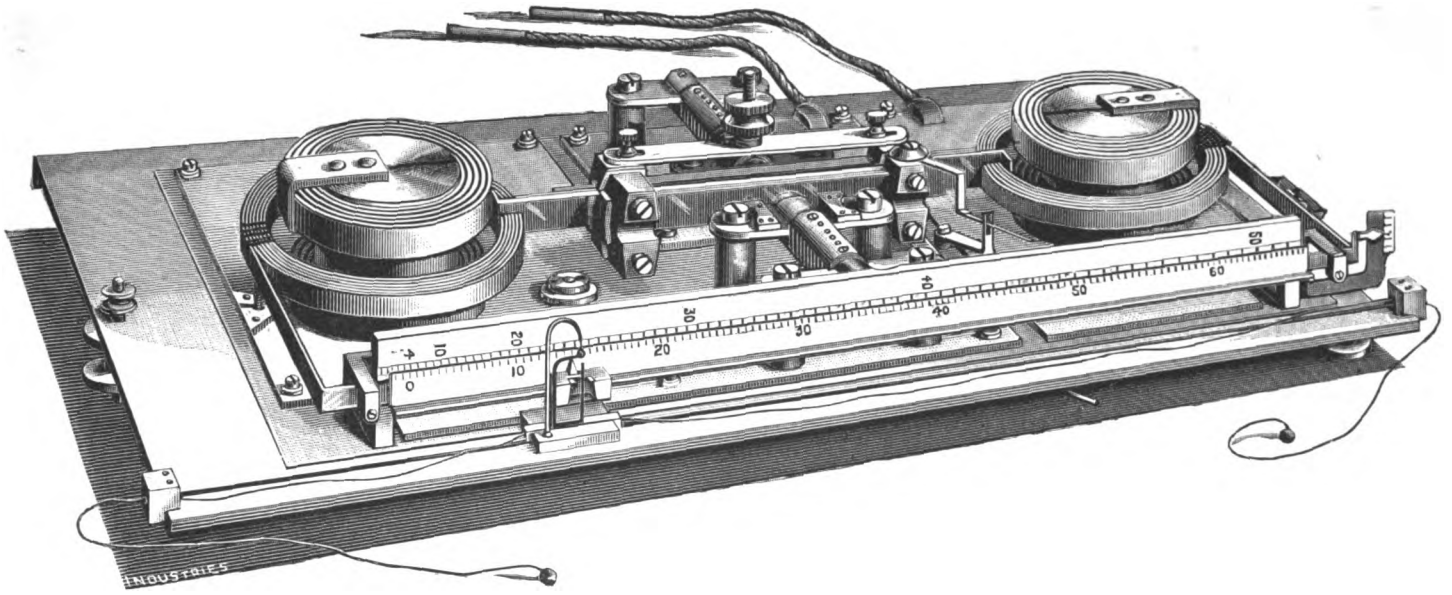


FIG. 1.

SIR WM. THOMSON'S NEW STANDARD ELECTRICAL MEASURING INSTRUMENTS.

BY J. A. FLEMING.

FOR the last six years, Sir William Thomson has been engaged in developing and perfecting a complete series of instruments for the measurement of electric currents. Beginning with the now well known graded galvanometers, he has finally accomplished the task of providing a connected group of instruments, which may be broadly classified into three divisions: (1) Standard direct reading electric current balances; (2) magnetostatic galvanometers or lamp counters; (3) marine and engine room voltmeters. The standard direct reading electric current balances are standard instruments, in which every source of possible error arising from the use of permanent magnets or soft iron is eliminated, and the operation of these instruments consists entirely in weighing, by means of standard weights, the attraction or repulsion between movable and fixed coils of wire conveying electric currents. These standard current balances may be said to be modifications of the electro-dynamometer, which was first described by Weber in his "Electro-dynamische Maasbestimmungen" (Leipsic, 1846). The foundation of the electro-dynamometer was, however, laid long previously. On 25th September, 1820, Andrè Marie Ampère announced to the Royal Academy of Sciences, in France, that he had discovered the existence of forces of attraction and repulsion between conductors of non-magnetic material traversed by electric currents. The experiments of Ampère and the elaborate researches of Weber (W. Weber, "Electro-dynamische Maasbestimmungen, Thl. I., s. 10, 1846, Auszug in Pogg Annal, Bd. LXXIII., s. 193), established the fact that if there be a fixed and a movable conductor in the neighbourhood of each other, traversed by the same electric current, there will in general be a mechanical stress brought into existence, which will tend to displace the movable conductor, and bring it into a position relatively to the fixed conductor in which the mechanical stress between them is zero. The mutual force or stress between these mutually influencing portions of the same circuit is, in any given position, proportional to the square of the strength of the current traversing the two portions of the circuit. In Sir William Thomson's standard instrument this stress is measured by comparing it with or balancing it against the weight of certain standard masses; in other words, the electro-dynamic stress is compared with the gravitation stress on a given mass.

The great difficulty which has hitherto presented itself to all who have attempted to design instruments on the electro-dynamometer principle for any but very small currents has been that of getting the current into and out of the movable conductor. The device on which most experimentalists have fallen back is that adopted by Ampère himself, viz., to use mercury cups as a means of constructing a flexible and conducting joint. The use of mercury is open to many objections. The surface gradually becomes oxidised, the cups must be filled and emptied each time, the instrument has to be transported, and the joint with impure mercury is by no means exceedingly flexible. The great achievement in these instruments has been, first, the invention of a joint or electric coupling which is excessively flexible, and at the same time capable of being constructed so as to carry with safety any current desired. This has been accomplished by the introduction of a device which may be called a metallic ligament. The general principle of its construction, and the mode of rendering a circuit freely movable, yet accessible to a large current, may be described as follows: Let A A (Fig. 2) be a pair of semi-cylindrical fixed trunnions, which are carried on some form of supporting frame, and held with the flat sides downwards. Let B B be two similar trunnions, which project out from the sides of two strips, connecting together a pair of rings C C. The pair of rings and the connecting strips constitute the circuit which is to be rendered movable. A current entering by the trunnion + B flows round the two halves of the circuit, as shown by the arrows, and emerges at the trunnion – B. In Figs. 2 and 3 the current is shown dividing round the two rings; but we should explain here that this has been done by an oversight. The circuit should be shown so that the current goes round both rings in series, in figure of 8 fashion. This is the case in all but the kilo- and hekto-ampère balances, in which the current divides round the ring. To the upper surface of the upper trunnion are soldered a very large number of exceedingly fine copper wires (No. 60 B.W.G.), which are laid close together. These wires are also soldered to the under surface of the lower trunnion. The movable circuit C C thus hangs from the

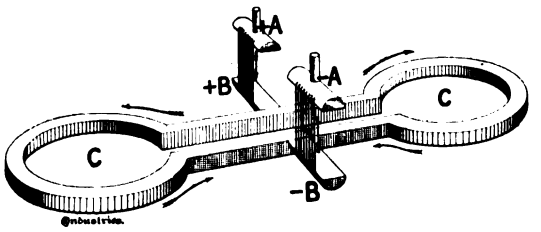


FIG. 2.

upper trunnion by two ligaments, which appear like thin strips, but which are really composed of an immense number of very fine wires. In Fig. 2 these ligaments are intentionally drawn much longer in proportion to the rest of the figure than they really are in the instrument, the object being to render the mode of suspension clear. This method of suspension enables the conductor C C to vibrate freely like a balance by a motion which is partly a bending of the flexible ligaments, and partly a sort of rolling and unrolling of the lower trunnion on the ligament attached to it. By this ingenious method not only can a heavy copper conducting circuit of the shape shown be suspended as freely as the beam of a good balance, but at the same time a very large current density can be permitted in the flexible ligament, since its great radiating surface, and the freedom with which heat is taken out of it by conduction into the mass of the trunnions, allows a proportionately very large current to be transmitted. If, then, the trunnions A and B are the electrodes, the method above described affords the means of passing a very large current into the circuit C C, which yet at the same time retains within certain narrow limits great freedom of movement. Let such a suspended conductor be arranged so as to have a circular conducting circuit of annular form, briefly called an ampère ring, placed above and below each of the movable rings of the balanced arm. Let the connections be made as shown diagrammatically in Fig. 3, in which it will be seen that the current entering by the + electrode flows in series through all four fixed ampère rings F, and in parallel through the two movable ampère rings M. An examination of the direction of current flow in each ring will then show that, in consequence of Ampère's law (parallel currents in same direction attract, in opposite direction repel), forces of attraction and repulsion will

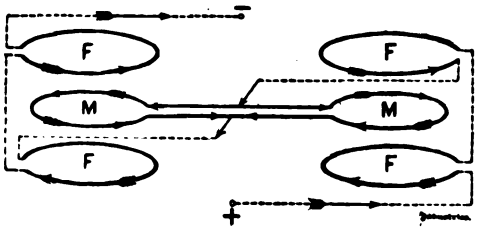


FIG. 3.

be brought into play between each fixed ring and the movable rings, which tend to lift one ring M and depress the other, and tilt over the balance arm to which they are attached. The ampèrian forces thus exert a couple on the movable part. To bring back the movable part to its initial position, which we may suppose to be half way between each fixed ring, an equal and opposite mechanical couple must be applied. We shall in what follows call the movable part of the conducting circuit the balance coils, and the other portion of the circuit the fixed coils. The operation of weighing an electric current consists,

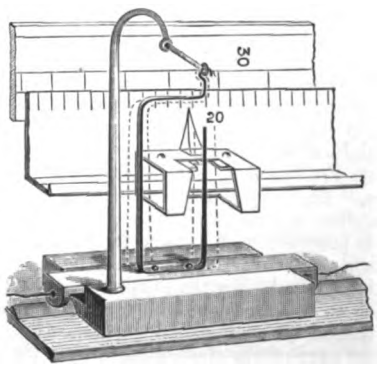


FIG. 4.

therefore, in bringing first of all the balance coils into a definite sighted position between the fixed coils, then passing the current, and bringing back the balance coils into the sighted position against the displacing electro-dynamic forces by applying to the balanced part a couple produced by a standard weight. The restoring couple is applied as follows: Attached to the balanced part or movable portion is a stiff metal bar, turned up at the bottom edge so as to form a sort of long shelf. This shelf or tray extends the whole length of the movable beam, and moves or tilts with it when the balanced part

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SIR WILLIAM THOMSON'S ELECTRICAL MEASURING INSTRUMENTS.

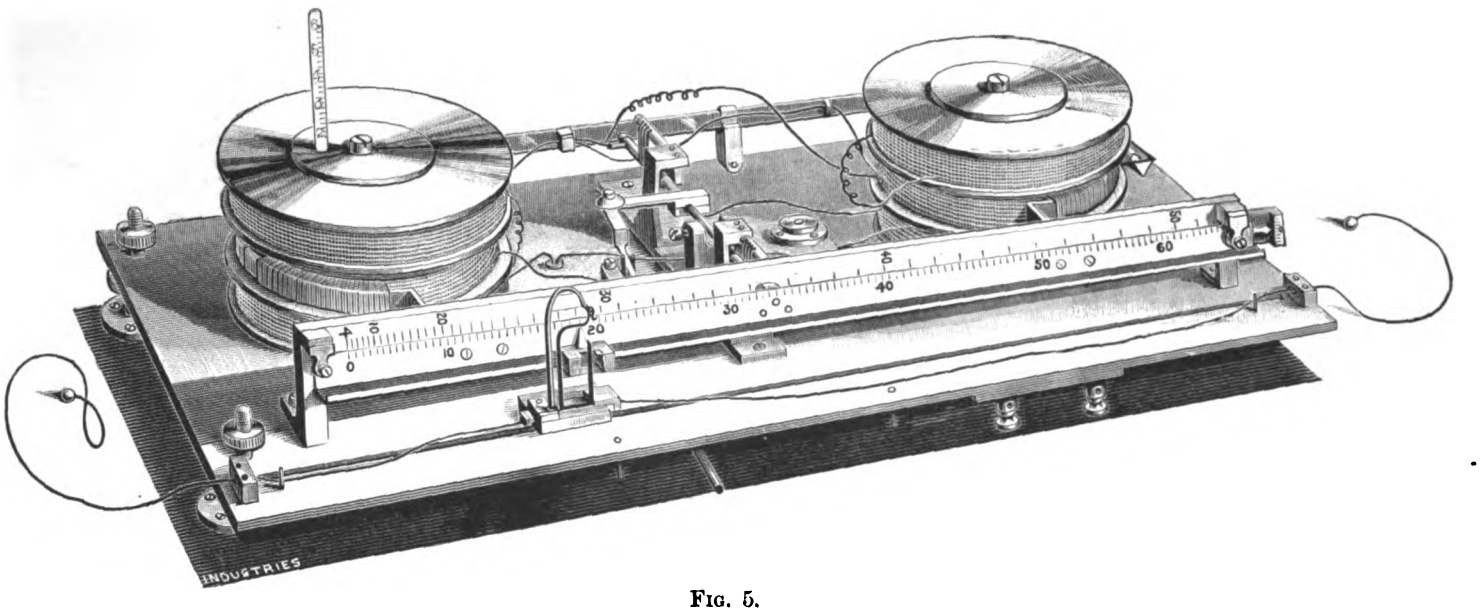


FIG. 5.

is displaced (see Fig. 1). At one end of the balanced part, at the extreme right of our illustration, is a small V shaped tray, in which a weight is placed. A standard weight is then placed at the opposite end of the shelf. This weight is of such form as to slide along the shelf easily (see Fig. 4). When placed at the zero position on the shelf it exactly balances the counterpoise in the V trough, and the balanced part should be in equilibrium when no current is passing. If it is not so, then a small adjustment can be made by means of a metal flag on the beam (Fig. 1), similar to that on a gravimetric balance. If the sliding weight on the shelf is moved along towards the middle the equilibrium is disturbed and a couple brought to bear upon the balanced part, which is proportional to the displacement of the sliding weight from its zero position. If a current is passed through the circuit, and the sliding weight displaced so as to restore the balance to its sighted position, the current strength is proportional to the square root of the distance by which the sliding weight has to be shifted in order to restore equilibrium. The shifting of this weight is performed by a very ingenious piece of mechanism, which will be understood from the enlarged view (Fig. 4). On the base board of the instrument, and just underneath the shelf on which the weight slides, is placed a little metal block, which carries a stout vertical wire extending a little above the shelf carried on the balanced beam. From the top of this wire is carried a pendant wire, which hangs down through a notch in the weight which slides on the shelf. This block, carrying the pendant, is pulled along the railway by a silk cord. When pulled it drags with it the weight on the shelf; but when the string is released the pendant returns to its vertical position and disengages itself automatically from the weight, leaving the balance free to tilt according to the direction of the forces acting upon it. By this means the weight can be shifted along until a balance is obtained, whilst at the same time the whole balance is covered with a glass case to protect it from currents of air. With each current balance three sliding weights and three corresponding counterpoises are provided, the weights being in the ratio of 1, 4, 16. Thus if with the ampère balance the lightest weight on the sliding tray in a certain position corresponds to a current of half an ampère through the instrument, the next weight at the same place corresponds to one ampère, and with the heaviest weight on it the current is two ampères. The upper edge of the shelf on which the weights slide is graduated into equal divisions, and the weight is provided with a sharp tongue of metal, in order that its position on the shelf may be readily and accurately determined. For the purpose of avoiding continual reference to square root tables, another fixed scale is placed behind the shelf, called the inspectional scale. On the upper edge of the shelf, along which the graduations are made, a small notch is cut at those divisions whose numerical denominations are exact squares; thus corresponding to divisions 1, 4, 9, 16, 25, 36, &c., on the scale engraved on the shelf are cut little notches in its upper edge. The inspectional scale is fixed close behind this, and yet not touching, and at those points on it exactly behind the notches are engraved numbers which are twice the square roots of the corresponding numbers on the shelf; thus corresponding to 1, 4, 9, 16, 25, &c., on the shelf the numbers 2, 4, 6, 8, &c., are engraved on the inspectional scale. Since the current passing through the balance when equilibrium is obtained with a given weight is proportional to the square root of the couple due to this weight upon the balance, it follows that the current strength when equilibrium is obtained is proportional to the product of the square roots of the weight used and of the distance of this weight from its zero position; but the inspectional scale is so graduated as to show at a glance the square root of the distance of the weight from its zero position, and hence the numbers on the inspectional scale indicate half ampères, ampères, or double ampères, according to the weight used.

The fixed inspectional scale shows approximately enough for many purposes the strength of the current; the notches in the top of the aluminium sliding scale or shelf show the precise position of the weight corresponding to each of the numbered divisions on the inspectional scale, and practically annuls error of parallax due to position of the eye. When the pointer on the weight is not exactly below one of the notches corresponding to integral divisions of the inspectional scale, the proportion of the space on each side to the space between two divisions may be estimated inspectionally with accuracy enough for all practical purposes. Thus, we may readily read off 34·2 or 34·7 by estimation, with little chance of being wrong by ·1 in the decimal place. But when the utmost accuracy is required, the reading on the fine scale of equal divisions must be taken, and the strength of the current estimated by aid of a table of square roots supplied with each instrument.

These general principles being understood, we proceed to describe the details of the several types of instruments adapted for various ranges of useful measurement. The range of each instrument is from 1 to 50 times the smallest current for which its sensibility suffices. The ranges of the different types of instrument regularly made are:—

The	Centi-ampère	Balance	from	1 to 50	centi-ampères
„	Deci-ampère	„	„	1 to 50	deci-ampères
„	Ampère	„	„	½ to 25	ampères
„	Deka-ampère	„	„	2 to 100	„
„	Hekto-ampère	„	„	10 to 500	„
„	Kilo-ampère	„	„	50 to 2500	„

Fig. 5 shows the general appearance of the centi-ampère, deci-ampère, ampère, and deka-ampère balances. In these instruments the outer diameter of the fixed coils is slightly greater, and the inner diameter less than those of the movable rings attached to the balance arms. The position of the movable rings when in equilibrium and equi-distant from the fixed ones above and below it, is a position of minimum force, and the sighted position for the sake of stability is above it at one end of the beam and below it at the other, in each case being nearer to the repelling than to the attracting ring by such an amount as to give about $\frac{3}{4}$ per cent. more than the minimum force. In order to adapt these balances for alternating currents, a special mode of arranging the conducting circuit has to be adopted. In the balances intended for alternate currents (which may be used also for direct currents) of from 5 ampères to 250 ampères, the main current through each circle, whether consisting of one turn or of more than one turn, is carried by a wire rope, of which each component strand is insulated by silk covering or otherwise from its neighbour, in order to prevent the inductive action from altering the distribution of the currents across the transverse section of the conductor; whilst to avoid induced currents in these parts the coil frames and base board are constructed of slate. The hekto-ampère and kilo-ampère balances are slightly different in arrangement from the foregoing. In these the whole current to be measured is passed through a single fixed ring and then divides through the two halves of a movable ring, which are urged, one up and the other down, by the resulting ampèrian force. The largest balance yet made is one for measuring currents up to 2500 ampères, constructed for Messrs. Paterson and Cooper. The centi-ampère balance (Fig. 5) is provided with a thermometer to test the temperature of its coils, and it may be used as a voltmeter when provided with platinoid resistance coils, which make it available for the measurement of potential difference from 10 up to 200 volts, or more.

The direct reading engine room voltmeter is an instrument based upon the same principle, but which indicates potential difference between certain limits without the

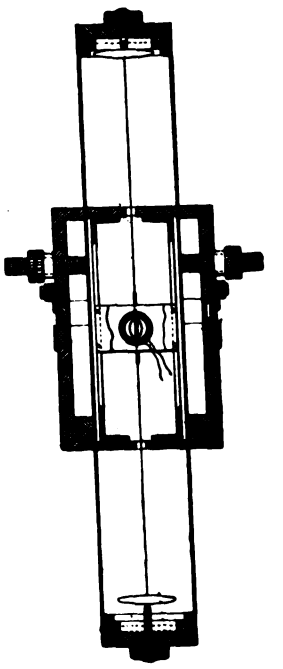


FIG. 6.

performance of any operation of weighing. This inspectional voltmeter (Fig. 7) consists of a fixed platinoid resistance, which is in series, with a fixed and movable ampère ring. On the base board of the instrument is fixed, horizontally, a single coil of highly insulated copper wire. Over this, and suspended parallel to it, is a movable coil, carried at the end of an aluminium rectangular frame, which is suspended by ligaments near the opposite extremity. The weight of the coil is counterbalanced by adjustable weights, so that its normal position is parallel to and a little removed from the fixed coil. When these three coils (viz., the platinoid resistance coil below the base board, the fixed coil, and the movable coil) are traversed by one and the same current, the electro-dynamic repulsion lifts the movable coil, and raises it slightly from the surface of the fixed coil, on which it rests when no current is passing. If the current through the coils is slightly

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SIR WILLIAM THOMSON'S ELECTRICAL MEASURING INSTRUMENTS.

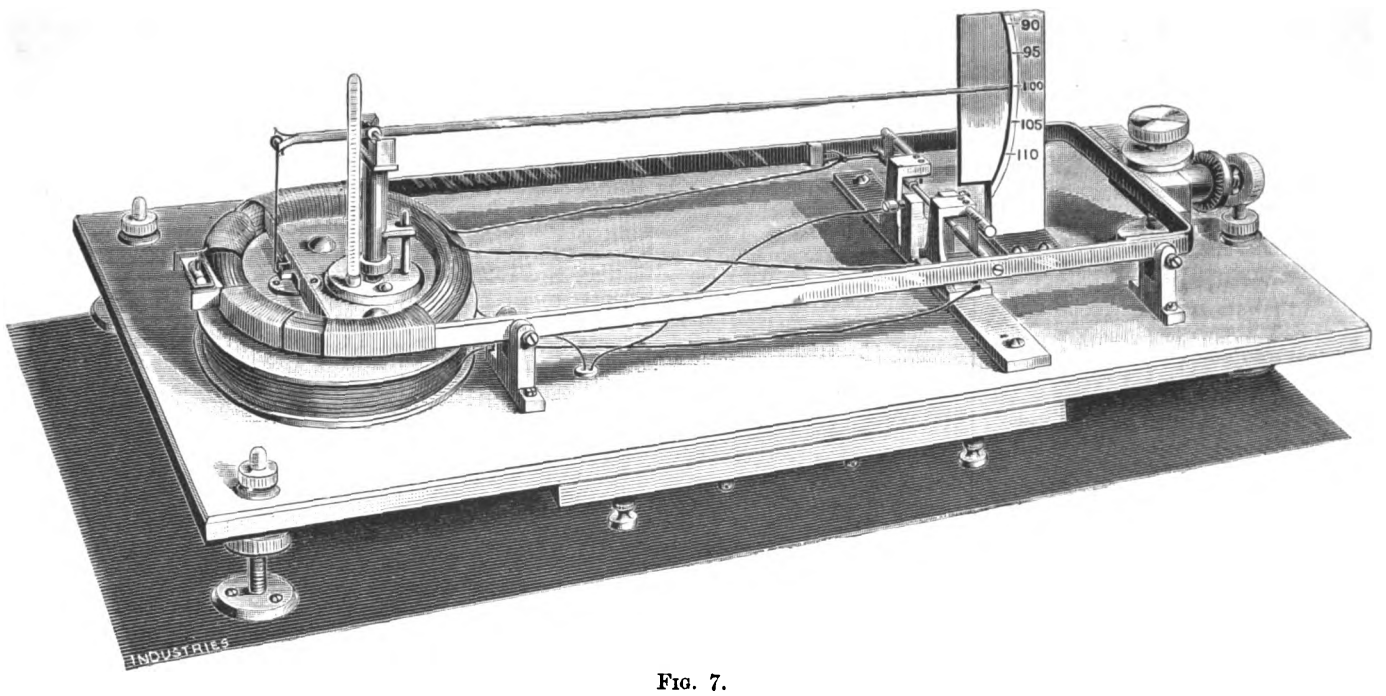


FIG. 7.

increased, the movable coil is repelled a little more; and if it is diminished, it is repelled a little less. These small movements of the coil are multiplied by a lever, the long arm of which moves over a scale, and the short arm of which is connected by a stiff wire with the balance bar carrying the coil. The fixed and movable ampère rings are each composed of many turns of fine insulated copper wire, having a total resistance of 100 ohms. The amount of added platinoid resistance depends on the potential to be measured in the ordinary use of the instrument. Thus for potentials of from 10 per cent. below to 10 per cent. above 100 volts the platinoid resistance is 700 ohms. The scale is divided so as to indicate directly in volts. The instrument is specially designed for use as an engine room voltmeter, and indicates directly, within allowable limits, the excess or deficit of e.m.f. from the normal. Temperature error is annulled by providing a thermometer, placed in the coils, and a set of compensation weights. Four weights, corresponding to centigrade temperatures 15°, 20°, 25°, 30°, are supplied, and when the thermometer indicates any atmospheric temperature between these limits, the weight most nearly corresponding to that temperature is placed in the V trough attached to the end of the balance bar on the left. When not in use, the weights are kept in little receptacles marked with the temperature, so that no mistake can be made in seeing which is in use.

The marine voltmeter (see Fig. 6) is an instrument designed for use at sea. The foregoing engine room voltmeter, and the deci- and centi-ampère balances, are not suitable for this purpose, as the mass of the moving part of the balance is too great. The marine voltmeter consists of a small oblate spheroid of iron, resembling a small round bean or flattened pea. It is attached to the middle of a platinoid wire, which passes through its equator, so that it is suspended with its equatorial plane vertical. If such an oblate is placed in a magnetic field, it will endeavour to place the plane of its equator in the direction of the lines of force of the field; and the couple required to hold it in any given position will depend upon the mass of the iron, and the form and strength of the field. In the marine voltmeter the magnetic field is created by a current circulating in a coil of copper wire in series with a set of platinoid resistance, variable according to the potential to be measured. The platinoid wire carrying the oblate is stretched by attaching it to the ends of a tubular support, whilst the oblate carries a pointer which moves over a dial. The magnetic field due to a current in the coil is a uniform field, and the zero portion of the oblate is, with its equatorial plane, inclined at an angle of about 45° to the lines of force. The platinoid wire bearing it is arranged so that its torsion tends to turn it into a position at right angles to the lines of force. This tendency is resisted by a stop against the needle, so placed that when no current, or any current less than 90 milliampères is passing through the instrument, the needle remains at the end of the scale. When a current exceeding 90 milliampères is passing through the instrument, the e.m.f. operates against the torsion, and turns the oblate into a definite position in the field. The position of the oblate is thus a measure of the current passing through the instrument, and hence of the potential difference at the terminals of the coils. When the mean potential difference to be measured is 100 volts, the platinoid resistance is adjusted to make up with the fine copper wire solenoid, the resistance of which is about 60 ohms, a total resistance of 1000 ohms. Thus the direct reading of potential on the scale is in volts.

Another instrument for use in electric light installations is the adjustable magneto-static current meter and lamp counter. This instrument is a convenient modification of the well known graded galvanometers. It is a direct reading galvanometer, and has certain advantages over the electric balances in portability, and in being direct reading through a continuous range of from 1 to 90 or 100 times its smallest current, which may be anything from half a milliampère to one ampère, according to the number of turns in the coil supplied with the instruments. The general design of the instrument may be described as follows: Underneath a circular dial plate are fixed a pair of semi-circular coils, which may consist of many

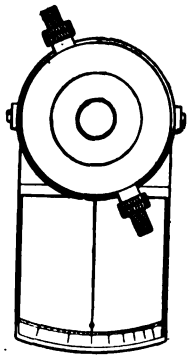


FIG. 8.

turns of wire or of a massive copper bar, according to the strength of the current to be measured. Centrally beneath the dial plate is a short glass tube, in which is suspended a circular disc of magnetised steel. The suspension of this disc is very ingenious. On the surface of the dial plate is fixed a piece of platinoid spring, and from this depends, by a short cocoon fibre, an aluminium needle, which is carried on the same vertical axis as the magnetised disc. If the cocoon fibre were attached to some rigid support any shaking of the instrument would be certain to break it; but suspended as it is from a yielding and flexible support, any jolt or shake causes the spring to yield sufficiently to let down the needle on to the dial plate, and so saves the cocoon fibre from fracture. Underneath the coils is attached a permanent magnet, which creates the controlling field. The instrument thus virtually consists of a galvanometer with a powerful controlling field, and in this respect it has all the disadvantages of this class of apparatus: in not being available for alternate currents, and in that the value of the deflections is dependent upon the permanence of a steel magnet. With a good quality of steel and a proper ageing of the magnet (by heating it several times in boiling water and cooling it again, and subjecting it to somewhat varied rough usage), a very nearly permanent condition is reached, and its magnetism will probably remain constant from year to year. Still it can never be relied upon as absolutely constant, and hence the magneto-static instruments require from time to time to be re-adjusted by the aid of a balance instrument, the adjustment consisting in shifting the controlling magnet. The scale has one hundred divisions, corresponding to equal differences of tangents of the angle between the magnetic axis of the needle and the electromagnetic axis of the rings. The divisions may be numbered from 0 to 100, but for many purposes it is convenient to number them from 30, 20, or 10 on the left of zero, and from zero to 70, 80, or 90 on the right; because we have thus larger divisions in the neighbourhood of the zero than when it is taken at the extreme left of the scale, and because it is sometimes convenient to measure small currents in the direction opposite to that of currents ordinarily measured. The scale being so divided that its divisions indicate equal increments of current through the coils, it is possible to set the magnet beneath the coils, so that the unit of current shall be within certain limits of what is desired. It may, for example, be one milliampère, one ampère, or a tenth of an ampère; or, more convenient still, it may be made equal to the average current through a lamp on the installation in connection with which the instrument is used. It becomes thus a lamp counter, and when put on the circuit shows at once the number of lamps in actual use at that instant. The instrument may be made with such massive coils as to count lamps up to a thousand or more. When the instrument is used as a lamp counter, primary adjustment or re-adjustment can be performed at any time with great ease by turning the screw platform which bears the adjusting magnet, so as to raise it or lower it until it is found that the deviation from zero produced by the current of any number of lights shows a corresponding number on the scale of the instrument. With scales numbered from 1 to 90, any number of lamps within these limits can be directly counted by inspection; and for greater numbers of lights the instrument can be set to count by five or by ten, so that the attendant knows at any instant the load on his dynamo by simple inspection. The instrument must be, however, removed as far as convenient from the neighbourhood of the dynamo, or else calibrated in the position in which it is to be used. The most convenient instrument of the complete series for an ordinary installation or workshop would be the deci-ampère balance, which measures from about $\frac{1}{10}$ to 5 ampères, and a magneto-static galvanometer reading from 1 to 100 ampères. The magneto-static instrument can then at any time be re-adjusted by the aid of the balance. This is simply performed by placing the instruments in series on a circuit and passing a current of 5 ampères through them. The current should be adjusted until the deci-ampère balance indicates exactly 5 ampères, and then the magneto-static instrument set by raising or lowering its controlling magnet until its needle points exactly to 5 on the scale

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when the current is on, and to the zero of the scale when the current is off. At the last meeting of the British Association Sir William Thomson stated that the balance instruments have a sensibility of one-tenth per cent. over a range of something like 1 to 25 times the smallest current they are designed to read; but it should be understood that the balances may be used for double these currents with a slight sacrifice of accuracy.

THE PARNELL-SIMPSON PROCESS.

We have already referred to this process as one recently brought out for the recovery of sulphur from alkali waste in combination with the ammonia-soda process. Ever since the Leblanc soda process was established, the insoluble residue left in the vats after lixiviation of the black ash balls has proved a source of annoyance and expense to the manufacturer, and an offensive nuisance to the neighbourhood. Besides this, the sulphur used in the process, and obtained from pyrites or brimstone, is lost almost entirely in this residue, which is usually termed alkali waste. Numerous have been the attempts to utilise this waste, or at least to extract the sulphur from it in a usable form, and though some manufacturers have worked several distinctly different methods for long periods with more or less success, there has never yet been devised a process which has commended itself to the main body of soda makers. The most promising have been those proposed by Ludwig Mond, by Schaffner and Helbig, at Aussig, by P. W. Hofmann, at Dieuze, and by Chance Brothers, near Birmingham; but these have not yielded results commensurate with the expectations reposed in them. Various causes have contributed to this: increased value of hydrochloric acid, the difficulty in the treatment of sulphuretted hydrogen (especially when diluted with carbonic acid and nitrogen), the incomplete reaction of sulphurous acid on sulphuretted hydrogen, and the exceedingly low price to which Spanish pyrites have fallen per unit of sulphur. The tank waste amounts to from 1½ to 2 tons per ton of soda ash produced, and consists chiefly of calcium monosulphide when in the fresh damp state. This, when piled in heaps, changes by the action of the oxygen and carbonic acid in the air with production of heat, and also eventually sulphuretted hydrogen, and soluble sulphides and hyphosulphites of calcium, which latter are washed out by the rain and pollute the water courses. Thus it is very desirable for the general comfort that some useful outlet should be found for this troublesome substance, and with this object in view Messrs. Parnell & Simpson have taken out a series of patents, in which they propose to make use of the waste in quite a new way, and which, if it prove as successful as its inventors predict, will give a new lease of life to the Leblanc soda process.* Their method is embodied in Patent No. 381, 12th January, 1885, and is elaborated and improved upon in numerous other patents, viz., No. 1937, 12th February, 1885; No. 8440, 13th July, 1885; No. 7657, 24th June, 1885; No. 14364, 24th November, 1885; Nos. 46 and 47, 2nd January, 1886; and No. 14711, 13th November, 1886. There are also several other patents, which have not yet been published, bearing on the same matter.

The *rationale* of the process is as follows, as contained in their first patent, viz.: Fresh alkali waste is treated in a closed vessel with a solution of ammonium chloride and boiled, whereby sulphide of ammonium is driven off in the gaseous state, and a solution of chloride of calcium is left in the vessel, which may be run to waste. The ammonium sulphide is conducted into brine, and this is treated with carbonic acid gas. The sulphide of ammonium is decomposed, forming carbonate and eventually bicarbonate of ammonia, and sulphuretted hydrogen is driven off and collected in a gas holder and utilised for making sulphur or vitriol. The bicarbonate of ammonia left in the brine reacts on the salt, forming bicarbonate of soda, which is precipitated, and chloride of ammonium in solution. The precipitated bicarbonate is separated by filtration, and the chloride of ammonium used over again for the treatment of fresh alkali waste. The inventors find that it is necessary to use very pure carbonic acid gas for this process, or otherwise the sulphuretted hydrogen would be too much diluted with nitrogen, and suggest procuring it from limestone heated to redness in iron retorts with a jet of steam. They also find that if the waste is heated with an excess of dilute ammonium chloride solution the ammonium sulphide is not driven off as such; but during the first period of heating a considerable quantity of sulphuretted hydrogen in the free state is given off, and during the last period ammonia is predominant. They therefore collect this sulphuretted hydrogen by passing the gases through a condenser, where the sulphide of ammonium and free ammonia are condensed, leaving a gas containing only sulphuretted hydrogen and slight traces of ammonia, which are taken out by passing through an acid tower. This gas is taken to a gas holder for use. It is stated that as much as 50 per cent. of the suphuretted hydrogen given off from the waste can be recovered in this way. They assert in this patent that in a works where carbonate of soda is produced in about equal quantities by the Leblanc and by the ammonia process, the sulphur required may be recovered for repeated use or sale; the expense of moving the waste is avoided, an offensive nuisance obviated, lime is saved, that from the lime kiln may be used for bleaching powder or caustic, and the vitriol made from the sulphuretted hydrogen will be very pure. In their second patent, No. 1937, they merely propose a means for the better recovery of the ammonia and sulphuretted hydrogen. They cause the gases from the treatment of alkali waste with ammonium chloride to pass through a coke tower, down which acid sulphate of ammonium is running. This decomposes the ammonium sulphide, forming neutral sulphate of ammonia and free sulphuretted hydrogen, which is collected in a gas holder after passing through an acid tower, to absorb any ammonia which may be carried over. The neutral sulphate of ammonia is boiled down in a lead vessel to dryness, and the dry sulphate heated in a cast iron vessel until the surplus of ammonia is driven off, forming again the acid sulphate, which is dissolved and used over again in the tower. The temperature in the iron vessel must not exceed 800° F., or some ammonia may be decomposed. It is preferred to bring steam in contact with the heated sulphate, as it helps the evolution of ammonia, and keeps the temperature more regular. They also propose to use sulphates of the alkalies, adding them to the ammonium sulphate before boiling down, by which an increased yield of ammonia is obtained. In their next patent, No. 7657, they appear to have found a difficulty in obtaining the sulphuretted hydrogen sufficiently pure by any of the means formerly proposed, and therefore this patent is for "Improvements in the separation of sulphuretted hydrogen from nitrogen."

There is no doubt that the patentees found that their method of using bisulphate of ammonia was impracticable, and also that it was highly difficult and expensive to obtain pure carbonic acid, and therefore they resolved to abandon the former, and obtain their carbonic acid from the ordinary lime kiln, which is of course very dilute (containing only from 25 to 30 per cent. CO_2), and necessarily providing sulphuretted hydrogen largely contaminated with nitrogen. Therefore this patent, which is as follows: A solution of ammonium sulphide is treated with carbonic acid gas from a lime kiln, whereby carbonate of ammonia is formed, and sulphuretted hydrogen driven off, diluted with a large amount of nitrogen and some carbonic acid. This dilute gas is then taken through a tower filled with cokes, down which monosulphide of ammonium in solution is flowing. This takes up the sulphuretted hydrogen from the gas forming sulphydrate of ammonia according to the equation

$$(NH_4)_2S+H_2S=2NH_4HS.$$

The temperature in this tower should not exceed 70° F. The solution of sulphydrate of ammonia is boiled or subjected to a partial vacuum, whereby the sulphuretted hydrogen absorbed is given off in the pure state, and which, after passing through a condenser to an acid tower, may be taken to a gas holder for use. Monosulphide of ammonium is left in solution after the boiling, and may be cooled and used over again, or, according to the drawing with the specification, it is distilled before again entering the cycle of operations. A patent No. 8440 was completed earlier, though filed provisionally after the one just mentioned. It is proposed to treat the sulphide of ammonium solution with sesquicarbonate of ammonia in a closed vessel with a steam coil or jacket, or to employ a vacuum; monocarbonate being thus formed, and sulphuretted hydrogen set free. This is washed in sulphide of ammonium or of the alkali metals to take out any trace of carbonic acid, and taken through an acid tower to a gas holder. The monocarbonate is treated with lime kiln or other carbonic acid gas, and fresh sesquicarbonate produced. The monocarbonate may be also used in the ammonia-soda process, or for treating alkali waste; if for the latter, the sesquicarbonate solution may be very weak, say 5 per cent.; but if for the former it should be as concentrated as possible, even with crystals of bicarbonate formed in it. The crystals dissolve in the sulphide of ammonia. They prefer to use two equivalents of sesquicarbonate to one of sulphide of ammonium, or a slight excess over this of sesquicarbonate.

In patent No. 14364 they refer to the production of sulphuric acid from a mixture of sulphuretted hydrogen and sulphurous acid gases. They point out that hitherto the yield from this combination has been much less than that given in theory, and that this is generally accounted for by the formation of pentathionic and other sulphur acids. To obviate this it has been proposed to conduct the process in the presence of chlorides of calcium or magnesium; but this has not been attended with any satisfactory results. The inventors therefore propose to carry on this reaction in the presence of vitriol, of say 15° Tw. to 20° Tw., and preferably at about 100° F. The vitriol is run down a tower, up which the mixed gases are caused to travel, and by this means all sulphur acids are absorbed by the vitriol, which yields, on boiling, sulphur, sulphurous acid, and sulphuric acid. The sulphur, together with that from the reaction between the sulphurous acid and sulphuretted hydrogen, is separated by subsidence, washing, and filtration, and the sulphurous acid is used over again. The excess of sulphuric acid formed by the decomposition of the thionic acids can be withdrawn from the vitriol from time to time. The tower is leaden, filled with flints. The boiling of the vitriol takes place in leaden pans, with a steam coil or jacket.

Their next patent, No. 46, 1886, is devoted to the production of pure carbonic acid gas, which is accomplished as follows: Monocarbonate of ammonia is treated with carbonic acid from lime kiln or other well known source, forming thereby bicarbonate of ammonia in crystals. The temperature must not rise above 70° F. These crystals are heated in a small amount of their mother liquor in a closed vessel to 165° F., whereby the carbonic acid is liberated in the pure state, leaving monocarbonate behind for re-use. The monocarbonate solution contains from 25 to 30 per cent. $(NH_4)_2CO_3$, and may be carbonated in a Solvay tower. Drawings are given, as the inventors aver that this mode of obtaining pure carbonic acid will be of use in very many manufactures. No. 47 aims more than the former ones at combining the ammonia soda process with this recovery of pure sulphuretted hydrogen. They treat waste with ammonium chloride solution, and lead the ammonium sulphide into water or weak ammoniacal solution in a closed vessel until it contains from 8 to 10 per cent. ammonia. This solution is treated with carbonic acid as pure as possible, obtained as in No. 46, preferably in a Solvay tower, bicarbonate of ammonia being precipitated, and sulphuretted hydrogen nearly in the pure state being given off. This is washed, to arrest any CO_2 and NH_3, and conducted to a gas holder. The bicarbonate of ammonia is agitated with brine, forming bicarbonate of soda and chloride of ammonium, which latter is used over again to decompose fresh waste. The inventors claim the following: (1) Decomposition of ammonium chloride by waste or other material containing sulphide of calcium; (2) absorption of the sulphide of ammonium by water or weak ammoniacal solution (this weak solution is obtained from the towers after the precipitation of the bicarbonate of ammonium, and consists of carbonate and sesquicarbonate of ammonium); (3) decomposition of sulphide of ammonium in solution by carbonic acid, forming bicarbonate and sulphuretted hydrogen; (4) removal of bicarbonate of ammonium and employment for making alkali; (5) addition of ammonium sulphide solution to compensate for ammonia removed as carbonate or bicarbonate. In their next patent, No. 14711, the patentees appear to have given up the idea of producing sulphur by means of the reaction between sulphurous acid and sulphuretted hydrogen, and their invention consists in apparatus for regulating the air supply in order to burn the sulphuretted hydrogen, producing either sulphur or sulphurous acid according to the equations $H_2S+O=H_2O+S$ and $H_2S+3O=H_2O+SO_2$. This is done by means of an ingenious arrangement of vessels attached to an oscillating beam and suspended therefrom in water. By the oscillation of this beam, air and sulphuretted hydrogen are drawn into the vessels, the quantity of each being regulated by moving the vessels along the beam towards or away from the fulcrum. The air and gas are forced out in the same way to the burners or furnace. For producing sulphur five volumes of air to two of H_2S are necessary, and for sulphurous acid eight of air and one of H_2S. If vitriol is to be made, the proportion is ten to one. The water may be covered with blue oil to prevent absorption.

With regard to the commercial value of this process, a few remarks will not be out of place. Presuming that the operations are as successful as the inventors expect, and that the combined Leblanc and ammonia-soda works are capable of turning out a quantity of soda ash divided equally between the two processes, first of all will be saved all the lime now used in the ammonia process, amounting to about 14cwt. per ton of ash made, or 8s. 9d. in value. Again, for each ton 58 per cent. ash made by the Leblanc process, a quantity of waste containing about 7·4cwt. of sulphur is produced; and if 90 per cent. of this is recovered, that is, 6·63cwt. of sulphur (pyrites 49 per cent. being worth about 16s. 4d. per ton for sulphur), this 6·63cwt. is worth about 11s. There is also saved the cost of removal of the waste, amounting to about 3s. per ton on the ash. Therefore we have a saving to the ammonia process of 8s. 9d. per ton 58 per cent ash, and in the Leblanc process of 14s. per ton 58 per cent. ash, and since

*Messrs. Schaffner & Helbig proposed in 1882 to combine the Leblanc and ammonia-soda processes by treating the ammonium chloride liquors from the latter with magnesia, distilling off the ammonia and adding waste to the solution of magnesium chloride left, thereby producing sulphuretted hydrogen, magnesia, and calcium chloride. The magnesia is left ready for use again.

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the quantity of ash made by each process is the same, the result is a saving of 11s. 4½d. on each ton of ash made. Against this saving of 11s. 4½d. per ton of ash there are the following expenses: The extra cost incurred in treating the ammonium chloride liquors with waste over the same with lime, as there is 18 or 20 per cent. of insoluble matter in the waste which must be removed from the decomposing vessel; the cost of filtering the ammonium bicarbonate (made to produce pure carbonic acid), of heating this bicarbonate, collecting, and then forcing this carbonic acid through the ammonium sulphide liquors, also collecting the sulphuretted hydrogen, and freeing it from carbonic acid and ammonia; treating the sulphuretted hydrogen with sulphurous acid and collecting the sulphur, also the production of the sulphurous acid and increased loss of ammonia over the ordinary ammonia process. These expenses would in all probability be amply covered by the 11s. 4½d. before mentioned, and if the recovered sulphur could be produced without much extra cost in such a form as to compete with Sicilian brimstone, there would be added to this a further working margin of from 17s. 9d. per ton on the total ash made, taking brimstone as worth £5. 17s. 6d. per ton.

This process, therefore, seems to have substantial prospects, and should it prove workable it would do much to encourage the drooping spirits of the Leblanc soda makers. The Leblanc process can still make caustic soda, which the ammonia process cannot do (at least, at a profit), and with that and the bleaching powder it should manage, even without the sulphur recovery process, to hold its own. But there are signs that in the near future this staff, on which the old soda process has been leaning so long, will be removed, and that bleaching powder will be made from the residual ammonium chloride liquors of the ammonia process. It is a fact that MM. Pechiney, at Salindres, can produce chlorine from their magnesium chloride liquors (obtained in their salt gardens) at a price equal if not lower than it can be produced by Leblanc soda makers, and therefore the only difficulty seems to be in the decomposition of the ammonium chloride liquors by means of magnesia to form a not too dilute solution of magnesium chloride. This seems a difficulty to be easily surmounted after those which MM. Pechiney & Cie. have conquered.

We are also threatened with entirely new processes for making soda and chlorine directly from common salt. Of course, if any of these are successful, both the Leblanc and the ammonia-soda processes may hide their heads. But until either bleaching powder can be made by the ammonia-soda process sufficiently cheaply, or the whole trade is revolutionised by some new process, this means for the recovery of sulphur by Messrs. Parnell & Simpson may fill up the gap, and bring more grist to the mill of the alkali trade.

A NEW OXYHYDROGEN LIGHT.

An application of the oxyhydrogen light to general illumination purposes has been introduced by Messrs. Georges Delaporte & Co., of Paris, and was recently on view at Dashwood House, 9, New Broad-street, London. In this application a special burner is employed, in conjunction with an ordinary gas burner. In the case of Argand burners, the special burner is placed in the centre of the ring of lights; in the cases of fishtail or batswing burners, the special burner is placed close to the ordinary burner. The supply of gas to either of the burners is controlled by a three-way cock, the turning of which determines whether ordinary or oxygen gas is to be used, or the light extinguished altogether. The difference between the two lights is very striking, the change from the dull light of the ordinary gas to the brilliant illumination of the oxyhydrogen allowing colours which are not distinguishable by the former to be readily distinguished by the latter. For the production of the oxyhydrogen light, oxygen and ordinary gas are burnt together in the special burner, the best results being obtained when the ordinary gas is carburetted, which is done by passing it through gasolene. Messrs. Delaporte & Co. employ steel reservoirs 8ft. long by 5in. diam., with hemispherical ends. The oxygen is forced into these under a pressure of about 120 atmospheres, each reservoir containing gas equal to 125 cub. ft. of gas at atmospheric pressure, the supply being stated to be sufficient for one burner for 125 hours. The reservoirs are charged at Brin's Oxygen Company's Works, Westminster (see *Industries*, Vol. III., page 457), and as they become exhausted are changed for others fully charged. The light of one special burner is said to be equal to that given by seven Argand burners, each burning 5 cub. ft. per hour; and the consumption of 28 cub. ft. of carburetted gas with 16 cub. ft. of oxygen is stated to equal in illuminating power 140 cub. ft. of ordinary gas.

The system requires two sets of pipes, one to carry oxygen from the reservoir to the burners, and the other to convey ordinary gas. When carburetted gas is used, a third pipe is necessary in addition. The idea of the firm introducing this method of using oxyhydrogen gas, or "electric gas," as they call it (which, by the way, is a misnomer, as it has nothing whatever to do with electricity), is that many large shops and houses whose proprietors do not care to incur the expense of dynamos, steam engines, and boilers, are desirous of having a better light than the ordinary gas gives them at special times, and that a system which enables them to change quickly from cheap, economical gas to a brilliant light equalling the electric light, will find favour. Whether this advantage is sufficient is open to doubt, as the expense of duplicate or triplicate pipes must be considerable. The changing of reservoirs must also be a costly item, besides entailing a certain amount of inconvenience which, we think, many consumers might object to. We shall watch with some interest the introduction of this system of illumination, should the promoters be successful in establishing it in this country beyond the experimental stage. We are informed that it is being introduced with success in Paris.

Notes.

AMERICAN RAILWAY BRIDGES.

One of the characteristics of the railways of the United States is the large number of accidents which occur annually by the failure of bridges. In a review on the past year, the *Railroad Gazette* of New York states that the railway companies, as a body, have not only improved their permanent way, but largely substituted iron and stone for wood in bridges. Our contemporary continues: "The year has been remarkable for the number of short spans replaced by plate girders or iron trusses. This is one of the most important changes in practice. The long span bridges are reasonably sure to be built with some approach to the best usage, and it is the little ones that are most pernicious. A further notable advance in this direction is that of the Pennsylvania Railroad Company in the use of stone arches for short spans."

MINING IN VENEZUELA.

The richest mining properties in Venezuela are the gold mines in the State of Bolivar and the copper deposits in the State of Lara. The United States Consul at La Guayra states that gold and silver are also found in the States of Carabobo, Lara, and Bermudez; gold, copper, and kaolin in the State of Guzman Blanco; coal, pitch, and sulphur in the States of Zulia and Bermudez, and petroleum in the State of Los Andes. There is also a pitch lake at the mouth of the Pedernales River, on the Gulf of Paria, that is quite as extensive and valuable as that of the island of Trinidad. All these mineral deposits are as yet undeveloped, except the gold of Bolivar and the copper of Lara. The gold mine "El Callao," Guayana, State of Bolivar, is, so far as is known, the only important and valuable one, which, from its opening in 1871 to 1884 inclusive, has yielded £2,961,585. In the latter year the product amounted to the sum of £659,141. No later statistics can be obtained, but its reputation is fully maintained. The copper mine of Aroa, State of Lara, like the "El Callao" mine, is directed by an English company, and the ore is exported to Swansea. The only available information shows that from 1880 to 1883 inclusive the product amounted to 75,200 tons of ore, of the value of £622,925. The yield from October 1st, 1883, to September 30th, 1884, was 26,261 tons.

A NEW STORAGE BATTERY.

M. Carrière has taken out a patent in France for a new method of constructing the electrodes of storage batteries. The object of his improvement is to reduce the weight of lead required for a given capacity, and to make the plates absolutely rigid, so that no short circuit can occur through buckling. In his patent the inventor points out that in batteries of light weight the lead frame of the plates must necessarily be mechanically weak, and if made sufficiently thick to resist transportation and rough usage, the battery becomes too heavy. Moreover, the frame is continually subject to oxidation, and just when the battery gets into the condition of maximum capacity the plates are near mechanical destruction. Whatever may be the scientific value of these arguments, the inventor has certainly produced an ingenious combination, which is not open to the same objections, though perhaps practical use may reveal other and possibly more important faults. The support of the active material in M. Carrière's battery is formed of carbon plates. The material of the plate need not be pure, and, in fact, the inventor uses a mixture of two parts of common retort carbon and one part of lamp black or charcoal ground up together, and mixed with a little flour paste. The plastic mass is rolled into slabs, cut into the desired form with a projecting tag for the connections, and then baked at a temperature of 1300°C. After this it is slowly cooled, and both sides are covered with a layer of litharge from 1 to 1½ millimetres thick. By a peculiar process the litharge is made to adhere firmly to the surface of the carbon plates. The inventor claims that these batteries require no process of forming, and give a current after the first time they are charged; also that the supports are mechanically perfect, and are not attacked by the acid solution, whilst the whole of the lead is actually available for storage.

THE ALUMINIUM COMPANY, OLDBURY.

The works at Oldbury, near Birmingham, for the manufacture of aluminium and sodium on a large scale, by the Castner process, are rapidly approaching completion, and it is expected that sufficient progress will have been made to start about March 1st. The works cover an area of six acres, and are calculated to give employment to a hundred men, working night and day. They adjoin Messrs. Chance Brothers' alkali works, and the muriatic acid required in the Castner process will be delivered by a pipe from the alkali works direct to the aluminium works, whilst the caustic soda employed in the production of sodium will also be obtained from Messrs. Chance's works. Thus on two of the materials for the manufacture there will be no carriage to pay. The whole of the fuel employed will be gas, made in eight of Wilson's gas producers. The furnaces, of which there are forty, are calculated to produce 300lb. of aluminium and 1000lb. of sodium per day; but as 900lb. of sodium are required to produce the aluminium, there will only be 100lb. of sodium available for sale. The aluminium will be produced in pigs, weighing about 2½lb. each. As the present production of aluminium is probably only about 100lb. per day, it will be seen that the Aluminium Company are taking time by the forelock in endeavouring to be prepared for the increased demand which will follow on the reduction in price of this metal. In the production of aluminium bronze for telegraph and telephone wires, and in the manufacture of "Mitis" wrought iron castings, and in producing soundness in steel ingots, the use of aluminium has probably a future before it. Plant for the manufacture of chlorine by the Weldon process is also being erected on the works.

BASIC STEEL ABROAD.

The statistics of the production of steel and ingot iron from phosphoric pig in the year ended 31st October present two salient facts which cannot fail to arrest attention. First we have the unquestionable evidence of officially verified figures to prove that the basic process is making constant and rapid progress; and, next, we learn from the same source that our rivals abroad are making much better use of the process than we. The total production of Europe in the year 1886-87 amounted to 1,702,252 tons, against 1,313,631 tons in 1885-86, an increase of 29·6 per cent. But of the former quantity Great Britain produced only 364,526 tons, or scarcely more than one-fifth, a relatively insignificant quantity when we regard it in connection with the total make of iron in this country. The production of Germany, Luxemburg, and Austria is given as 1,102,496 tons; but as the output of the two latter countries is very small, it is practically the make of Germany which is presented in these figures. Thus absolutely the Germans have made in the last year some three times the quantity of basic steel that we have produced, while relatively the difference is much greater in favour of our Teutonic rivals. The question which naturally suggests itself is—Who is at fault in this matter? Clearly we must have a good reason for neglecting this process, or we must admit that our foreign rivals are more apt than we are to profit by the discoveries of science, and that they have stolen a march upon us to our serious disadvantage. Probably the only legitimate reason we can assign for our rearward position in this matter is the action of Lloyd's in condemning basic steel for shipbuilding on account of the imperfections which revealed themselves in the product in the early days of the manufacture. This condemnation was doubtless a serious obstacle to the development of the process. The obstruction, however, no longer exists, the report of their surveyor and that of the Admiralty, on which we commented some time ago, having practically withdrawn the condemnation. We see already the stimulating effects of these reports in the latest statistics issued, which show the increase in the out-put of basic produce in the year to be 41 per cent. for England and only 27 per cent. for the rest of Europe. In comparing these figures, we must bear in mind that 41 per cent. represents for us only 106,060 tons, while 27 per cent. for the rest of Europe amounts to 282,561 tons. The advantages of being enabled to utilise our phosphoric ores cannot be less for us than for our neighbours, and it is certain that if we are to keep the lead in the iron trade, we cannot afford to be wasteful of our opportunities.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

13th January, 1888.

535. Brown, J. ..... Screw gill machines.
536. Clegg, A. ..... Underpick looms.
541. Gill, J. E. ..... Mechanical navvies.
543. Rawstron & Chapman. Sewing machine.
545. Turner, C. ..... Chaff cutters.
580. Sack, H. ..... Rolling mills.
581. Thickpenny, T. E. ..... Washing machines.
585. Hoeborn, H. ..... Paper making machines.
587. Becker, W. ..... Casting of metal ingots.

14th January, 1888.

594. Thwaite, B. H. ..... Steam generators.
597. Moulton, G. ..... Engraving machines.
600. Johnson, J. Y. ..... Hot air engine (*Genty*).
612. Wright, S. ..... Machine for shaping heads of casks.
619. Böttcher, E. ..... Sewing machines.
620. Böttcher, E. ..... Sewing machines.
629. Mayer, M. ..... Calculating machines.
632. Mannlicher, F. ..... Magazine fire arms.
634. Parker, W. W. ..... Lifeboat.
636. Simpson, W. S. ..... Movable crucible for conveying molten glass.
638–9. Pinkney, C. W. ..... Punching, riveting, and shearing machines.

16th January, 1888.

645. Mathieson, J. ..... Looms.
651. Parker, J. B. ..... Edge planing machines.
653. Evans, R. ..... Machine guns.
654. Marshall, J. ..... Looms.
655. Skipton & Rhodes ..... Coal getting machinery.
656. Hargreaves, J. ..... Thermo-dynamic engines.
660. Briggs, J. W. ..... Rotary pumps and engines (*Barber*).
669. Ide & Love ..... Machinery for rolling and figuring glass.
681. Lake, H. H. ..... Type writing machines (*Allen*).
685. Watson & Starkey ... Machines for pressing vegetable matter.
686. Lake, H. H. ..... Casting of metal ingots (*Illingworth*).
688. Abel, C. D. ..... Gas motor engines (*Gas Motoren Fabrik*).
680. Aniello, J. A. ..... Lifeboat.

17th January, 1888.

699. Hay, W. ..... Machinery for the manufacture of groats.
701. Stuart, H. A. ..... Driving mechanism to obtain continuous rotary motion.
710. The Arracan Company and Dale ..... Rice hulling and cleaning machinery.
716. Noble, J. ..... Regenerative furnaces.
719. Boult, A. J. ..... Mining machines (*Westbrook*).
721. Thompson, W. P. ..... Roller mills (*McAnulty*).
725. Hearn, M. ..... Type writing machines.
730. Weidenbusch, A. ..... Machinery for making paper bags.
731. Rickard & Rickard... Tip waggons.
745. Brab, A. ..... Manufacture of casks or barrels from paper.
749. Lake, H. H. ..... Spooling machines (*Wilkins*).
755. Stubbs & Stubbs ..... Winding yarns or threads.
756. Prenez, J. E. ..... Apparatus for treating crushed grain.

18th January, 1888.

763. Watts, W. ..... Wire rolling.
764. Munro, G. ..... Hydraulic apparatus for testing the working pressure of steam boilers.
766. Anderson, A. ..... Sewing machines (*Singer Manufacturing Co.*).
768. Duncan, R. ..... Bending iron or steel bars.
773. Justice, P. M. ..... Triple expansion steam engines (*Davidson*).
774. Yeadon, J. ..... Loom reeds.
775. Willis, J. ..... Improved steam wheels as motors.
776. Bowman, W. ..... Propulsion of ships.
777. Smith, G. ..... Machines for combing wool.
783. Smith, J. ..... Gas engines.
787. Myers, F. ..... Machines for forming the heads of nails.
790. Blum, J. ..... Rotary engine.
792. May & May ..... Self acting mules.
793. Webster, G. T. ..... Mitre planing machine.
794. Pickles, J. H. ..... Apparatus for punching holes through the crowns or sides of hats.
807. Hacking & Hacking ... Rag engine.
814. Jensen, P. ..... Manufacture of plates of copper. (*Martin*).
818. Anderson, W. ..... Disappearing mountings for guns.
824. Sharpe, A. H. B. ..... Apparatus for drying leaves of the tea plant.

19th January, 1888.

831. Baird, R. ..... High pressed steam engines.
844. Lindley, H. ..... Compound steam engines.
846. Groth, L. A. ..... Knitting machines (*Grosser*).
856. Herbertz, F. A. ..... Furnaces.
859. Struthers, A. ..... Cloth steaming machines.
863. Bernhardt, G. ..... Spinning machines.
869. Hooper & Moore ..... Polishing and grinding machines.
872. Simon, H. ..... Circularly moving sieves.

ELECTRICITY.

13th January, 1888.

549. Blackburn, J. ..... Dynamo-electric generators.
584. Madgen, W. L. ..... Electric railways.

14th January, 1888.

609. Berghausen, A. ..... Apparatus for determining the poles of electrical circuits.
616. Brookes, A. G. ..... Phonographic apparatus (*Jacques*).
623. Gülcher, R. J. ..... Thermo-electric piles.
633. Coerper, C. ..... Dynamo-electric machines.

16th January, 1888.

664. Lovett, F. J. ..... Electrical lamp for bicycles.

17th January, 1888.

698. Cornthwaite, R. ..... Electric lamps.
705. Percy, L. E. ..... Telephone mouthpiece.
713. Coad, T. ..... Galvanic batteries.
718. Guitton, E. ..... Electric batteries (*Suppey*).
727. Kennedy, R. ..... Thermo-dynamo electric machines.
729. Urquhart, D. ..... Electric batteries.
734. Noad, J. ..... Galvanic batteries.
750. Lake, H. H. ..... Electric railways (*Weems*).

18th January, 1888.

789. Kingdon, J. A. ..... Distribution of electricity.
791. Scott, R. A. ..... Junction boxes for electric conductors.
804. Pulverman, M. ..... Electric clocks (*Bohmeyer*).

19th January, 1888.

873. Hen & Weinmann ..... Electric igniting apparatus.
874. Judson, F. H. ..... Electric incandescent lamps.

CHEMISTRY.

13th January, 1888.

571. Seaver, F. I. R. ..... Manures.
582. Redwood, T. H. ..... Photographing by artificial light.

14th January, 1888.

607. Rave, C. ..... Acid residuums from the refining of mineral oils.
614. Brown, J. ..... Camera dark slides.

16th January, 1888.

676. Paul, L. ..... Disulpho and dicarbo acids of the diamidoazo-benzidines.
678. Nipper, J. ..... Distemper colours.
687. Abel, C. D. ..... β-naphthylamine-λ-sulphonic acid from the so-called β-naphthylamine β-sulphonic acid (*Actiengesellschaft fur Anilinfabrikation*).
692. Clark, A. M. ..... Cobalt and nickel ores (*La Société Anonyme*).

17th January, 1888.

700. Claus, C. F. ..... Phosphates of alumina.
708. Wyley & Wyley ..... Chlorate of potash pellets.
728. Grimshaw, H. ..... Recovery of sulphur from black ash waste.

18th January, 1888.

767. Andria, M. N. d' ..... Recovering tin from tinned metal.
788. Tipping, H. ..... Production of oxygen.

19th January, 1888.

826. Kington, W. ..... Improved combination of metals.
857. Ellice-Clark & Chapman ..... Production of oxygen.
870. Crossley, A., & others.. Oxide of iron pigment.
871. Crossley, A., & others.. Evaporation of ferrous sulphate solution.

MISCELLANEOUS.

13th January, 1888.

538. Mullineux, M. ..... Cartridge cases.
539. Fletcher, J. M. ..... Spurs.
540. Needham, T. ..... Electric balloon carriages.
542. Shand, F. J. ..... Safety fuse for blasting.
544. Oxley, J. ..... Curing stinking casks.
547. Hunt, R. ..... Cotton seed oil foots.
550. Hunt, R. ..... Purification of cotton seed oil.
551. Morris & Small ..... Asbestos tipped lamp wicks.
552. Fletcher, J. H. ..... Hoods for vehicles.
553. Johnson & Boots ..... Coupling gear for railway trucks.
554. Burns, D. ..... Chimney cowls and ventilators.
558. Hornby, F. ..... Apparatus for recording numbers and fares.
559. Ivatt, H. A. ..... Apparatus for supporting windows of railway carriages.
560. Barthel & Möller ..... Projectiles.
562. Free, R. ..... Kilns for drying malt and hops.
564. Bodenham, W. ..... Indicating the strength of brine.
566. Poidevin, T. le ..... Springs for locks.
569. Hedick, W. ..... Gas and dust recorder.
570. Stains, V. D. de ..... Propulsion of carriages.
573. Pyne, R. W. ..... Adjustable horseshoe.
574. Balk, W. J. ..... Street gullies and traps.
577. Cheswright, C. ..... Capsules for the necks of bottles.
578. Moore, F. ..... Speaking tubes.
579. Walkden, S. ..... Eccentric adjustable as regards throw and angle.
583. Hughes, G. R. ..... Facilitating the composing of printing type.
588. Gries, W. ..... Buckles for straps.

14th January, 1888.

591. Sargeant, T. C. ..... Belt fastener.
593. Johnson & Green ..... Controlling the supply of steam to compound locomotive engines.
598. Jones, R. ..... Stoppering bottles.
601. Hallam, S., & others ... Valve gear.
603. Dames, C. R. ..... Preparing fuller's earth.
604. Dolman, F. H. ..... Hoof picks.
606. Nicholl, W. A. ..... Filters.
608. Stubbs, D. H. ..... Clutch.
610. Morecroft, S. ..... Metallic coffins.
613. Trench, C. ..... Kerosene lamps.
615. Tabrar, J. ..... Stoppers for bottles.
618. Fraser, W. ..... Air cushion water tap.
621. Jewell & Mark ..... Joining lead pipes.
622. Jones, A. ..... Ornamenting vitreous surfaces.
624. Chinnery & Tarbutt... Combustion of liquid hydrocarbons.
625. Moore, T. W. ..... Tricycles and bicycles.
626. Stobbs & Grant ..... Dating and numbering stamp.
628. Walker, C. M. ..... Gas lamps.
630. Andersen, W. K. ..... Valves.
631. Thorne & Burr ..... Lamps for railway purposes.
641. George & Armstrong.. Fuses for projectiles.
642. Easton & Hoyland..... Extracting juice from sugar canes.

16th January, 1888.

643. Robinson, A.S., & others. Stoppers for bottles.
644. Wetherell, F. W. ..... Rope wheels.
646. Pickard, W. ..... Metal perforated liners adapted for sewing on a covering of material.
648. Dimitry, C. P. ..... Indelible ink.
650. Crabtree, J. ..... Couplings for railway vehicles.
652. Herbert, F., & others .. Cast iron flange pipes.
658. Jackson, J. O. ..... Valves or taps.
659. Dunn, H. P. ..... Pneumatic speaking tubes.
660. Briggs, J. W. ..... Rotary pumps and engines (*Barber*).
661. Lugrin, A. ..... Repeating watches.
665. Dick, G. A. ..... Manufacture of metal stampings.
666. Bennetts, W. ..... Safety fuses.
667. Mackay, M. ..... Fusible cements.
668. Christopher, G., & ors.. Preparations of extract of tea.
671. Clay, R. ..... Lock nut.
672. Newton, H. E. ..... Life saving rafts (*Allmann*).
673. McClellan, E. S. ..... Air inlets for sewers.
675. Morgan, D. J. ..... Pistons for steam engines.
677. Quick, G. ..... Cartridges.
679. Haley, J. ..... Manufacture of glass tiles.
680. Sears & Kelley ..... Snap hooks.
683. Holzapfel, W. C. A. ... Anti-corrosive composition for steel vessels.
691. Martinson, O. ..... Apparatus for measuring and drawing off liquids.

17th January, 1888.

693. Blizzard, W. ..... Disposal of sewage.
695. Fenby, H. P. ..... Corrugated boiler flues.
696. Varley, T. ..... Propellers for ships.
697. Sisson, W. ..... Valve gear of oscillating engines.
702. Schott, G. A. J. ..... Apparatus for measuring oils and other liquids.
703. Oldfield, G. ..... Ratchet brace for giving a continuous motion to drills.
712. Brookes, J., & others.... Driving chain for bicycles, tricycles, &c.
714. Harrison, J. ..... Compensating roading used on railway points, for contraction and expansion for same.
715. Noble, J. ..... Gas producers for the generation of steam.
717. Jardine, J. W. ..... Railway fog signalling.
723. West, J. ..... Charging and drawing gas retorts.
724. Higham, A. ..... Marking strip for the use of boiler makers.
733. Sanderson, J. ..... Channel bar for ships' keels.
735. Melhuish, R. ..... Tool cabinet and bench.
736. Worssam, C. S. ..... Cutter block for wood planing.
737. Schoop, E. ..... A new agglomerated fuel (*Jouannique & Co.*)
738. Smart, H. R. ..... Ventilating apparatus.
739. Suart & Hanwell ..... Roofing tiles.
740. Grosjean, J. E. ..... Roofs.
741. Gear, H. G. ..... Improvement in wood laths (*The Coleman Grooved Lath Syndicate*).
742. Groth, L. A. ..... Tanning hides and skins by the aid of electricity.
744. Wright, R. ..... Posts, and securing them to the ground.
746. Perkins, A. B. ..... Pulleys and drums.
752. White, T. R. ..... Heating railway carriages.
754. Hawley, C. P. ..... Fastening devices for packages.
760. Smith, W. H., & others Fire lighter.

18th January, 1888.

761. Rayner, T. J. ..... Refrigerators.
762. Birley, W. ..... Railway signalling.
765. Gyde, E. L. ..... Night clock.
770. Woodhead, T. ..... Bolts, rivets, and screws.
771. McDonald, T. ..... Manufacture of cake from oil seeds.
772. Comings, W. R. ..... Dies for cutting and forming sheet brass.
778. Metcalfe, G. F. ..... Printing frame.

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779. Jutson & Poupard..... Shoes for horses.
784. Dutton, T. ..... Automatic sprinklers.
785. Hurst, S. ..... Automatic lock.
786. Buckland, F. ..... Portable conservatories.
796. Reade & Shaw..... Bottles.
801. Smith & Smith ..... Twist lace fabrics.
802. Winfield, F..... Ventilating sewers.
803. Nicholls, A..... Balance rifle and gun sights.
808. Hinks, J. ..... Extinguisher mechanism for lamps.
809. Tonks & Burn..... Latches.
810. Chatwin, J. ..... Screw spanners.
815. Defries, H. ..... Ships' signal lamps.
821. Rose, J. H. ..... Railway signalling apparatus.
822. Haddan, H. J. ..... Power storing brakes (*Reimer, Reimer, & Koenecke*).

19th January, 1888.

825. Hudson, S. ..... Taps.
829. Wylde, A..... Fire escape.
830. Peyton, W. ..... Automatic tilter for beer.
833. Newcombe, H. J..... Abatement of smoke.
837. Hibbert, F. ..... Railway signals.
838. Sayer, R. C..... Filtering and storing rain water.
839. Robertson, A. W. ..... Hinges of furnace doors.
841. Lind, J..... Tubular lanterns.
842. Dale, T..... Feed valves for steam boilers.
845. Samuel, S. I. ..... Velocipedes.
847. Restall, G. F..... Disinfectant for drains.
850. Tulley, J. S..... A wheel guard.
852. Reed & Kennedy..... Manufacture of fenders.
853. Thuron & Renard..... Apparatus for transmitting motion.
855. Fox, W..... Guards for revolving shafts.
860. Conacher & Williams Production of ice.
861. Joice, J..... Carriages.
862. Leeman, E. G..... Automatic extinguishers for lamps.
866. Lingley, G. ..... Permanent way of tramways.
875. Gledhill, M. ..... Projectiles.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

21st January, 1888.

613. Boult, A. J. ..... Boring and tapping mains (*Clausolles*).
1013. Yeadon & Middleton. Apparatus for the manufacture of artificial fuel.
1270. Lake, H. H. ..... Pulverisation of mineral substances (*Raymond & Raymond*).
1784. Griffin, J. ..... Saw sharpening and saw setting apparatus.
2838. Rose, A. T. F. ..... Machinery for turning oval shaped discs.
2920. Rylands & Potter..... Regenerative gas furnaces.
3439. Campbell, C..... Washing machine.
3692. Smith, P. ..... Trap levers of twisting frames.
3820. Laing, W. R..... Frames for spinning flax, hemp, cotton, worsted, &c.
3836. Heggan, J..... Sewing machinery.
3879. Benson, G..... Machinery for slotting.
3885. Jepson, H..... Machinery for hardening felt hats.
3934. Griffin, S. ..... Gas motor engines.
3954. Rowley, J..... Canal locks.
3957. Hart, W. F. ..... Sewing machines (*Larrabee and Fischer*).
4004. Haworth & Mason..... Water heaters for steam boilers.
4006. McCorkindale, D. ..... Preparing malleable iron for making tubes.
4025. Anderson & Pollock... Sewing machines.
4115. Rogerson & Downie... Rapid-firing guns.
4140. Gover, H. C..... Apparatus for stamping.
4172. Roberts, R. R..... Machinery for opening and spreading the twist in fabrics.
4191. Lysaght, J., & others... Rolling thin gauges of iron and steel sheets.
4197. Milne, W. L..... Boilers.
4476. Lloyd, S. ..... Appliances for transferring boats from one level to another on canals.
4591. Brook & Vickerman ... Sizing, drying, and warping machines.
4601. Marshall, R. ..... Steam boiler furnaces.
4641. Holderness, W. ..... Improved ship.
4806. Halliwell, J..... Manufacture of laces.
4889. Tomlinson, T..... Apparatus for cutting sugar cane
6911. Beaudry, A..... Punching and shearing metals.
11142. Lake, H. H. ..... Casting of metal ingots or bars (*Atha*).
11455. Cooper, G. P. ..... Reaping machines.
12900. Morris, T. E. ..... Slate working machinery.
13059. Tongue, J. G. ..... Machine for cleaning leaves containing fibre (*Hemphill Fibre Machine Co.*).
15239-40-42-43-44. Cochrane, W. F..... Roller mills.
16497. Thwaite & Noble ..... Manufacture of steel.
16738. Gibbs & Olson..... Manufacture of horseshoe nails.
16745. Noble & Thwaite ..... Ingot and crucible heating arrangement.
16983. Lake, H. H. ..... Turning lathes (*Hoopes*).
17142. Jensen, P..... Nail punches (*Cowl*).
17159. Johnson, J. Y..... Machines for planing metal (*Sellers & Bancroft*).
17211. Schmidt & Spiegel..... Machine for distributing fertilisers.
17289. Tomlinson, T. ..... Apparatus for cutting sugar cane.
17295. Wilcock & Pearson ... Roving machines.
17414. Lake, H. H. ..... Machines for attaching buttons to leather (*Saunders*).
17451. Ridgway, W. H. ..... Cranes.
17486. Boult, A. J. ..... Manufacture of water proof fabrics (*Sinsabaugh*).
17531. Schott, J. C..... Button making machines.

ELECTRICITY.

21st January, 1888.

563. Leigh, H. H..... Dynamo-electric machine (*Clerc*).
701. Ferranti, S. Z. de ..... Electrical meters.
702. Ferranti, S. Z. de ..... Dynamo-electrical machines.
717. Sayers, W. B. ..... Disc dynamo-electric machines.
800. Willis, J. B..... Telegraph apparatus.
831. Immisch, M. ..... Converting alternating currents into continuous ones.
2390. Liepmann, H. ..... Electrolytical treatment of ores.
2959. Chocqueel, H. C..... Automatic switch for electric alarms.
3605. Selden, C..... Simultaneous telegraphy and telephony.
3878. Boardman, H. ..... Electric alarm clocks.
3943. Douglas, W. H..... Measuring electric currents.
4138. Cockburn, A. C. ..... Safety devices in electric circuits.
4153. Churton, T. H. ..... Mechanical telephone.
8329. Langdon, W. E. ..... Electrical signalling apparatus for railways.
11923. Menges, C. L. R. E..... Electrodes for batteries. (Received 2nd September, 1887. Ante-dated 19th February, 1887, under International Convention).
14768. Dorman & Smith..... Electric switches.
16376. Noble & Noble ..... Electric arc lamps.
17157. Lake, H. H. ..... Batteries (*Whitten*).

CHEMISTRY.

21st January, 1888.

9948. Watson, T. P. ..... Photographic cameras.

MISCELLANEOUS.

21st January, 1888.

14899. Gare, T. ..... Apparatus for copying designs.
497. Warner, A., & others... Registering mechanism.
951. Enright, J. ..... Regulating the supply of gas.
1515. Schlichter, H. ..... Lighting by means of gas.
1843. Kirk, A. C. ..... Supply of distilled water for marine boilers.
1955. Mathey, A. ..... Alarm communication for railway trains.
2043. Stickings, G. F. ..... Coupling railway rolling stock.
2252. Stevens, T. G. ..... Brake for railway trains.
2379. Crastin, C. ..... Gas burners.
2418. Moorwood, H. S. ..... Fire grates.
2484. Thornton & Walker. Straightening steel wire.
2517. Wilson, D. ..... Telegraph poles, &c.
2727. Roberts, S., & others... "Foundations" of cards for carding fibres.
3012. Keeling, T. ..... Permanent ways of railways.
3301. Lockerbie, T. ..... Pipes for conducting acids, alkalies, &c.
3387. Mills, G. E., & others... Discharge pipe, &c., of street gullies.
3475. Augé, E. J. B. ..... Chains for transmitting motion.
3532. Leynen-Hougarets, J. A. H..... Lamps.
3580. Comrie, J. S..... Torpedo indicating light gear.
3849. Meyer, B..... Preventing the explosion of steam boilers.
3859. Lovibond, J. W. ..... Apparatus for estimating the colour of liquid bodies.
3860. Golding, H..... Treating leather.
3861. Betjemann, S. ..... Appliance for attaching and releasing objects when held at a tension.
3901. Hickey, M. ..... Machines for cleaning bottles.
3909. Collier, J. L. ..... Machine for splitting almonds.
3912. Bourne, J. J. ..... Locks.
3940. Defries, H. ..... Railway lamps.
3942. Bayliss, A. A. ..... Lock bolt.
3982. Tandy & Tandy ..... Velocipedes.
4034. Killey, J. G..... Pipes of earthenware.
4040. Shaw, G. H..... Guard for drums employed in thrashing machines.
4065. Prosser, J..... Extinguishing oil lamps.
4066. Davy & Benton ..... Valve gear of steam hammers.
4079. Enright, J..... Burglar alarms.
4089. Attree, G. F. ..... Fog signalling apparatus.
4095. Phillips, R. E..... Velocipedes (*Overman*).
4119-20. Spencer, A. ..... Chains for sprocket wheels.
4160. Beechey, C. G..... Gas bags for gas engines.
4203. Kerfoot, T..... Dry saccharated extract of tea.
4246. Reed, J. W. ..... Apparatus for cutting button holes.
4295. Maynes, J. ..... Manufacture of fire lighters.
4487. Lindsay, W. H..... Utilisation of cinder waste.
4541. Dutton & Cay..... Railway lamps.
4704. Noble, A..... Gas checks for the joints of jointed guns.
5464. Bertling, L. ..... Lithographic process.
5962. Holland, H. W. ..... Counter for guns for recording the number killed.
6893. Downie, T. ..... Copying presses.
9097. Stone, L. W..... Creasing cardboard.
14023. Willway & Moon ..... Apparatus for regulating temperature.
15364. Mason, D..... Treating wool (*Schlamm and Brassard*).
16372. Sayer, R. C..... Filtering and storing rain water.
17029. Vanzini, J. M..... Lubricators.
17239. Taylor, W. ..... Locking device for the covers of rotating shafts (*Lejeune*).
17328. Schubert, J..... Locks.
17342. Finch, W..... Fumigating apparatus.
17452. Kennedy, De L. ..... Projectile.
17458. Horne & Hollyman ... Chimney top to induce up draught.
17467. Bosch & Kumpfmiller. Sheets of metal combined with rubber or analogous gum.
17483. Boult, A. J. ..... Concrete pavements (*Barber*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 14th October, 1887, inclusive.)

Year 1883.

4766. Jameson, J. ..... Coke ovens.
4767. Twigg, G..... Cap for teeth of horse clippers.
4772. Davison, J. S. ..... Stoppers for bottles.
4773. Robbins, E. ..... Cements, &c.
4776. Bartlett, W. A. ..... Controlling gases for motors (*Haight & others*).
4779. King, J. T. ..... Metallurgical furnaces (*Bissell*).
4791. Kenyon, J. ..... Permanent ways of railways.
4793. Justice, P. M. ..... Railway signal systems (*Cutala*).
4795. Clark, A. M..... Fire escapes (*Zerr*).
4796. Clark, A. M. ..... Bottle washing (*Cowles*).
4797. Potter, C. W. ..... Compressors and engines.
4800. Johnson, J. H..... Electromagnets (*Recordon*).
4802. Haddan, H. J. ..... Velocipedes (*Overman*).
4804. Haddan, H. J. ..... Nails (*Tenney*).
4805. Lake, W. R. ..... Bearings for journals, &c. (*Traylor*).
4809. Dey, D. P., & another... Hydraulic steering.
4814. Richardson, J., & ano.. Picking motion for looms.
4816. Williamson, T. M. & ors. Gas motor engines.
4817. Sibree, J. T., & another Propelling velocipedes.
4819. McHardy, J..... Sewing machines.
4821. Glaser, F. C. ..... Railway brakes (*Bolzano*).
4823. Wesselmann, B. ..... Snap hooks.
4835. Bonson, M. ..... Magneto generators (*Stabler*).
4838. Kerfoot, J..... Piston rings.
4839. Sturge, E. ..... Generating motive power.
4844. Gedge, W. E. ..... Purifying lighting gas (*Secrel*).
4851. Price, A. P..... Extraction of precious metals from their ores.
4852. Davis, T. ..... Compressing, &c., packets of substances.
4853. Pieper, C. ..... Solidifying liquid acids (*Vorster and another*).
4854. Sackur, H. ..... Grinding machine.
4856. Redfern, G. F. ..... Gas (*Giraudon*).
4863. Vallet, L. ..... Internal stoppers for bottles.
4865. Muir, A. ..... Coupling shafting.
4871. Simon, H., & another... Ammonia.
4876. Briggs, J..... Kilns.
4878. Jacobsen, C. ..... Steam engines.
4880. Anders, G. L. ..... Telephonic apparatus.
4884. Wrild, E..... Ticketing bobbins.
4885. Benton, C. H. ..... Dynamo-electric machines.
4888. Greig, A..... Street sweeping.
4891. Kinder, W. J..... Spinning, &c., textile materials.
4894. Williams, S. de la G... Kilns.

Year 1882.

4803. Britain, W. ..... Bicycles.
4806. Hornsby, J., & others... Harvesting machines.
4814. Motherwell, W. ..... Moulder's nails.
4817. Dowrie, T. ..... Transparent block ice.
4854. Wise, W. L. ..... Transmitting heat to fluids (*Röber*).

Year 1881.

4410. Morgan-Brown, W. ... Planing wooden hoops (*Campbell*).
4452. Wise, W. L. ..... Frictional couplings (*Mégy and another*).
4455. Swan, J. W. ..... Secondary batteries.
4474. Wise, W. L. ..... Motors (*Mégy*).

Year 1880.

4094. Elmore, W. ..... Extracting copper from its ores.
4097. Webb, H. C..... Producing coloured patterns.
4098. Dick, G. A. ..... Furnaces.
4116. Lake, W. R. ..... Transmitting electrical currents (*Maiche*).
4125. Mathewson, J., & ano... Coal plates.
4175. Gallie, S..... Bolt making.
4185. Marshall, F. C. ..... Valve gearing.

Year 1879.

4080. Lindsay, R. B. ..... Ashes lifters.
4117. Alexander, J., & ano... Utilising gases of blast furnaces.
4141. Clark, A. M. ..... Steel (*Launay*).

Year 1878.

3966. Wilson, J. W. ..... Bobbins, &c.

Year 1877.

3722. Rodger, G. ..... Producing vacuum in condensers, &c.

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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Hydraulic Riveting.—*H. T. Shaw & C. Chittick, London.*—The object of this invention is to provide machinery by which hydraulic punches can be shifted readily whilst forming holes in girders, &c. The work to be riveted is erected between gantries set at a distance apart. A traveller resting on rails at the top of the gantries bridges over the space between them. This traveller carries the tools, and also has a roof suspended from it, under which the men can work in any weather. The traveller consists of girders crossed with purlins, on which is carried a corrugated iron roof. A beam extends transversely to the girders, and is suspended from wheels which run on the bottom flanges of the girders. This beam carries the riveting tools, which can thus be moved from place to place. The inventor claims the combination of traveller and gantries for the purpose described.—No. 2743. February 22nd, 1887. 8*d.*

Mowing Machines.—*S. S. Bromhead, London.* (*G. A. Weaver, Newport, U.S.A.*)—The object of this invention is to provide means for adjusting the pivots of the rollers placed between the finger bar and the sliding cutter bar. The rollers are journalled in blocks, which are provided with slots diagonal to the direction in which the block is moved during adjustment. Bolts or screws pass through the blocks and finger bar, and secure them in position. The adjustable blocks are provided with an extension, which projects over the knife bar, and prevents it springing from its seat. Five claims are made for the improvements described.—No. 15349. November 10th, 1887. 6*d.*

Planing and Chipping Machines.—*S. Bastow, Leeds.*—This invention introduces certain improvements for facilitating the correct setting and adjustment of the knives and cutters of moulding, planing, and chipping machines. Fig. 1 represents a front elevation, and Fig. 2 a plan of the improved cutter heads. A are the loose heads, which may be either square or hexagonal, and the cutter blocks are placed upon spindles B, which are adjustable by means of the screws P^1 and P^2. The bed D holds the board which is required to be operated on, and the lock

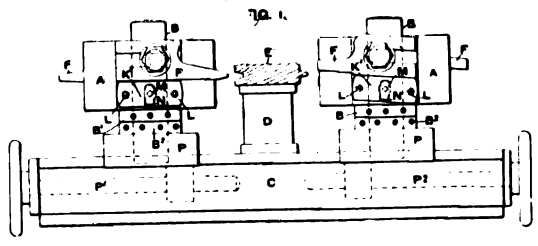
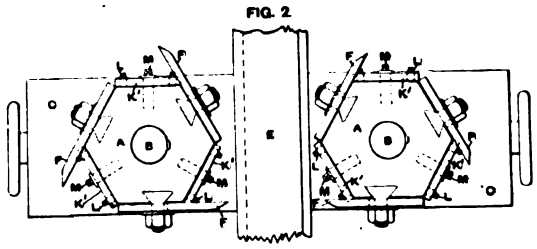


FIG. 2

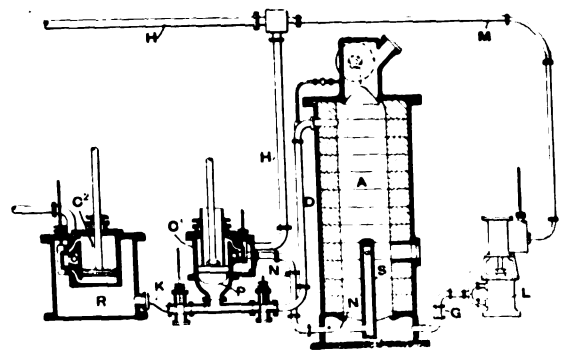


nuts B^1 B^2 allow the spindles B to be raised or lowered. For the adjustment of the knives a pivoted plate K^1 is employed, which is provided with screws L; a centre pin M with a square neck is tapped into the cutter block, and radiates to any angle in the slot N of the pivoted plate. By slackening the screws L the plate can be made to move on its pivot, and to slide up and down on the square of the pivot. The plate may be again secured by tightening the screws L, and the knives bearing against the plate can be taken off and put on without disturbing the angle of the plate. There are two claims made.—No. 6913. May 11th, 1887. 8*d.*

Calcining Furnaces.—*F. M. Spence & D. D. Spence, Manchester.*—This invention relates to furnaces for heating, drying, and calcining mineral substances, and has for its object the performance of the usual operations with greater efficiency and economy. An annular rotating dry-luted furnace is employed, having fixed sides and roof. Across the bed of the furnace are placed two vertical diaphragms at such a distance from each other as to allow between them the feeding apparatus and discharge plate. The bottoms of the diaphragms extend to the surface of the layer of material on the bed of the furnace. The heating gaseous medium enters through apertures on one side of the diaphragm, and passes through and leaves the furnace on the other side. A number of flues are arranged over the annular bed for the purpose of leading away the waste gases from the bed. The material is placed on the floor forming the covering of the flues before being put on the annular bed, and is thence fed continuously to the revolving floor of the furnace. The apparatus used in feeding the material consists of a plate on the right of the left hand diaphragm and at a short distance from it, the space between the plate and the diaphragm thus forming a hopper, which is supplied continuously with the material. To secure the proper confinement of the gaseous medium, a roof is provided; and through the side wall of the furnace are apertures through which the workmen can inspect the progress of the operation. The inventor makes four claims for the combinations.—No. 2119. February 10th, 1887. 8*d.*

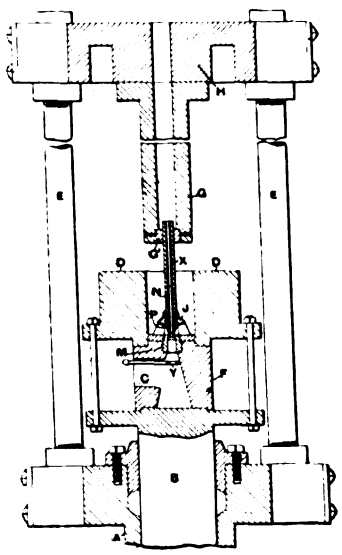
Cold Drawing Machines.—*E. Sandkuhl, London.*—This invention relates to machines for cold drawing and compressing metal bars, rods, tubes, and wires, and to hydraulic apparatus for actuating the same. The die is made with its exterior surface slightly coned, and the internal surface of the die holder is made to correspond therewith. As a better support is given, a lighter die may be used than is usual. The grippers in the cross head are also provided with conical surfaces. The die holder is placed on a spherical seat in the head of the drawing machine so as to form a universal joint. The slide valve of the hydraulic mechanism is provided with a lever, which is drawn over and allows the water to enter the cylinder. Upon the completion of the stroke, the lever is operated by any part of the mechanism, and the machine is stopped. The inventor makes five claims for the improvements described.—No. 13506. October 5th, 1887. 8*d.*

Steam Engines.—*M. P. W. Boulton, Tew Park, Oxford, and E. Perrett, London.*—In this engine the chief agent employed is steam, but a certain quantity of hot gases resulting from combustion are at some stage of operations introduced into the apparatus, and mixed with the steam. The principal service of these gases is to superheat the steam, but they also assist the steam in the performance of work by their own expansion. One of the forms of apparatus designed according to this method is shown in diagrammatic manner in the annexed figure. A steam boiler of ordinary construction supplies the high pressure steam



through the pipe H. The steam passes through the valve case at the upper end of the cylinder C^1, and acts on the annular area on the upper side of the differential piston P^1. The exhaust steam passes by the pipe N to the combustion chamber A, in which the steam mixes with the products of the combustion therein maintained. This mixing causes the steam to be superheated, and the resulting mixture of gas and steam is led by the pipe D to the lower end of the cylinder C^1, and there acts on the full area of the under side of the piston P^1. The exhaust from the lower end of the cylinder C^1 passes by the pipe K to a reservoir R, from which both the ends of the low pressure cylinder C^2 are supplied. The superheater A is supplied with the air required for the combustion of the liquid fuel by a pipe G from an air compressing pump L, which may be worked as shown by an engine supplied with steam from the boiler by the pipe M. In another form of this invention the superheating chamber is constructed for the combustion of solid fuel. The vessel is lined with refractory material, and has in the middle of its height a grate, on which such fuel as coke or charcoal is placed. At the higher end of the vessel is a valve, like those which are used for feeding fuel to hot air engines, and the pressure on this valve is balanced, when it has to be opened, by admitting steam above it. Air for the support of combustion is forced in underneath the fire, and steam from the boiler is introduced above the fire in quantity regulated by a valve. The inventors make five claims.—No. 459. January 11th, 1887. 11*d.*

Apparatus for Covering Electrical Conductors with Lead.—*R. W. Eddison, Leeds.*—The diagram represents a transverse section of the press, and shows the improvements introduced. The invention refers to machines of the type described in Tatham's Patent No. 11879 of 1885, and has for its object the

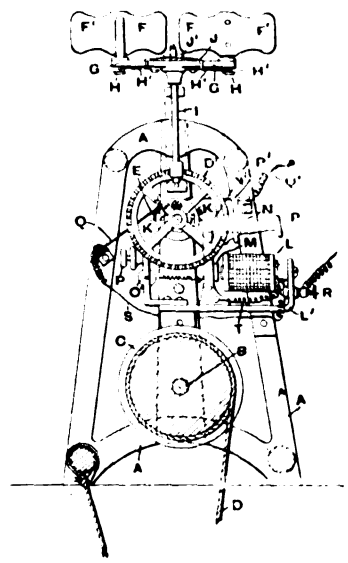


prevention of injury to the insulated covering of the conductor whilst it is being covered with hot lead. A is part of the hydraulic cylinder of a lead pipe press, and B is part of the plunger which carries the lead reservoir D. The interposed column F contains a lateral passage C, and the upper fixed ram G is bolted to the cap H, which is secured to the cylinder by means of the pillars E. The block J has a central chamber and opposite lateral passages; and into a threaded opening in the bottom of the block is screwed the die M, the projecting portion of which is contained in a recess in the column F. A threaded opening in the top of J admits the hollow core N, the upper end of which fits in a block G^1 in the lower end of the ram G. The core N has a detachable end P, which is held in position by a set screw. The insulated wire is drawn through the cap H, the ram G, the hollow core N, and out through the lateral opening C. The core and its projection are lined with asbestos as at X, in order to protect the insulating material from the injurious effect of the heat of the core; and an internal shoulder is formed in the tube close to the nose to keep the lining in its place. A perforated pipe Y is placed beneath the die so as to throw jets of water on to the covering of the insulated conductor directly it issues from the die. The inventor makes four claims for the combinations of reservoir, ram, and die, with the hollow core and its shoulder.—No. 15329. November 9th, 1887. 8*d.*

Compound Steam Engines.—*R. R. Bevis, Birkenhead, and J. D. Churchill, London.*—This invention is designed for the object of more perfectly controlling and governing multiple expansion engines. A double beat throttle valve is placed in the pipe which conducts the exhaust steam from the high pressure cylinder to the expansion chamber of the second cylinder. The same governor is made to operate this valve simultaneously with the usual valve in the steam supply pipe. The result of this arrangement is to cut off the supply of steam to both cylinders, and to cause the exhaust steam from the first cylinder to exert a back pressure. This extra throttle valve is connected to the governor by a gear, which, however, allows the valve to open temporarily when the pressure against it exceeds a certain limit. This locking gear is enclosed in a pipe which is carried in suitable brackets. The inventor makes five claims for the placing of the throttle valves and the details of the locking gear for the object described.—No. 2432. February 16th, 1887. 8*d.*

ELECTRICITY.

Electric Unison Motors.—*A. J. Boult, London.* (*J. F. McLaughlin, Philadelphia.*)—These instruments are designed for the purpose of synchronously revolving two or more separated shafts, one of them being placed at each end at the extremities of a line circuit. In the accompanying diagram, which represents a vertical sectional view, are shown the essential features



of the instrument. A train of wheels, comprising a clock movement, is operated by a weight attached to the cord D, which is wound on the drum C. The governor wheel D^1 transmits motion to the governor F, and also to a vertical shaft, by means of bevel wheels, which are not shown in the drawing. The revolution of this vertical shaft is controlled by the devices which are the subject of this invention. The governor F consists of two adjustable wings F^1, vertically pivoted in the adjustable cross bar G. Two curved springs H^1 are secured each to the under side of the cross bar G, and at their bifurcated extremities press down upon the bolts H, so that their tension will exert sufficient pressure on the pivot pins to prevent the resistance of the air from displacing the set position of the wings. A spring friction clutch J is secured to the shaft I by a pin J^1, and bears equally on either side of the cross bar, thereby preventing the cross bar from being dislodged by the revolution of the wings. The contact wheel E is fixed to the same shaft as the governor wheel D^1 by a pin K, which passes through an insulated traverse aperture. This contact wheel is insulated by a sleeve of hard rubber from its shaft, and upon its periphery is embedded a platinum contact pin K^1. The electromagnet L, provided with a yoke piece, is supported by the bracket L^1, and the armature M is fastened to the lever N, and is provided with a platinum point N^1 to engage with the pin on the contact wheel. O is a retracting spring fastened as shown, and P P are adjustable screws to limit the play of the lever N. P^1 and Q are two metallic contact brushes which are fixed to and insulated from the frame work, and they bear respectively at their inner free ends upon the contact wheel E. The brush P^1 is in circuit with a battery by the wire Q^1, and the brush Q is in circuit with the line and electromagnet L through the binding posts R and the wire S. The inventor makes nine claims for these improvements.—No. 11200. August 16th, 1887. 8*d.*

Electric Furnace.—*S. Z. de Ferranti, London.*—According to this invention, the current which circulates in the crucible is not conducted there from the outside, but is to be induced in it by a varying magnetic field. In one form of apparatus designed according to this principle, the crucible is of an oblong annular shape, and magnet core pieces rise up through the open space in the centre and outside each of the two longer flattened sides of the crucible, and an insulated conductor is wound between the pole pieces below the crucible. The

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central and outer pole pieces are connected at the bottom so as to form two horseshoe magnets embracing the two longer sides of the crucible respectively. Removable connecting pieces are also placed over the tops of the pole pieces. The crucible forms a continuous trough open at the top, and a suitable lid is provided by which it can be covered over when the surface is in operation, while the whole furnace may be mounted on trunnions. In another form of the furnace, a coil of insulated conductor is placed above the crucible as well as below it, and the pole pieces by which each side of the crucible is surrounded are formed from concentric rings of sheet iron, each formed of a bent iron sheet. The inventor claims an electric furnace in which the material is heated by currents induced directly in it. —No. 700. January 15th, 1887. 8*d*.

ELECTROLYSING BLEACHING SOLUTION.—*E. Hermite, E. J. Paterson, & C. F. Cooper, Dalston, London.*—This invention relates to the construction of the electrolysing apparatus and connected with the method of bleaching described in Patent No. 13929 of 1884. The material to be bleached is acted on by a solution of magnesium chloride which is subjected to electrolytic action. In communication with the bleaching vessel is placed another vessel, through which the bleaching liquor is caused to circulate in contact with the electrodes. The improved electrolysing apparatus is shown in elevation and plan in Figs. 1 and 2. The object of the improvement is to increase the surface exposed

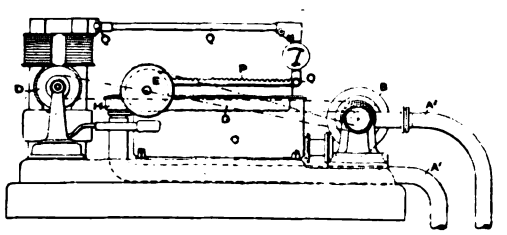


FIG. 1.

to the liquid, and to render the apparatus accessible for repair. The rotary pump B draws the liquor from the tank A and discharges it into the electrolysing cell C, while the pipe A^1 allows the electrolysed liquor to flow back to the tank A. The dynamo D, the shaft E, and the rotary pump B are all driven by belt gearing from one motive shaft. The liquor enters C through a perforated pipe which lies at the bottom of the cell; and after rising between the negative and positive elements overflows into side channels G and end channels H, and thence to the descending pipe A^1. The cell C is partly divided by a longitudinal partition, and in each of the compartments so made are journalled the shafts K, which are caused to revolve by worm

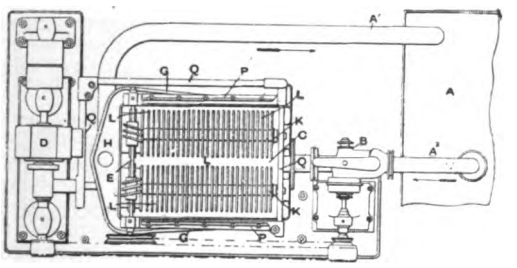


FIG. 2.

gearing on the shaft E. Zinc discs L are fixed to these shafts, and between each pair of discs is placed a platinum plate. Each of the platinum plates is held in a frame, from one corner of which projects an arm carrying a bolt. These bolts are all held in the notches of the rack P, which is insulated from the cell and connected with one pole of the dynamo by the rods Q. The other terminal of the dynamo is connected directly to the metal of the cell C. On the partition, which partly divides the cell, the inventors place inclined scrapers, which scrape the discs L and the shaft K as they revolve. There are five claims for this improved apparatus, together with certain alternative modifications.—No. 1993. February 8th, 1887. 11*d*.

CHEMISTRY.

CYANOGEN COMPOUNDS FROM COAL GAS.—*O. Knublauch, Cologne.* —In the improved process the gas mixtures are passed through a liquid containing alkaline earths and oxides or hydrates of iron suspended in it. The cyanogen is thus brought into closer contact with the iron and alkali, and the resulting ferrocyanogen salt, being immediately dissolved on its formation, does not form an obstruction to the further combination of the iron, alkali, and cyanogen. If there is any sulphuretted hydrogen in the gases, the prussic acid combines with it, and thus the amount of ferrous sulphide formed is small. The inventor makes two claims.—No. 15184. November 7th, 1887. 6*d*.

SULPHATE OF ALUMINA.—*J. J. Hood & A. G. Salamon, London.* —These improvements relate to the separation of the iron salts from crude sulphate of alumina. The ferrous salt is first oxidised and brought into the ferric state by adding a certain quantity of potassium chlorate to the solution. The precipitation of the iron is then effected by the gradual addition of sodium tungstate. The inventor makes two claims.—No. 2966. February 25th, 1887. 4*d*.

PURIFICATION OF ALCOHOL.—*T. G. Bowick, Harpenden, Hertfordshire.*—The essential feature of the combination of operations described in this invention is that alcohol is brought in an atomised condition into intimate contact with certain hydrocarbons, and that this mixture forms an emulsion which is separated by osmotic action. The carrying out of this process involves the use of a series of cylinders, each of which is jacketed for the circulation of warm water. The cylinders are made about 7ft. high and 2ft. in diameter, and are all filled to a height of 2ft. with pure alcohol, except the last of the series, which is completely filled. Six inches from the bottom of the cylinders are placed diaphragms of some filtering material. The upper 5ft. of the cylinders are filled with well refined hydrocarbon, preferably that known as "intermediate oil" in the refining of petroleum. A similar diaphragm is also placed 6in. from the top of each of the series of vessels which contain the hydrocarbon and the alcohol; and each of the cylinders is provided internally with a four bladed turbine or sparger, which revolves on a tubular vertical axis. The blades of the turbine are hollow, and are provided with roses at their ends, which are so placed that, when liquid is forced through the axis and through the blades and roses, the whole turbine revolves rapidly. Two series of pipes connected with a supply of hydrocarbon and alcohol respectively admit these two liquids to different ends of the vertical tubular axis of the turbine, and when pressure is exerted by pumps these liquids are forced together through the roses and become intimately mixed. The alcohol falls through the pure hydrocarbon contained in the cylinders, and the diaphragms filter it, and abstract all its hydrocarbon and impurity by osmotic action. This action takes place through the whole succession of cylinders until the alcohol arrives at the end of the series in a purified condition. The inventor makes eight claims for the process described.—No. 14737. October 29th, 1887. 8*d*.

ARTIFICIAL MANURES.—*A. Campbell, London.*—This invention involves the mixing together of a phosphate of alumina or iron, such as Redonda, with low class phosphates of lime. The phosphates of alumina or iron are calcined and ground to a fine powder. By calcination the phosphates lose their water, and the percentage of phosphoric acid is thus increased and rendered soluble in citrate of ammonia. By virtue of the latter property, these phosphates are suited to mix with low class superphosphates of lime, thus furnishing manures soluble in water and citrate of ammonia, which is capable of dissolving any desired percentage of phosphoric acid. The inventor makes two claims.—No. 2459. February 17th, 1887. 6*d*.

SOAP.—*S. S. Sugden, Woodford, Essex.*—The inventor takes fatty matters and treats them with oxide of lead, so as to produce the usual soap with a lead base. As soon as saponification is complete, the glycerine is removed by means of hot water, and soda lye is run upon the lead soap. By the application of heat a rapid decomposition takes place, the fatty acids relinquishing union with the lead base and combining with the soda base. The saponaceous paste floats on the surface, and the lead subsides to the bottom of the vessel. After the precipitated lead has been washed, it is mixed with oil, and can be used as a pigment; while the glycerine produced is decolourised with charcoal. The inventor makes three claims.—No. 1033. January 22nd, 1887. 6*d*.

MISCELLANEOUS.

FRICTION CLUTCH.—*I. G. Hooper, Newark, New Jersey, U.S.A.* —In the accompanying drawings the improved clutch is shown as applied to the drum of a hoisting machine. Fig. 1 represents a section through the clutch, and Fig. 2 a longitudinal section of the barrel. At one end of the drum A is a recess K^1, in which is arranged a sliding collar B. This collar has a bevelled surface B^1, which engages with a correspondingly inclined surface on the blocks C. The rods C^1 are pivotally attached to these

FIG. 1.

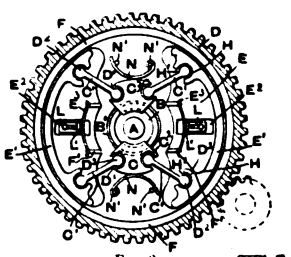
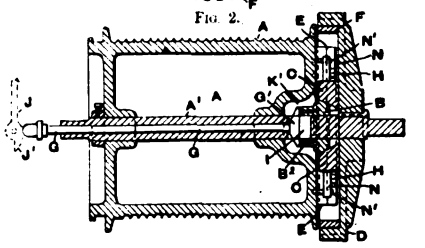
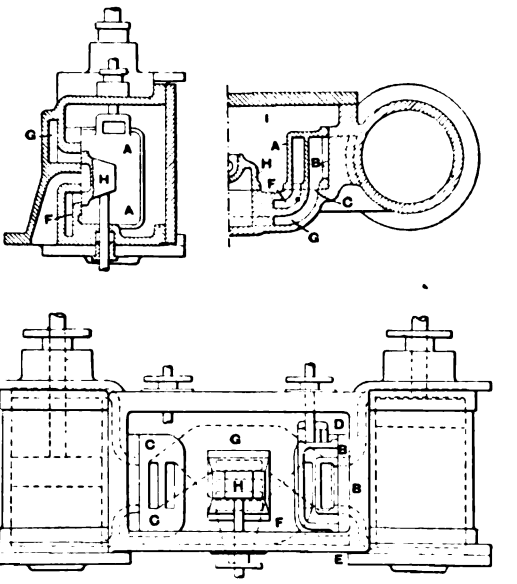


FIG. 2.



blocks C, thus forming an elbow joint. The segmental expanding plates E are provided with broadened flanges F^1 on the outside, which form frictional surfaces. When the plates are thrown outwardly, these surfaces engage with the inner peripheral surface of the gear wheel D. In the segmental plates are slots E^2, in which are arranged slotted angle plates L, secured to the recessed face of the hoisting drum. These plates serve to cause the segmental plates to turn with the drum, while permitting their necessary outward movement. The projecting part L^1 of the angle plates provides a fixed stop, against which the springs E^3 bear at their central point. The springs N, secured to the drum by pins N^1, bear against the top of the blocks C, and the rods C^1 are secured to the plates and the blocks C by forming annular recesses F^1 and C^2 therein. Springs are also arranged between the end of the driving collar and the gear wheel, and upon the release of the collar these springs force the collar backward away from the blocks, and thus co-operate with the springs E^3 and N in returning the several parts of the clutch to their normal disengaged position. The mechanism for producing the forward motion of the collar against the inclined surface of the blocks consists of a rod G arranged within the hollow shaft A^1. One end of this rod bears against a plate G^1 moving in a slot I, and the opposite end projects from the shaft and is provided with an adjustable cap. An arm and cam lever J engages the said cap when the lever is depressed, and forces the rod G forward, causing the sliding motion of the collar and its engagement with the blocks C. The inventor makes two claims for the combinations of various parts.—No. 14817. October 31st, 1887. 8*d*.

SLIDE VALVES.—*C. H. Thompson, Gateshead.*—The novelties introduced by this invention are that the steam face of the cylinder has two admission ports but no positive exhaust port, that the steam pressure is always upon the outside of the slide valve, and that the regulating valve for reversing the motion works upon a steam face which has two admission and one exhaust passages. The accompanying figures show sections of the apparatus in the three principal directions. The slide valve A slides against two surfaces B C, one at the side and one at the bottom of the valve. In the side face of the steam chest there are only two ports D E, one leading to each end of the cylinder. In the bottom face C are two ports F G, which communicate with the two passages leading to the regulating valve H. The valve A is so constructed that the fluid medium, air, steam, or water, can only enter the cylinder by means of the two pipes communicating with the valve H, although the slide valve works inside the steam chest in the ordinary way. In



the side face B of the valve an exhaust recess is made with an opening leading into it from the bottom face C, and communicating with the passage G; and the edges of the recess regulate the admission and exit of steam in the usual way. The edges on the ends of the valve A act in the same way as the steam edges of the D shaped slide valve. Thus as regards the admission and exhaust of steam directly to the cylinder, the inventor has an ordinary slide valve; but he carries round the back or top of this D valve a covered passage, and makes a port leading out of this passage through the bottom of this valve to communicate with the other passage leading to the regulating valve H. If the regulating valve H is placed so as to allow the steam to flow through the passage G to the exhaust recess of the valve, the passage F will act as an exit passage for the steam, and the exhaust edges of the valve will be turned into steam edges and *vice versa*. If the valve H be moved so that the steam is allowed to flow through the passage F to the ports or outside edges of the slide valve, the action will be immediately changed, the steam going past them in the usual manner, and the exhaust steam going through the passage G, thus allowing the steam to flow into the opposite end of the cylinder, and so reverse the engine. The inventor makes one claim for a two-faced D valve, each face being provided with two ports supplied with the motive agent through a regulating valve for determining the action of the main pistons, as described.—No. 2054. February 9th, 1887. 8*d*.

DIFFUSING APPARATUS FOR TREATING SUGAR CANE.—*H. H. Lake, London.* (*Compagnie de Fives-Lille, Paris.*)—This invention introduces improvements for operating the doors of cylindrico-conical diffusers of great capacity. The movable bottom of the diffuser constituting the discharge door is articulated at the centre of its height, and is provided with a counterweight for the purpose of balancing the door in any position. The opening of the bottom is effected by means of two rods supported in sockets which are attached to the shell of the apparatus between the hinge of the door and the axis of the diffuser. Each rod is screw threaded at its lower part, and carries a nut which slides freely in a guide fixed to the diffuser. To each nut is articulated one end of a rod, the lower extremity of which is connected to the door of the diffuser, so that when the screwed rods are turned in one or other direction, the nuts are moved upwards or downwards, the doors being consequently opened or closed. These two opening rods are connected with each other at their upper ends by a shaft and bevel wheels, and are operated by a single crank. The movable bottom when closed is secured at points diametrically opposite to the opening rods by the following means: Two locking rods, screw threaded at their lower ends, are supported in bearings upon the shell of the diffuser; and each of these screw threads carries a nut, to which are articulated two connecting rods united at their lower extremities to a link having a counterweight. These connecting rods are guided in grooves in the sides of the bearings supporting the locking rods. A small rod pivoted upon each locking rod socket has a slot in its lower part, and limits at a certain moment the vertical descending motion of the closing link, and afterwards causes it to describe an arc of a circle upon the lower axis of the small rod, and disengages this link from the catch riveted to the door. The two locking rods are connected at their upper

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part by a shaft and gear wheels, which are actuated by a single crank. The door is thus supported at four points, and the operation of opening and closing can be performed from the top of the whole apparatus. The inventor makes three claims.—No. 2905. February 24th, 1887. 8*d*.

Apparatus for Mixing Granular Materials.—*J. Crosfield and E. Beck, Warrington.*—The object of this invention is to mix two or more granular or pulverulent materials in definite proportions. The materials are placed in separate hoppers, which empty themselves into the mixer. The feed apparatus consists of a feed wheel with a screw-regulated slide below it. The wheels are placed in the necks of the hoppers, and are preferably of the form of spindles with arms placed thereon. The spindles are geared together by pitch wheels and chains, which are driven from the mixer shaft, and the diameters of the pitch wheels are regulated according to the required proportions of the constituent materials. The mixer made use of is a horizontal cylinder, revolving on a central shaft, which is provided with stirrers of the form of Archimedean blades. The inventors make three claims for these combinations. —No. 2231. February 12th, 1887. 8*d*.

Adjusting Apparatus for Carding Engines.—*G. Ashworth and E. Ashworth, Manchester.*—This invention provides means for adjusting and levelling the side frames of carding engines. Instead of using wedges and other temporary apparatus, the inventors make use of a jack, which consists of a flat metal plate recessed to contain an anti-friction bowl projecting slightly above the level of the plate. The jack plate is provided at each end with set screws having thumb or other heads to facilitate their being turned. When in use the plates are put beneath the frames and between the feet, the conical ends of the set screws bearing upon smaller counter-sunk plates laid directly upon the floor. By turning the screws the frame may be raised entirely from the floor, and as it then rests on anti-friction bowls it may be easily moved in either direction and adjusted longitudinally or perpendicularly. In a modification of this invention the set screws are employed to slide wedges which raise or lower the frame, and cams also may be used to serve the same purpose. The inventors make three claims.—No. 1762. February 4th, 1887. 8*d*.

Lubricators.—*H. Bamford, London.*—These lubricators are more particularly applicable to gas engines, but may be used for other purposes. A glass vessel or reservoir contains the oil, and from its lowest part a pipe communicates with the cistern of the lubricator. The orifice at the lower end of the pipe must be in such a position that the oil covers it when at the desired level, thus preventing the return of air up the pipe when the surface of the oil is lowered. No air can enter the lubricator except through this pipe. For the purposes of filling, the upper part of the reservoir is perforated with an opening, which is made air tight by a valve on the inside of the case. A spiral spring keeps the valve in its seating. This valve is attached to a spindle, which projects downwards and carries another valve, for the purpose of opening and closing the orifice in the upper end of the pipe communicating with the lubricator. The spindle is also carried through the opening in the upper side of the reservoir, and terminates in a button which can be pressed down by hand. The position of these valves on the spindle is such that when the upper valve is opened for filling by pressing down the button, the lower valve closes the orifice in the upper end of the pipe, and prevents the oil escaping into the lubricator. When the pressure on the button is removed the upper valve is returned to its seating by the spiral spring, which at the same time lifts the lower valve and establishes the communication with the lubricator. The inventor claims the arrangement of parts for the purpose described.—No. 2236. February 12th, 1887. 8*d*.

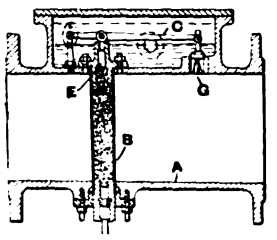
Manufacture of Explosives.—*H. S. Maxim, London.*—The object of this invention is to diminish the liability to accidental explosion of dynamite, blasting gelatine, &c. One source of such danger is that dynamite and blasting gelatine contain a large proportion of air between their particles, and when a sudden impact is imparted to the compound, the compression of this air generates sufficient heat to cause an explosion. In order to eliminate the air from dynamite, the inventor places it in a vacuum, and then compresses it into a solid inelastic mass; or by filling the interstices between the grains with water, drives out the air hitherto located there. The apparatus used consists of a cylinder provided at one end with numerous perforations; a piston works in the cylinder, whose perforated end is connected with a chamber in communication with an air pump. The explosive material is placed in the cylinder between the piston and the perforated end, and is forced through the holes in fine threads into the vacuous chamber, where it is completely exhausted of air, and while in that condition is compressed into blocks. To eliminate air from blasting gelatine, the material is placed under water or in a vacuum, and is there subjected to the action of rotating and stationary knives or other suitable mixing and kneading apparatus. The inventor claims: (1) The method of decreasing the danger of explosives by eliminating the air therefrom; and (2) the apparatus for pressing the material through the fine holes into a vacuous chamber for the above purpose.—No. 2628. February 19th, 1887. 8*d*.

Agitators.—*W. Creswick, Wakefield.*—The improved apparatus is employed for turning over, agitating, and propelling forward substances in a powdered, broken up, or semi-liquid state, over floors the temperatures of which are raised or lowered according as the substances are to be heated, dried, or cooled. Endless bands or chains are passed round pulleys or drums mounted at the ends of the floor, and carry sets of ploughs or scrapers which act upon the material spread over the floor and gradually move it from one end to the other, at the same time turning it over. Two claims are made for the improvements described.—No. 15590. November 14th, 1887. 6*d*.

Manufacture of Ropes.—*G. H. Hebblethwaite, Huddersfield.*—The inventor proposes to construct ropes for the transmission of power by rope and pulley gearing, without twisting or folding the strands. Either cotton, flax, worsted, or hemp may be employed, and the fibres are so woven as to form a solid belt or strip of a certain width. Several widths required to form a sectional rope of V form are secured together by means of rivets or wire stitching, in order to fit the V groove in the rim of the pulleys. The top and bottom layers may be made of leather. The inventor claims the manufacture of ropes as described.—No. 2592. February 19th, 1887. 4*d*.

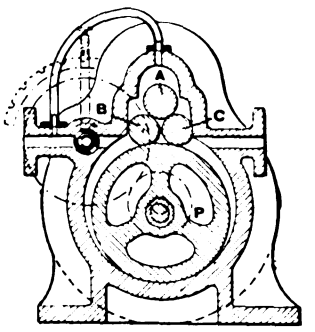
GERMAN PATENT ABSTRACTS.

Superheating of Steam.—*Max Gehre, Düsseldorf.*—This invention relates to an apparatus for regulating the superheating of steam. A tube B is inserted into the steam pipe A and filled with quicksilver. The end of B is closed by a piston E, which actuates a lever C, carrying on one end a valve G. As soon as



the temperature in A exceeds a certain limit, the quicksilver expands and lifts the piston E, thereby raising the lever C and opening the valve G, which admits water into A until the temperature has again become normal.—No. 41473. May 4th, 1887.

Rotary Pump.—*L. Neut & Co., Paris.*—A drum P is attached in such a manner as to move freely round the crank of the shaft fixed in the centre of the circular casing shown in section in our illustration. This shaft is actuated by two toothed wheels. The rollers A B C are pressed against P and the inside



of the casing by the water flowing through the small pipe connecting the suction pipe with the upper part of the casing. The rollers A B C take the place of a valve, and prevent the water from running back. The supply is cut off by a valve in the suction pipe.—No. 41438. January 22nd, 1887.

UNITED STATES PATENT ABSTRACTS.

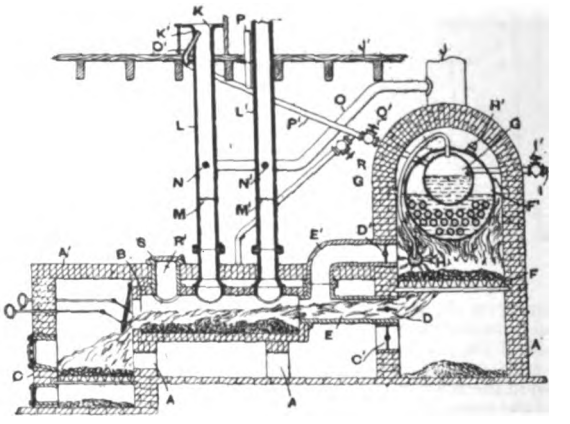
Machine for Shaping Heads of Screws.—*C. F. Roper, Cambridge, Massachusetts.*—This invention consists essentially of a race way to contain the screws, the heads of which are to be shaped, a cut-off slide, and ejector, combined with an intermittently rotating holder, provided with jaws to hold the screws, and with a rotating head shaping tool. The improvements refer to a machine described in Letters Patent No. 162665, granted to the same patentee. The holder is rotated intermittently by a gear wheel, which has three teeth missing at different points of its periphery, so as to place the clamps of the holder in position to have a screw placed therein by the ejector. The holder is composed of a hub, slotted in the direction of its length to receive a series of clamp jaws. A number of punches are pivoted inside the hub, and act by gravity as the holder rotates. The ends of the punches tap against the ends of the screws, and knock them out of the holder. The head shaping cutter is pivoted loosely by a pin in a socket piece. The cutter has attached to it a guide, which is made to pass round the head of the screw before the toothed end of the cutter meets it. The ejector places a screw between the ends of the clamp members while they are separated under the action of a spring, and while the screw is being so placed another pair of clamps, closed firmly upon the shank of another screw, holds it while the cutter finishes the head, the screw so operated on being subsequently discharged from between the clamps before the clamp in the intermittent rotation of the holder again arrives in position opposite the hub of the race way and ejector. The inventor makes six claims for the various combinations of holder, clamps, cutter, and ejector.—No. 372276, dated 25th October, 1887.

Stone Sawing Machine.—*G. M. Viernow, St. Louis.*—This machine is intended more especially for use in cutting solid rock in the quarry, where it is desirable to have a saw which is operated from one end only. The chief improvements introduced consist of the means of driving the saws, and of the manner of feeding as the saw advances in its cut. The two pitman rods are attached to one end of a frame which carry the saws, and the other ends of the rods are geared to cranks which are fitted one at each end of the driving shaft. On the middle of this shaft is a pulley, round which passes the driving belt. In order to increase the grasp of the belt, an attachment is made on the shaft of two arms held together by a spiral spring, with idlers at their ends which press on the two branches of the belt. The feed motion for lowering the saws and their driving mechanism is constructed as follows: Vertical screwed shafts pass through threaded apertures in blocks which support each end of the driving shaft, and rest at their lower ends in bearings in the frame. At their upper ends are bevel wheels, which gear into similar wheels placed on another horizontal shaft. This horizontal shaft carries another bevel wheel, which meshes into a wheel on a hand-rotated shaft, and also a chain wheel, which, by means of a chain, causes a drum to revolve. On this drum is wound a rope, which, passing over a pulley on the end of a crane beam, serves to raise and lower the saws and the ends of the pitman rods nearest to the saws. A handle on the hand-rotated shaft before mentioned is operated by the workman, and serves to lower both ends of the pitman rods simultaneously. The ropes lower one end of the rods, and the other end of the rods is lowered by means of the bevel gear, which causes the upright screwed shaft to turn in the blocks, and in their descent these blocks carry the driving shaft and cranks along with them. The inventor makes nine claims for the improvements.—No. 372996, dated 8th November, 1887.

Converter.—*S. C. Collin, Braddock, Pennsylvania.*—This invention consists of a form of tipping converter, which is so constructed as to dispense with the ladle. The converter is provided with trunnions, by which it is journalled in bearings. One of the trunnions is hollow, and a pipe serves to convey the blast through the trunnion to the end of the converter at which the tuyeres are situated. A crank is fitted to one of the trunnions, and is connected by means of a link to a mechanism which supplies motion to the crank in order to tip the converter when required. A tramway is formed underneath the foundations, and the moulds and waggons for slag run on these rails, and in that position receive their contents directly from the converter. The inventor makes two claims for this form of tipping converter. —No. 372302, dated 1st November, 1887.

Oscillating Engine.—*F. L. Wheeler, Southington, Connecticut.*—The trunnions which support the cylinder are fixed in the middle of its length, and their central line forms a tangent to the circular cross section of the cylinder. The cylinder itself thus supplies the requisite oscillatory motion for the circular slide valves which the inventor makes use of. Steam is admitted to the valve box through one of the trunnions, and leaves the engine through the other on its exhaust. There is also a special system of levers attached to the valve gear for reversing the engine. The inventor makes twelve claims for these combinations of steam chest, valve ports, reversing gear, and the position of the trunnions.—No. 372348, dated 1st November, 1887.

Sewage Furnace.—*A. Engle, Barter, Iowa.*—This furnace is designed for volatilising and burning wet and offensive substances in such a manner as to cause them to furnish fuel for their own disintegration. The annexed diagram represents a longitudinal section of one form of furnace described in the specification. The invention consists of the combination of the fire places C and F with the boiler F¹ and retort G and oven B, for the purposes described. The pipes L L¹ R¹ supply solid garbage for combustion in the oven B, and the pipe K¹ P¹ separates the liquid refuse and conducts it to the retort G. The supply valves and the valves D D¹ being closed, and the valve C¹ being open, the fires are lit at C and F. The flames pass round the oven B, and volatilise the garbage. The resulting

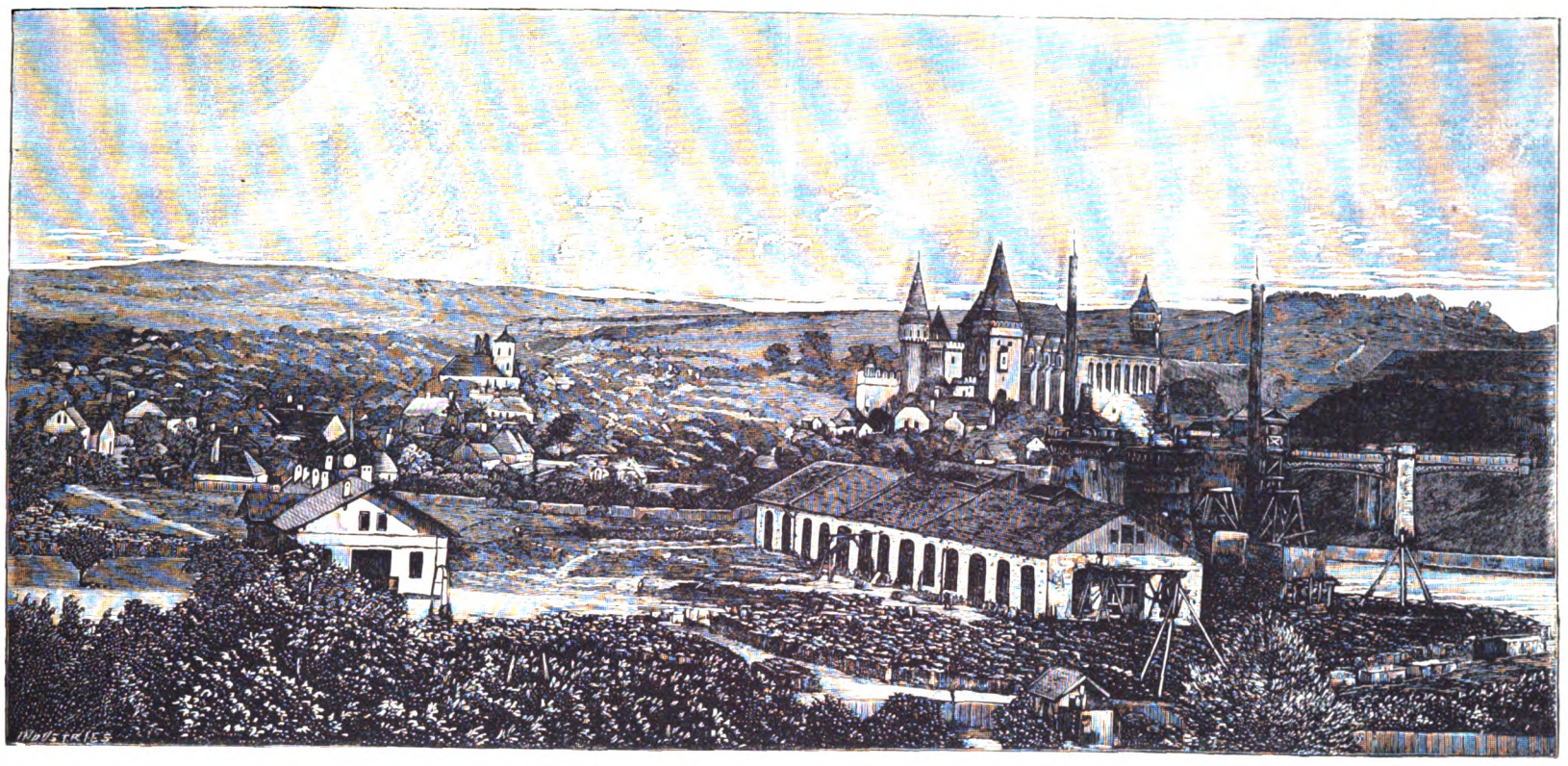


steam and gases pass over the fire place C, and along with the smoke of that fire place through the fire burning at F. During this time the heat of the flames in F has been communicated through the water in the boiler F¹ to the retort G. The refuse therein contained is evaporated, and the gases are conducted by the pipe G¹ to the nozzle H, where they are consumed by the furnace F. When this process has been continued for a time sufficient for the drying of the garbage in the oven B, the valve C¹ is closed and the valve D opened. The flames of the furnace C then pass through the oven B and ignite the refuse. Any unconsumed products of combustion are finally destroyed in the furnace F. The liquid refuse may be sent directly to an oven alongside the oven B, instead of being disintegrated in the retort G, or part of it may be destroyed in the oven, and part in the retort, as in the arrangement shown in the figure. By this invention only a slight sediment is left behind in the retort G. The inventor makes seven claims for the combinations described. —No. 372305, dated 1st November, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE INDUSTRIAL RESOURCES OF TRANSYLVANIA.



The Government Iron Works at Vaida-Hunyad, Transylvania.

THE INDUSTRIAL RESOURCES OF TRANSYLVANIA.

One of our correspondents, who has travelled in Transylvania with the special object of acquiring a knowledge of the capabilities of the district for industrial development, sends us the following account:—

There are countries in Europe of which much less is known than of South Africa, or any other distant region. Such is the case with Transylvania, a country full of natural resources, waiting to be explored, and practically utilised. Transylvania was the California of the Romans—whose traces we find everywhere in the country—and gold mining is still carried on to a large extent, but as far as I could gather, with very little profit, a result which is natural if we consider the peculiar form and manner of the occurrence of gold in the Transylvanian gold district. Far more important, however, than these gold mines (which have been brought under the notice of the English public, at the time of the gold mining rage in 1881), are the other mineral resources of this country, of which nobody ever speaks, but which I shall now try to enumerate, so far as they have come under my notice during a professional tour through Transylvania last summer.

The basis of all industrial enterprises, cheap fuel, abounds in Transylvania, both in the shape of wood and coal. The whole country is densely wooded, especially the western part of it, where I traversed over a great many square miles of virgin forest. Giant trees of more than 6ft. diam. are very common, but nobody uses them. They die and fall, and on their decaying trunks new life springs forth. Most of these virgin forests consist of pine trees, but there are also many magnificent oak and beech forests. Many of these forests are Government property, others are owned by the aristocracy of the country, who derive a very small income from them. The only reason which can be given for the almost total absence of any attempt to utilise these enormous quantities of timber is the rough and hilly character of the country, and the absence of navigable streams, which renders the removal of the trees from the place of their growth a matter of great difficulty. No attempt seems to have been made to introduce the manufacture of wood cellulose by the sulphite or any other rational process, although I am of opinion that good profits could be realised from such an enterprise in a country where the value of pine wood is next to nothing. The beech forests are utilised for producing charcoal in a very rough and irrational manner. This charcoal is delivered at a ridiculously low price to some of the iron works, of which I shall speak presently.

Coal occurs in very large quantities and in thick strata in several places. Of these, the most important one is Petrozsény, near the Roumanian frontier. Here there are eighteen beds of coal, one overlying the other; and of these, four or five are sufficiently thick to be worked profitably. The greater part of this mining district is the property of the Hungarian Government, who tried to work the mines. This, however, proved a signal failure, so the Government leased their mines to the Kronstadt Mining and Smelting Company, who are also the owners of the mines adjoining the Government property, and who now work the combined coal mines, to considerable advantage, supplying fuel to the Hungarian, Servian, and Roumanian railways, and to some extent also to the Danube steamers. Petrozsény coal is of excellent quality, burning with a long and good flame, and leaving very little ash. It has, however, the drawback of yielding a very inferior coke. Experiments have been carried on for several years to improve the quality of the coke; they have resulted, however, in failure. An iron works with two Scotch blast furnaces, which was built by the Kronstadt Company, at Kalan, in the hope of utilising the Petrozsény coke for the production of pig iron, proved a failure, and is lying idle at the present moment. Petrozsény is connected both with Kalan and the main line of the Transylvanian Railway by a branch line, which leads through one of the most picturesque mountain districts of Europe. Recently, a new bed of tertiary coal was discovered in the north-east of the country, in the neighbourhood of Bistritz. The quality of this new coal is said to be very good, but the nature and extent of the occurrence is as yet hardly known.

The mineral wealth of Transylvania is astonishing, and probably superior to that of any other European country. The frequent occurrence of gold has already been mentioned; it has been an object of industrial enterprise ever since the times of the Romans. The gold occurs both in a free state and in combination with silver, lead, and tellur. The peculiarity of Transylvanian gold is that it is not contained in quartz, as in many other gold bearing districts; nor is it mixed with the sand of streams which spring from auriferous quartz mountains; but the gold occurs in the shape of sublimed crystals in fissures of volcanic rocks, especially trachyte. These fissures have subsequently been infiltrated with carbonate of lime, which encloses the gold crystals. The fissures never exceed 5in. or 6in. in thickness, and generally they are much thinner. In order to get at the auriferous calcite, large quantities of trachyte, which contain no trace of gold, have to be removed; consequently, gold mining in Transylvania is connected with an unusual amount of work, and cannot leave the result profitable. Besides the Government mines, there are also a few gold mines belonging to companies or private individuals. Of the Government mines, the most important one is Nagyag, situated at the summit of a very steep mountain. There the gold occurs only in combination with silver, lead, and tellur, in the shape of sylvanite and nagyagite. Nagyag is the only place in the world where tellur is found in quantity. All the gold ores, from Nagyag as well as from the other gold mines (where gold occurs in the metallic state), is brought together to Zalatna, where the gold is extracted and refined. The tellur is volatilised during the operation of extraction, and is deposited in the shape of crude tellurous acid in certain chambers connected with the furnace. If tellur should, as it seems likely to, be capable of finding a useful application in electricity, then Zalatna would probably be the only place in the world where it could be obtained.

Silver and lead occur, as I have already mentioned, in combination with the gold at Nagyag; but they are also found in the shape of argentiferous lead ore, which is worked up together with the gold ore at Zalatna. There is also a lead and silver smelting works at Deva. Manganese ores are very plentiful, and magnificently crystallised pyrolusite occurs in various places. I am not aware, however, of the existence of any manganese mines. The same is the case with certain minerals of baryta and arsenic. Iron ores occur in many places in great quantity and of excellent quality. Transylvanian iron ores are remarkably free from phosphorus. Several works exist in which these ores are worked up in charcoal blast furnaces. The pig iron obtained is of excellent quality, and quite as good as the best Styrian iron. It used to find a ready market for the manufacture of steel and wrought iron. At present, however, iron smelting in Transylvania is no longer profitable, because the introduction of the Thomas-Gilchrist process has considerably lowered the value of pig iron free from phosphorus. The largest Transylvanian iron works is that of Vaida-Hunyad, and is Government property. At the time of my visit to this works, a stock of pig iron was to be seen which no private company would dare to accumulate. Even the Government engineers seemed to be uneasy about it, and a steel making plant was being put up, so as to utilise this enormous quantity of pig iron. The above engraving, which is prepared from a photograph, shows these iron works. The low, long building in front is the foundry, and behind it are two blast furnaces. The establishment is connected by an overhead steel rope way, with the collieries nineteen miles distant; and the iron ore mines are situate on the same track, at a distance of six miles from the furnaces. The building at the end of the foundry contains the blast engines, and the offices are on the opposite side of the yard. The building on the hill is the famous castle Vaida-Hunyad—built by Johannes Corvinus—the birth place of Matthias Corvinus, and for centuries the residence of the Grand Dukes of Transylvania. It is now the property of the Austrian Emperor, who received it as a free gift from the Hungarian nation.

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Another iron works is that of Roskitza, which belongs to the Kronstadt Company. Its produce is transformed into wrought iron at Ferdinandsberg, another of the same company's works. Ferdinandsberg wrought iron is generally known and liked all along the Danube, in Servia, Roumania, and even in Turkey. The Ferdinandsberg puddling furnaces are heated by gas, obtained in a peculiar generator from beech wood. Both at Hunyad and Roskitza the iron ore occurs in the immediate neighbourhood of the works. I have already mentioned the blast furnaces at Kalan, which had to be abandoned, being constructed for the use of coke, and situated in a valley where charcoal made from beech wood cannot be obtained as cheaply as in Hunyad and Roskitza. There is, however, still some iron casting carried on at Kalan. Domestic iron stoves are produced, which find a ready market in the neighbourhood.

Large quantities of china clay occur in two extensive beds in the neighbourhood of Deva, but nobody thinks of using them. Ordinary clay occurs everywhere, and yields the raw material for a rough kind of pottery carried on by Wallachian peasants, who have, in the shape of their productions, most faithfully preserved the Roman traditions.

There are beds of rock salt of astonishing size and depth in various places. The most important of these is the one situated at Maros-Ujwar, where the colour of the rock salt is almost white, and large transparent cubes of salt are of common occurrence. The salt mines I visited are those of Viszakna, in the south of Transylvania, and in the immediate neighbourhood of Hermannstadt, a city of 30,000 inhabitants of Saxon origin. At Viszakna the Romans have left evidence of rock salt mining. Their pits were of a conical shape, enlarging as they descended. The natural consequence of this irrational mode of mining was, that the pits fell in after a while, forming very deep funnel-shaped holes, which becoming filled with rain water were in the course of time transformed into small lakes of saturated brine. These lakes are now used for bathing, and wonderful cures are said to have been effected by the brine in cases of severe rheumatism and gout. No other use is made of this brine, although it would be a suitable raw material for the manufacture of soda by the ammonia process, with the use of cheap coal from Petrozsény or Bistritz. In the immediate neighbourhood of these lakes is a modern salt pit, worked by the Hungarian Government, who have made the mining of salt a State monopoly. This mine descends to a very great depth (there are some 350 steps leading down into the main gallery), and then widens out into a succession of halls with galleries hewn into the solid rock salt. The mine is only worked during winter time, when it gives employment to the agricultural labourers. The salt is hewn away in the shape of large rectangular blocks, which are hoisted up by means of buffalo hide bags, attached to a long rope. There is a primitive mill connected with the mine, where the rock salt is ground into a powder, which is sold for domestic purposes. The Transylvanian salt mines seem to supply all the salt used throughout Hungary, and in the shape of ground rock salt. Crystallised salt, prepared by the evaporation of brine, seems to be an unknown luxury throughout the kingdom, and even in first class hotels only the ground rock salt is to be found.

In the immediate neighbourhood of Transylvania, in the famous Tömös valley, in Roumania (where the king's well known summer residence, Sinaia, forms an attraction for tourists), petroleum was discovered a few years ago, and it is more than probable that it will also be found on this side of the frontier. At present it is brought over from Roumania by rail, in a crude state, to Kronstadt, where two or three small refineries are employed in its purification. The rectified oil is sold for domestic purposes throughout Hungary. Kronstadt is a city of about 35,000 inhabitants, and the only place in Transylvania where some attempts at industrial enterprise are made. Besides the petroleum refineries mentioned, there are two large distilleries and a paper mill. The latter is said to use, amongst other raw materials, the straw of Indian corn, which is grown in extraordinary quantity everywhere in the south of Hungary and in Transylvania. There is quite as much, if not more, Indian corn grown in the country as there is wheat. Indian corn forms the chief and favourite food of the Wallachian peasants, who make a peculiar kind of yellow bread from it, which tastes very unpleasant to a civilised palate. Indian corn is also, as has been shown in the United States, an excellent raw material for the manufacture of starch and spirit.

From the above sketch it will be seen that Transylvania is full of industrial opportunities, which, hitherto, have not been utilised. There are various reasons for this. The most important one seems to be the total absence of capital. I have met with very little poverty during my voyage in Transylvania; neither have I met with or heard of a single rich man. The aristocracy of the country are certainly very rich, if we consider the extent of the land they own; but their income derived from this property is barely sufficient to keep them. Moreover, they are all Magyars, a race whose want of industrial enterprise is almost proverbial. The Wallachians, who form by far the majority of the inhabitants of Transylvania, are all either peasants or agricultural labourers. They are good natured and hard working, but almost invariably illiterate and wanting in intelligence. The most intelligent race in Transylvania are the Saxons, who form three separate large colonies, Kronstadt, Hermannstadt, and Bistritz. They are leading a quiet and happy life, having enough for their wants, but nothing to spare. They do not seem to understand the importance of industrial enterprise; and being in constant opposition to the Hungarian Government, they have very little inducement to go in for work in which they would be largely at the mercy of that Government.

Another reason for the absence of industrial enterprise in Transylvania is its comparative remoteness. It is true that Transylvania is connected with the surrounding countries by railways. But, on the other hand, the rates for goods traffic to great distances are anything but encouraging, whilst the once existing outlet for Transylvanian goods into the adjoining kingdom of Roumania is at present entirely blocked by the "zollkrieg," a system of prohibitive tariffs enforced by Roumania upon Hungarian goods, and *vice versa*. Ever since the existence of this "zollkrieg" the commerce of Transylvania has been in a ruinous condition. Finally, it must be mentioned that the peculiar geological formation of Transylvania is such that there are very few important water courses in the country. The absence of water in the otherwise most magnificent mountain scenery of the South Karpathic range is quite striking to anyone conversant with other European mountain districts. On the summit of some of the highest mountains there is generally one or a couple of small but very deep lakes, without visible outlet; but even in the deepest ravines and valleys there is frequently a mere suspicion of a brook, where, in a similar locality in Switzerland, there would be a raging torrent. This scarcity of small water courses in the mountains very naturally results in a corresponding insignificance of the streams in the plains. This is an item to be considered by all who intend to go in for industrial undertakings in Transylvania.

At present the Hungarian Government are the only proprietors of industrial enterprises in Transylvania worth mentioning, excepting the Kronstadt Company, which is in the hands of a few large Vienna capitalists. It is difficult to state how these Government enterprises prosper. On an average they may be assumed to fairly pay their way. It is, however, generally acknowledged that Government enterprise is almost the worst method to utilise natural opportunities. Even the most zealous and intelligent Government officials will always lack that enterprising and active spirit which is the first condition of industrial success, whilst the unavoidable red tape stifles even the last trace of a pushing spirit which might now and then actuate the officers in charge of the works.

UNIVERSITY EXTENSION AND TECHNICAL EDUCATION.

By Henry Dyer, C.E., M.A.

II.

(Continued from page 78.)

In this country opinion has been almost unanimous against attempting to teach trades in schools, and has insisted on these being taught in actual workshops or manufactories. In some trades, however, especially those requiring a high degree of manipulative skill, the practice in the workshop may with advantage be supplemented in evening classes; but the expense of these should be borne by those most interested in them, and not either by local rates or Imperial grants. Professor Fleeming Jenkin, speaking on this subject, said: "If you mean by technical education, attempting to teach a man his business by a college course, I think it is a very mischievous delusion indeed; but if you mean by that, in addition to his practical training, you would give him some theoretical training, some technical courses, I think it would be very useful indeed." If, then, we define technical education as a training in the applications of science to special departments of industry, and, of course, presuppose that the students have had fair opportunities of obtaining a knowledge of the theoretical principles involved, we see at once that it falls within the legitimate sphere of university work, not only in its higher but also in its most elementary departments. The universities have for some time held local examinations in the elementary departments of literary and scientific subjects, and there are no reasons why these should not be extended to applied science, as a sufficient board of examiners might be appointed which would be competent to deal with all the subjects required in the districts covered by its operations. The Victoria University has made arrangements for undertaking work of this kind, and has opened a register for technical schools, mechanics' institutes, and the like, so that their students may be examined in the different departments of applied science; and no doubt the movement will extend, as it has done in the case of the literary and scientific subjects in Cambridge, so as to lead to the recognition of the work done in the local institutions for a part, and possibly in the not very distant future, for the greater part of the degree examination. This step taken by the Victoria University is another illustration of the fact that the newer institutions are more anxious to keep themselves up with the spirit of the times than are the older. In this matter the authorities concerned, in formulating their scheme have acted upon the advice of practical men, and men who were best competent to give counsel on the subject, an example which might with advantage be followed by the older institutions.

We have throughout the country an extensive system of teaching and examination in connection with the Science and Art Department and the City and Guilds of London Institute, which ought to be utilised and improved as far as possible. I do not wish to deny that some good work has been done by both of those systems during the past few years; but even their warmest admirers admit that there has been a great deal of very bad work. Both systems labour under all the disadvantages of what is known as "payment by results," but should be called "payment by passes," which is quite another thing. These disadvantages are evidently realised by those in charge of the arrangements, for at the last meeting of the British Association I heard Sir Philip Magnus, the Director and Secretary of the City and Guilds of London Institute, say, when asking his audience to consider the proposals of the Technical Schools Bill, that he hoped that nothing would be done to extend the fetters of the method of payment by results, while the examiners of the Science and Art Department have always tried to minimise the evils connected with it. The whole system, however, must be changed, for the principles on which it is founded are unsound. There must, of course, be payment by results, but not by the results of individual students, but rather of the average work done in a district; and moreover there must be a decentralisation of examination, or the present system will break down through sheer weight. Want of space in the meantime, however, prevents me from entering into details of this part of the subject, and I would simply indicate that the different Universities should be made the centres of educational districts, and the local examinations be conducted from these centres, aided, of course, by the most competent persons in the different localities. The subjects in the syllabuses of the Science and Art Department and the City and Guilds of London Institute represent very fully those for which classes should be instituted; but each educational centre should issue its own syllabus. Even these should not attempt to bind the teachers as to the details of subjects and methods of teaching; but considerable latitude should be given, so that variety of treatment might be possible and the originality of the teachers and scholars developed, as well as modifications introduced to suit local circumstances.

The unit of the organisation required should be the public elementary school, in which would be laid the foundation for technical subjects in as good a general education as could be given within the limits of age prescribed. In the evening classes of these, in the secondary schools, and in special scientific institutions, such as technical schools and colleges, more advanced classes would be formed. Under the Technical Schools (Scotland) Act, the Scotch School Boards will have extended powers for organising and maintaining such classes, and it is probable that in a short time English School Boards will have similar powers. The most promising students would pass from the evening classes to the day classes of a College or University, which would also be attended by some of the best students from the secondary schools. Those who had gone through a full course of study in the evening classes should be allowed to proceed to a degree after a comparatively short attendance at the day classes, on condition, of course, that they passed all the examinations required. This they would have no difficulty in doing, as those who had ability and perseverance enough to complete the evening classes curriculum would be far above the average College or University student who attended the classes by his father's orders, and not because his heart was in his work.

This outlined scheme is no mere dream, for in the West of Scotland we are within a short distance of making it a reality, if only a few more comparatively simple steps were taken. The constitution of the Glasgow and West of Scotland Technical College is such that it allows students to pass from the most elementary to the highest classes. At present, its evening classes are conducted according to the requirements of the Science and Art Department; but it is to be hoped that these will ultimately be modified in the direction I have indicated. For these classes, complete courses of instruction extending over four years have been arranged in the following

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departments: (1) Mechanical engineering; (2) naval architecture; (3) electrical engineering; (4) architecture; (5) building construction; (6) chemical industries; (7) metallurgy; (8) mining; (9) agriculture; (10) textile industries; and students who complete them will receive the College certificate, while those who take an additional year at the day classes will obtain the College diploma, which can also be got after three years' attendance at the day classes alone. For both the day and evening classes certificates of attendance are accepted from any properly organised institution, or from teachers of known ability. The College, which was formed by the amalgamation of Anderson's College, the College of Science and Arts, and Allan Glen's School, has just been inaugurated, so that as yet no arrangements have been made for the institution of branches in Glasgow and the West of Scotland; but throughout that district numerous classes already exist in connection with the Science and Art Department and the City and Guilds of London Institute, and it is probable that these will be extended, and many more founded. It is to be hoped that, instead of working as isolated units, these will be formed into one system, in which the great body of the students will obtain all they require, but from which the most promising would pass by means of bursaries or otherwise to the day classes of the College, or of the University.

It will be observed that only one further step requires to be taken to make the system reach from the lowest class in the elementary school to the highest class in the University, and that is the recognition by the authorities of the University of the attendance required for the diploma of the Technical College, as equivalent to the greater part of what is required for a degree, and it is to be hoped that they will see that it is their duty to take this step at the earliest possible time. It may be argued that such a step is still premature; but all educational history shows that unless the highest institutions take the lead, and encourage and maintain a good standard of teaching and examination, the lower have a sickly existence. The possibility of obtaining a degree would infuse life and energy into the students, and give them an object in their studies, which would be the means of doing more good to the local institutions than a large addition to their endowments. No favour is asked, as the students would in all cases be required to attend systematic and lengthened courses of instruction, and to pass whatever standard of examination might be decided upon, and that being so, and the Universities being public institutions for the advancement and spread of learning, it is evidently their duty to lead the new educational movement which is everywhere rapidly developing. In these democratic days privileged monopoly cannot exist, and the Universities must clearly recognise that they cannot retain at the same time the positions of national institutions and private establishments. I do not think that there will be any wish to lower the standard of work in the Universities, or to make the position of professor any less honourable. On the contrary, I believe the educated public will see the necessity for giving encouragement to every department of learning in all stages, of making the professors independent of competing for fees or grants, and of making their position as honourable as possible; but it will insist as a return for all this on them efficiently meeting the demands of the times in every department of education, and it will expect those who occupy high educational positions to lead and guide public opinion in all educational and social questions, and not simply allow themselves to drift before it.

(To be continued.)

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting held on the 24th of January, a paper was read on "The Erection of the 'Jubilee' Bridge carrying the East Indian Railway over the River Hooghly, at Hooghly," by Sir Bradford Leslie, K.C.I.E., M.Inst.C.E. The author stated that this bridge carried a double line of railway, of 5ft. 6in. gauge, over the Hooghly River, which, at the site of the bridge, was 1200ft. wide, with a depth of 86ft. at high water spring tides in the flood season. The bridge had a clear headway of 33ft. 6in. above the highest tides, or 54ft. above low water in the dry season. Excepting in the deep channel on the right side, the river flowed over a bed of silt, which was very unstable and subject to scour. This, together with the strength of the tidal flow, and the periodical floods, five or six miles an hour, was very unfavourable to the use of any kind of temporary staging in the river bed. Taking into account the danger of any such staging being carried away by the unwieldy country craft navigating the river, it was considered advisable to dispense, so far as possible, with the use of staging or false work for the erection of the superstructure of the bridge, and the general design was arranged accordingly. A central double cantilever, 360ft. long by 52ft. high over all, was supported by two piers 120ft. 6in. apart from centre to centre. The piers were 66ft. long by 25ft. wide, with semi-circular ends and flat sides, and were sunk by means of iron caissons of the same dimensions, and each 108ft. high, 70ft. into the river bed, and rested on a stratum of hard yellow clay, into which they penetrated 12ft. The caissons were divided by four cross partitions into three excavating chambers, open from bottom to top, and two intermediate water tight compartments. They also had lateral water tight compartments in the central excavating chamber. The weight of iron work in each caisson was 453 tons. They were built in rings 4ft. deep, connected by internal angle irons. The lower length of 16ft. of each caisson was built on shore, and was launched and floated into position at the site of the pier. Here the caissons were moored by chain cables and anchors, with the assistance of a pair of coupled pontoons occupying the space between them. These pontoons formed a working platform for the erection, pitching, and sinking of the caissons. The caissons were built up of the 4ft. rings, and weighted with brick work and concrete until the lower edge approached the river bed at low water; they were then adjusted exactly true to position, and pitched by admitting water into the water tight compartments, which were afterwards filled with cement concrete and brick work. The caissons, when pitched, were sunk into the river bed by removing the earth from the interior through the excavating chambers, by means of special boring apparatus similar to that used at the Gorai Bridge on the Eastern Bengal Railway. When sunk to the full depth they were filled with cement concrete and brick work, and the piers were built of brick work up to a height of 34ft. above high water. Upon the brick piers, and connected with them by holding down bolts and anchor castings bedded in the brick work, were erected cellular steel standards 30ft. high, each weighing 205 tons. These completed the piers up to the under side of the cantilever girders. For the erection of the central portion of the cantilever, 180ft. long, a staging constructed of timber and rails, and springing from the brick work of the river piers, was constructed. Upon this staging the cantilever was erected by means of derricks 70ft. to 90ft. long, guyed from the pontoons, which were moored to the piers, and from buoys laid for the purpose. The end portions of the cantilevers, projecting 90ft. beyond the timber staging, were erected by first placing in position a 30ft. length of bottom boom with gusset plates attached, and suspending it temporarily by tackles to the completed portion of the cantilever, then raising and fixing the inclined suspension bars, and afterwards the vertical struts and sections of the top boom, thus completing the 30ft. panel or bay. The erection of the cantilever complete, including riveting, weighing 1465 tons, occupied six months, and was carried on while the river was in full flood. The two side abutments of the bridge were built of brick work and concrete; they were rectangular in plan, 65ft. long by 28ft. wide at the base, reduced to 42ft. long by 15ft. wide at the top. They were founded by means of wrought iron curbs, 8ft. deep, divided by cross partitions into three excavating chambers, with openings 6ft. by 12ft., through which the earth was removed from inside the curb. The right abutment was sunk through clay to a depth of 40ft. below ground level. As but little water leaked in, the material was excavated by hand digging. The left abutment was sunk through silt to a depth of 84ft. below the ground level. The borings showed no better foundation, even at a depth of 140ft., and as further sinking would have required an enormous weight to overcome side friction, it was stopped at this depth. The water percolated freely through silt, in which this abutment was founded; it was therefore excavated by Bull's dredgers, worked by steam winches. When sunk to the full depth, the excavating chambers of both abutments were filled with concrete and brick work. Approach viaducts, 450ft. long, were built of brick work on both sides of the river. The piers of these viaducts were 4ft. 1in. thick, 15ft. apart from centre to centre, the intervening spaces being spanned by semi-circular arches. The viaducts were 37ft. 9in. wide at the top over all. In rear of the left abutment of the main bridge, the ground had been disturbed by the excavation of the silt from the chambers of the abutment curb, drawing in the stuff from the back and undermining it. To bridge over this disturbed area, it became necessary to have recourse to a block foundation 60ft. square, with twenty-five excavating chambers, from which the earth was removed by dredging. This 60ft. block was sunk to 20ft. below ground level, and the excavating chambers having been filled with concrete, the approach viaduct was built upon it. Upon the spandrel or side walls of these viaducts, the steel girders of the main side spans, 420ft. long by 47ft. deep, of a weight of 1000 tons per span, were erected and riveted up complete. For launching them into position, four flat footed or Vignoles rails were laid in juxtaposition on three longitudinal balks of timber on the viaduct walls under the centre of each of the main girders. These lines of rails extended the whole length of the viaduct and over the abutments, projecting 3ft. beyond the face of the same. The shore or rear ends of the main girders, weighing 250 tons each, were carried on trollies by means of the end bearing pins. The trollies distributed the weight over a wheel base of 22½ft. A roller platform, resting on fourteen 3¾in. round iron rollers, was inserted under each of the main girders at a distance of 60ft. from the outer or river end, the girders being stiffened, by temporary counter-struts in two bays, to sustain the abnormal strains due to their being supported 60ft. from the end. The main girders, thus carried on the roller platforms and trollies in the rear, were then hauled out until they overhung or projected beyond the abutment 51ft. The two pontoons used in sinking the caissons of the river piers, each 225ft. long by 26ft. 6in. wide by 9ft. deep, with a combined displacement of 300 tons per foot of immersion, were closely coupled together and rigidly connected by a strong staging of timber and rails, designed to carry the girders of the main side spans, supporting them at the outer end and at a point 30ft. from the end, at a height of 48ft. or 50ft. above the water level. The pontoon staging thus prepared was floated under the projecting ends of the main girders at low water on a suitable tide, and the packings having been adjusted to distribute the weight equally on the two pontoons, the outer ends of the girders were lifted by the rising tide, and the shore ends being carried on the trollies, the girders were hauled across and deposited on their seat at the cantilever ends. The pontoons with the staging were removed at low water. The operation of launching or floating out each main side span occupied about an hour and a half. The hauling out gear consisted, first, of two three-fold 1in. chain tackles, made fast to the outside of the abutments and hauling on the shore end of the girders, operated by a pair of semi-portable engines fixed on the approach viaduct in rear of the girders; and secondly, of three double steel 4in. wire ropes (six parts altogether) attached to the deck of the outer end of the main girders, hauled on by rope tackles ranged on the cantilever deck, and worked by powerful steam winches. During the operation of floating out the main girders, the pontoons were guided in a straight line, and prevented from drifting sideways by up and down stream warps made fast to barges moored at a suitable distance above and below bridge; the warps were hauled in or paid out from capstans on the pontoon decks. After the main girders had been placed in position, it was necessary to remove the launching trollies from the shore ends, and to transfer the girder ends to the pendulum suspension links by which they are permanently carried, and which allow of expansion and contraction of the girders due to variations of temperature. The first caisson was launched on the 2nd of March, 1884. The second side span was floated into position, and the shore ends were suspended by the pendulum links to the saddle castings on the abutment, thus practically completing the bridge, on the 22nd December, 1886.

NOTES ON SCREWING APPLIANCES.

II.

(Continued from page 80.)

Gas Master Taps.—These taps are only used for finishing the dies of screwing machines or of guide screw stocks; their outside diameter is exactly twice the depth of the thread greater than that of the ordinary gas tap, for reasons already explained.

Table V.

Giving the Best Dimensions of Gas Taps.

Size of Tap.	Number of Threads per in.	Diameter at Top of Thread.	Diameter at Bottom of Thread.	Diameter of Neck.	Diameter at Bottom of Grooves.	Number of Grooves	Total Length.	Length of Screwing	Thickness of Collar.	Size of Square.	Length of Square.
in.		in.	in.	in.	in.		in.	in.	in.	in.	in.
	28	·3825	·3367	·3342	·2867	3	2·9	1·1	⅛		·5
	19	·518	·4506	·4181	·4006	5	3·1	1·2	⅛		·55
	19	·6563	·5889	·5864	·5389	6	3·3	1·3	⅛		·6
	14	·8257	·7342	·7293	·6842	6	3·5	1·4	⅛		·65
	14	·9022	·8107	·8057	·7606	6	3·7	1·5	⅛		·7
	14	1·041	·9195	·9240	·8995	6	3·9	1·6	⅛		·75
	14	1·189	1·0975	1·09	1·0475	9	4·1	1·7	⅛		·8
1	11	1·309	1·1925	1·185	1·1425	9	4·3	1·8	⅛		·85
1¼	11	1·492	1·5755	1·368	1·3255	9	4·8	1·9	⅛		·9
1½	11	1·65	1·5335	1·526	1·4835	12	5	2	⅛		·95
1¾	11	1·745	1·6285	1·6185	1·5785	12	5·2	2·1	⅛		1
1¾	11	1·8825	1·7660	1·756	1·7160	12	5·4	2·2	⅛		1·05
1¾	11	2·021	1·9045	1·8945	1·8545	12	5·6	2·3	⅛		1·1
1¾	11	2·047	1·9295	1·9205	1·8805	12	5·8	2·4	⅛		1·15
1¾	11	2·215	2·1285	2·1185	2·0785	15	6	2·5	⅛		1·2
2	11	2·347	2·2305	2·2205	2·1805	15	6·2	2·6	⅛		1·25
2¼	11	—	—	—	—	15	6·4	2·7	⅛		1·3
2¼	11	2·5875	2·4710	2·456	2·396	15	6·6	2·8	⅛		1·35
2½	11	—	—	—	—	15	6·8	2·9	⅛		1·4
2½	11	3·0013	2·8818	2·8698	2·8098	15	7	3	⅛		1·45
2¾	11	—	—	—	—	15	7·2	3·1	⅛		1·5
2¾	11	3·247	3·1305	3·1130	3·0555	15	7·4	3·2	⅛		1·5
2¾	11	—	—	—	—	15	7·6	3·3	⅛		1·55
3	11	3·485	3·3685	3·3510	3·2935	18	7·8	3·4	⅛		1·6
3¼	11	3·6985	3·5820	3·5645	3·507	18	8·2	3·6	⅛		1·7
3½	11	3·912	3·7955	3·7780	3·7205	18	8·6	3·8	⅛		1·8
3¾	11	4·1255	4·009	3·9915	3·934	18	9	4	⅛		1·9
4	11	4·399	4·2225	4·205	4·150	21	9·4	4·2	⅛		2

N.B.—The diameter of the collar on the neck of the tap is equal to the diameter at top of thread.

Table VI.

Giving the Best Dimensions of Gas Master Taps.

Size of Tap.	Number of Threads per in.	Diameter at Top of Thread.	Diameter at Bottom of Thread.	Diameter of Neck.	Diameter at Bottom of Grooves.	Number of Grooves	Total Length of Tap.	Length of Screwing	Size of Square.	Length of Square.
in.		in.	in.	in.	in.		in.	in.	in.	in.
	28	·4283	·3825	·38	·3575	5	2·95	1·4		·45
	19	·5854	·518	·5155	·493	5	3·15	1·5		·5
	19	·7237	·6563	·6538	·6313	6	3·35	1·6		·55
	14	·9172	·8257	·8207	·8007	6	3·55	1·7		·6
	14	·9937	·9022	·8972	·8772	6	3·75	1·8		·65
	14	1·1325	1·041	1·0335	1·016	9	3·95	1·9		·7
	14	1·2805	1·189	1·1815	1·164	9	4·15	2		·75
1	11	1·4255	1·309	1·3015	1·284	12	4·35	2·1	⅛	·8
1¼	11	1·6085	1·492	1·4845	1·442	12	4·65	2·2	⅛	·9
1½	11	1·7665	1·65	1·6425	1·6	12	5	2·35	⅛	1
1¾	11	1·8615	1·745	1·735	1·695	12	5·25	2·475	⅛	1·05
1¾	11	1·999	1·8825	1·8725	1·8325	15	5·5	2·6	⅛	1·1
1¾	11	2·1375	2·021	2·011	1·971	15	5·75	2·725	⅛	1·15
1¾	11	2·1635	2·047	2·037	1·997	15	6	2·85	⅛	1·2
1¾	11	2·3615	2·215	2·235	2·195	15	6·25	2·975	⅛	1·25
2	11	2·4635	2·347	2·337	2·297	18	6·5	3·1	⅛	1·3
2¼	11	—	—	—	—	18	6·75	3·225	⅛	1·35
2¼	11	2·7040	2·5875	2·5725	2·5125	18	7	3·35	2	1·4
2¼	11	—	—	—	—	18	7·25	3·475	2	1·45
2½	11	3·1178	3·0013	2·9863	2·9263	18	7·5	3·6	2¼	1·5
2½	11	—	—	—	—	18	7·75	3·725	2¼	1·55
2¾	11	3·3635	3·247	3·2295	3·172	18	8	3·85	2¼	1·6
2¾	11	—	—	—	—	18	8·25	3·975	2¼	1·65
3	11	3·6015	3·485	3·4675	3·41	18	8·5	4·1	2¼	1·7
3¼	11	3·815	3·6985	3·6810	3·6235	21	9	4·35	2¼	1·8
3½	11	4·0285	3·912	3·8945	3·837	21	9·5	4·6	3	1·9
3¾	11	4·242	4·1255	4·1080	4·0505	21	10	4·85	3	2
4	11	4·4555	4·399	4·3215	4·264	21	10·5	5·1	3¼	2·1

Manufacture.—The first step in the making of taps is to heat the steel bars and saw them off to the required length; the necks are then forged to the required size, and

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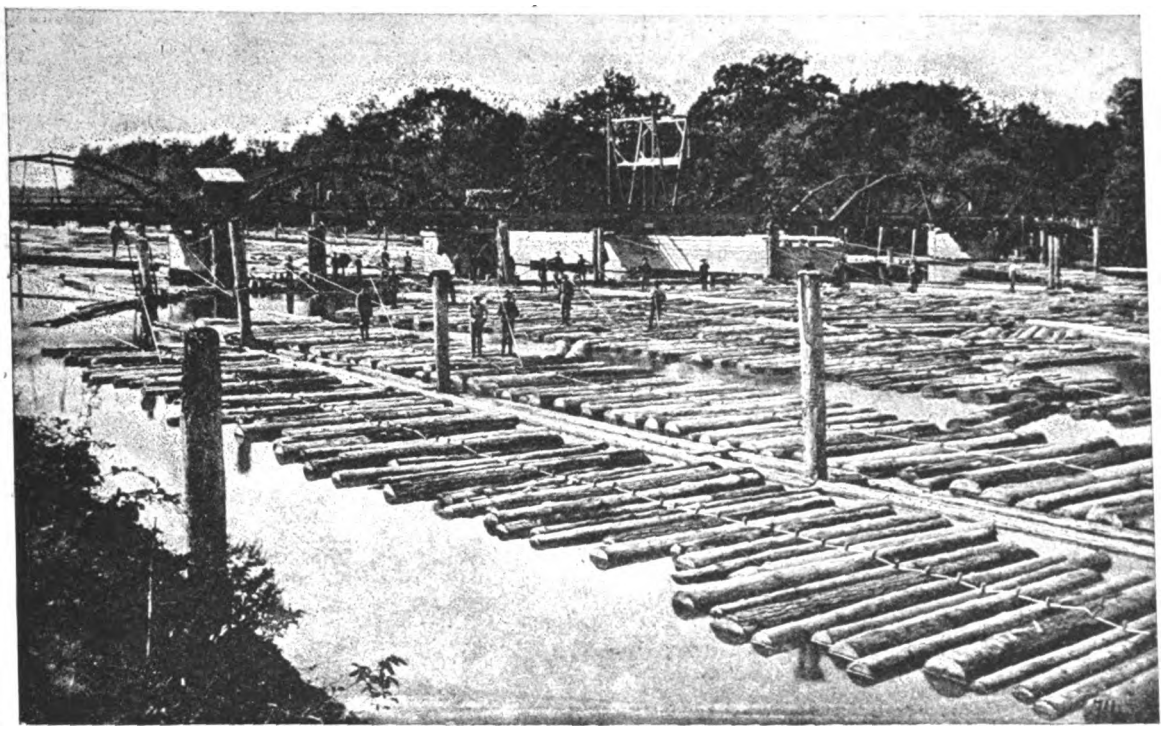
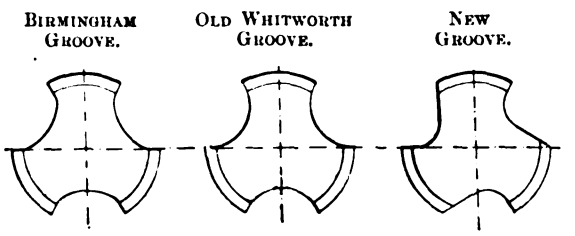


FIG. 8.—A SORTING BOOM.

the forgings carefully annealed to soften and make them easier to cut, and to relieve any strains induced in the outer skin of the steel by forging, so that they may be less likely to warp or bend in hardening. It does not follow that the higher a piece of steel is heated the softer it will be when cooled, no matter how slowly it may be cooled, therefore there is nothing to be gained by heating a piece of steel hotter than a bright cherry red. On the contrary, it would be rendered brittle and liable to crack in hardening, and the threads would, after hardening, not be nearly so durable as if it had been annealed at a lower heat; in fact, the steel has lost that almost undefinable property called "body." For the purpose of annealing the taps should be placed in a furnace and raised to not more than a cherry red heat, and then slowly cooled. After this they are centred by one boy and passed on to another, who turns them to the proper length, after which the part to be screwed is rough-turned; they are then laid aside to be inspected for seams or "roaks,"—those taps which are defective in this respect being turned down to make smaller taps, and if they will not do this, they are sent back to be re-melted. The next operation is to turn the neck of the tap to the proper diameter and length, and cut a fine line as a guide for length of square. When this is done, the taps are placed in an automatic centreing and gripping chuck on a small shaping machine (no setting is required), and the thread end is placed in the chuck and forced into it by a loose headstock; each side of the square is then cut at one operation, and the machine stopped automatically at the proper point; in this way the length of each side of the square is made precisely the same without any attention on the part of the boy in charge of the machine. The taps are then screwed to slightly below the standard gauge and passed on to the grooving machine.

TAP GROOVES.—The grooves of any tap should always be of uneven number, so as to keep the tap steady in the hole, and they should obviously be of such a form and size that the least possible force may be expended in tapping a hole and withdrawing the tap. The grooves should contain all the cuttings without wedging the tap. There are three distinct forms of groove cut by different makers, as shown in Figs. 5, 6, and 7. That shown in Fig. 5 has the cutting edge a radial line, and so far is a very good one; but it frequently happens that on withdrawing the tap the cuttings get jammed, and it has the objection that it will not easily contain all the cuttings; this latter defect could be remedied by making the grooves deeper, but then the tap would be rendered too weak for its work. Fig. 6 shows a groove which has been in use for many years, and is such that it leaves little room for improvement. This is a segment of a circle, and the circumference of the tap is divided equally into six parts, the widths of thread and groove being equal. The diameter at the bottom of the grooves is $\frac{9}{16}$ths the diameter of the tap; this groove contains all the cuttings without difficulty, and being symmetrical, the force necessary to withdraw the tap is comparatively small, and much less than for a tap grooved as in Fig. 5. The only objection is that the cutting edge, though radial at the top of the thread, is an obtuse angle at the bottom of the thread, and consequently not the best for easy cutting. The groove in Fig. 7 has this defect remedied, for the cutting edge is radial from top to bottom of the



FIGS. 5, 6, AND 7.—WORKING TAPS.

thread; it also gives more room for the cuttings without perceptibly weakening the tap, and may fairly be considered the best groove possible. Years ago, the three grooves were cut at one operation by a machine specially constructed for the purpose; but it has been abandoned by most tap making firms, and now each groove is finished separately, and the three-groove machine used only for roughing out. The thread is then backed off with the file, and the taps are ready for hardening.

HARDENING AND TEMPERING.—This is an operation requiring some care, for if the taps are too hard they break in use, and if too soft they do not wear well. Again, if proper care is not taken in the hardening, the taps may be bent, and once bent, they are not easily straightened. They should be uniformly heated in a coal or gas fired furnace, preferably enclosed in a box of charcoal to protect them from the action of the air, and so prevent scaling. If, however, the furnace is properly managed, there will not be much trouble; they must be left in the furnace for a short time after they have attained the proper heat on the surface, so that they may be of the same heat all through, as any inattention to this point may result in cracking. The heat to which the steel should be raised will vary slightly for different steels, and must be determined by experiment; but in no case should they be made hotter than a full red. When ready for slacking they should be lifted separately by a pair of tongs, and held in a vertical position whilst plunged screwed end first into a tank of water at 80°F., and held there until quite cold; if they are taken out before this there is a great risk of water cracking, and if they are plunged into this tank in any other position than a vertical one, they will almost certainly be bent, owing to irregular cooling and contraction. If moved about in the tank to hasten the cooling, they should be moved up and down and not sideways. It is of the utmost importance that the water should be warm, as probably more taps are cracked along the grooves from inattention to this point than from all other causes put together. Before tempering, one of the grooves is polished on a leather buff, coated with emery powder. If there are not many taps to temper, the best way of heating them is to hold them in a red hot iron ring and move them about along the tube to heat them slowly and regularly, and when the polished groove becomes light straw colour, plunge them in water as before. If there are large numbers of taps to harden, they may be heated in a lead bath or in an oil bath to which a pyrometer is attached, and when they have been heated to the proper temperature as indicated by the pyrometer, they are plunged into water; but for the latter process it is not necessary to polish the grooves. The latter methods do not, however, give the same general satisfaction as when the taps are heated separately, but are often preferred on account of the saving in time and fuel. The squares of the taps are always tempered at a blue heat, to give them greater toughness, and so prevent fracture in the corner of the square. Some steels expand more than others in hardening, and thus cause trouble in getting all the taps of the proper size; it is, however, very easy to test a piece of each batch of steel delivered for expansion, and allow for it in cutting the thread; but in works where large numbers of taps are made, this gives rise to considerable inconvenience, and generally, if all the steel is carefully annealed before use, there will be very little trouble from different amounts of expansion in hardening. After tempering, the tap grooves are polished on a leather buff coated with emery, and the necks and ends in a small polishing lathe, when they are ready for sale.

STEEL FOR TAPS.—The selection of steel for any cutting tool is a matter of great importance, and cannot be too carefully attended to. There are several kinds in use for taps, and of these there is none better than good crucible steel, which has been carefully melted and had sufficient work done on it under the rolls or tilt hammer. A large amount of Siemens steel is used for taps, and also some Bessemer steel. A special soft centre steel is also greatly used for taps. It is made by placing soft ingots in a cementation furnace until the outside has absorbed sufficient carbon—about $1\frac{1}{2}$ per cent.—to make it hard enough for its purpose; the centre of the steel is softer than the outside, and is said to increase the strength of the tap after hardening. The first thing to be careful about is that the steel is of the right "temper," that is, that it contains the proper amount of carbon to fit it for the work it has to do, as nothing is more common than for steel to be rejected as bad in quality, because it has been used for a purpose for which its temper was unsuitable. The treatment of the steel from the ingot to the rod is also a matter of the highest importance; it should never be made too hot, a suitable amount of forging should be done on it at each heating, and as the forging of round bars under the hammer has a tendency to produce rottenness at the core and subsequent cracking in hardening, the steel for taps should always be rolled to size.

(To be continued.)

LOGGING IN CANADA.

IV.

(Concluded from page 81.)

WHEN the timber, after being driven down a side stream, as described in the last chapter, reaches the main river, it falls in, and becomes mixed, with logs belonging to other firms, which have arrived from the numerous tributaries. All the logs are allowed to float along indiscriminately until they reach a point where they are to be sorted previous to delivery. To this end, they are gathered into a "boom," which is merely a water enclosure formed by timbers strung together endwise, and held in position by piles driven into the bed of the river at suitable intervals. The boom is sub-divided into several smaller enclosures, designated "pockets." These are ranged usually on either side of the boom, each having an opening towards the centre of the main enclosure. Down this centre channel all the logs are floated as they arrive, and men stationed at the opening of each pocket examine the logs, and after indentifying them by the marks (made by the log makers, as previously explained) pass them into the pockets apportioned to the firm or company to which they belong. Fig. 8 illustrates such a sorting boom. In such a vast accumulation of logs, it naturally happens that a considerable number arrive which cannot be identified, on account of their marks having been obliterated during their long journey. These are put into a special pocket set apart for "stray" logs, and sold once a year to the highest bidder on account of the boom company. After being sorted the logs are formed into rafts, and towed down the river by steamers to the various saw mills, where they are to be converted. These rafts are sometimes made by simply enclosing the loose logs by a string of timbers joined endwise, thus forming a sort of movable boom; but more often each log is made fast to the next one by means of a sort of wooden staple, called a "rafting pin," through which a

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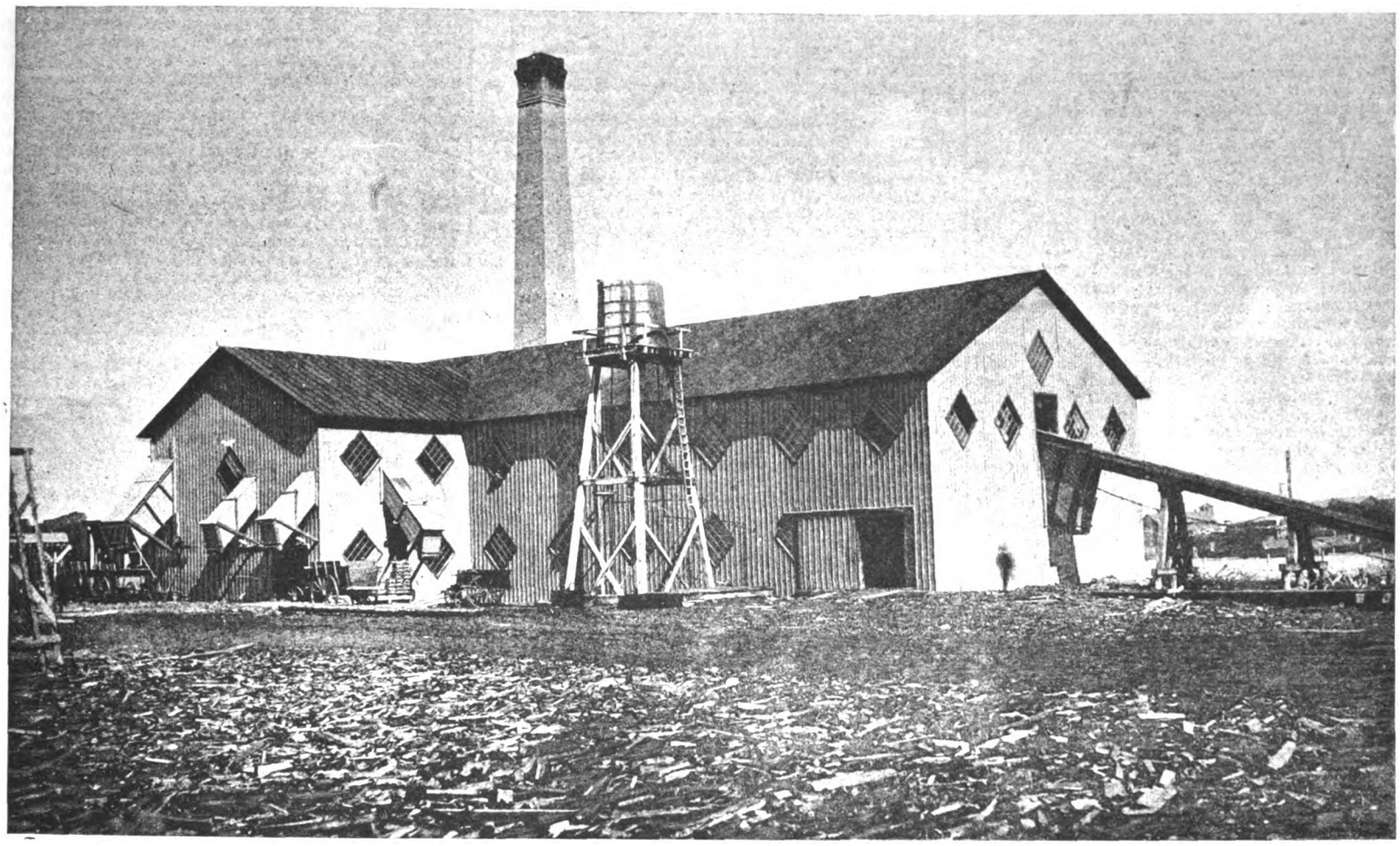


FIG. 9.—A SAGINAW SAW MILL.

rope is passed. This latter plan is preferable to the former, as the logs being individually fastened, they would, at all events, keep more or less together in the event of a rope breaking, whereas, in the other case, if the enclosing ring were to be broken, the logs would be all liberated, and would cause much trouble and expense to collect again.

One steamer will tow a number of rafts simultaneously, and men ride down on the latter for the purpose of detaching and delivering them at their respective destinations, which they do without stopping the progress of the main body of timber. After safely placing the consignment in the hands of the saw mill men they catch up the remainder of the raft by boats. A raft containing 1,000,000ft. of timber is looked upon as one of ordinary dimensions, but rafts made up of three or four times that quantity are found quite convenient to manipulate, although they cover, perhaps, 8 or 10 acres of water. As far as the writer knows, the largest raft ever floated contained about 8,000,000ft., and occupied a water area of 25 acres. It is, however, as a rule, considered not to be a profitable business to raft such a quantity of timber in one mass, as rafts beyond 3,000,000ft. or 4,000,000ft. become very cumbersome. The United States are great consumers of Canadian pine, and such being the case the log traffic across Lakes Huron and Superior is very considerable. The transport of sawn timber, or "lumber," is carried on by boats specially constructed for conveying large quantities; but the logs themselves are merely towed across the lakes, after having been made up into rafts, as explained. This importation of foreign wood by America is not due entirely to there not being enough home grown timber to satisfy the demand, but it is in a great measure owing to the fact that a great proportion of the pine growing districts in Michigan is in the hands of a few wealthy men, who, knowing that the value of timber must increase yearly as the supply diminishes, are in no hurry to dispose of them except at their own prices, and consequently lumbermen are driven into seeking their timber in Canada, notwithstanding the extra cost of transport, &c. The result is that a great many of the Ontario timber limits are being run by Americans. A good instance of this is that of the Saginaw Salt and Timber Company, whose saw mills are in Michigan, U.S.A., while their timber is derived from three large tracts of forest land situated not far from Lake Wannapitae, in Canada. The logs have to be driven down two rivers into the Georgian Bars, and then rafted across Lake Huron, a distance in all of close on 350 miles. Stormy weather during transit over the lakes is by no means uncommon, and the effect of a high sea on a huge timber raft is very remarkable. The outside logs only get tossed about by the waves to any extent, and they form such an efficient breakwater to the rest of the raft that 50ft. from the edge the swell is scarcely felt. The centre of this floating island is perfectly quiet, and to leeward the logs are as free from motion as if they were in a river.

We have now followed the course of the timber from the forest to the saw mills, and have seen it pass through a good many hands during its journey by sleigh, river, and lake; but these articles would hardly be complete were they to be closed without some reference to the saw mills themselves, since the latter play so important a part in the timber industry. Being both constructed and worked in a different way to what is usual in England, a brief outline of their *modus operandi* will probably be of interest. The saw mills in Michigan and Ontario bear a striking resemblance to each other, which is not surprising considering the proximity of the two places, and the constant interchanging of ideas arising from the business transactions, which bring a great many men from one country to the other. Consequently Fig. 9, which is in reality taken from a Saginaw saw mill, is typical of the ordinary saw mill of either Canada or America. The situation chosen for the erection of a mill is usually on the water's edge, at a spot where the logs can be floated right up to the foot of the incline shown on the right hand side of the illustration. Up this incline they are conveyed by means of an endless chain furnished with projecting dogs at suitable intervals along its upper surface. The lower part of this chain works below the water level, so that a man with a pike pole can readily guide the logs within range of the dogs, which take them up on to the mill floor.

The sawing machines are always placed on the first floor, and this is a very practical arrangement, for several reasons. Firstly, it is a great safeguard against injury from floods; secondly, it permits of the shafting being placed below the mill floor, which keeps the belts out of the way, leaving more space between the machines; thirdly, it enables the men whose duty it is to look after the shafting, to do so without danger to themselves, as they have plenty of room to move about, and can see what they are doing when approaching a revolving shaft for lubricating the bearings, or putting on a belt. This last point is one the importance of which is too often under-rated in England, where accidents frequently occur, owing to the shafting being fixed in narrow and obscure pits, only just large enough for the pulleys to revolve in, which obliges the men to climb in between running belts, a highly dangerous proceeding, especially if the light is imperfect. In North American mills everything is sacrified to quantity, whilst quality of work and waste of wood are but secondary considerations. A few years ago waste of wood was hardly considered at all, as will be readily understood from the fact that the rack bench was the only saw machine used, even for planking. However, since the price of wood has gone up, the band saw is replacing the rack bench in cases where a number of cuts are required in a log. The saving effected by this change can be realised by the following figures: The saw cut (or "kerf") of a circular saw, as used in rack benches, is $\frac{5}{16}$in., and of a band saw blade $\frac{1}{8}$in.; so that by the use of the latter a saving of $\frac{3}{16}$in. per cut is effected. This would show, in the case of a log in which twelve cuts were taken, no less an economy than 2$\frac{1}{4}$in. of wood.

In American mills nearly all the shifting of the timber is done by mechanical appliances, a system which obviates a great deal of hand labour, and which might be used to advantage also in England. The sawn lumber is passed out of the mill on trucks, and the refuse is shot down the diagonal shoots shown in the illustration. The lower extremities of these shoots are at a sufficient height to allow of carts being drawn up under them. In the whole of Canada there are between five and six thousand saw mills, employing collectively about forty-five thousand men, and the value of their annual output is stated to be very nearly £8,000,000. Many of the mills are working only six months of the year. The total number of factories in Canada dependent on the timber industry—that is to say, turning out wood, or articles made from it—may probably be put at twenty thousand, and the number of hands employed in them amounts to at least one hundred thousand.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 31st January, 1888.

The Iron Market.—The business of the iron market grows steadily. The revival evidently is not due to transient influences, and there is a constant development in progress, proceeding from a gradually increasing consumption. There is an expanding tendency, too, in the export trade, clearly shown in the Customs returns for the month of December. Thus the improvement is likely to continue. The Paris merchants persevere in the attitude which they assumed at the end of the last year relatively to the manufacturers of the North, whose movements they now follow closely. During the last week a fair amount of business has been transacted at firm prices. The abolition of the traffic in *acquits-à-caution*, that is, permits to temporarily import pig iron duty free, has given satisfaction to the manufacturers of the North and North-East, and stimulated business in that locality; but it has occasioned something like consternation in the centre and South, where manufacturers are henceforth deprived of the advantage afforded by the system of temporary admission. The necessary consequence will be to direct the foreign business to the Northern districts. An effect of this change is already to be seen in the blowing in of more blast furnaces in the Meurthe-et-Moselle. Prices of pig iron in the latter departments are steadily rising. The value of the exports of iron and steel of all sorts in the year 1887 amounted to £689,920, against £304,400 in the previous year.

State of Trade.—The Customs returns for the last month of 1887 show a marked revival in our foreign trade. Relatively to December of 1886, exports have largely increased. The expansion is especially noticeable in manufactured goods, showing a revival in the home industries. This greater activity has naturally rendered necessary larger purchases of raw materials, and accordingly we find a notable increase in the imports of such commodities. The railway accounts for the last year also reveal a better state of trade. The Lyons railway has gained in receipts, relatively to the preceding year, 2·37 per cent.; the Northern line has gained 2·06 per cent.; the Western 0·30 per cent.; and the Midi 0·75 per cent. The Eastern and the Orleans show a small deficit.

Alcohol Manufacturing Company.—An important industrial affair has just been brought to a satisfactory issue. M. Philippart, well known for his achievements in company promoting, obtained control of the patents granted to MM. Bang & Ruffin for the rectification of alcohol; but falling out with the patentees, he took the matter into the Law Courts. But time brought wisdom, and the litigants arranged their affairs outside. The result was that these valuable patents were sold to the firm of Dansaert & Loewenstein, of Brussels and Paris. The latter have now transferred their rights to a company founded for the purpose, and called the Société Universelle de la Fabrication des Alcools Chimiquement Purs. This will be the parent company, from which we may expect a numerous offspring; the first, to be launched in a few days, will be called the Société Française pour la Fabrication de l'Alcool. The capital for these companies, in each case 3,000,000fr., has, it is said, been already subscribed. As soon as the French companies are fairly afloat, the Société Universelle, which, by the way, is controlled by the Comptoir Industriel, founded last year by M. Philippart, will give its attention to the foreign patents, of which the German and the English are likely to be the first dealt with.

BERLIN, 30th January, 1888.

The Iron Market.—Up to the present time Government has not taken any decided position either for or against the various syndicates in the iron trade; but owing to the latest action of the Blast Furnace Owners' Union, which determined to boycott all those merchants who do not conform to their rules, it is quite possible that the intervention of the State will be invoked by the merchants and by others interested, so that the irksome restrictions which the syndicates endeavour to place upon the home trade may be removed. If the opposition party are successful in this matter, it is quite possible that the whole artificial fabric of syndicates may tumble to pieces. Up to the present the market remains exceedingly firm. Blast furnaces and rolling mills in the Silesian district are overwhelmed with orders, and stocks are constantly diminishing. The demand for sheets has also risen to such an extent that quick delivery cannot be guaranteed. Considerable impetus has been given to the wire trade by the formation of a syndicate of wire nail makers, to which I referred two weeks ago, and the production of most wire works is already sold up to the end of the current quarter.

Importation of Petroleum in Bulk.—German importers of petroleum are devoting increased attention to the employment of tank waggons and tank vessels. Messrs. W. A. Riedemann & Co., of Geestemünde, and Messrs. N. Schutte & Son, of Bremen, have given an order to Messrs. Armstrong, Mitchell, & Co., of Newcastle, for a new tank steamer to carry 4000 tons of petroleum. The steamer is to be delivered by the 1st September next. With this addition the two firms will own five tank steamers and one tank sailing vessel.

The Chemical Industry.—The general management of Count Guido Henckel von Donnersmarck's chemical works in Neudeck, Upper Silesia, propose to erect in connection with their ovens for the roasting of zinc-blende a factory for the working up of calcination gases into liquid sulphurous and sulphuric acid. It is hoped that by this process the calcination gases will be completely freed from sulphur, and will then have no injurious effect upon the neighbouring vegetation: whilst the value of the acid produced will cover the working expenses. A chimney 190ft. high is now being built to discharge the purified calcination gases.

Lubricants.—Messrs. Born Brothers, of Ilversgehofen, near Erfurt, are introducing a kind of mustard oil which has been found to be exceedingly suitable for lubricating purposes, and which may be used to advantage where no other lubricator can prevent the heating of bearings. It has proved especially suitable in those cases where either speed or pressure is great, as for instance in turbines, rolling and crushing mills. The new lubricant has recently been tested at the Machinenfabrik Geislingen on the testing machine of Messrs. W. H. Bailey & Co., of Salford, when for purposes of comparison tests were also made with the best olive oil, and a mixture of olive oil and mineral oil. The results obtained showed that compared with olive oil the lubricating value of mustard oil is as 263 to 168, and as compared with a mixture of olive and mineral oil the lubricating value is as 263 to 125. A further advantage of mustard oil is its low freezing point. This oil solidifies at a temperature of from 7°C. to 8°C. below zero, so that even in cold weather it still retains its lubricating value, while olive oil, as is known, solidifies at a temperature slightly above zero.

The Spirit Industry.—Since the Excise duty on spirits came into operation, business in the better qualities of spirits has considerably declined. Previous to its imposition, both retailers and large householders bought largely in anticipation of the increase of duty, and consequently business during the last quarter of the year, when it is generally pretty brisk, is this year very quiet. The consumption of the ordinary class of spirits has also decreased. A tax of 20 per cent. is now imposed on methylated spirit, but notwithstanding its moderate price the consumption remains low.

VIENNA, 30th January, 1888.

The Coal Market.—With the exception of some lines in Eastern Galicia, traffic has again become regular on all the Austrian railway lines, and the coal trade is very brisk. This is partly owing to a good demand for household coal, but chiefly to the arrears accumulated during the interruption of traffic, which lasted for nearly a month.

The Iron Market.—The spring trade is developing very slowly indeed, and in many centres which are usually animated at this season of the year, no transactions of importance have taken place during the week. Notwithstanding this dulness in the general trade, prices are maintained without difficulty; and the organisation of the iron masters' syndicate, which I reported in my previous letters, has given an unusual firmness to the Austrian iron market. Engineering works and foundries in Bohemia are well supplied with orders, but in Hungary there is scarcity of work. The makers of such tools as spades, picks, and shovels specially complain of insufficient orders. Under these circumstances the action of the Hungarian Government in dismissing the board of management of the State iron works, which I reported in a previous letter, appears fully justified. What little business there is done in these works is now superintended by two civil servants of the Minister of Finance; but the Government has some difficulty in obtaining offers from private firms for taking over the works. Iron masters in Austria contend that the rent stipulated by Government could only be paid if the quantity of iron produced and sold at these works were in excess of last year's returns; but as there does not seem much prospect of trade reviving to any large extent, these works will probably remain idle. At the principal works in Vaida Hunyad enormous stocks of pig iron have accumulated during last year, and the Government have sent down a commission of experts to report on the best way of utilising these stocks. The commission are of opinion that the crude iron would be eminently suitable for the manufacture of Bessemer steel, and the Government, acting on their advice, have transferred 100,000 tons of this pig iron to the Dyosgyor works, to be converted into steel rails for the State railways.

The Hungarian Small Arms Factory.—The first general meeting of the shareholders in this enterprise took place last week. According to the statutes, the total capital amounts to £240,000, divided into 30,000 fully paid up shares. The company has been formed for the manufacture of rifles and ammunition, and negotiations have already begun with the Hungarian Government for the supply of 180,000 rifles and a corresponding quantity of ammunition.

Portable Electric Light Plant.—Since you recently published particulars of the portable electric lighting plant made by Messrs. Siemens & Halske for the North-Western Railway of Austria, it may perhaps interest your readers to learn what has been done in Hungary in the same direction by Messrs. Ganz & Co., of Buda-Pesth. Their electric light plant has been tried in various parts of the country, having been transported in all over a distance of 1600 miles without any breakdown. The general arrangement is very similar to that of the plant illustrated by you, but in the details the two differ. Messrs. Ganz & Co. employ an alternating current dynamo, and put all the eight arc lamps in series. For incandescent lighting they employ a small transformer. Power is supplied by an 8 h.p. portable engine working at 60lb. pressure, and making 130 revolutions per minute. On a platform projecting back over the fire box, and therefore over the driver, is mounted an alternating current machine, driven direct from the fly wheel at 750 revolutions per minute. The engine and dynamo are protected by a roof against the weather. The car contains eight alternate current arc lamps, suspended from flexible bars so as to protect them against jolting on the road; also a small four-wheel trolly, on which are mounted two drums containing a mile and a quarter of suitable wire; also two water butts, insulators, earth anchors, a screw jack, and an assortment of tools. The lamp posts are of wood, and fixed on brackets fixed to the outside of the car. The total cost of the plant was about £830. All the circuits are carried overhead, and at a recent trial one superintending engineer, one driver, one lineman, and eight labourers erected the plant and began lighting up in seven hours, reckoned from the time when the engine and car were unloaded from the railway trucks. After finishing work the whole of the material was again replaced, and the engine and car loaded in four and a half hours.

Safety in Mines.—Some time ago the owners of the Ostrau-Karwin coal mines offered a prize of one thousand ducats (about £500) for the best method of rendering shots in fiery mines safe, or for substituting some other method of breaking down coal for shot firing. None of the proposals were considered to be sufficiently meritorious to obtain the prize; but as two of them were yet of considerable utility, an award has been given to these, Lieutenant-Colonel Lauer obtaining 300 ducats for a special fuse, and Herr Walcher 150 ducats for his mechanical coal breaker, which was illustrated in *Industries*, Vol. I., page 372.

BRUSSELS, 31st January, 1888.

The Coal Market.—The situation of the market continues firm, and with the exception of household coal, the tendency of prices is to advance. Steam coal, coal for metallurgical purposes, and nuts have risen. Important contracts for coke have been made up to the end of June at 10s. 9d., but no business is being done for the third quarter of the year. Dross is exceedingly scarce. Unscreened coal is quoted at 8s. 5d. to 10s., cobbles at 13s. 7d. to 15s. 2d., and small coal at 5s. to 6s. 2d. Several collieries which could work seams of coking coal decline to do so, as they consider that the price at present obtainable would not be remunerative. The Sambre coke furnaces have been rented and re-lighted.

The Metal Market.—Although more blast furnaces have been re-lighted, the price of pig iron has not been affected. Other metals, however, are fluctuating. Rolling mills are somewhat less busy, but there is a good demand for sheets; and girders are also in request. The State railways will shortly contract for 2000 trucks and thirty to a hundred passenger coaches. Fifty locomotives will also be ordered, and there is some talk of forty being required for the economic railways. Ten third class carriages for the new train-tramways have been ordered, which will be ready by May. This order has been obtained by the Société des Ateliers de Malines at £1,878, as well as one for fifteen small baggage vans at £1,860. The firms of Veuve Frédérix, of Liège, and the Dyle-Bacalan Company have received commissions for bridge work for the Dutch colonies, and the Malerie Works for mail vans for the Italian railways. During this week tenders will be opened by the State railways for 167 passenger coaches, 287 trucks, and thirty-nine baggage vans. There is therefore good business for our works in prospect. The erection of iron buildings is making much headway, and the Société des Forges d'Aisneau are making a specialty of this branch. M. Villut and the representative of the Biesme works are putting up a number of iron buildings for the Brussels Exhibition. The whole of the material for a railway, about fifteen miles long, to be laid from the Caspian Sea to Amal, has been ordered from the Cockerill Company, who will also supply the locomotives and trucks. The gauge of the line is 4ft. 8½in. The rails are to weigh 47lb. per yard, the total weight of rails required being about 1200 tons. The Committee on the Metal and Coal Exchange consists of Messrs. Herpegnies, managers of the Jeneppe collieries; Ch. Semal, manager of the Montigny-sur-Sambre colliery; M. Delaive, of the Louvière works; A. Roubert, A. Passelecq, and E. Kelecom. M. Valère Mabille, the president, is not eligible for re-election, and a meeting will shortly be held to elect his successor.

Glass Works.—Although the prices of all kinds of glass have been reduced, very few orders are received; but the demand is always small at this season.

The Lighting of the Exhibition.—The executive committee are making arrangements for the division of the lighting of the Exhibition, the total light required being about 600,000 c.p., distributed among 1200 glow lamps and 350 arc lamps. English and Belgian electricians are taking the principal part, French and German firms being less prominently represented. The motive power is supplied free, 500 h.p. being available for the buildings and 500 h.p. for the gardens. For the illuminated fountains, there will be a separate installation, with 100 h.p. M. Pieper, with Mr. Sennett, will take up this section. The Thomson-Houston, Edison, and Bernstein companies, M. Bouckaert, and M. Dulait will undertake portions of the

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lighting, for which very advantageous offers have been received. Paris and Brussels firms have undertaken the gas lighting on almost gratuitous terms.

THEATRE LIGHTING BY ELECTRICITY.—The Molière Theatre at Ixelles, a suburb of Brussels, is entirely lighted by electricity, small glow lamps being used in the auditorium, on the stage, and in the rooms, and an arc lamp being placed in the chandelier. The atmosphere of the house has been much improved since gas was done away with. The price charged for the electric light is the same as was previously paid for gas. The generating plant is placed in the basement at the back of the theatre, a 35 h.p. Meunig engine and two Thomson-Houston dynamos being employed. Steam is supplied from a De Naeyer boiler.

HELIOGRAPHY.—During trials with an ordinary heliograph made by the special army corps, some difficulty was experienced in interpreting the signals. It was found that the bright image of the luminous point was, with some individuals, prolonged on the retina, causing them to confuse dots and dashes. To overcome this difficulty an improvement has recently been tried by which the distinction is not made by the time of the flash, but by its colour, red being used for the dashes and green for the dots. The trials were made at Mont-sur-Marchienne over a distance of 1¼ miles, when inexperienced operators were able to send three twenty-word messages in twenty-eight minutes. When the heliograph was worked by expert Morse telegraph operators the same messages were sent in eight minutes.

DÜSSELDORF, 30TH JANUARY, 1888.

THE IRON MARKET.—We have had another busy week in iron. Judging from their eagerness to transact business, buyers appear to have still unshaken confidence in the near future. The demand for crude iron is a remarkable feature of the present time. In spite of high prices and a consequently failing export trade, it tends to increase rather than diminish. Some of the blast furnace owners have sold the whole of their make until the end of May, and all have their order books well filled. The demand for forge pig has this week been so great that prices have further advanced, Rhenish-Westphalian white forge being now quoted at 52s., and Luxemburg forge at 49s. to 50s. Spiegel pig, for which a brisk foreign demand has sprung up, has advanced by leaps and bounds. It is hard to ascertain the price at the present moment; but it is about 58s. for the 10 to 12 per cent. quality. This sensitiveness of the market is in part due to the reported purchase, by a large share company established for the purpose, of all the limestone quarries from which the blast furnaces are supplied. An event of this sort cannot but have a pernicious effect upon the iron industry, which seems to be destined to be controlled by "rings." The markets for finished iron have followed those for crude. Bars are in better demand for home consumption. All manufacturers are sufficiently provided with work for the first quarter of the year, and some have booked orders much farther forward. There is, however, much complaining concerning the prices, the advance in those of the raw material having seriously diminished the margin for profits. It is certain that a further rise must shortly be declared all round; that in boiler plate is expected to be as great as 20 per cent. The business in common plates steadily increases. Wire is now the cheapest class of goods. The rail market has been stimulated by a victory gained over the English makers in Chili, where a contract for 7500 tons has been secured for the Rhenish-Westphalian works.

THE PRODUCTION OF CRUDE IRON IN 1887.—The make of pig iron in Germany, including Luxemburg, in the month of December amounted to 359,867 tons. This brings the total for the year 1887 up to 3,907,364 tons, an increase of 17 per cent. on that of 1886, and 4·15 per cent. on that of 1885, which was the highest ever previously reached. The make of the first quarter of the year, consisting of ninety days, amounted to 880,318 tons; that of the second quarter, of ninety-one days, to 962,663 tons; that of the third quarter, of ninety-two days, 1,011,010 tons; and that of the last quarter, of ninety-two days, 1,057,873 tons. Hence it will be seen that the daily make rose from 9781 tons in the first quarter, to 11,499 tons in the last quarter of 1887, an increase of 17·6 per cent. In view of the present large production of crude iron and the blowing in of fresh furnaces, it is hard, despite the heavy demand which now characterises the markets, to avoid the conclusion to which these figures seem to point, that we must soon reach a stage where production will begin to exceed consumption. Of the quantity manufactured last year 48·7 per cent. was forge and spiegel pig, 11·1 per cent. Bessemer pig, 27·5 per cent. Thomas pig, and 12·6 per cent. foundry pig.

CANAL EXTENSION.—Vigorous and persistent efforts have for several years past been made, chiefly on the part of colliery owners and iron masters, to obtain an extension of the canal system. It is generally perceived that the future development of the staple industries of Germany depends largely upon the cost of transport, and as water carriage is still the cheapest available, it seems desirable to increase the navigable ways. The subject was earnestly discussed at a recent meeting of the Miners' Association at Dortmund, where it was announced that the project for connecting Ems with Dortmund was making steady progress towards realisation. Dr. Natorp directed attention to the movement in progress in France for the further development of the waterways, and showed that in five years, from 1881 to 1886, the traffic on the existing canals had increased from 15,000,000 tons to 23,900,000 tons, or fully 53 per cent.

THE PETROLEUM TRADE.—An attempt to syndicate the petroleum trade has proved abortive. Prices have risen notwithstanding, though not in the degree contemplated by the speculators, who thought to corner this commodity. A change is being effected in the mode of dealing with American petroleum in this locality. At Rotterdam, the port of delivery, two large iron reservoirs are in course of construction of sufficient capacity to hold 1,250,000 gallons, or about 30,000 casks. The oil will be brought from the United States in tank vessels, and discharged into these reservoirs, from which it will be pumped into casks and transported by river boats to this district. The same casks will be used over and over till they become unsound. The system will put an end to the importation of American casks, a matter of considerable importance to the coopering industry, which here is of some magnitude.

LILLE, 31ST JANUARY, 1888.

TEXTILE MANUFACTURES.—The last two weeks have been marked by activity in the linen goods trade. Our markets have been visited by buyers from Paris and the West, who have dealt largely, but who cannot be said to have purchased freely; since they have sought to depress prices, and have, in most cases, driven hard bargains with the manufacturers. The latter have with difficulty obtained a small advance for goods woven wholly or partly of jute yarn. The present activity seems likely to last for at least a few weeks. The establishment of a wool market at Havre and Antwerp has induced the principal merchants of Roubaix-Tourcoing to provide a similar market for that wool manufacturing centre. Steps have been taken in conjunction with some of the first banking houses of Roubaix to carry the project into effect as speedily as possible. The matter is in the hands of a commission of twelve members, of whom six are merchants of Roubaix and six merchants of Tourcoing, all men of great influence. The woollen goods trade is growing more animated. For "fancy" goods, the season promises to be very satisfactory. Judging from present indications, we are approaching a period of general activity. For Rouen cotton goods there is also a fair prospect. Manufacturers regard the future more hopefully, and the tone of affairs throughout is decidedly stronger.

FLAX AND YARN MARKET.—The demand for home grown flax is still strong. Walloon is specially inquired after. A large quantity of produce has changed hands this week at full prices. In some cases there has been a slight movement in favour of sellers. Russian has been bought in large quantity for future delivery. Prices are very firm. There is nothing new to report concerning yarns; the demand continues active, and spinners are easily able to maintain the recent advance. Jute yarns command a ready sale at full prices. During the week 52 tons of linen yarns and 19 tons of jute yarns were shipped from Dunkirk to Leith. The market here, both for raw flax and for yarns, has been favourably influenced by reports of activity in the market at Ghent.

THE IRON MARKET.—The iron market remains unchanged in its general features. The tone of business is strong. A further advance in prices being expected, both consumers and merchants are buying freely. The decision come to at the beginning of the week, to abolish the traffic in *acquits-à-caution*, has occasioned much rejoicing among manufacturers of this and the South-Eastern department. An immediate result will be the blowing in of four blast furnaces in the Meurthe-et-Moselle.

MARGARINE.—At a meeting of the Société des Agriculture du Nord, held last week, it was stated by one of the speakers that not less than 33,000lb. of "margarine butter," containing from 80 to 90 per cent of margarine, are brought every week into Lille. This is sold as butter from our best dairies. It would be interesting to know how much of "best French butter" manufactured in this way is exported.

MADRID, 30TH JANUARY, 1888.

PIG IRON.—The three makers of pig iron at Bilbao have for some time worked under an agreement as to prices, by means of which they were enabled in their home sales to obtain the full benefit of the high duties charged on pig iron imports. These firms have been selling foundry pig in the home market at 56s. per ton, and forge pig at 52s. per ton. Owing to some misunderstanding, this syndicate has now been broken up, and Spanish consumers will, in consequence, obtain their supplies in future at lower rates. The excess of the production of pig iron over the home consumption is at present about 120,000 tons per annum.

THE PYRITES FUMES.—Although the general question regarding the fume nuisance has not been settled, a decision has been come to by the Home Minister in the case of the Calanas mine. The municipal authority, on the plea of sanitary requirements, prohibited the burning of pyrites in the open air, but the governor of the province thought himself authorised to suspend the order until a decision was arrived at by the Central Government. The Minister has now decided that the governor had no right to reverse the order of the municipality of Calanas. It is very difficult to say what will come next, because there is a very warm controversy over the various points of the question, both on legal, economical, and technical grounds. To my knowledge the fact is that the open air burning is not necessary, nor even convenient, and that the improved method of roasting, as adopted at the Cuchichon mine and at St. Domingo, can be equally employed by Rio Tinto, Tharsis, and the other works with great advantage. A foreign engineer has assured me that copper can be produced £5 per ton cheaper without the open air burning of the pyrites.

QUICKSILVER.—The Almaden mines produced last year 53,109 flasks of quicksilver. This quantity could have been very easily increased to 60,000 or more; but either the Government, or the London agents under the contract of the loan extending to 1900, have the idea that the output ought to be kept low, so as to increase the price. Last year's statistics show that a larger profit can be made out of 53,000 flasks at present prices, than out of 80,000 at the rate prevailing at the commencement of 1887.

NEW YORK, 21ST JANUARY, 1888.

THE METAL MARKET.—There has been but little change in the condition of the market since the beginning of the month. Merchant iron is but little sought after, but there is a good demand for plate and tank iron and steel. Tin is not much in request, lead is steady, and copper has dropped during the past week. There were in blast on January 1st 341 furnaces having a weekly output of 140,690 tons, and out of blast 246 furnaces capable of an output of 61,020 tons; at the same date last year there were 332 furnaces in blast with an output of 127,660 tons. The building of cars during the past year has been active, and prospects are good for continued prosperity in this line. The Missouri Car and Foundry Company did business to the extent of £550,000 in 1887, and are now working at their full capacity, turning out twenty-five cars a day, and having orders ahead for 1000 cars. The wire cables in use on the Chicago street railways are being made by the John A. Roebling's Sons Company, of Trenton, New Jersey. They are of cast steel wire, having an outside diameter of 1¼in., and guaranteed to stand 194,000lb. per square inch. The strike of the miners and railroad men has not yet been adjusted, and the price of fuel will advance if the strike continues. As many of our manufacturers are dependent on the Reading companies for their supply of fuel, the prices of pig iron must advance or the cost of production must be lowered, neither of which seems possible at present, for an increase of price will open the market to competition from other sources.

STEEL RAIL PRODUCTION.—The production of steel rails by our Bessemer steel works during last year amounted to 2,049,638 gross tons, an increase of 487,228 tons over the previous year. The New Year, however, does not open very auspiciously, as many large orders are still withheld, and the works which closed down in December continue idle.

THE CALUMET AND HECLA MINE.—The copper produced from this mine during last month was 1503 tons, making a total for 1887 of 31,373 tons, against 30,700 in the previous year. Part of the mine was closed owing to fire from August 4th to September 12th, and from November 20th up till now. The present output is all from the South Hecla location.

PHILADELPHIA, 21ST JANUARY, 1888.

COPPER.—A petition is being circulated for signature by manufacturers who use copper, asking Congress to remove the 4 per cent. duty on copper. It states that there are over 10,000,000lb. of ingot copper used in the United States per year, that the home supply exceeds the demand, and that the present duty is not needed to protect home production, but simply benefits speculators, allowing them to export copper at a less price than is demanded for home consumption. It is probable that the petition, which is being extensively signed, will result in the removal of the duty.

THE USE OF STEEL FOR STREET PAVING.—A new pavement for use in streets subjected to heavy traffic is being laid in Chicago. It consists of steel rails, each 16ft. long, having corrugations on the top, laid a few inches apart, with a patent composition between. The first order for 50 tons of these rails has just been completed.

THE COST OF GAS AND ELECTRIC LIGHTING.—The following figures are taken from a report made by Professor Barret to the City Council of Chicago on the relative cost of lighting the city by gas and electricity. The cost of maintenance, interest, deterioration, repairs, and all other charges which can be properly placed against the systems of lighting have been taken into account in estimating the cost:—

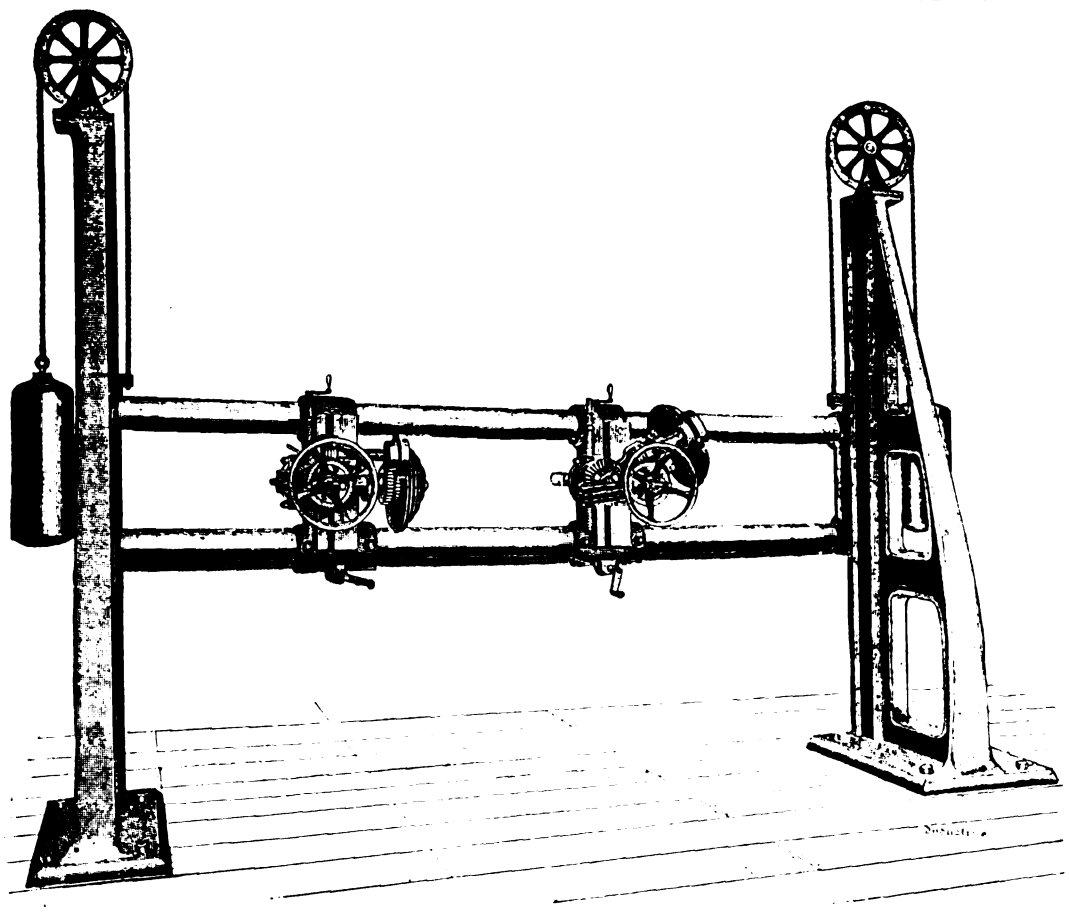
	Number of lights.	Candle power.	Cost per year.
Gas	3,273	52,368	£12,351
Incandescent lights	3,273	98,190	£9,346
Arc lights	750	1,500,000	£7,180

THE PROGRESS OF THE SOUTH.—The last year has seen wonderful mechanical progress throughout the South. In Georgia, Alabama, Tennessee, and Kentucky furnaces and manufactories of all kinds are being erected, and cities are being built. In the city of Birmingham alone, which had at the beginning of 1887 ten blast furnaces, with a total daily output of 850 tons of pig iron, there have been erected fourteen new furnaces. When all are in blast the total daily output will reach 2000 tons.

HEATING BY PETROLEUM.—The Bethlehem Iron Company have been experimenting for some time on the use of petroleum. The apparatus used is what is known as the Archer gas fuel process. Their experiments were made with two ingot re-heating furnaces, and were so successful that two additional plants have been contracted for, and are now in course of erection.

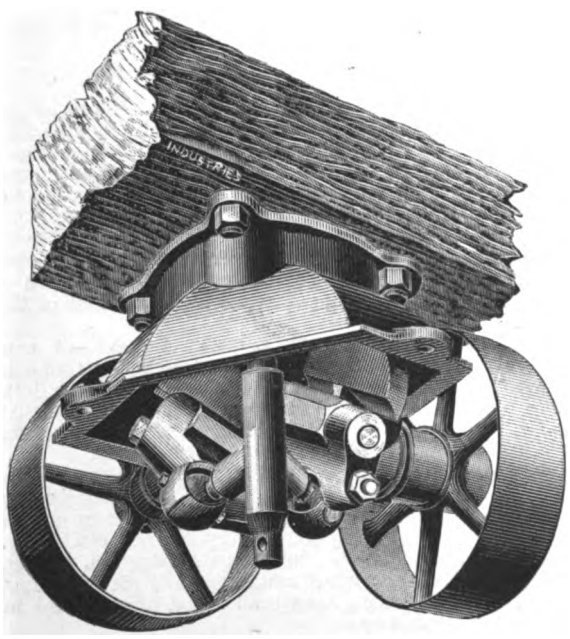
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DALETT'S BOILER SHELL DRILL.

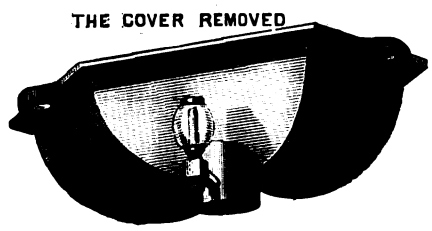


ALMOND'S COUPLING.

ATTEMPTS have from time to time been made to substitute some other gear for the usual bevel wheels employed to communicate motion between two shafts crossing each other at an angle. At the Inventions Exhibition a very ingenious gear was exhibited, in which two right angle



THE COVER REMOVED



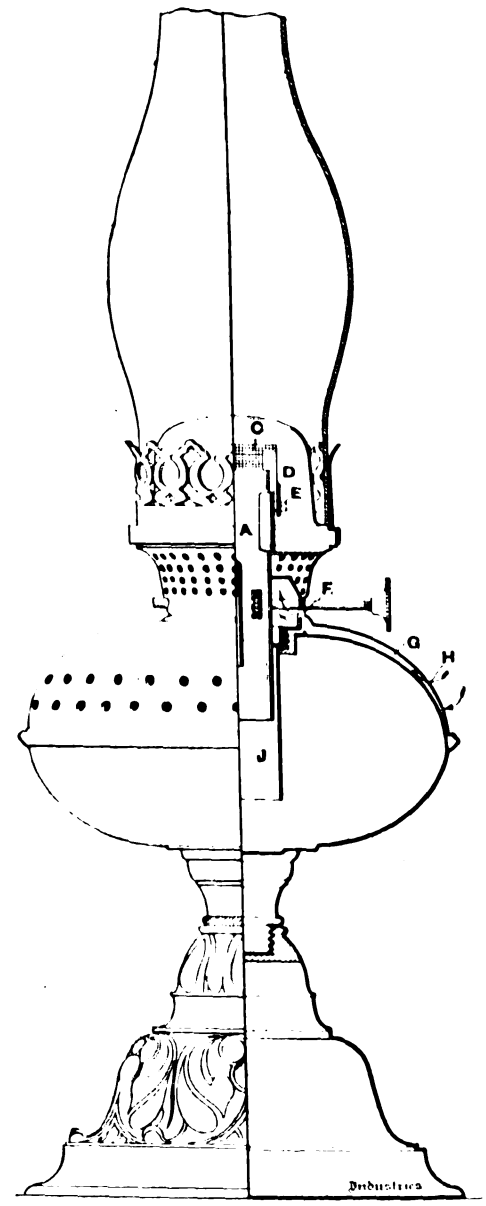
shafts terminated with perforated discs, the latter being connected by a set of steel rods joined at right angles to each other, and sliding in and out of the holes as these come nearer and further from each other whilst the shafts rotated. Another type of angle gear is illustrated in the above engraving. It is the invention of Mr. Almond, an American engineer, and is now being introduced into this country by Messrs. Clark & Wellington, of 73, Queen Victoria-street, London. Motion is supplied to the coupling and taken off from it by two belts running in planes at right angles to each other. The coupling consists of a cast iron box secured to an overhead beam, and containing two bearings with special lubricating arrangements. A short length of shaft is laid through each bearing, carrying outside the pulley and inside a peculiar crank resembling somewhat a toggle joint. In the centre of the casing is fixed a steel stud, the lower end of which is secured in the centre of the cover shown removed in our illustration. Upon the stud slides a sleeve, having two cross arms at right angles to each other, in which slide steel pins, each terminating in a ball. This ball engages in a socket at the extremity of each toggle crank, and as one wheel is revolved this crank imparts an oscillatory motion to the sleeve on the central pin, at the same time carrying it up and down. This motion is transmitted by means of the other arm and ball and socket joint to the crank of the other pulley. As far as can be judged from an inspection of this coupling, and from turning it by hand, motion is transmitted very evenly and silently, there being no backlash or dead point in this gear. The gear is lubricated by pouring oil into the box, and as the cranks revolve they dip into the oil and gradually distribute it over the whole of the working parts. The oil can be drawn off from time to time by a gun metal plug, to which is attached a glass vessel showing the amount of oil contained in the casing. These couplings are at present made in three sizes, viz., for 1¼in. shafting to run at five hundred revolutions per minute, the pulleys being 12in. diam. by 4in. wide; for 1½in. shafting to run at three hundred revolutions per minute, with pulleys 16in. by 6in.; and for 1 $\frac{15}{16}$in. shafting to run at 250 revolutions, with pulleys 20in. by 9in.

DALETT'S BOILER SHELL DRILL.

WE are indebted to our contemporary, the *American Machinist*, for the accompanying illustration, showing a boiler shell drilling machine, designed and constructed by H. Dalett & Co., Philadelphia, Pa. These machines are used for drilling rivet holes, stay bolt holes, &c., in boiler shells. The improvement claimed on the old design is that the plates may be drilled after they are bent and put in place, so that there is but one handling of both plates in laying out as well as in drilling. The machines are made of two types, the "A" style consisting of a turntable on which the boiler shell is set on end, and around which three or more uprights carrying horizontal drilling heads are arranged. A novel and effective arrangement for driving the portable drills has been provided. In the "B" type, as shown in our illustration, the boiler shell rests on four or six rollers, on which it freely turns. The drilling heads, provided with the same driving apparatus as in the "A" type, rest on horizontal beams, these in turn being supported at both ends by strong uprights. The weight of the beams and heads is counterbalanced, so that the whole can be readily lowered or raised. The heads are moved horizontally by means of a pinion gearing into a rack on the lower beam, while the vertical adjustment is effected by a screw. Care has been taken to design the head in such a way that the operator, standing on either side, has full command over both crank handles, which materially assists in quickly setting the drill. The machine is adapted for drilling all sizes and kinds of boiler shells, including those for large marine and small stationary boilers, and can be built of any length and with any number of heads.

THE "VICTORIA" SAFETY LAMP.

THE accompanying illustrations show a new safety lamp invented by Mr. E. Sherring, of 39, Hanging Ditch, Manchester, and intended for burning either petroleum or paraffin. The inventor claims for this lamp that it prevents the disastrous results accompanying the upsetting of ordinary lamps. The novel features claimed for the



lamp are the following: An air chamber G is placed as a jacket over the oil reservoir, thereby preventing the oil from becoming over-heated and producing an explosive mixture. The air supplied to the flame enters through the perforations H, passes along G, and reaches the flame through the perforations at F. In this arrangement the air gets heated before it comes in contact with the flame, and is therefore in a better condition for giving economical light than in the case of the ordinary lamp. In case of the lamp getting upset, the extinguishers C D, which are pivoted at E (Fig. 3) at each end of the wick tube A, automatically close over the wick, as shown in Fig. 1, and instantly extinguish the flame. A cylinder or tube J is placed in the orifice of the oil reservoir, which is constructed on the well known principle of the safety ink bottle, and prevents waste of oil when the lamp is

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thrown over, as the oil runs behind the cylinder instead of escaping through the wick tube. This wick tube A is elongated, so as to prevent the ignited or smouldering wick from being turned downwards into the oil reservoir

FIG. 1.

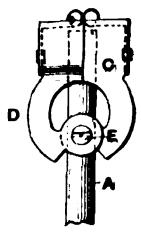


FIG. 2.

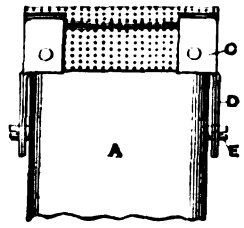
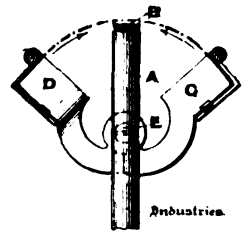


FIG. 3



and probably cause an explosion. The oil reservoir and all the fittings are made of metal, so that breakage is scarcely likely to occur. The lamp, as will be seen from the illustration, is artistically designed, and the details are well thought out.

Notices of Meetings.

THIS WEEK.

INSTITUTION OF MECHANICAL ENGINEERS.—Friday, 3rd February, 7-30 p.m. Continuation of forty-first annual general meeting, commenced on Thursday, 2nd February, for which the following business was set down: Annual report of Council and election of office bearers, and resumed discussion on "Irrigating Machinery on the Pacific Coast," by Mr. John Richards. The following papers to be read and discussed as far as time permits: "On the Position and Prospects of Electricity as Applied to Engineering," by Mr. William Geipel; and "Third Report of the Research Committee on Friction: Experiments on the Friction of a Collar Bearing."

ARCHITECTURAL ASSOCIATION.—Friday, 3rd February, 7-30 p.m. Ordinary meeting. Paper to be read by Mr. R. P. Spiers.

GEOLOGISTS' ASSOCIATION.—Friday, 3rd February, 7-30 p.m. Annual general meeting, after which a paper will be read "On the History and Work of the International Geological Congress," by Mr. W. Topley, F.G.S., Assoc.Inst.C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, 3rd February, 9 p.m. Lecture on "Ancient Microscopes," by Mr. Frank Crisp.—Saturday, 4th February, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

UNITED SERVICE INSTITUTE.—Friday, 3rd February, 3 p.m. Paper to be read on "Speed as a Factor in Naval Warfare," by Admiral the Hon. E. R. Fremantle.

JUNIOR ENGINEERING SOCIETY.—Friday, 3rd February, 7-45 p.m. Paper to be read on "Some Novel Mechanisms," by Mr. W. J. Tennant.

NEXT WEEK.

CLEVELAND INSTITUTION OF ENGINEERS.—Monday, 6th February, 7-30 p.m. Paper to be read on "The Working of the New Patent Law," by Mr G. J. Clarkson, F.I.P.A.

SOCIETY OF ENGINEERS.—Monday, 6th February, 7-30 p.m. Presentation of premiums. Inaugural presidential address by Mr. Arthur T. Walmisley.

SOCIETY OF ARTS.—Monday, 6th February, 8 p.m. Cantor lecture on "Yeast, its Morphology and Culture," by Mr. A. Gordon Salamon, F.I.C., F.C.S.—Tuesday, 7th February, 8 p.m. Foreign and Colonial Section. Paper to be read on "British Columbia," by Mr. Henry Coppinger Beeton, Agent-General for British Columbia.—Wednesday, 8th February, 8 p.m. Ordinary meeting. Paper to be read on "The Continuation of Elementary Education," by Mr. W. A. Lant Carpenter, B.A., B.Sc.—Thursday, 9th February, 8 p.m. Special lecture on "Etching and Mezzotint Engraving," by Professor Hubert Herkomer, A.R.A.—Friday, 10th February, 8 p.m. Indian Section. Paper to be read on "The Work of the Afghan Frontier Commission," by Captain Manisfold, R.A.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, 6th February, 8 p.m. Paper to be read on "The Alkaloids: a Review of the Synthetic Methods of Preparing 'Closed Chain' Azo-carbon Compounds," by Dr. H. E. Armstrong, F.R.S.; and "Studies in Coal Distillation," by Mr. Lewis T. Wright, C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Monday, 6th February, 5 p.m. General monthly meeting.—Friday, 10th February, 9 p.m. Lecture on "Safety Lamps in Collieries," by Mr. W. H. Preece.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 7th February, 8 p.m. Ordinary meeting. Paper to be read with a view to discussion, No. 2208, "The Alexandra Dock, Hull," by A. C. Hurtzig, M.Inst.C.E.—Friday, 10th February, 7-30 p.m. Students' meeting. Paper to be read on "Arched Ribs and Voussoir Arches," by H. Medway Martin, Wh.Sc., Stud.Inst.C.E.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Wednesday, 8th February, 7-45 p.m. Discussion on the paper on "The Combustion of Coal, and some Evaporative Experiments with Natural and Forced Draughts," by Mr. W. G. Spence. Paper on "The Results of some Experiments made on Rowe's Double Strapped Butt Joints," by Mr. James Patterson.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, 9th February, 8 p.m. Paper to be read on "Alternate Current Transformers, with special reference to the Best Proportion Between Iron and Copper," by Mr. Gisbert Kapp.

PHYSICAL SOCIETY.—Saturday, 11th February, 3 p.m. Annual general meeting. Paper to be read on "The Limit of Refraction in Relation to Temperature and Chemical Composition."

PRICES CURRENT, 2ND FEBRUARY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/9	Cash
Scotch Warrants, m/n		40/8	"
Hematite Warrants, m/n		42/10½	"
Stocks in Stores. Scotch	943,919—Inc. for week,	1169	Tons
Middlesbro'	348,242—Inc. "	1509	"
Hematite	212,833—Inc. "	189	"

Exclusive of stocks in makers' yards.

Market dull and lifeless.

	No. 1.		No. 3.		
Coltness	50/6	.....	43/3	f.o.b.	Glasgow.
Gartsherrie	46/6	.....	43/-	"	"
Dalmellington	43/-	.....	40/9	"	Ardrossan
Eglinton	41/9	.....	39/6	"	"
Glengarnock	46/9	.....	41/6	"	"
*Derbyshire	—	.....	38/-	f.o.t.	Works.
*Lincolnshire	—	.....	33/6	"	"
*Lancashire	—	.....	38/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 17 6	.....	5 7 6	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 5 0	.....	5 15 0	Manch'r.
" Angles	5 15 0	.....	6 5 0	"
Crown Sheets	6 15 0	.....	7 0 0	"
" Hoops	5 10 0	.....	5 12 6	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 15 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

No. 1 Selected.	No. 3.	No. 4.
53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£20	5	0	to	£20	10	0
Copper: British Cakes and Ingots	80	0	0	"	81	0	0
" Chili Bars	76	10	0	"	76	15	0
" Manufactured (strong)	90	0	0	"		——	
Lead: Common Pig	14	15	0	"	15	0	0
" English Sheet	15	15	0	"		——	
Tin: Straits	168	10	0	"	170	0	0
" Australian	169	10	0	"	171	10	0
" English Ingots	163	0	0	"	165	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER has during the past week been irregular, fluctuating from £73. 15s. to £79 per ton for Chili bars; at the time of writing £76. 12s. 6d. is quoted. It appears to be steadily recovering from the recent depression, and as it is now understood pretty widely that the French syndicate has arranged with the principal producers of raw copper to limit the production and to regulate the price for the next two or three years, it may be expected that prices will steady to the new level, and that buyers will come forward. It is quite clear that the syndicate is powerful enough to accomplish their objects, at least for some time; and as very little copper has gone into consumption for many months, the stocks of manufactured copper at home and abroad must be getting very low. The slackness, however, continues, the copper trade in all its branches being almost at a standstill.

TIN has again advanced, on account of a steady demand for America; the stocks show an increase, but the consumption continues to be large.

LEAD unchanged and steady at slightly lower prices.

SPELTER is flat, but stocks are small, and the market shows signs of recovery.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	28	0	0
" Ceylon	"	24	0	0
Cottonseed	"	20	15	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	19	0	0
Palm, Lagos	"	22	0	0
Rapeseed: English	"	25	15	0
Seal: Pale	"	23	0	0
" Brown	"	17	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	8	6
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6⅝
" Spirit	"	0	0	7¼

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	8	—		.....	
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6¾	—	0	1	7
Alum: Lump (powder 10/- ex.)	ton	4	15	0	—	4	17	6
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	12	10	0	—	12	12	6
" Liquor	lb.	0	0	3½	—		.....	
Bleaching Powder	ton	7	12	6	—		.....	
Bisulphide of Carbon	"	13	0	0	—		.....	
Borax	"	28	0	0	—		.....	
Benzole (90%)	gal.	0	3	9	—		.....	
" (50/90%)	"	0	2	9	—		.....	
Copper Sulphate	ton	21	10	0	—	22	10	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	23	10	0	—	25	10	0
" White Sugar	"	28	0	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	6½	—		.....	
" Prussiate (Yellow)	"	0	0	7⅝	—		.....	
" Sulphate (Basis 90%)	ton	9	0	0	—		.....	
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	7	0	0	—		.....	
" " (" 60%)	"	6	0	0	—		.....	
" " (Cream, 60%)	"	5	18	9	—		.....	
" Crystals	"	2	10	0	—		.....	
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	2	—		.....	
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

POLYGONAL WHEELS FOR LOCOMOTIVES.—We quote the following from the *Railroad Gazette*, of New York, respecting a new departure in the design of locomotive driving wheels. Our contemporary says: "A locomotive possessing several unusual features has been recently built by the Hinckley Locomotive Company, of Boston. The engine is designed to run fast passenger trains, and has a single pair of drivers, 67in. diam. on tread, and a pair of 42in. trailing wheels with radial motion. The front end of the engine is carried on a four-wheel truck as usual. The engine has piston valves, but the most novel feature is the form of the tread of the driving wheels. The circumference of the tyre, instead of being a true circle, is polygonal, and formed of 105 flats, each about 2in. long. The object is to prevent slipping. The engine has not yet been tried, but it is claimed that polygonal tyres have been running on a four coupled engine on the Boston and Lowell during the last year, with satisfactory results. A flat wheel is generally regarded as damaging to the rails, while the motion of an engine or car with flat wheels is exceedingly unpleasant.

NEW STEAM TUG FOR DUNDEE.—A meeting of the works committee of the Dundee Harbour Trustees was held recently to consider the offers for the construction of a new twin screw steam tug. The offers were six in number, four of them being from local builders, one from Leith, and the other from a Glasgow firm. After examination it was found that the offer of Messrs. Pearce Brothers, Dundee, amounting to £6,700, was the lowest, and it was accordingly accepted. The new tug is to be constructed of steel, and the following are its dimensions: Length, 120ft.; breadth moulded, 24ft.; depth of hold to the top of floors, 10ft. 8in. The light draught of the vessel is not to exceed 6ft. 6in., and with water ballast 8ft. 6in. She is to be fitted with two triple expansion, direct acting, surface condensing engines, with three cylinders of 12in., 17in., and 30in. diam., and having a stroke of 20in. The boilers are also to be of steel, 13ft. diam., 10ft. 6in. in length, with three furnaces about 40in. diam. each, and having separate combustion chambers. They are to bear a pressure up to 160lb. to the square inch. The steamer is to be built under special survey. She is to be classed 100 A1 at Lloyd's, and is to have a No. 3 passenger certificate from the Board of Trade for twelve months. Her equipment will consist of a steam winch, windlass, and all other necessary fittings. The steamer will also be fitted with a strong iron foremast, and a derrick capable of lifting 5 tons. The contract stipulates that the tug must be completed within six months from the date of acceptance of offer.

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HOME INDUSTRIES.

MANCHESTER, 2nd February, 1888.

The Cotton Trade.—There is still some uncertainty as to the extent of the crop of American cotton, although it is more than three months since the first delivery of the new growth. The receipts at American ports have been small, but there is little doubt that stocks in spinners' hands are unusually large. In the meantime the delivery has been much greater than that of last year, and it appears probable that the crop will be very near Messrs. Neill & Co.'s later estimate. Prices remain very steady, and do not show any signs of weakness. This state of things naturally reflects on the yarn market, and in consequence there has not been any increase of business this year. Spinners are, however, in most cases favourably situated, having a profitable margin, and being well sold forward. In addition to this many of them are now running short of cotton, and will have to purchase at the higher current prices. These causes indispose them to accept the prices which are being offered by consumers, and the result is that very little business is being transacted. The cloth market is inactive, although at a little less than current rates a good deal of business could be placed. Manufacturers are indisposed to accept lower prices, especially in the face of the firmness in yarn quotations. In the meantime extensions of manufacturing establishments continue. The contracts for a shed to contain 1200 looms at Bank Top, Burnley, have just been let to Mr. George Keighley, of that town. It is stated that a strong syndicate is being formed in this country for the purpose of working a German patent for a process of dyeing cotton before carding it.

A New Limited Company.—The well known firms of Messrs. Tootal, Broadhurst, Lee, & Co., and the Lee Spinning Company, are now amalgamated into a limited liability company, and will in future trade under the style of Tootal, Broadhurst, Lee, & Co., Limited. The capital is to be nominally £1,000,000, of which £300,000 will be held as preference shares, and the remainder as ordinary shares. A reserve of uncalled capital of £302,260 is retained, and all of the shares will be held by members of the present firm. This is a good example of the private limited concerns which have of late years become very popular.

The Ribble Scheme.—The dredging of the Ribble is being steadily conducted, and when the new dredger recently ordered gets to work, considerable progress will be made. Careful soundings have established the fact that the depth of the river channel has materially increased, not only at the actual point of dredging, but also behind it. In the meantime, in order to satisfy that body of ratepayers who have some doubt as to the ultimate success of the scheme, the Corporation has determined to call in Mr. Deas, C.E., of the Clyde Navigation Trustees, to examine and report.

LONDON, 2nd February, 1888.

The Money Market.—Money continues to be a drug in Lombard-street, one explanation being that a stringency was anticipated about this time, and those who had money to lend arranged that it should be free now. They have rather overdone this, and as the demand is really unimportant, the rates are kept very low by the excess of loanable capital available for use. The Stock Markets continue rather dull. There is still a little speculating going on with copper, and the price of the metal has strengthened again. The Parisian syndicate is gradually embracing all the mines in its toils, and when the few who still hold out are brought into subjection, the higher prices will rule again. The Postmaster-General made rather a rash declaration at Wolverhampton at the end of last week, to a deputation which desired greater telephone facilities. Mr. Raikes said the purchase of the telephone undertakings was only a matter of a short time, which was no doubt reassuring to the deputation. But the Postmaster-General counted without the telephone companies, whose shares bounded up at once, calming down a little when Mr. Raikes attempted to explain away his untimely remark. Among recent issues of an industrial nature is a company formed to work the patents for making glass bottles by machinery, to which reference was made in *Industries* last week.

Popular Lectures.—The lectures to be given this month at the Royal Victoria Hall include "Germs in the Air, and What They Do For Us," by Dr. Percy F. Frankland, B.Sc., F.C.S.; and "Earthquakes and Volcanoes," by Mr. E. Wethered.

Companies.—Since our last report the following new companies have been registered: The Skytmyr Copper Mines, Limited, with a capital of £120,000, to acquire copper mines in the county of Nedenoes, Norway; Booysen Land and Mining Company, Limited, with a capital of £120,000, to explore farms, lands, minerals, &c., in South Africa; Central Argentine (Carpa Valley) Exploration Company, Limited, with a capital of £120,000; the Sussex Mineral Waters Company, Limited, with a capital of £5,000; Joseph Robinson & Company, Limited, with a capital of £100,000, to carry on business as cement and plaster manufacturers at Knothill, Cumberland; Vulcan Fire Brick Company, Limited, with a capital of £10,000; Bradley Water Works Company, Limited, with a capital of £600; North Australian Mining Company, Limited, with a capital of £100,000; J. F. Blyth & Company, Limited, with a capital of £10,000; Worcester City Mills Company, Limited, with a capital of £5,000; Darling & Sons, Limited, with a capital of £50,000, to carry on business as printers, lithographers, &c.; Stannaries Company, Limited, with a capital of £10,000, to work mines, quarries, &c., in the United Kingdom; and the Discoveries, Limited, with a capital of £20,000, to acquire any novelties, new inventions or discoveries.

Produce.—The sugar market has been very quiet, and speculative purchases of beetroot sugar have been made at a decline. Coffee continues to be very depressed, and prices have fallen. A proposal is on foot to establish a clearing house in London for time bargains in coffee and sugar, on the lines of the Caisse de Liquidation at Havre. The clearing house would act as stakeholder between buyer and seller, each of whom would make a small deposit. This would create a feeling of greater security, and Messrs. N. M. Rothschild & Sons, Baring Brothers & Co., and other prominent firms are interesting themselves in the matter.

Hemp.—The demand for Manilla hemp has been fair, and the arrivals this year have been easily disposed of. The Russian market is reported as firmer. No change has taken place in the price for spot parcels of Baltic hemp. There is but little doing in Italian hemp, the prices for which, however, remain firm.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 22nd January, amounted to £1,100,462, on 15,830¾ miles, as compared with £1,083,146 in the corresponding period of 1887, when the mileage was 15,706¾ miles. An increase is thus shown in the mileage of 124 miles or 0·7 per cent., and in the receipts of 2·4 per cent.

The Navy.—The torpedo cruiser "Tartar," which was built by Messrs. Thompson, of Clydebank, has now been completed for sea at Sheerness. Her engines are of 3600 h.p., and she is able to steam at the rate of 17 knots per hour. Two new sloops are to be built of a similar type to the "Daphne," which is being built at Sheerness. The engines will be of 2000 h.p.

Engineering Students for the Navy.—Among the alterations to be carried out in connection with the training of engineering students for the navy, no entries are to be made this year, and the maximum age for 1889 is to be extended to 17 for that year only. Bonds and indentures are to be abolished, and the regular course of training will be reduced to five years, and under certain conditions to four years.

GLASGOW, 2nd February, 1888.

Glasgow International Exhibition, 1888.—The progress of the arrangements was reported at a meeting of the Executive held last week. The buildings are rapidly approaching completion, and about six hundred men are at present employed upon the works. It has been arranged to erect a stone gateway at one of the principal entrances, and to fill it with an iron gate. The electric light installation is now being proceeded with rapidly, and the work of the various sections is in an advanced state. Foreign exhibits have already begun to arrive. The machinery section will be 330ft. long by 285ft. broad. In addition to the floor space there will be a gallery round three sides, which will accommodate light pieces of machinery. Upwards of three hundred applications for space in the machinery section have been accepted, and the committee are at present engaged in allotting the space to the proposed exhibitors. The electric light section, containing dynamos, four steam engines and nine Lancashire boilers, forms an annexe to the machinery section, and is 118ft. long by 100ft. broad. Altogether the floor space of the whole Exhibition will be 474,500 sq. ft. The fountain to be erected by Messrs. Doulton is in course of construction, while the culvert and the excavations have been made for the fairy fountain to be supplied by Messrs. Galloway. The contracts for the steel shafting, and for the steam pipes for the Exhibition, have both been placed with Messrs. Kesson and Campbell, Parkhead.

Patent Boat Apparatus.—There was exhibited at the Royal Exchange this week a model of Evans' apparatus for connecting and disconnecting boats from the davits. The device is intended to secure automatic action of the lowering gear, and simultaneous release of the boat when it has reached the water. The patentee is Captain Evans, of the Shaw-Saville Line.

Shipping.—The demand for freights outwards was fairly energetic last week. Cotton goods to the value of £84,000 went to India and to China, and to the value of £12,000 elsewhere. Iron manufactures to the value of £28,000 went to India, and £22,000 elsewhere. This week the market is a little easier, the number of vessels having come up to the demand. Shipments of coal and pig iron show a considerable increase. The year, so far as it has gone, exhibits a great increase on coal and on pig iron shipped coastwise, but a reduction on pig iron shipped abroad.

Clyde Steam and Sailing Ship Association.—A series of addresses to the members of these Associations, dealing with important subjects specially relating to mercantile law and shipping management, was arranged for early in the winter. The fourth of these was delivered on Monday evening, by Mr. James Mackenzie, on "The Relative Province of the Charter Party and the Bill of Lading." He stated the existing provisions of mercantile law in this connection, and suggested that charter parties should be made more uniform in their terms than is now the case. He also urged that great care should be observed in describing the class and carrying capacity of the vessel, and her position at the date of the charter party. He also urged that the greatest care should be taken that the bill of lading accords with the charter party. The exception of risks, and other important questions which arise in practical business, were referred to at length. Mr. Mackenzie concluded by urging clearness and precision in framing charter parties, and pointed out that mere deletion of a clause in a printed charter party did not imply agreement to its opposite. He also reprobated the practice of permitting informalities, such as the insertion of an untrue date, or the signing for goods as sound which were known to be damaged. These joint meetings of the Associations have been well attended, and have been highly successful.

Shipbuilding.—Messrs. Fleming & Ferguson, Paisley, have booked an order from Mr. Walker, the contractor for the Manchester Ship Canal, for a powerful twin screw dredger. The vessel will be fitted with Messrs. Fleming and Ferguson's patent quadruple expansion engines of 700 h.p., and will be constructed to raise from a depth of 35ft. a quantity equal to 600 tons per hour.

Diminution of Postal Facilities.—An alteration in the arrangements of the Caledonian Railway has been made, by which the train which formerly left Glasgow Central Station for London and intermediate stations at 6 a.m. has been withdrawn for some unexplained reason. This train carried a mail which was made up in Glasgow at 5-30 a.m., and which was delivered in Manchester early in the afternoon, and in London the same evening. The result is that the first mail train for the South is that leaving at ten o'clock, but letters dispatched by it are not delivered until the next morning. It is to be hoped that the railway and postal authorities will see their way to resume the former arrangements, both in the interests of the travelling public and of the postal system.

Carbrook Forge and Bessemer Steel Company.—This well known Sheffield firm have appointed Mr. Robert Horsburgh, 48, Robertson-street, Glasgow, as their representative for Scotland.

Edinburgh Cable Tramways.—On Thursday and Friday last, experimental runs were made over the new cable tramway in Edinburgh, and public traffic was commenced on Saturday. The steepness of the hill on which a considerable portion of the tramway is constructed, offers peculiarly favourable conditions for success.

(From our own Correspondents.)

LIVERPOOL, 1st February, 1888.

The Liverpool Electric Supply Company, Limited.—Since the granting of the license by the Board of Trade for the laying of the wires, &c., underground, and other important provisions, the company has made rapid progress with the extensive new premises in Harrington-street, which, when opened, will be their central station. The buildings are nearly completed, the three boilers are seated and bricked up, and the foundations for the dynamos and engines are well advanced. It is expected that the whole station will be in actual working order early next month.

Compressed Air Engines on the Tramways.—At the general meeting of the shareholders of the Liverpool Tramway and Omnibus Company, held last week, the chairman, Sir David Radcliffe, stated that although every facility and opportunity had been given to Colonel Beaumont to experiment with his engine on the lines at the North End, it was found that the system in its present state of efficiency was not suited to the traffic of the city, and could not therefore be adopted.

The Timber Trade.—The total amount of timber of every class imported last year amounts to 395,003 tons, against 398,094 tons in the previous year; and although the decrease is only about 3000 tons, yet the improvement in the trade which was anticipated this time last year has not been realised. The stocks now in hand are not heavy, and if the foreign shippers will only be moderate in their exports, a fairly remunerative business would follow. Of Honduras mahogany there have only been six cargoes imported, against thirteen the previous year; for six months there was a total cessation of imports, which had a decidedly beneficial effect upon the market. Tabasco has consisted of large sized wood, but much of it faulty, the prices ruling low in consequence; the prices have lately advanced 20 per cent., and the market is bare. Minatitlan and Placotalpam have been chiefly of small wood, the imports being greater than that of previous years. Prices have been low, with an increase on recent sales, as there is only one cargo in stock. African mahogany has been very little imported; the supply and quality cannot be depended upon. The supply of St. Domingo and Cuba has been very insignificant. The imports of cedar from Honduras and Cuba have been very small, and that from Mexico was about one-fifth that of the previous year, and is the smallest on record. From the West Coast, Central America, and Australia none has been imported worth mentioning. There has been a moderate supply of American walnut, which sold at steady prices ex quay. Satin walnut was in brisk demand last year, at varying prices, which have fallen off latterly, and stocks have accumulated.

SHEFFIELD, 1st February, 1888.

Iron and Steel.—There is not much alteration in the condition of local trade, which continues on the whole very brisk. At the rolling mills there is much activity, and the engineering firms are better employed than they have been for some time past. Heavy machinery is in extensive

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demand just now, and one Sheffield house is engaged on plant to be sent to China. At most of the large works employment is tolerably plentiful, and recently good orders for heavy material have been received. For railway material there is a steady demand with firmer prices, and tyres, axles, and springs are selling readily. In the lighter branches of industry trade is satisfactory. Edge tools find a ready market, and the export of sheep shears to the Colonies is very extensive. In cutlery and electro-plate business is more profitable, and is daily increasing. There is now a probability of the small-pox epidemic being speedily stamped out; and it is satisfactory to state that the Sheffield manufacturers and working men have acted with great energy in checking the disease. The working men have established funds with which to pay the wages of their fellow workmen who have stayed away from work because of the small-pox in their homes; and the manufacturers have in many cases not only persuaded their men to be re-vaccinated, but have defrayed the cost.

NORTH STAFFORDSHIRE, 1st February, 1888.

The Iron Trade.—The improvement noticed at the close of 1887 is not being maintained, more particularly with regard to finished iron, and prices are receding. The present outlook for the year is by no means favourable, and iron masters fear that the expected revival is to be again postponed. Only those actually engaged in the trade know what this means. Owing to its land-locked position, North Staffordshire has to bear a heavy burden of railway or canal charges, and it is a fact that, even without these, recent prices would have been unremunerative. The critical time with regard to prices of the crude metal will be a few weeks before next quarter day, when consumers will be in the market. If makers can hold out for an advance at that time, buyers will contract at higher figures, and the value of finished iron must necessarily be enhanced.

Checkweighmen.—At the Hanley Stipendiary Police Court, on Monday last, the Hanley Colliery Company summoned their checkweighman for "affixing on the colliery a certain notice calling a meeting of the driftmen employed in the said colliery, in consequence of which the workmen absented themselves from their employment," and, under sub-section 4 of section 13 of the New Mines Regulation Act, asked for his removal. In granting an order for his removal, the Stipendiary said it was perfectly clear that the man had been attending to matters far beyond his authority. At the same court, a large number of men were summoned by the same firm for absenting themselves from work; but the summonses were finally withdrawn on payment of costs. The working of the new Act with regard to shot firing is responsible for this and much more trouble in the district.

DERBY, 1st February, 1888.

Local Trades.—The recent improvement in the iron industry is well maintained, and inquiries for plates and bars come in freely. The stove grate makers had an accession of orders with the New Year, which enabled many houses to clear their stocks, and still retain some lines on hand to keep their men busy. In this branch Messrs. Russell & Son are well employed, their combination kitchener, which can easily be changed into an open or close range, being in great demand. Messrs. Pooley & Sons' branch establishment in Derby has been for some time and still remains fairly well employed, owing to the Markets and Fairs (Weighing of Cattle) Act, 1887, which came into operation on the 1st January, 1888. This Act makes it compulsory that at every market or fair where tolls are levied, provision shall be made by the owners or trustees for the official weighing of cattle. At the Derby cattle market this firm have laid down one of their patent weigh bridges, especially adapted for the purposes of the Act. The collieries in the district are working well, and a heavy tonnage of fuel is being sent away to London.

The Colour Industry.—Messrs. Leech & Neal, one of the largest firms in the kingdom in this trade, are very busy on American demand, their "Indian reds" especially being in great request. Other local houses in this line are also busy, and general improvement is manifest in a branch which has been somewhat depressed of late.

Railway Matters.—Great satisfaction is felt that the Beighton and Chesterfield Railway Bill, promoted by the Manchester, Sheffield, and Lincolnshire Railway, has passed the preliminary stage, as the new line will open an important coal field, and is likely to improve the trade of the district. The Midland Railway also have complied with the standing orders in regard to their Bill for amalgamating with their undertaking that of the Dore and Chinley Railway, and extending the time of its construction. Long Eaton, which, from a place of 1500 inhabitants in 1860, has in the interval, chiefly through the lace and similar industries, grown into a town of upwards of 10,000, is agitating for easier access by road to Trent Station, as the present carriage way is a winding one, and very inconvenient. Upwards of one hundred navvies were sent away from Ripley last week, and sent elsewhere to carry on the new line. This has emptied a number of houses in Ripley, and the circumstance necessarily affects the business of local tradesmen.

The Derby Tramways Company.—This company has just declared a dividend of 2s. 6d. per share for the past half year. Gross receipts for period £5,065, expenses £4,357, profit £708. Number of passengers carried 1,163,890, and car mileage run 123,154 miles.

BARROW-IN-FURNESS, 1st February, 1888.

Improvement in Trade.—In both the iron and steel trades there is an improvement to note this week. The quieter tone which characterised the hematite iron trade last week, in consequence of "bearing" operations on the Glasgow Exchange, has given place to a much better tone. There is a good demand for all classes of pig iron alike for prompt and forward deliveries, but prices have not improved, and are this week quoted at 44s. to 44s. 6d. per ton net f.o.b. for Bessemer numbers, and 6d. to 9d. under this price for forge and foundry sorts. The proposal to increase the make of iron has been checked in consequence of the lowering tendency of prices, and will not be resorted to, except under more favourable conditions than at present exist. The steel trade is steady, and there is an improvement to note in the demand for rails; but no change has taken place in prices, which remain steady at £4 per ton for heavy sections, and £4. 5s. per ton for light sections net f.o.b. Blooms are in better request on American account, at from £3. 12s. 6d. to £3. 15s. per ton. In a short time there will be a great increase in the output of steel in this district, as for some time past the works at Moss Bay, as well as those of the West Cumberland Iron and Steel Company, Workington, have been stopped during repairs. A good trade is doing in billets, bars, wire, and hoops, and wire rods and slabs are quiet.

Shipbuilding and Engineering.—There is a better trade doing in engineering in the district, both in the general and the marine departments; and it is almost a certainty that some large orders will be booked to supplement those already on the list. In shipbuilding next to nothing is doing, but preparations are being made on a large scale for what promises to be after all a very brisk year at one of the chief works in the country, viz., that of the Barrow Shipbuilding Company.

Iron Ore and Coal.—There is a great development going on in the iron ore mining industry of the district. The improved demand has not only set to work a largely increased number of men, but explorations have been made to prove the further existence of metal; and at the present time there is as much ore "in sight" as at any previous period of the history of this trade in Furness and Cumberland.

MIDDLESBROUGH, 1st February, 1888.

Pig Iron.—There was rather a scanty attendance on 'Change at the weekly market held yesterday, and the business done was but trifling. Makers being well sold do not care to offer at present prices, and there are no inquiries of importance. Prices thus are merely nominal, at 32s. per ton for No. 3 G.M.B. for February delivery. Warrants are 32s. per ton cash for Connal's No. 3 G.M.B., and 44s. for Connal's Nos. 1, 2, and 3 hematite.

Shipments of Pig Iron.—These have increased over those of the corresponding month in last year by upwards of 15,000 tons, and the improvement is both in home and foreign shipments. Up to the 30th ult. they amount to 57,465 tons, against 42,185 tons to similar date of the same month last year. The usual monthly returns are eagerly looked forward to, and if favourable it is expected that the price will advance accordingly.

Manufactured Iron and Steel.—Finished iron is unchanged, and maintains the improvement it gained. The annual meeting of the Board of Conciliation and Arbitration for the Manufactured Iron Trade, was held on Monday, when congratulations were expressed at the improvement. But the improvement, it would appear, came so late in the year as to have little effect on the year's returns. There has been less turned out in 1887 than in the previous year, the figures being 268,796 tons 17 cwt., as compared with 284,188 tons 19 cwt., and there has been no substantial increase in the price, the figures being £4. 12s. 8·69d., as compared with £4. 12s. 7·83d. In 1884 the output was 428,286 tons, and the average realised price £5. 5s. 6·99d. Finished steel is much the same, with prices unchanged. There is not so much pressure on the works, so that the North-Eastern have been in no hurry to resume after the holidays, when they were stopped for repairs. The lock out, however, has ended to the satisfaction of all concerned. The Board of Conciliation and Arbitration for the iron trade expressed a belief at their recent annual meeting that they could be of great use in steel as well as in iron disputes.

SUNDERLAND, 1st February, 1888.

Shipbuilding.—Additional orders come slowly to hand, but doubtless the thinning of fleets by the winter storms will give further impetus to the revival in this local industry. Messrs. Short Brothers, Pallion, have been fortunate in securing one or two orders since the New Year, and it is believed other shipbuilders have been similarly successful. The large amount of repairing work on hand is noteworthy, all the dry docks and slipways being kept actively employed. An instance of the rapid work effected in fitting engines and boilers into steamers, and completing their deck work, outfit, &c., is seen in the case of the steel steamer "Scottish Prince," which was launched on the 2nd ult., and on the 30th ult. was complete in all respects, and loading cargo.

Shipping Trade.—The coal shipments for last week were to foreign ports, 19,058 tons; coastwise, 50,438 tons; total, 69,496 tons. During the previous week, 74,072 tons were exported. The remaining shipments included 1210 tons of patent fuel, 570 tons of coke, 23,000 dozens of bottles, a cargo of lime and cement, and one of fireclay goods. Large consignments of wheat and potatoes were received. The River Wear Commissioners' annual returns have been completed, and show a very important increase in the trade of the port during 1887, as compared with 1886. The total revenue of the Commission last year was £129,373, as compared with £119,504 in 1886, an increase of £9,869. This was largely caused by the increased shipments of coal, which amounted to 4,261,292 tons, an increase of 315,858 tons over the year 1886.

Paper Manufactories.—All the paper mills are actively employed at Hylton, Deptford, and at Hendon. At the latter the new mill, No. 3, is now in active operation, having been completed at the close of last year. By this addition, the number of employés has been increased by about one hundred, and the production of paper by the Hendon Paper Works Company, Limited, is raised from 90 tons to 135 tons per week. The mill cost about £30,000, including machinery.

NEWCASTLE, 1st February, 1888.

Iron.—Though prices in the finished iron trade have undergone little alteration lately, and are still far from remunerative to manufacturers, the demand has greatly improved, and at some of the principal works the production is at least 50 per cent. greater than at the corresponding period of last year. Messrs. Hawks, Crawshay, & Sons' rolling mills are now being worked with a regularity unknown for years past, and their puddling furnaces are also kept in constant operation. The same may be said respecting Messrs. John Abbot and Co.'s mills, in the immediate vicinity; and the pressure of work at Messrs. Raine & Co.'s mills, Winlaton, is quite as great as it has been at any former period. Among other important contracts secured by the last named firm may be mentioned one for a large quantity of smithing iron from the North-Eastern Railway Company, and another of equal extent, for a similar description of the material, from Messrs. Armstrong, Mitchell, & Co. On the whole, though there is little probability of the demand for finished iron becoming so strong as to cause any sudden or extraordinary upward turn in prices, it is generally felt, by those most interested in the fortunes of the industry, that during the present year at all events a fair measure of business will be done.

Steel.—The new steel works which have recently been erected by the Consett Iron and Steel Company, have commenced operations, and are already helping to satisfy the want so greatly felt of late for the different descriptions of steel required in boiler and ship construction. The Company are pressed with orders, the high quality of the material manufactured being generally recognised; and largely as their productive resources have been increased, they will be taxed to the uttermost to supply the demand upon them for many months to come. The new steel furnaces now in course of erection by Messrs. Hawks, Crawshay, & Sons, are expected to be ready for commencement of productive work early in March. The manufacturers of steel and iron sheets are still exceedingly busy, and it is probable that in some instances additional plant, with a view to extended production, will be put down.

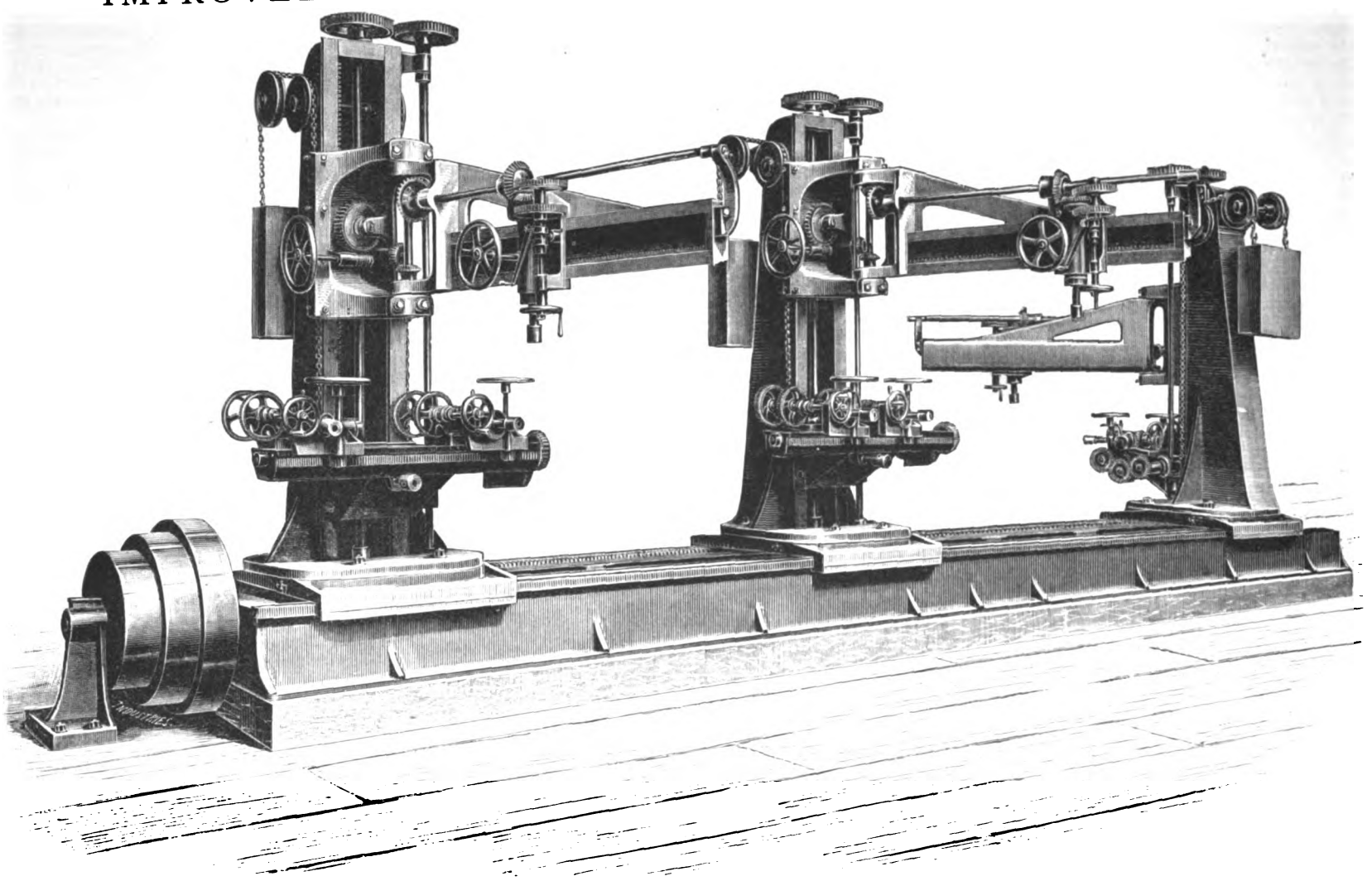
Chain and Anchor Trades.—Improving business is the feature to be noticed at different establishments devoted to the manufacture of cable chain; but the anchor making departments connected with such concerns do not show the same tendency towards better trade, owing, no doubt, to the fact that patent cast steel anchors are largely superseding the wrought iron anchors of the old pattern.

DUNDEE, 1st February, 1888.

Flax and Jute Trades.—There has been no improvement in the trade of Dundee and district during the past fortnight. The linen branches have been fairly steady, but the jute trade has been adversely affected by a heavy failure in the bag trade in New York, in which some local firms are involved to a considerable extent. In the flax market the tone is quiet, and business mainly confined to small lots for immediate use. Spinners are anxious to ascertain the quality of the new crop before adding to stock. Flax yarns maintain a steady tone, and spinners are inclined to hold for some advance; but manufacturers are not disposed to concede this, as orders now being executed were contracted for on the basis of late values. In linen goods the demand keeps well up, and looms are kept going. Several large Government contracts have been obtained by leading firms in the district for sailcloth, &c., which will assist the heavy end of the trade, and tend to steady prices for other fabrics. The market for raw jute has become quiet, and prices are scarcely so firm as they were. The export of jute from Dundee to Continental ports is increasing, and last week over 1000 bales were shipped to London, which has hitherto been the chief *entrepôt* for the fibre. The market for jute yarns has been affected to some extent by a strike. After being idle for some days the workmen returned to the mills on the old terms, and in view of the weakening tendency in the market mill owners and manufacturers are considering the propriety of lessening production. A general meeting of the trade is to be held this week to discuss the question. In jute fabrics there is a fair inquiry for Hessians, but buyers hold back unless they can place their orders at the lowest point. Sacking and bagging are in steady demand, and there is rather more doing in tarpaulin. Jute carpeting is also moving off freely, and makers are all busy.

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IMPROVED TRIPLE RADIAL DRILLING MACHINE.



TRIPLE RADIAL DRILLING MACHINE.

The above illustration represents a triple radial drilling machine, which has been recently made for the Tees-side Iron and Engine Works Company by Messrs. Scriven and Co., of Marsh Lane, Leeds. The machine is intended to drill large girders in position after they are plated; and the girders whilst being drilled are placed on their side with the top and bottom flanges vertical alongside the main bed. The machine consists of a bed 36ft. long with planed slides, on which are three standards, movable along the bed, and each carrying one radial drilling machine with a vertical spindle, which can drill from 1ft. 6in. to 6ft. 6in. from the centre, and swings through an arc of 180°. This radial drill can be moved up or down the standard to suit different sizes of girders; and is used for drilling all holes in the web. Each standard also carries two horizontal drilling spindles for drilling holes in the flanges of the girder, each spindle being carried by a separate saddle capable of being moved along a slide parallel to the main bed. These drills can move along the whole length of their slide and can pass across the face of the standard, the length of the slide being sufficient to enable a length of 4ft. along the girder to be drilled before moving the standard on the bed. This slide is also vertically adjustable on the standard. All the drills have self acting and hand feed motions. The standards are arranged to turn round so as to drill on either side of the bed—the right hand standard in the engraving being shown reversed,—so that whilst one girder is being drilled another can be prepared for drilling on the other side of the bed.

The driving power is communicated to the various drills from a main horizontal shaft adapted for three speeds, and running the full length within the bed. The main shaft is provided with a continuous key way, and sliding upon it are three bevel wheels with feathers, one wheel for each standard or set of drills. The sliding bevel wheel on the main horizontal shaft gears into a bevel wheel fixed on a vertical shaft passing upwards in the centre of the standard. From this vertical shaft motion is conveyed to the horizontal shaft on the radial arm by intermediate gearing, from whence the vertical drill spindle is driven by a pair of mitre wheels in the usual manner. For driving the two horizontal drills use is made of a second vertical shaft, shown on the right of the main standard, which is driven by spur gearing, shown at the top. Motion from this second vertical shaft is transmitted by a pair of mitre wheels to a horizontal shaft in the centre of the saddle, carrying the two drill spindles and intermediate spur gear. From this horizontal shaft, motion is transmitted by spur gear to the horizontal drill spindles placed at right angles to it, through first a short horizontal shaft on the saddle, which in turn drives the spindles by bevel gearing. The saddle is balanced by a weight hung at the back of the main standard, as shown, and the balancing arrangement enables the cross slides to be worked up and down easily by hand, by means of a rack and pinion. The machine, we understand, has done some good work, and in a large girder and bridge yard it cannot fail to be useful. The drills being all on separate saddles and independent one of another, a blunt or broken drill can be easily removed by simply stopping the one spindle affected, and thereby no delay is caused in the other parts of the work.

THE STANLEY CYCLE SHOW.

The eleventh annual Exhibition of the Stanley Club was opened at the Royal Aquarium last Saturday, and will close to-morrow. In point of the number of exhibits the present show is slightly beyond its predecessors, and there is also a fair sprinkling of novelties in matters of detail. When describing last year's show we dealt to a considerable extent with the principles of the modern bicycle and tricycle, and we shall therefore limit our present account to the mention of some of the more important novelties exhibited. The Singer Company, who were the first to bring out multicycles, that is, machines carrying three, four, or more riders, have modified the original design of this multicycle so as to make it suitable for military service, and show a portion of a machine made to the order of the War Office. The whole machine, which is called the Victoria war cycle, consists of six pairs of wheels, and is intended to carry twelve riders. Each pair of wheels, with its frame and backbone, forms an independent section, and can be very quickly detached from and attached to the rest. Experience has shown that six sections are the maximum which can be used with safety and at considerable speeds. The cycle is so arranged that it can be rapidly split up into two independent portions carrying six riders each, or three portions carrying four riders each. The joints at the backbone are all ball and socket couplings, so as to make the machine flexible both in the horizontal and vertical direction. A somewhat similar exhibit, though for peaceful purposes, is shown by the Coventry Machinist Company. This is a hansom cab made to the order of the Sultan of Morocco, which is propelled by four drivers riding behind. The machine has four large driving wheels and a small wheel in front of the cab, which, however, does not touch the ground in ordinary running. Within the cab there are the steering and brake handles. The same firm also show a light tandem racing tricycle, and a 28in. racing tricycle, the latter weighing only 28lb. Messrs. Hillman, Herbert, & Cooper, of Coventry, have a good collection of safety bicycles and tandems. In one of the later exhibits the steering gear is brought forward of the steering axle by about 8in., the two axes being coupled together by connecting rods. The object of this arrangement is to increase the wheel base, without forcing the rider to lean too much forward. A small detail in connection with their treadle also deserves mention. It often happens that the foot of the rider slips off the treadle through the rubbers becoming worn or turning on the studs. To prevent this, a wire is inserted into the corrugations of the rubber, and riveted up in the end plates. Messrs. Starley & Sutton, of Coventry, have a good display of their special Rover bicycles. We notice that they are now introducing a band brake on the hind wheel, instead of the usual plunger or spoon brake on the fore wheel. In this, however, they are not alone, several other firms in the show having adopted these band brakes. The ball bearing on the steering stalk has been made larger this year, in order to obtain one or more complete revolutions of each ball in the bearing with the usual amount of steering. When this bearing is made of very small diameter the balls only revolve through a small arc, and are therefore liable to wear unevenly. By making the bearing of large diameter, this defect is overcome. The Humber Company have their usual large display, amongst which we noticed an exceedingly simple safety bicycle, and a tandem tricycle with a double band brake. To insure ease in running, the steering stalk is supported on double springs. We also noticed an alteration in the Cripper tandems shown last year, the present machine being specially adapted for lady riders.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
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Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

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FRIDAY, 3RD FEBRUARY, 1888.

ELECTRICITY AT THE PARIS UNIVERSAL EXHIBITION.

ENGLISH manufacturers of dynamos, motors, lamps, and electrical appliances generally will soon have to decide whether they will take part in the forthcoming Universal Exhibition at Paris, or whether, following the example of our Government, they will severely keep aloof from an enterprise which, rightly or wrongly, is by many considered to commemorate the centenary of the great French Revolution. It is always to be regretted when political considerations are allowed to interfere with business matters, and in this particular case the interference is the less justifiable as the French authorities themselves do not attribute any political significance whatever to the forthcoming Exhibition, but maintain that the date of 1889 has been fixed as the natural sequence according to which the French Capital has of late seen a great international exhibition every eleven years. We cannot disguise from ourselves the fact that the electric light and power industry has made enormous strides on the Continent, and that English firms, although two years ago they led the van of progress in electrical engineering, are now forced to strain every nerve not only to maintain what Continental business they happen to have, but also to prevent foreigners from invading our own markets. That the latter will surely attempt to do this, is already shown in two instances. A leading German dynamo maker is doing what he can to introduce his machines into England, and a Swiss firm have also lately appointed an agent here for the purpose of importing their dynamos and motors. That others will soon follow we cannot doubt, and our manufacturers would do wisely to ponder well over this state of the electrical engineering trades before they come to a decision with respect to the great international show which is to take place next year. There is no reason why English electrical manufacturers should not predominate in the markets of the world, to the same degree as our textiles, machinery, hardware, and other goods, for which English manufactures have long been famous. As a matter of fact, some of our electrical firms are doing at the present moment a fair amount of Continental and Colonial trade, but not nearly so much proportionately as the makers of agricultural, textile, and mining machinery. Now, this trade requires developing, and the question is whether attending the Exhibition at Paris or abstaining from it will be best calculated to produce this development. It is sometimes argued against exhibiting that the large manufacturer—who has, at a considerable sacrifice of labour and money, produced a machine which is better than anything made by his competitors—by exhibiting enables his rivals to copy his design, and thus to injure him. This may be true in certain exceptional cases; but, as a general rule, a manufacturer has so many opportunities of ascertaining the exact nature and construction of a rival's specialties, that the additional facility given by an exhibition counts for very little. If one man intends to steal the invention of another, he will generally find a way of doing so as soon as the new machine is placed on the market, and sometimes even sooner; but in electrical machinery we are inclined to doubt whether English makers are in possession of inventions of special types of apparatus which would give them a marked superiority over those Continental rivals, whom they are inclined to view with distrust. There is at the present moment no mystery whatever about the design of electric machinery. The general principles of such machinery are known to all the world, and superiority of the productions of one firm over those of another consists mainly in a better design of details, in better material, and in better workmanship. Dynamo makers on the Continent know quite as much as our own manufacturers about good electrical engineering; and they are not likely, for the sake of copying some minor details from the machines of their rivals, to abandon their own type, with which they have had considerable experience. If, therefore, on the one hand, English makers incur no great risk when exhibiting, they will, on the other hand, derive whatever benefit is attached to an international fair of such gigantic dimensions as that of next year is sure to be. To abstain from exhibiting would be a confession of weakness more damaging to the foreign trade of English electricians than the possible but remote disadvantage of teaching the foreigner our ways of electrical engineering. The question concerning the Exhibition is, therefore, not whether it will do us good or harm to exhibit, but whether the good done by exhibiting is in proportion to the expense incurred. In order that those of our readers who are interested in this subject may form their own conclusions, we give herewith a rough outline of the programme drawn up by M. Berger, the commissioner to the electrical section of the Exhibition.

Electrical appliances may be entered either as ordinary exhibits or as part of the plant which is to be used for lighting the Exhibition and grounds. Exhibitors are not charged for space, but will be called upon to pay towards the general expenses of supervision, installation, police, &c., a sum proportional to the space they occupy. They will also have to provide their own flooring and stands. Each national section will have its own attendants, and be subject to the rules and regulations of its own commissioners. Apparatus used for lighting purposes will be looked upon as exhibits, and if desired by the exhibitor, will be so considered by the jury. Power in the shape of steam, water, gas, or shafting will be supplied to the exhibitors free of charge; but no provision has yet been made for the supply of current for charging accumulators or running motors. The total power required for lighting purposes is estimated at 3000 h.p., for which purpose various types of steam boilers and engines will be installed by the syndicate intrusted with the carrying out of the lighting; but these boilers and engines in themselves will probably form exhibits, the syndicate being confident of obtaining support in this manner from the manufacturers of steam power plant. Out of the total power M. Berger offers to the English section, for the use of intending contractors for electric lighting, 500 h.p., at a charge of £40 per 10 h.p.—which is the minimum supplied—for the whole time the Exhibition is open. The admission to the Exhibition during the day time will be 1fr., and during the evening, when the electric light is on, 2fr., the additional franc being equally divided between the general administration of the Exhibition and the electric lighting syndicate. The working expenses of the syndicate will be paid out of the £4 per horse power received from the lighting contractors and out of the half franc extra admission money; and if any profit be left, it will be divided at the close of the Exhibition among the different firms who have taken

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part in the lighting, in accordance with the amount of power for which they have subscribed. Contractors will have to bear the cost of installing their own machines and arc lamps, provide their own lamp trimmers and attendants, and pay for carbons. Bearing in mind that at the last Electrical Exhibition in Paris, in 1881, a considerable profit resulted from electric lighting, it is more than probable that financially the programme we have just roughly indicated will also be a success, and that the profits made would to a large extent pay for, and perhaps exceed, the outlay of those firms who take part in the lighting.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

At the last meeting of this Society an interesting discussion was held on the paper by Mr. C. Cockburn on "Safety Fuses." These adjuncts have now become so indispensable to electric light installations, that almost every electrician has to take an interest in them; but the consensus of the opinions of the speakers seemed to be that the employment of safety fuses was in many cases overdone. Mr. Killingworth Hedges, who was one of the first to introduce properly designed safety fuses, pointed out that the arrangements adopted by Mr. Cockburn did not differ in principle from those which had long before been invented by Sir William Thomson, as could be seen by inspecting a collection of these early fuses which was exhibited. He strongly advocated that all fuses should be made to a common standard, and stamped with the current at which they are intended to melt. Professor Sylvanus Thompson pointed out that the size and material of the terminals must influence the fusing point of any given wire, an observation which was confirmed by Mr. Cockburn in his reply. The influence of a variation in the size of terminals is, however, eliminated by making each fuse wire so that it can only be clamped between terminals of a certain size. Mr. Preece made some very interesting remarks on the theoretical side of the question. He pointed out that the indefinite multiplication of safety fuses is in itself objectionable, because every fuse introduces the possibility of a bad contact, and to show to what absurdity the mania for an abundant use of safety fuses may lead, he instanced the case of a single building, in which he found no fewer than 6000 bad joints, owing to safety fuses being scattered all over the installation. In his opinion, nine out of ten failures of the electric light are directly attributable to bad contacts at the safety fuses. The principle of protecting cables by such fuses is not new. In fact, for the last twenty years telegraph cables have been protected by fuses, in addition to the vacuum tube and the flat plate lightning protector. These fuses consist of fine platinum wires, which are intended to melt before a discharge of atmospheric electricity can reach the core of the cable. It is necessary to bear in mind that the fuses used on cables must be exceedingly sensitive; the strongest working current in many cases is only slightly smaller than the weakest discharge of atmospheric electricity, against which the cable is to be protected, and hence there is only a small margin within which the fuse must act. Long experience has taught telegraph engineers that platinum is the only reliable material for such a purpose, and recently Mr. Preece made a long series of experiments to determine the exact fusing currents for different sizes of platinum wire, and of wires drawn from almost any other metal which could be used for the purpose. He found that for wires above 10 mils. the fusing current is given by the formula $C = a\,d^{\frac{3}{2}}$, where a is a constant depending upon the nature of the metal, and d is the diameter of the wire in mils. The formula only applies to such lengths of wire for which the cooling effect of the connections may be neglected—that is, for thin wires about 6in. long. He has, however, also repeated the experiment with wires 1¼in. long. The experiments were made to ascertain three conditions of the fuse wire. The first with a current which produces a temperature of 98°F. to 100°F., which will just give the sensation of warmth to the touch; but he found that the personal error in estimating the sensations of warmth so great as to vitiate the value of these experiments, and he therefore substituted for this test that of melting a thin flake of shellac, which was placed on the wire. The shellac melts at 77°C., and the experiments of the first stage were all taken for this temperature. The second stage of experiments was with reference to the temperature at which the wire becomes just visible in the dark. From the fact that all substances become just visible, that is to say, dull red at the same temperature, which is 525°C., the corresponding current for this temperature could also be ascertained with great accuracy. The third series of tests referred to the fusing current of wires made of copper, aluminium, platinum, German silver, platinoid, zinc, tin, lead, and an alloy of tin and lead. The thickness of the wires varied between 10 mils. and 40 mils. Mr. Preece found that platinum has some very valuable properties when used as the metal for a fusing wire. From his experiments, he found that if the current which a platinum wire will carry to melt a flake of shellac be called unity, the current which will make it dull red is twice as much, and the current which will fuse it is three times as much. We have thus the simple proportion of one, two, three for these three characteristic currents; and if the cut-out be exposed to view, it is possible to see by its appearance when the fusing point is being approached. As compared with tin, lead, and all other metals, platinum has also the advantage that it does not scatter molten particles about when fusing. As a general rule a cut-out does not melt owing to a slow and steady increase of current, but it melts suddenly upon the establishment of a short circuit or very heavy leak. In such a case a perfect shower of molten metal is scattered about if the wire consists of tin or lead, but with platinum wire the break occurs quietly without any scattering of molten particles. Mr. Preece strongly condemned the double pole fuse, because of the danger of a short circuit being established on the dynamo side of the fuse. Such a case actually came under his notice only recently, when an American visitor, in one of the London hotels, amused himself by bridging the two poles of a double pole fuse with his keys on the dynamo side of the fuses, so that, of course, the latter were quite unable to protect the branch leads. Mr. Preece does not condemn fuses on both branches, but he strongly objects to their being placed side by side.

Professor Ayrton corroborated Mr. Preece in his statement of the law for the current strength at which wires melt, but drew attention to the fact that this law only holds good for wires above 10 mils., for smaller wires the formula to be used is $C = a\,d$.

Sir David Salomons, who has had a long experience of the electric light in his own house, contrasted the imperfect methods of wiring and protecting lamps in the early days of electric lighting with those in use at the present time. In 1874, according to his experience, fuses went daily; but by degrees the wiring became more perfect and short circuits the exception, whilst also the fuses themselves became more reliable. He believes, however, that the length of time a fuse is in use will influence its melting point, and from his experience the older the fuse is the more current will it carry. He does not think there are any fuses in the market which can be absolutely relied upon. If we wish to work with certainty we must use an electromagnetic cut-out, such, for instance, as that invented by Mr. Cunynghame. He also deprecated the tendency to multiply switches and fuses to an unlimited extent, and thinks that the combination of fuses with switches is an advantage because of reducing the number of contacts. As to the claim of fuse makers to be able to protect single lamps, he considers it almost impossible, and, at any rate, very undesirable. It is better that occasionally a lamp should go, than that the lights should be extinguished at all times by the premature melting of the single lamp fuses, which must necessarily be adjusted with an insufficient margin.

Mr. Crompton spoke rather deprecatingly of the improvements introduced by Mr. Cockburn in his fuses, and also of the many other special modern designs of fuses now in the market, saying that his own very simple tin wire fuses, which were put up many years ago, have proved quite good enough for all practical purposes, and are in use to the present day. The difficulty is not one of construction but one of position, and on the latter point Mr. Cockburn's paper gave no information. A fuse should be put so as to be easily accessible, and it would require branch fuses to be fixed at some distance from the main; but to protect the whole of the branch, the fuse would have to be placed at its root where it leaves the main. Thus in most cases the two conditions are contradictory, and to reconcile them he has in several installations adopted the plan originally introduced by Mr. Henry Lea, of Birmingham, according to which all the fuses are placed in one box close to the main, from where all branches are taken through the house. Mr. Crompton spoke strongly against the hobby of having every switch, fuse, and other fitting mounted on slate, asbestos, porcelain, or other incombustible material. He thought it perfectly ridiculous that hard wood should be excluded from use in fuse boxes, when tin was the material employed for the fusing wire. It was utterly impossible to set fire to hard, well seasoned wood by molten tin; but the use of wood enabled them to get a high insulation resistance, which with slate was not the case. The double pole cut-out he characterised as a "Yankee absurdity," and a decided element of danger; and if he wanted to protect both leads, he would use two single fuses in preference. He thought that the Phœnix Fire Office rules went too far in imposing a multiplication of switches and fuses, especially when the fittings are put on slate. Slate is a bad insulator, and although the cables may be of the highest quality, it is impossible to get a high insulation throughout the building if slate forms any part of its fittings. Mr. Mordey said that the only way slate could be made an efficient insulator was to immerse the slate a little way in melted paraffin, without, however, covering the top. After a time the top surface assumes a greasy appearance from the percolation of the paraffin, and, after that point has been reached, the slate is an almost perfect insulator. Mr. Bernstein mentioned a slate quarry in Galicia, where slate oil is also found, and where nature has already paraffined the slate by impregnating it with this oil, thus making it a perfect insulator.

An interesting magnetic cut-out was described by Professor Crookes, who some years ago made use of the properties of nickel to lose its magnetism with a rising temperature for interrupting the circuit. A nickel wire, forming part of the circuit, was pressed against the contacts by the attraction of a magnet, and its size was such that a normal current did not sensibly raise its temperature. If, however, the current increased to a dangerous degree, it heated the metal wire, the magnet failed to protect it, and thus the wire fell from its contacts and interrupted the circuit.

THE LINEFF ELECTRIC TRAMWAY.

A further step in the application of electricity for working urban and suburban tram lines has been made by Mr. Lineff, who is now experimenting at the Chiswick depôt of the West Metropolitan Tramway Company with a small open passenger car running on a short line in the yard. To correctly assign the Lineff system its place among its rivals, it is necessary to briefly review what other inventors have done before. Amongst the first methods for conveying the current from the dynamo at the station to the motor on the car was the overhead conductor, either in the form of a copper tube with a longitudinal slot carrying a contact shuttle, or a solid rod or cable upon which runs a carrier. This arrangement does fairly well for a single line without any crossings or switches, and where the presence of an overhead conductor is not objectionable; but in the majority of tram lines overhead conductors are out of the question, while switches and crossings are unavoidable; and then the complications introduced are so great as to render the system objectionable. In order to overcome this latter difficulty, Dr. John Hopkinson introduced a most ingenious method of collecting the current. In his design the overhead conductor is duplicated, and consists of short spans of cables or wires suspended from cross beams over the track, whilst the collector consists of bars fixed transversely over the roof of the car. The points of suspension of each conductor are on different levels, so that the catenary formed is unsymmetrical, that is to say, the lowest point in the catenary of the left conductor is forward, and that of the right conductor is behind the geometrical centre between the supports. By this means at least one of the conductors must always be in contact with the collecting bar, and no difficulty whatever exists on sharp curves, crossings, or switches. But there is still the general objection to the use of an overhead conductor, and Dr. Hopkinson's system will therefore only be applicable on lines running across country, and not on town lines. To meet such cases Mr. Holroyd Smith introduced his well known underground conductor, which in principle is simply the overhead conductor transferred into a central underground channel. The same objections against crossings and switches apply therefore also in this case, with the additional drawback that the conductor must be a stiff rail, causing trouble from expansion and contraction, and the insulation resistance is necessarily much lower than with an overhead line. With regard to the difficulty of crossings and that of expansion and contraction, Mr. Lineff has done for the underground system what Dr. Hopkinson did for the overhead system; but whether he has succeeded in overcoming the great difficulty of imperfect insulation is a question which only experience can decide. With the Lineff system there is no difficulty whatever in arranging for crossings or switches, and his conductor being subdivided into comparatively short sections, the trouble of expansion and contraction through changes of temperature has also been avoided. The conductor on the line we inspected consists of a ¾in. gas pipe, with a stout naked copper wire drawn through it. At intervals of 3ft. contact pieces are attached to the pipe. These consist of saddle-shaped castings with a central stem, which is screwed through the pipe, and presses down on the copper wire. The pipe is supported by cast iron brackets at intervals of 6ft., which brackets are bolted against the U shaped castings supporting the two rails which form the central slot. These castings are placed 3ft. apart in the concrete trough which forms the underground channel. To protect the rubbing contacts from dirt and moisture, they are set to one side of the surface slot, and the gas pipe is insulated by being wrapped with insulation material where it rests in the brackets. The whole is, moreover, covered with some insulating compound, to

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reduce surface leakage. Electrical connection between the different lengths of gas piping is made by short pieces of flexible insulated cable. The current is taken off the conductor by means of a stranded steel cable, hanging from shoes at the end of the car, which project through the slot in the usual way. On this cable are threaded gun metal ferrules, ¾in. diam. and 3in. long. The object of covering the cable with these ferrules is two-fold. In the first place, they can be renewed when worn, without having to discard the whole of the collector; and in the second place the danger of having loose and frayed strands, as the result of wearing away the surface of the cable itself, is thus avoided. From the cable the current is led to an Immisch 4 h.p. motor, which works, by means of a Renold's chain, a counter shaft, and from this, by another chain, the axle of the car. The reduction of speed is twelve to one, and the car is designed to run at 6 or 6½ miles per hour. The return circuit is formed by the rails of the line. For places where a central channel is objectionable, Mr. Lineff arranges the conductor under one of the rails; but this system is not so good as that of a central channel, because more water must find its way into the circuit, owing to the curvature of the surface, and also because more dirt is likely to be brushed through the slot by the action of the wheels of the car itself, and of those of other vehicles running over the rails. The resistance of the line is estimated by Mr. Lineff at ·2 ohm per mile, and we are told that the insulation resistance of the short line at the Chiswick depôt is about 200,000 ohms. One advantage of the Lineff system is that it lends itself in an easy manner to automatic block working. For this purpose Mr. Lineff arranges a contact saddle between two of the regular contact saddles belonging to the conductor, but insulated from it and from earth, and when the car is passing the suspended cable establishes for a moment electrical connection between this signal contact and the rest of the conductor, by which means a current may be sent back to block the line, or to switch off the current from a section of the line, or do any other work which may be required in an automatic block system. This is in effect an adaptation of the principle introduced by Professors Ayrton and Perry on their telpherage line. Automatic block signalling would, of course, not be resorted to for town tramway lines; but it would certainly form a valuable adjunct to longer lines running across country. An improvement has also been added to the car, whereby its motion upon meeting an obstacle is automatically stopped and then reversed. The dash board in front of the car is suspended from hinges, and connected by rods with a specially constructed switch, and with the reversing gear of the motor. The switch serves to send a current through a long pull electro-magnet actuating the brakes, and also to first interrupt and then re-establish connection with the motor circuit. This switch is not turned directly by the movement of the dash board, but is under the control of a spring and an air cataract, which is released by the movement of the dash board. The action is as follows: Upon meeting an obstacle a trigger is moved, and releases the spring. The switch is slowly revolved by the force of this spring acting against the air piston of the cataract. By the movement of the switch lever the current to the motor is at once switched off, and at the next moment the current is sent through the brake magnet, the contact for which spans half the circumference of the switch, thus giving the car time to stop. By the time the car is stopped, the switch lever has passed on to another set of contacts which re-establish connection through the motor, the brushes of which have meanwhile been reversed, first by means of resistance coils, and then direct. The car now goes backwards. A similar arrangement is fitted to the other end of the car, so that the latter can be kept going automatically backwards and forwards between two obstacles placed on the line. The automatic reversal of motion we hold to be a useless refinement; but the arrangement of automatically switching off the current and putting on the brake upon the car meeting an obstacle will certainly prove of value in crowded streets. The action of the magnetic brake is extremely rapid, and on the occasion of our visit on Saturday last the car when going at full speed was stopped within a distance of 10ft. On that day a large party of visitors, mostly vestrymen of the neighbourhood, attended to witness a demonstration with this tramway; but, unfortunately, a "short" occurred in one of the circuits, and interrupted the experiments for a time. The fault was ultimately discovered and remedied without difficulty, when the trips were again resumed. Leaving out of consideration this slight mishap, which has really nothing to do with the Lineff system, and which might have occurred on any other electric tram car whilst yet in the experimental stage, the arrangement of underground conduction adopted by Mr. Lineff appears to have several distinct advantages, and it is to be hoped that the West Metropolitan Tramway Company may arrange for a more extended trial of it on a section of their lines.

TEMPORARY IMPORTATIONS.

The French iron trade has been thrown into a state of commotion by a fierce battle fought between the manufacturers of the North and North-east on one side, and those of the Centre and South on the other, over the traffic in *'acquits-à-caution*, or permits to import, which conflict has ended in a victory for the former, and a consequent suppression of that traffic. The hasty uprooting of a practice of this sort which, in some thirty years, has grown to great importance, must seriously disturb the relations existing between the several centres of the iron industry of France, and considerably modify the conditions under which the trade in iron is now carried on. Besides a general interest in the matter, we find ourselves directly involved in the direction of our export trade in pig. The imports of duty paying crude iron into France, that is, iron for consumption in the country, are small—only about 25,000 tons in 1887; but the free imports, that is, iron admitted according to a law of 1836, duty free, under a bond that it shall be re-exported after conversion, are considerable, amounting in 1887 to nearly 100,000 tons. This iron is derived chiefly from Germany and Great Britain. For a time the iron was conveyed, in the custody of the Customs officers, to the works authorised to receive it, whence it was re-exported in another form. This principle of identity was at first rigidly insisted upon; but the cost of transport to the frontier rendered it practically impossible for the manufacturers in the Centre and South to avail themselves of the privilege. The system was, therefore, modified to the extent of allowing an equivalent quantity of French made iron to be exported, instead of that actually received from abroad, in discharge of the bond. Hence arose the traffic in *acquits-à-caution*, which was carried on in the following manner: A manufacturer in the Centre or South having obtained a contract for the execution of work abroad, say a bridge, applies for an acquit, or permit, to import duty free as much pig iron as he deems necessary for the job. This he obtains by signing a bond to pay the duty of 15 francs a ton if he fails to export it, or its equivalent, within a specified time. But, as he cannot profitably use the permit himself by reason of the distance of his works from the frontier, he sells it at a reduced price to some manufacturer in the North or the North-east, who then imports the iron and uses it, the original holder of the permit being held responsible for the duty. The latter then uses French iron, by exporting which within the time specified he discharges his bond. His gain on the transaction is, say 7·50 francs a ton, and that of the Northern purchaser of his permit also 7·50 francs, assuming the reduction allowed the purchaser to be one half the amount of the duty. This practice, though favourable to the users of pig iron in all places, is manifestly unfair to the blast furnace owners of the North and North-east, since it deprives them of much of the protection afforded by the import duty. The system of the equivalent is now to be abolished, as far as forge pig is concerned, six months' notice having been given of the change to be made. It is said that the immediate effect on the industry of the Centre and the South will be to throw 10,000 hands out of employment, and that a more remote consequence will be the removal of the works to the neighbourhood of the frontier.

Letters to the Editor.

THE BOILER REGISTRY BILL AND BOARD OF TRADE INSPECTION.

To the Editor of "Industries."

Sir,—Lord Stanley, of Preston, in moving the second reading of the Boiler Registry and Inspection Bill in the House of Lords, on the 15th August last year, remarked that "he only proposed to ask the House to affirm the principle of the Bill, and did not intend to go further with the measure that session. He hoped to move for a select committee of their lordship's House in 1888 to inquire into the subject. The question would have the advantage of being before the public in the meantime, and of being subjected to the searching criticism which he hoped it would receive. The Government might thus, perhaps, get the means of ascertaining what was the general feeling on the subject, and how far they could deal with this matter at all." Since that time little has been done in the direction suggested, and there appears to be every likelihood that this Boiler Registry Bill will be as quietly passed through both Houses as was the Boiler Explosion Act of 1882, and the whole of the steam power of this country will then pass under the control of the engineers to the Board of Trade. Some idea of what that will mean may be fairly gauged by considering the report No. 242 of the preliminary inquiry into the explosion of a Green's economiser, regarding which your correspondent "Economiser" made some interesting comments in your issue of last week.

Mr. Thomas W. Traill, the engineer surveyor-in-chief, and Mr. William H. Woodthorpe in that report express no uncertain opinions regarding Green's economiser, or with regard to any economiser of a similar class and construction made of cast iron. Mr. Woodthorpe says: "The opinion has frequently been expressed by many that cast iron is unsuitable for use in such structures as boilers, in which class this fuel economiser should properly be included. The cost of the material, and the facility with which it is cast into various forms, renders its use much cheaper than that of any other metal; but it possesses well known properties which make it undesirable that it should be employed in such a manner as in the present case. In addition, the irregularity in the thickness of the tubes cast in the ordinary manner is another serious objection to its use in the construction of economisers. I have reason to believe that these views as to cast iron are becoming more general among engineers, and it is probable that some more suitable material will be employed for such purposes. Apart from the unsuitability of the material, the arrangement of these vertical pipes is most unsatisfactory, as it is quite impossible to examine them externally; the tubes should be differently placed, so as to afford facilities for this purpose, and in existing apparatus provision may be made by removing some of the tubes. . . . . The working of these so-called economisers should be attended to with great care, as only by so doing will disastrous explosions be avoided; and it would be well if the nature of the material from which these apparatus are constructed were fully understood by those interested." Again, Mr. Traill says: "Cast iron, it is hoped, is getting to be regarded as an unsuitable material of which to make such apparatus. I have before expressed my opinion on this point, and I regard such structures, as described in this report, to be a constant source of danger."

Now, what in the opinion of any unbiassed mind would be the probable action of these officials with regard to the continued use of Green's and other economisers now working, if, by the passing of the proposed Registry and Inspection of Boilers Bill, they were put in power, and the steam users of this country subjected to their authoritative interference? Is not the answer self evident? They have already prejudged this particular question. "The working of these so-called economisers should be attended to with great care, as only by so doing will disastrous explosions be avoided," says Mr. Woodthorpe. "I have before expressed my opinion on this point, and I regard such structures as described in this report to be a constant source of danger," says Mr. Traill. Could they consistently allow the continued use of such structures, that would be a constant source of danger, and the disastrous explosion of which could only be avoided by great care? Certainly not. What have steam users, then, to expect? Why, this: that the Board of Trade would, in carrying out their notions of what was due to the public interest, issue such orders and instructions as would compel steam users to discontinue using such dangerous appliances. Green's economisers, to the extent of, I believe, upwards of 1,000,000 h.p., are fitted to steam boilers in various parts of the kingdom, and I may estimate their value at about £4,000,000. Some notion of the vast injury and loss to the steam using public which would be caused by the inspection of the steam power of this kingdom passing under the control of the Board of Trade, can be formed from this instance. It is, perhaps, unnecessary to inform the readers of such a practical journal as yours that there are many other economisers of similar type and material at work, all of which would be similarly affected.

I will not at this stage enter into any question as to the accuracy of Messrs. Woodthorpe and Traill's opinions or the value of their evidence and judgment on this important question, as I simply want to draw the attention of those interested to what threatens them in the immediate future. To carry out these views of the Board of Trade officials would involve the expenditure of about £6,000,000. It would absorb fully that sum to replace the whole of the fuel economisers now working in this country with others made of a material that would satisfy the conditions laid down by the Board of Trade inspectors. It should be noted that the loss which would thus be sustained by steam users would far exceed the whole cost and expenses incurred by every explosion of steam boiler, fuel economiser, or steam generating vessel of any description, which has ever occurred in these realms, since the first introduction of the use of steam power.

Parliament will soon be sitting, and the promoters of the Boiler Registry and Boiler Inspection Bill will be ready to press forward their pet project. I therefore think it behoves the steam using public to be on their guard, and to look to their position in the matter by instructing their various representatives to oppose Board of Trade interference with their working of boilers, otherwise the material progress of this country will receive such a blow that many years will elapse before the injury can be repaired. If ever Board of Trade officialism, as represented by its Marine Department, is allowed to mount the shoulders of our giant manufacturing interest, it will cling to its neck, and continue to ride until it falls half strangled and exhausted, like the unfortunate victims of the other "Old Man of the Sea."

Yours, &c.,
Manchester, 31st January, 1888. Boiler.

CHALK FOR VIOLINISTS' HANDS.

To the Editor of "Industries."

Sir,—Will any of your chemical readers be good enough to inform me what proportion of salicylic acid and chalk are required to absorb the perspiration of violinists' hands, and also what chalk is best?

Yours, &c.,
Manchester, 27th January, 1888. Paganini.

THE TRANSMISSION OF ENERGY BETWEEN SOLOTHURN AND KRIEGSTETTEN.

To the Editor of "Industries."

Sir,—Having only read the letter of your correspondent "Erg," and not the account of the report of the committee, that appeared in the previous week's issue, I do not know if any reference was made to me personally; but as the designer of the whole plant and the patentee of the machines used, you will no doubt allow me to make a few remarks. In the first place, I may say that I quite agree with your correspondent that if you want an efficient dynamo or motor, you must make it big and heavy enough to do its work. I had to make the Solothurn machines so that they could work continuously the whole day for years, and so that they could in every way compare favourably with steam engines, which, as everyone knows, should

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work with a margin of reserve power. They can be worked up to 30 h.p. without the heat becoming at all excessive, and the volts increased quite safely up to 1500. Their actual weight with pulley, but without bed plate, is only 58cwt., and not 72cwt., as stated in the report. It must also be borne in mind that the necessity of thickly insulating a high tension machine that shall have a high efficiency must always make it larger and heavier than a low tension machine having the same output. In conclusion I may say I am an Englishman, though a permanent resident here, and, therefore, the difference between English and Swiss practice as shown in this instance is not so great as your correspondent imagines.

Yours, &c.,

C. E. L. Brown.

Oerlikon, near Zurich, 27th January, 1888.

A NEW DEPARTURE IN BRAZING AND WELDING.

To the Editor of "Industries."

Sir,—With reference to Mr. Wildy's remarks, my statement as to the impossibility of welding with ordinary coal gas, referred to its use under the ordinary conditions usually available under the ordinary pressures as supplied from the gas works. Taking the same town's gas service as supplied, without compression, and an ordinary Root's blower for the air, a weld cannot be obtained; whereas if oxygen is used the welding is an easy matter. Under ordinary conditions a gas and air flame, if of high temperature, is always an oxidising one; hence the difficulty referred to.

Yours, &c.,

Thomas Fletcher.

Warrington, 28th January, 1888.

THE LATE MR. JAMES T. CAIRD.

The death of Mr. James Tennent Caird, senior partner of Messrs. Caird & Co., shipbuilders, Greenock, removes one of the pioneers in iron shipbuilding. Mr. Caird was seventy-two years of age, having been born at Thornliebank, near Glasgow, in 1816. Being related to the members of the firm of Caird & Co., he entered their employment as a boy in 1831, but shortly after removed to Glasgow, and to the works of Messrs. Randolph, Cunliff, & Co. His next step was back to Caird & Co.'s, where John Scott Russell was then manager. Mr. Caird became chief draughtsman, and in conjunction with Mr. Scott Russell designed a number of steamships for the Royal Mail Company. On the departure of Mr. Russell for London, where he designed the "Great Eastern," Mr. Caird became manager. Partnership followed, and in 1863 he became sole partner of the concern. Mr. Caird's history is practically that of the firm. Their work for the Peninsular and Oriental Company, the Cunard Company, the Inman Line, the French Compagnie Transatlantique, the North German Lloyd, the Hamburg-American Company, and other well known lines, has placed them in the first rank of shipbuilders. For the Peninsular and Oriental Company alone Messrs. Caird have constructed upwards of twenty vessels, aggregating nearly one hundred thousand tons. Mr. Caird was to the last actively engaged in business, though he had been suffering from heart disease, to which he succumbed while taking a drive in the neighbourhood of Greenock. He was a man of cultivated tastes, and of exceptionally genial temperament.

THE LATE PROFESSOR ASA GRAY.

The scientific world lost an eminent member on Monday last by the death of Professor Asa Gray, the distinguished American botanist. The deceased professor occupied the Chair of Natural History at Harvard College for thirty years, and his scholarship and treatises will cause his name to be ever remembered in conjunction with his contemporaries, Darwin and Hooker. The last visit of Professor Gray to this country was at the time of the meeting of the British Association, held at Manchester last autumn. Everyone who listened to him on that occasion will have reason to regret his death.

University College, Bristol.—On Thursday in last week, Professor Ryan delivered a lecture on steam engineering in the Athenæum Hall, Bristol. The lecturer sketched briefly the history of his subject, noting the various improvements which formed the most important stepping-stones in its course of development. He emphasised the part which Bristol had taken in the development of the applications of steam. Near Bristol, Hornblower's compound engine was first set up. The patents for the use of the crank and fly wheel were held by Wasborough, a Bristol engineer; in Bristol, the Newcomen engine was first applied for mill purposes; and from Bristol the "Great Western" started on its celebrated first journey across the Atlantic. The modern steam engine, in its multiplicity of types and adaptations, was then discussed, characteristic examples being described and illustrated by transparencies. The part played by science in the evolution of the steam engine was dwelt upon, and an appeal on behalf of technical education concluded the lecture.—At a recent meeting of the Engineering Society, the officers for the ensuing term were elected as follows: President, Professor Ryan, M.A., D.Sc., M.Inst.M.E.; Hon. Vice-President, D. C. Selman, Assoc.M.Inst.C.E.; Vice-President, John P. Littleton; Secretary and Treasurer, A. J. Ward; Librarian, C. P. Banham; Committee, Messrs. Dix, Fonseca, Pinto, Ames, Shepherd, and Bruce. A few remarks were made by the secretary upon the satisfactory nature of last term's proceedings, alluding to the successful excursions and interesting papers, animated discussions at the close of each—promising a renewal of the same during the present term. After a few remarks by Professor Ryan the meeting terminated.

SHIPBUILDING NOTES.

Messrs. Russell & Co., shipbuilders, Greenock, recently launched from their yard a steel screw steamer, the "Ocean," for the petroleum bulk carrying trade between America and the Continent. The vessel is 310ft. long, 35ft. beam, and 25ft. depth, and is capable of carrying about 3500 tons of oil. The vessel is divided into sixteen oil tight compartments, exclusive of the water ballast tanks. The tanks have been subjected to exceptionally severe tests before launching, which they stood very satisfactorily. The vessel will be lighted throughout by electricity, and is fitted with a powerful set of Worthington pumps, capable of discharging the entire cargo in twenty-four hours. Triple expansion engines will be supplied by Messrs. Duncan, Stewart, & Co., of Glasgow, the cylinders being 22in., 36in., and 58in. diam., with a stroke of 42in. There are two large single ended boilers, the working pressure being 160lb. The "Ocean" has been built to the order of Messrs. Hermann, Stursberg, & Co., of New York, from the plans and specifications of Messrs. Flannery & Blakiston, consulting engineers, of Water-street, Liverpool, who have also superintended the construction of the vessel. The "Chester," a sister ship to the "Ocean," was launched some weeks ago. The managers in this country for both vessels are Messrs. R. W. Leyland & Co., Liverpool.

An official trial trip of the "Kisanga," a new steamer built for Messrs. Hatton & Cookson, of Liverpool, was made recently, when the vessel attained a speed of thirteen knots per hour, the machinery giving every satisfaction. Her leading dimensions are as follow: Length, 265ft.; breadth, 35ft.; depth of hold, 18½ft.; draught, 14½ft. She has been built by Messrs. John Reid and Co., of Port Glasgow, to the drawings and specification of Mr. G. Hepburn, of Liverpool, and is intended for the African trade. The engines, boilers, and machinery have been supplied by Messrs. David Rollo & Sons, of Liverpool, the engines being of the triple expansion type, with cylinders 25in., 38in., and 62in. diam. respectively, and supplied with steam at a pressure of 160lb. by two steel boilers 12ft. 2in. diam. and 14ft. long, each being fitted with four of Brown's patent ribbed furnaces.

On the 28th January there was launched from the Sunderland Shipbuilding Company's yard, South Docks, Sunderland, the steel screw steamer "C. A. Bade," which has been built to the order of Messrs. Leech, Harrison, and Forwood, of Liverpool. The dimensions are: Length between perpendiculars, 170ft.; breadth, 26ft. 3in.; depth of hold, 12ft. 6in.; and 700 tons gross register. The vessel has a long poop extending over the engine and boiler space, and topgallant forecastle, the latter for crew accommodation. The state rooms, for captain, officers, engineers, and a few passengers, are being fitted up amidships. The steamer has been built under special survey to class 100 A1 at Lloyd's. The engines, which are on the three-crank triple expansion principle, have cylinders 14in., 23in., and 39in. diam.; length of stroke, 27in.; and, together with the boiler, of 160lb. per square inch working pressure, have been constructed by the North-Eastern Marine Engineering Company, Limited, Sunderland. The steam winches are by Messrs. Welford Brothers, Pallion, and the patent windlass by Messrs. Emerson & Walker.

Messrs. Short Brothers, Pallion, Sunderland, launched, on the 30th ult., the steel screw steamer "Diligent," built to the order of Mr. James Westoll & Partners, Sunderland. The vessel is constructed to the 100 A1 class at Lloyd's, on the web frame principle, and has a short poop aft on a long raised quarter deck extending to the after end of the engine and boiler space. A hurricane house extends over the machinery to before the foremast, the crew accommodation being in the fore end instead of in the topgallant forecastle. The double bottom is constructed on the cellular system, and there are four cargo holds, divided with water tight bulkheads. The dimensions of the "Diligent" are: Length over all, 292ft.; length between perpendiculars, 278ft.; extreme breadth, 39ft.; depth of hold, 18ft. 9in.; depth moulded, 21ft. 2in. The vessel is fitted with all the latest improvements for dispatch in loading and discharging cargo. The "Diligent" is the twentieth steamer built by Messrs. Short Brothers for the same owners, and they have another in course of construction. The vessel is to be fitted with engines and boilers of 180 n.h.p., by Mr. John Dickinson, Sunderland, on the triple expansion principle, having three cranks, the shaft being Dickinson's patent. Bremme's valve gear, piston slide valve on the high pressure cylinder, and other improvements have been adopted. The boilers are of Siemens-Martin steel, and work at a pressure of 150lb. per square inch.

The armour plated ship "Victoria," which was launched at Elswick, Newcastle, last March, and which is of similar design and size to the "Sans Pareil," launched by the Thames Iron and Shipbuilding Company a few weeks later, is expected to leave her present position beside the Elswick yard some time in April, when she will proceed to Chatham to be taken in charge by the officials of the Admiralty. Her guns are nearly ready for putting on board, and will be all in position by the time of her departure.

A fine steamer, named the "Rufford Hall," was launched on Tuesday, 31st January, from the yard of Messrs. C. M. Palmer & Co., Jarrow-on-Tyne. This is a sister ship to the "Bremscome Hall," launched on 15th December, 1887, from the same establishment, and also to the "Locksley Hall," launched a few weeks earlier. The vessel, which has accommodation for a limited number of first class passengers, has a carrying capacity of about 6000 tons, and will be employed in the Indian and general trades. Her engines, which are of the modern type, are supplied by the builders. The vessel, like the other two named, has been ordered by Messrs. Alexander, of Liverpool, for the "Hall" line of steamers. Her boats, which are of special strength and beautifully finished, have been supplied by Mr. Wake, of the Low Quay Boat Works, Sunderland.

The "Taroba," steel screw steamer of 5000 tons, was launched on Tuesday by Messrs. A. & J. Inglis, Pointhouse, Glasgow. The "Taroba" is 410ft. long, 46ft. beam, and 31ft. deep. The vessel will be fitted with triple expansion engines of 4000 i.h.p.

Reviews.

The Land Question. By the Right Hon. Lord Herbert and Lady Herbert of Lea. Analysed by Thomas J. Elliot, M.R.A.C., Professor of Estate Management at the Royal Agricultural College, Cirencester. London: Cassell & Co.

We have on several occasions pointed out that in the cry for improved technical education and the necessity for improving what are usually considered industries, we are apt to overlook the oldest and most important industry in the country, that of agriculture. The above mentioned book is issued along with two pamphlets, and with them practically form one work, and Professor Elliot claims that by a careful examination and analysis he has been able to solve the land question in its bearings on agriculture. This analysis is too lengthy for us to reproduce, even in outline; but the student of agriculture will find it well worthy of study, both in its form and materials. The result at which Mr. Elliot arrives, is that even with the present low prices corn can be grown profitably in England; but it is by a system of high farming, for he says: "If you use sufficient capital in farming, you will be able to compete with low prices, and stand safely against a series of bad seasons," and he illustrates this by reference to the Wilton farm of 278 acres, on which the capital employed was £3,500, and the average of twenty-three years' farming has yielded a profit of about 11½ per cent., and he maintains that he proves the fallacy of Sir J. B. Lawes' idea that the reduction in the price of an agricultural crop cannot profitably be met by an increase of the yield; and he tries to disprove the oft-repeated statement that cereals and butchers' meat cannot be produced profitably in Britain at the present low prices. We must leave the discussion on this point to those who are thoroughly acquainted with the details, and we trust they will also consider the possibility of small farms—not so small as crofts usually are, but sufficient to maintain on them a healthy and patriotic race of men.

Technical School and College Buildings. By Edward Cookworthy Robins, F.S.A. London: Whittaker and Co. 1887.

Mr. Robins has done good service to the cause of technical education in revising and re-publishing his various papers on technical school and college buildings, for a well designed building for an educational institution is only second in importance to a well arranged curriculum. It is a comparatively simple matter for those who are taking a part in the work of technical education to make themselves acquainted with the courses of instruction in the different institutions, by a careful study of their calendars or prospectuses, and by a selection of the characteristics suited to the locality in which they live, to draw out a curriculum which embodies the results of a considerable number of institutions. Mr. Robins' book has done for the buildings what a collection of calendars, or better still, a digest of these, would do for the curricula, by bringing as it were into a focus, the results of the experience of many of the best equipped schools and colleges in Britain and the Continent. To managers and governors of technical schools and colleges such a book is indispensable, if they wish to save themselves endless expense and trouble, for in it they are presented with the results of what must have cost a large amount of both.

The author in the first chapter attempts to clear the ground by giving some idea of what technical education means, and illustrates his remarks by the observations he made on the Continent in 1882. The recent debates on the Technical Instruction Bill show that there are still very indistinct ideas as to what is the scope and object of technical education. As Mr. Robins remarks, one enthusiast connects technical education with the development of manual dexterity, another with mental activity and scientific training, a third with a combination of both in one and the same person. One thinks the study of the application of scientific principles to industrial pursuits should precede apprenticeship, another that it should follow it, and a third that it should go on con-

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currently with it. One thinks our apprenticeship system the best, another the worst, and another denies its present existence and sighs for its resuscitation, or the substitution of something else in its place, neither English nor foreign, but emphatically suited to the needs of the age we live in, and the social peculiarities we represent. One thinks technical education should commence in our primary schools, another in our secondary schools, and a third that every school should have its technical side as sharply developed as its classical proclivities were, are now, and ever shall be. One thinks it is our artisans who are at fault, another their masters, and a third the altered conditions of both; but all are agreed that the maintenance of our acknowledged superiority in technical matters cannot long be continued while we ignore the deficiencies which may exist in our present practice, and complacently shut our eyes to the advantages which other nations are affording to their populations. We have on many occasions given our opinions on the chief points enumerated above, and will often return to them; but we recommend a careful study of the first chapter of Mr. Robins' book for a very good synopsis of the different kinds of answers which have been given to the questions involved, and an outline of the constitutions of the schools and colleges which have been arranged for putting these answers into practice.

The second chapter contains a very useful analysis of the second report of the Royal Commissioners on Technical Education. This report itself has not received the attention which it deserves from the British public, partly we suppose because of the innate dislike of that public to all Blue Books, but chiefly on account of the great length of the report. To many readers of Mr. Robins' book, the contents of that report will to a large extent be unknown, and hence the synopsis which is given of it affords a very useful introduction to the more strictly professional part of the work.

Chapter third is to a great extent a reprint of a paper read by the author before the Royal Institute of British Architects in 1883, and in it is given a description of some of the most interesting and notable of foreign laboratories, illustrated by plans of the principal floors. The author has in this way striven to present to the scientific world, and promoters of similar institutions, the result of much study and travel, which he trusts may issue in the saving of much time and labour, and wasted energy, resulting from going repeatedly over the same ground; and also by his comparative analysis of the best examples, aid in the development of that discriminating power, without which the weaknesses of a design are as likely to be mis-stated as its strong points. We need not go over the list of the various institutions which have been illustrated, but we have much pleasure in noting that the illustrations and descriptions of the new chemical laboratories of the Zurich Polytechnic School, and of the buildings of the Conservatoire des Arts et Metiers, Paris, have been copied from *Industries*, due credit of course being given. We may on some future occasions return the compliment, and give a few of Mr. Robins' illustrations and descriptions.

In the fourth chapter a series of English examples is given, nearly all of which have been completed and opened since the first chapter was written, and, as Mr. Robins remarks, it will be observed that in all these our native independence of character asserts itself in a marked manner, and considerable originality is displayed; the objects sought to be accomplished having generally been attained, at all events wherever the professors and architect have had an opportunity of consulting before the preparation of the plans. The most important institutions illustrated are the Central Institution, South Kensington; the Technical College, Finsbury; the Yorkshire College in its various departments, the Merchant Venturers' School, Bristol; the Mason College, Birmingham; Owens College, Manchester; and various others more or less directly connected with technical instruction.

The next two chapters, the fifth and sixth, although not so generally interesting as the preceding, are almost as important, as they are devoted to the description, analysis, and illustration of the various fittings required to render technical buildings suitable for their educational purposes. The importance of this branch of the subject cannot be too strongly insisted upon, because the fittings are not independent of the structure in science laboratories, but in most cases are an integral part of it, and their suitability or otherwise makes the greatest possible difference in the quantity and also the quality of the work done; and no room or combination of rooms can be said to be properly designed upon the plans of which the whole of the intended fittings have not been arranged before their erection; and Mr. Robins' remarks that if promoters of such projected buildings were to insist upon the association of the architect with the several professors by whom they are to be used, they would save much costly subsequent variation in the plans, which, after all, can never be so perfect as they might have been had previous consultation been enjoined.

In the seventh and eighth chapters the subject of ventilation is very fully discussed and illustrated by a considerable number of examples, all of which will be very useful. The ninth chapter is taken up with middle class school buildings, and examples given of several which the author has designed, and the volume is appropriately concluded by a chapter on sanitary science in its relation to civil architecture. However important technical education may be, we must agree with the author that no subject of study can be more useful and honourable than that of the principles which should govern the direct application of sanitary science to the development of our national architecture—no duty greater than the recognition of our responsibilities in this matter, and of fitting ourselves for it. The growth of contaminating influences injuriously affecting the healthfulness of the elements, the earth upon which we live, the air we breathe, and the water whereof we drink, is commonly the result of culpable ignorance of the simplest sanitary laws, and of the appropriate mechanical appliances necessary to give effect to them. This is generally acknowledged in the abstract, and there are few subjects upon which philanthropists are more ready to expatiate or more reckless in the adoption of any suggestion which sounds sufficiently iconoclastic or revolutionary.

The book is dedicated to Professor Huxley in token of the author's reverence for his genius, and in grateful remembrance of his uniform courtesy and friendly counsel at all times. From the short description we have given of it, it will be evident that it is such a piece of useful thorough work that even Professor Huxley, with all his love of thoroughness, will have no reason to be ashamed of having his name associated with it.

PAPERS: LITERARY, SCIENTIFIC, &c. By the late Fleeming Jenkin, F.R.S., LL.D., Professor of Engineering in the University of Edinburgh. Edited by Sidney Colvin, M.A., and J. A. Ewing, F.R.S. With a memoir by Robert Louis Stevenson. In two volumes. London: LONGMAN, GREEN, & Co. 1887.

The study of the lives and works of scientific men is often of more use to the student than that of formal treatises, for, if these be properly presented, they reveal to us their methods of working and the stages in their mental development. A formal treatise may very often have a narrowing effect on the minds of men who have a tendency to follow precedents closely, and who do not take the trouble to investigate matters for themselves; but if they turn to a record of the life of the man who wrote the treatise, and learn the labour which he bestowed on what appears to be a very insignificant piece of work, they will find an incentive to individual effort and investigation. The recently published "Life and Letters of Charles Darwin" are likely to do more to instil a true scientific spirit into a young student of natural science than all the text books which have been published since Darwin's first work appeared, for in them he will find a record of vast patience and great observing and organising power in certain limited spheres, combined with a simplicity of life and a want of what is usually considered general culture which will alter his ideas of what is necessary to attain to a high position as a scientific man, and to influence thought in all its departments. If he turns from Darwin to Fleeming Jenkin, he may almost find the change too sudden for his mental equilibrium, for then he will be introduced to a man of quite a different type. Instead of slow, patient observation, and careful deduction, he will find a brain of peculiar alertness, and able to attack the most subtle problems in science, or criticise the details of a Greek drama; to lay ocean cables or write stage plays; to lecture on any department of engineering, or to discourse brilliantly in four languages on any subject which turned up in general conversation. And with all this, he was no sciolist; whenever he attacked a subject, he went a considerable depth below the surface. The greater part of the two volumes, as is indicated by the title page, is taken up with Professor Jenkin's papers, the memoir by Mr. Stevenson occupying little more than one-third of the first; but still it will be the first which will receive the greatest attention from general readers. Mr. Stevenson has been sufficiently influenced by the orthodox forms of biography to begin with a chapter on genealogy, and the only point of interest in it to those acquainted with Professor Jenkin is where it shows that, like other distinguished men, he owed the most of his intellectual qualities to his mother, who was a woman remarkable for fortitude, and physical as well as intellectual courage. His father was a naval officer, who had no active service after a comparatively early age, and who, with his wife and son, led a somewhat wandering life. The future professor's first school days were spent at Jedburgh; afterwards he was sent to Edinburgh academy, where he had as contemporaries Clerk Maxwell, and Tait; but the chief part of his education was obtained on the Continent, at Frankfort, Paris, Genoa, all in a very irregular fashion, but which at least had the merit of giving him a good command of modern languages. At the University of Genoa he took the degree of Master of Arts, and there he appears to have obtained his only systematic instruction in physical science, for the University had one of the best appointed physical laboratories of the time. At Genoa, too, he studied art, and made attempts at music, so that his early training affords a key to his whole character, which was a curious combination of French or Italian versatility combined with German or British stability. In 1851 Jenkin returned to England, and began his practical engineering training at Fairbairn's works, at Manchester, where "from half-past eight till six he had to file and chip vigorously in a moleskin suit, and infernally dirty;" but he entered into his work with spirit, for throughout life his principle was, that whatever was worth doing was worth doing well, and he wrote that he "never learned anything, not even standing on his head, but he found a use for it." At Manchester "he was moving daily among those strange creations of man's brain, to some so abhorrent, to him of an interest so inexhaustible, in which iron, water, and fire are made to serve as slaves, now with a tread more powerful than an elephant's, and now with a touch more precise and dainty than a pianist's." But even in Manchester he could not confine himself to mechanical subjects, and for some time he spent three nights a week with Dr. Bell, "working away at certain geometrical methods of getting the Greek architectural proportions," a course of study which was in all likelihood the beginning of that love and intimate appreciation of things Greek, from the least to the greatest. From Fairbairn's and Manchester, Jenkin passed to a railway survey in Switzerland, and thence again to Mr. Penn's, at Greenwich, where he was engaged as draughtsman. There in 1856 we find him in a terribly busy state, finishing up engines for innumerable gunboats for the ensuing campaign. After some time he passed into the service of Messrs. Liddell and Gordon, who had begun to dabble in the new field of marine telegraphy, where he remained for fully two years of very great activity, now in London, now at Birkenhead, fitting out ships, inventing new machinery for new purposes, and dipping into electrical experiment, and now on a telegraph cruise in the Mediterranean. At this time, too, he made the acquaintance of Professor (now Sir William) Thomson, which ripened into the warmest friendship, and had the greatest influence on his future career. They worked together on the Committee on Electrical Standards, they served together at the laying down or the repair of many deep sea cables, and were associated in many valuable inventions and scientific investigations.

In 1859, Jenkin was married to Miss Austin, and shortly after he entered into a general engineering partnership with Mr. Forde, and for some years he had very uphill work in his profession, although his position continued rapidly to improve, not only as a lecturer on various departments of engineering, but also as a practical engineer, and when the Chair of Engineering in Edinburgh University was founded in 1868 he was appointed to it, a position which he occupied till his death in 1885, at the early age of fifty-three. We must refer to Mr. Stevenson's volumes for an account of his Edinburgh life, and for a fuller description of his character, as our remaining space will only allow us to glance at the articles and papers which are reprinted in these volumes. These are thoroughly representative of the man, containing as they do valuable contributions to literature, drama, art, political economy, and science, pure and applied. All except the last of these may be looked upon as the by-labours of a busy life; but they also show much more than taste and appreciation. They reveal a strong individual judgment, which, if not always correct, is always intelligent and suggestive. The papers on "Lucretius and the Atomic Theory," and on "Darwin and the Origin of Species," are especially valuable; and such men as Munro and Darwin have acknowledged the force of his arguments. Like almost all other thinking men he found himself drifting, or being forced into, the study of social and political economy. His paper on trade unions, on supply and demand, all show great grasp of the subjects; and while we may not be prepared to adopt all his conclusions, those on scientific and technical education abound in good sound common sense.

Professor Ewing has selected three papers, each representative in its way, from among Jenkin's technical writings. The first gives in a popular form an account of the scientific development of submarine telegraphy; the second is on "Telpherage," a subject to which the latter years of his life were chiefly devoted, while the third is "On the Application of Graphic Methods to the Determination of the Efficiency of Machinery," and only needs the wider publicity now given to it to make it more appreciated by engineers. The work is concluded by abstracts of "Jenkin's Scientific Papers," and with a list of his British patents, the number of which shows how carefully he must have utilised his time, and taken as a whole gives a very complete view of the professor as a man and as an engineer; and moreover has much intrinsic value.

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BACKMAN'S HELICOIDAL LIFT.

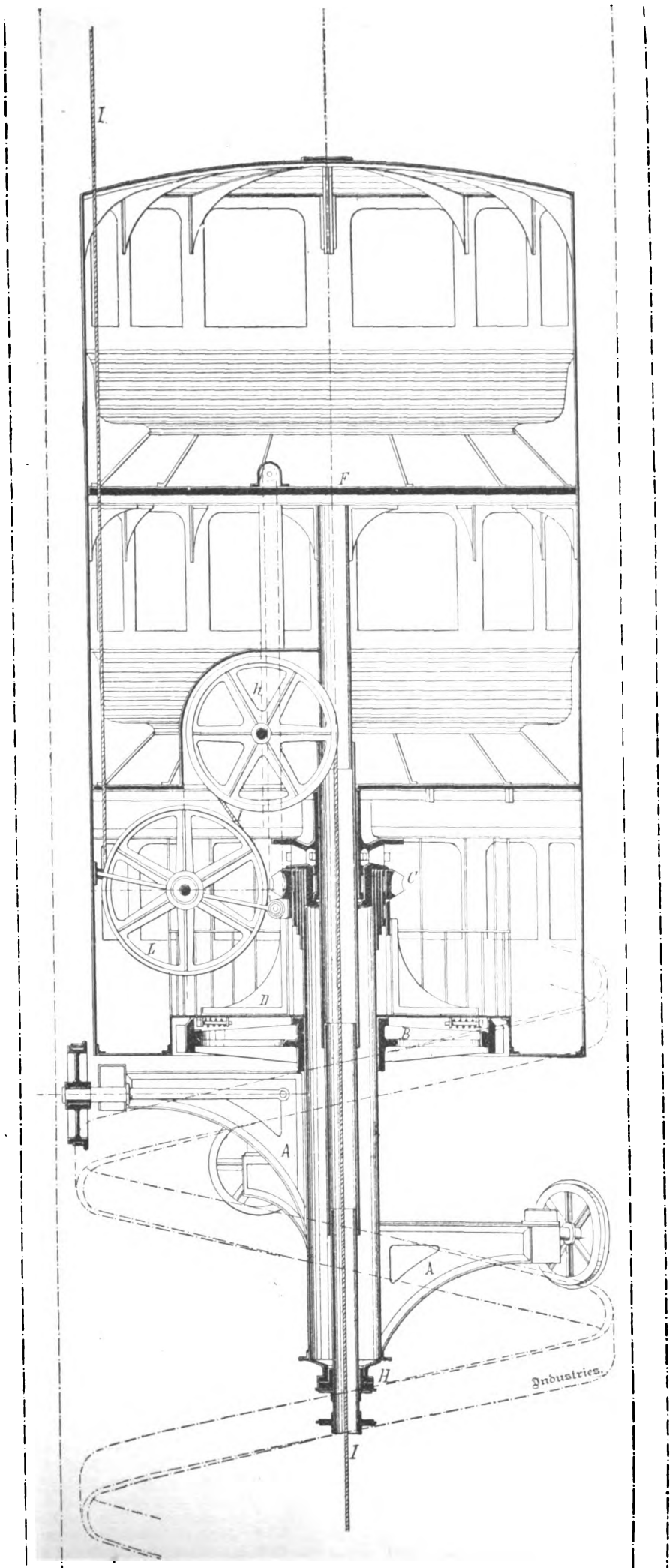


FIG. 1.

BACKMAN'S HELICOIDAL LIFT.

THE immense height of the Eiffel Tower—which is to constitute one of the chief attractions at the great Paris Exhibition in 1889—precludes the employment of any of the ordinary systems of lifts applicable only to moderate elevations. On the other hand, to erect a tower nearly 1000ft. high, and not provide some means for carrying passengers safely up and down, would render the undertaking commercially a failure; for visitors who are necessarily already fatigued with the labour of perambulating the Exhibition proper, will scarcely care to make an ascent as tiring, and perhaps more so, than a climb up a mountain in the Highlands. In fact, most tourists would rather climb a mountain 2000ft. high than walk up a winding staircase to half this height. Some kind of lift is, therefore, an absolute necessity; and as the ordinary winding engine rope and cage would be inadmissible, because not sufficiently safe, a new system has been devised by M. Backman, which has the advantage of being applicable to any height, and yet perfectly safe. Briefly described, the lift consists of a helicoidal railway, on which runs a truck supporting the cage. The truck is revolved on the irons of the helicoid, and thus screws itself up or down, whilst the cage with the passengers, which is placed above the truck, is guided by vertical rods, and participates in the vertical, but not in the rotary movement.

The construction of this apparatus will be clear from the accompanying drawings taken from the *Genie Civil*. Fig. 1 shows a sectional elevation, Fig. 3 the plan of the truck, and Figs. 3 and 4 show details of the mechanism for revolving the truck. The cylindrical cage, which is in two storeys and capable of holding one hundred passengers, is supported on a hollow central tube, which serves as an axis for the larger tube forming part of the revolving truck. The cage is guided between two vertical guides in the shape of riveted plate girders, each supporting a double headed rail as shown in plan (Fig. 4). There are guide pieces sliding against the webs of these rails and rollers running on the heads, these rollers being pressed inward by means of spiral springs *d*. At the lower end of the central tube is a cross piece H (shown in transverse section in Fig. 1), the arms of which are similarly provided with sliding pieces and rollers. The truck consists of the large tube already mentioned, and of five radial arms A (Fig. 3), each carrying a wheel. To insure an equal load to all the five wheels, notwithstanding some slight irregularity which might exist in the helicoidal track, the axes are not rigid, but are pivoted at the inner, and supported on spring washers at the outer end, these spring washers allowing a vertical play of about $\frac{3}{4}$in. The wheels are intended to run at seventy-two revolutions per minute, whilst the truck itself revolves thirteen times a minute. The well of the lift is formed by six vertical lattice girders for the support of the guides and of the helicoidal track. The latter is of rectangular section, and of cast steel strengthened by flanges. The inclination of the spiral is 18° to the horizontal, and the diameter is about 13ft. The vertical guides are placed inside the track, but are interrupted at suitable intervals to allow of the passage of the axes of the wheels. The larger central tube is provided at its upper end with a worm wheel C, and about its middle with a spur wheel B. Power is supplied by an endless rope I running at a speed of 3000ft. per minute, whilst the lift itself travels at about 100ft. per minute. The diameter of the rope is only ·6 of an inch, and to insure a constant tension, notwithstanding possible stretching, it is taken round a weighted pulley at the bottom of the tower. The rope runs in the same direction whether the cage be ascending, descending, or standing still. As will be seen from Fig. 1, the rope, which enters from below through the central tube, is taken within the cage over the pulley *h*, then round the pulley L, and up close to the wall of the cage. The pulley L serves to transmit power to the mechanism, as is illustrated in Figs. 2 and 4. Upon the shaft of this pulley are mounted two loose bevel wheels J and K, which can be coupled to the shaft by means of the friction clutches N and M respectively. These couplings are put in and out of gear alternately by means of two spiral springs and two pairs of levers, the ends of which are controlled by a double right and left handed screw S (Fig. 4). When M is in gear the wheel J communicates motion to the wheel O and pinion P, which gears into the spur wheel B above mentioned. This wheel is keyed to the tube forming the centre of the truck, and the latter is thus caused to rotate in the sense to raise the cage. During the ascent the friction clutch N is out of gear, and the wheels K and Q as well as the worm R and the worm wheel C are standing still. The worm wheel is fastened not directly upon the central tube, but upon a barrel D, which can revolve in one direction only round this tube. On the under side of this barrel there are eight pawls forced out by spiral springs against seventeen ratchet teeth arranged on the inner circumference of the spur wheel B. The inclination of these teeth is such as

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to allow the spur wheel to rotate whilst the worm wheel is standing; but during the descent the motion is reversed, and one of the pawls engages with one of the teeth, thereby tending to revolve the worm wheel with its barrel round the tube. The worm wheel is allowed to follow this tendency by receiving motion from its worm R in the same direction. The inclination of the teeth in the worm is such that the latter cannot be turned from the worm wheel, and by this arrangement the possibility of the cage descending by gravity alone is excluded, even if the driving rope should break. The worm wheel simply permits the descent as long as the mechanism is in proper working order; but should the rope break or the friction clutches refuse to act, the worm wheel performs the function of a very efficient brake. In addition to this

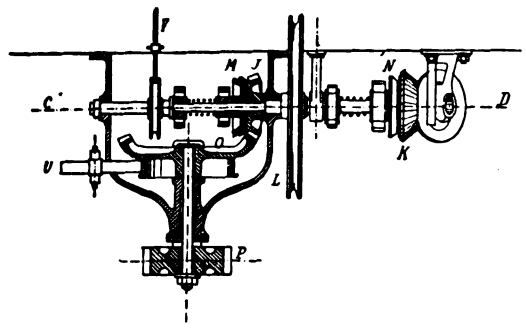


FIG. 2.

there is also a brake V on the shaft of the pulley L, and another brake U on the shaft of the pinion P. It will be seen that by thus sub-dividing the mechanism into two parts, one for the ascent and the other for the descent, it has been possible to employ spur gear for lifting the load, where efficiency is of importance, and worm gear for lowering the load, in which case efficiency is of no importance whatever, and safety is the first consideration. The lift is started, stopped, or reversed by means of a hand chain actuating the screw spindle S, and tappets are fixed at the top and bottom of the lift well, by which the chain is automatically operated at either extremity. The lift will be worked by a steam engine of 120 h.p. placed at the bottom of the tower. In this system the efficiency of the lift is almost independent of the height, and there are no signals whatever required between the cage and the driving engine.

ELECTRIC LIGHTING IN SWITZERLAND.

IT is not surprising in a country like Switzerland, where water power is abundant in almost every locality, that the electric light should be more rapidly introduced than in other countries, where coal is the chief source of power; but probably few English electricians have a just conception of the magnitude of installation work now in progress in Switzerland, with a view to utilise the natural resources of the country for electric illumination and transmission of energy. These large schemes are carried out almost in secret, and very little concerning them finds its way into the scientific or daily press. We have lately given an account of the electric power plant at Solothurn, and we propose in the present article to give a short description of some of the more important electric light and power installations now building in Switzerland, or already completed. The following list is by no means complete, but it is sufficient to show the general tendency of electric lighting in Switzerland, and the manner in which the work is carried out :—

LUCERNE.—The electric light installation at this town has already been briefly mentioned in our columns. Power is supplied by a 300 h.p. turbine, with vertical shaft, fed from a brook, which is a tributary to the river Reuss. The turbine shaft is geared by bevel wheels to a horizontal shaft, from which power is taken by bevel wheels again to two 1800-light self exciting Ganz dynamos, by a pulley and belt to a third Ganz dynamo of the same power, and by another pulley and belt to an Oerlikon continuous current dynamo of 100 h.p., the latter acting as a generator for a transmission plant, the power being given out by an Oerlikon motor installed at a mill near Lucerne. A 200 h.p. steam engine is also provided as reserve, to be used in case of scarcity of water in winter time. At present only one of the three alternate current dynamos is required for lighting purposes; but in summer, when there are many visitors and tourists in Lucerne, two dynamos are used during the evening. All the circuits from the central station are carried overhead across country on poles, and along the streets of Lucerne either on poles or on insulated brackets attached to the houses. At suitable places within the town are installed large transformers of 250 lights each. These are placed in underground localities where possible; but where room within the building could not be obtained the transformer is fixed in a kind of weather proof dovecot on a pole in the street. All the transformers are connected in parallel to the primary circuit, and their secondaries are connected to a network of double lead covered underground distributing mains, through which the subscribers are supplied at 100 volts pressure. The subscribers buy their own lamps, and are at liberty to use the light for as many hours as they please, paying 16s. for every 10 c.p., and 32s. for every 20 c.p. lamp installed. In summer one dynamo only is in use before noon; but in the middle of the day the machinery is stopped for ten minutes to allow a second dynamo to be put into gear, when both dynamos are worked for the rest of the day. Late at night, when the consumption again decreases, one dynamo is thrown out of gear without stopping the machinery, and to provide for this being done with safety an ingenious brake is added to the main shaft, actuated by a centrifugal governor. A sudden increase of speed throws out the weights of the governor and tightens a band brake, which for a short time is able to absorb 100 h.p., thus giving the attendant time to reduce the inlet of water at the turbine. The brake is also useful in case a circuit should be accidentally interrupted, and thus a considerable amount of power be taken suddenly off the shaft. The staff of the station consists of four men in summer and five in winter. Although the work is lighter in the winter time, a larger staff is required to cope with the difficulty of ice. There are no meters in use, but a log book is kept at the station,

BACKMAN'S HELICOIDAL LIFT.

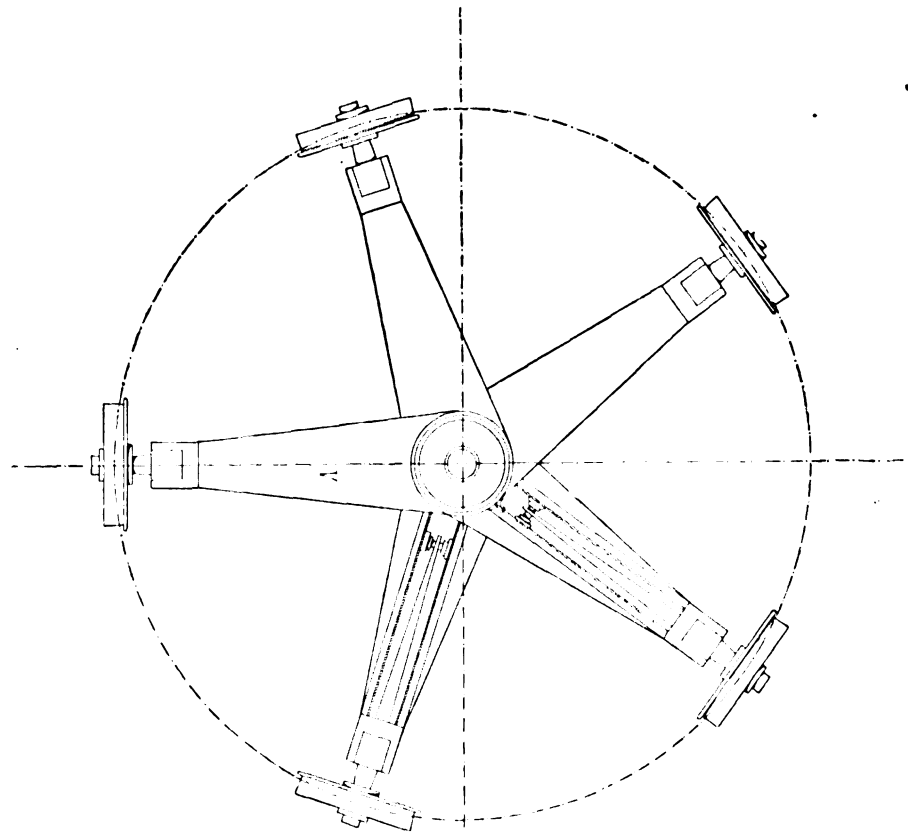


FIG. 3.

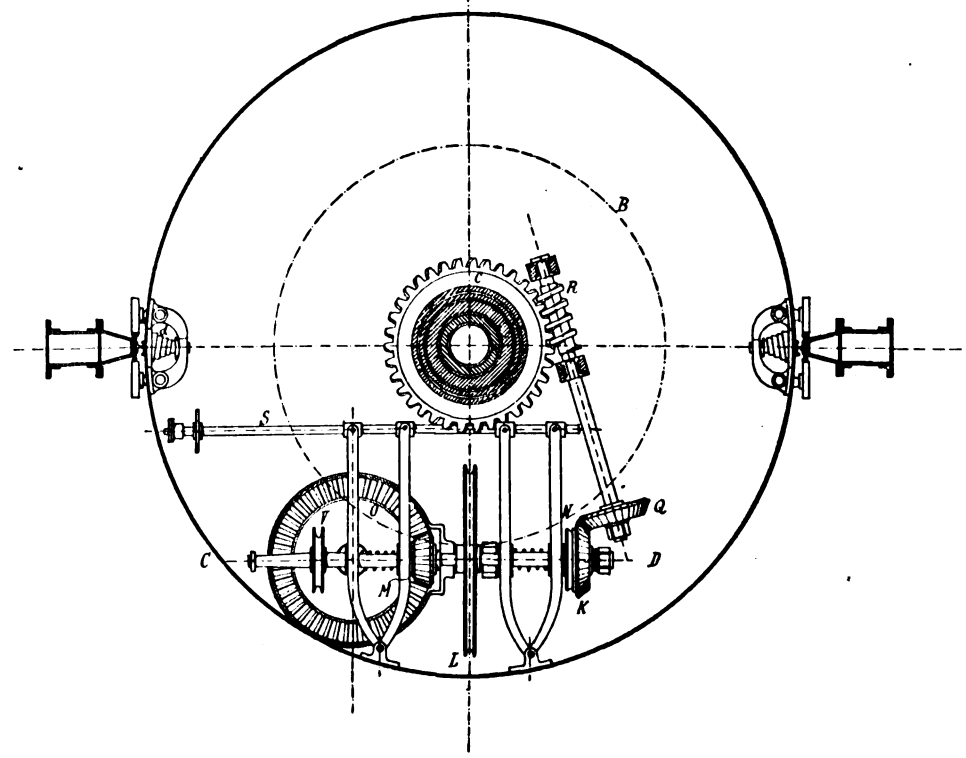


FIG. 4.

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where the current is entered at stated intervals. The potential difference at the points of consumption is kept constant by regulating the speed of the turbine in conformity with the indications of audible and visible signals so arranged as to notify any departure from the normal pressure if this exceeds a certain small limit. The total cost of the central station, including land and buildings, turbine, boilers, steam engine, dynamos, and accessories, but exclusive of distributing plant, was about £16,000.

LAUSANNE.—This town is supplied with water at 12 atmospheres pressure (180lb. per square inch), from a lake lying at a higher level. Although this water is sufficiently pure for domestic use, it is mostly employed for power purposes, there being a second supply of potable water besides. The high pressure supply has been utilised in a small central electric light station, where there are installed three vertical turbines (by vertical we mean wheels revolving on horizontal axes), constructed by F. Duvillard on the Girard principle, with variable admission, and some dynamos, partly Edison machines for 250 lamps each, and speeded at 1100 revolutions, and partly Thury machines for 350 lamps each, and speeded at 500 revolutions. The supply is on the direct system, each dynamo sending current to its own circuit in the town during the evening; but during the day time, when very little current is required, all the circuits are coupled in parallel and served by one dynamo only. The company who own the installation pay 1s. 3½d. per thousand gallons of high pressure water, and as each thousand gallons is equivalent to 1·92 h.p. in falling water exerted for an hour, or say about 1¼ h.p. hour of electrical output, corresponding to 15½ 60-watt lamps, the cost of lighting for power alone amounts to the high figure of about 1d. per lamp hour. There are no Coulomb meters in use, but in some places special clocks are employed which are automatically started by the current as soon as it is switched on, and stopped again when the current is switched off, the clocks therefore acting as lamp-counters. The distributing circuits throughout the town are above ground, consisting partly of naked copper wires on poles, and partly of lead covered cables fastened along the walls of the houses. The light is used in the hospital, and in several hotels and restaurants.

MONTREUX.—The installation for light and power at Montreux is as yet only partially finished; but when completed, it will be the largest of its kind in Switzerland. The current is supplied to Vevey and Montreux for lighting purposes, and also for working the electric tramway between these two places. Water power is obtained from a small mountain torrent called the Baie, which is tapped above Sonzier, a distance of 1000 yards from the central station. As the demand for power in an installation of this kind is only intermittent, it was necessary to accumulate water power during the day for use at night, and an artificial basin, containing about 1½ million gallons, has been erected. From there piping, 16in. diam., of riveted ⅝in. steel plates, is carried to the station lying between 700ft. and 800ft. lower than the reservoir, so that a pressure of about 360lb. to the square inch is available in the mains. The reservoir and conduit cost £1,900. The water is used for actuating vertical Girard turbines, and to avoid breakage of the supply pipe in case the admission valve to any turbine should be closed too abruptly, there are provided two huge air vessels, made of steel boiler plates 40in. diam. by 25ft. high. The whole of the machinery is installed on the ground floor of the stations. There are in all five turbines, which are supplied by branch pipes from the mains situated in the cellar of the building. The main can be shut off by a sluice valve, and each branch pipe is also controlled by a valve. A sluice is also fitted at the intake near the reservoir, and the water from the mains can be run off through waste pipes to prevent bursting of the pipes in very frosty weather. It is, however, not contemplated to run the water off in winter time, except when the cold is very intense. At ordinary winter temperature the water in the pipes will be kept in motion by a small quantity being continually drawn off, whether the turbines are used or not, and by this means it is hoped to prevent accident to the pipes from frost. Considerable difficulty was experienced in making tight connections at the main in the cellar. In the outside conduit the pipes are fitted with steel flanges, riveted and caulked; but in the building the joints are made by screwed flanges, and after several failures to obtain a tight joint, brass rings, with india-rubber packing, were employed, and up to the present have given very little trouble. In addition to the five turbines there are provided two 200 h.p. Sulzer steam engines working direct on to the same shaft as three of the electric light turbines. The two other turbines out of the five are used for power purposes, each actuating a pair of Thury dynamos, the current from which is employed in working the electric tramway already mentioned. The mechanical installation is probably unique, in so far as the two engines and the three turbines all work upon the same shaft, upon which are also mounted the armatures of three Ganz alternate current machines. The whole length of shaft is close upon 65ft., and there are only two couplings in it. When the steam engines are not in use, a portion of the shaft is uncoupled, or the connecting rods taken off. The machines are disposed as follows, beginning at the end of the shaft nearest to the boilers: A 200 h.p. steam engine, a Ganz dynamo for 1800 lights, a 250 h.p. turbine, a 200 h.p. steam engine, a Ganz dynamo similar to the above, a 250 h.p. turbine, another Ganz dynamo for 1800 lights, and a rope pulley at the extreme end of the shaft transmitting motion to a counter shaft, which can be coupled to the shaft of one set of 60 h.p. turbine and pair of Thury dynamos—one on each side of the turbine. The coupling on this shaft is provided so that the Thury machines can be worked either from the main shaft when the water to the turbine is shut off, or by the turbine when the coupling is out of gear. In addition to this, there is another set consisting of a 60 h.p. turbine and a pair of Thury machines as reserve for the tramway. The wheels for the 250 h.p. turbines are contained in casings about 6ft. 6in. in diameter and 20in. wide. They run at 250 revolutions per minute. Steam is supplied to the engines by two boilers of 125 h.p., but space has been reserved for two more boilers. On the main shaft there is also space for some more dynamos and turbines. The boilers, which are worked at 150lb., are fed direct from the high pressure mains; but small feed pumps are supplied in case the water should have to be run out of the main in frosty weather. The steam engines are of short stroke, of very compact design, and intended to run at a speed of 250 revolutions per minute. All the electric distributing mains are placed underground; but the mains supplying current to the electric tramway are carried overhead and arranged in the same manner as on the Frankfort electric railway, that is to say, the conductors are slotted copper tubes in which travel contact shuttles drawn after the car by flexible connections. The tramway passes through Vevey, along the Rue de Samplon, then along the shore of the lake over Bel Air, Maladaire, Clarense, Vernex Montreux, Veytaux to the famous castle of Chillon, the whole length of the tramway being about 5¼ miles. The current is supplied about the middle of the line by four copper wires 285mils. diameter. The overhead conductor is supported on poles in the open, but on brackets from the houses where it passes along the streets. This line is to be opened in a few weeks. At the present moment about 2000 glow lamps have been installed in various shops and restaurants in Montreux, but the company expect to have 7000 installed by the end of the year.

GENEVA.—The central electric light station at Geneva has also been established with a view to utilise the extensive water power now running to waste in the river Rhone as it leaves the lake of Geneva. The employment of this water power for purposes of public utility is not a new feature in Geneva, since water wheels and turbines have for many years been installed for working the pumps which supply the town with water. This installation was, however, on a modest scale, and some ten years ago a scheme was elaborated, by which some 4200 h.p. was to be obtained from the Rhone at a point slightly below the old pumping station. The work was, however, not taken in hand until 1884, and in May, 1886, the new power station was started with six turbines placed in a large house, the turbines developing together 1200 h.p., and space has been provided in the building for fourteen more turbines, which will be gradually installed. Each turbine drives a horizontal three-throw pump, supplying water under a pressure of 750lb. to the square inch, the water being used in the town for motive power purposes. The power is paid for by consumers at the rate of £4. 16s. per horse power per annum, if it is used not longer than ten hours daily. Each turbine is automatically regulated to maintain the pressure in the supply mains constant, and a large air vessel is added to each pump so as to compensate for the slight irregularity of flow in the delivery from the pump. Although this installation has strictly speaking nothing to do with electric lighting, we mention it because owing to its establishment, the old pumping station nearer the town has become available, and a company was formed to utilise this site for the supply of electricity from a central station erected at that place. Up to the present there are erected two vertical turbines of 200 h.p., each directly coupled with two Thury dynamos, whilst a third set of turbine and pair of dynamos is being added. The four dynamos together are able to supply 2600 ampères at a pressure of 140 volts. The lamps installed are 105 volt lamps, and the extra pressure is required to overcome the resistance of the leads. The distribution of the current in the town is intended to be on the three-wire system by underground lead covered cables, and about 3½ miles of mains have been laid down up to the present time. The cables are laid under the surface of the street, and not under that of the footpath as usual. At present the distribution is effected temporarily by two overhead wires, there being only as yet 500 lamps subscribed for; but eventually the installation will comprise at least 6000 lamps fixed. In concluding our rapid sketch of some of the electric light installations in Switzerland, we would draw attention to the fact that the work is practically carried out by means of three types of dynamos, viz., the Thury dynamo for the direct supply at low tension, the Oerlikon dynamo for the transmission of energy at high tension, and the Ganz dynamo for lighting extended districts by means of alternating currents and transformers.

A NEW TRANSMISSION DYNAMOMETER.

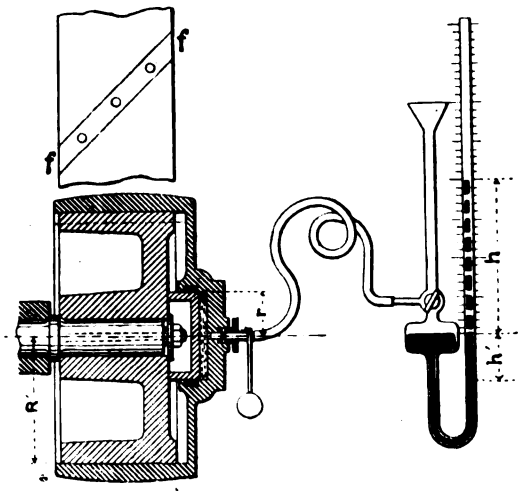
AT a recent meeting of the Berlin Society of Electricians Herr von Hefner-Alteneck read a paper describing a new belt dynamometer, in which the turning couple on the pulley is balanced by hydraulic pressure, and made visible on the mercury column of a gauge fixed against the wall of the dynamo room in any convenient position. The instrument was peculiarly designed for use in dynamos, but is of course also applicable to other power consuming machines. This extremely simple device will easily be understood by reference to the accompanying illustration. The usual pulley of the machine is removed and replaced by a cast iron drum, having a loose cylindrical rim which takes the belt. The rim is connected with the drum by obliquely set feathers *f f*, the inclination being as near as possible 45°. If a turning couple is now applied to the rim and resisted by the drum, the effect will be to slide the former more or less over the latter, and if the inclination of the feathers be exactly 45°, the axial force is exactly equal to the tangential force applied at the circumference of the drum. The sliding in of the rim is resisted by the pressure of some fluid (preferably glycerine) contained in the central chamber, as shown in our illustration. Escape of the fluid inwards is prevented by an ordinary leather packing, such as is used in hydraulic machinery, and its outward pressure is transmitted by a small metal tube with stuffing box to a mercury gauge fixed against the wall. One limb of the mercury gauge is very wide in comparison to the other, so that the variation in the level of the wide limb is only trifling as compared with the height to which the mercury is forced in the narrow limb. The small tube is prevented from turning round under the friction of the stuffing box by a pendant weight as shown. It might at first sight appear that the indication of the mercury column cannot be a true measure of the turning couple applied, because the friction of the feathers between the rim and drum must introduce a considerable error; but Herr von Hefner-Alteneck says in his paper that although when the apparatus is at rest such friction might cause a very considerable error, when the machinery is in motion no ordinary friction will prevent an exact balance being obtained between the turning moment and the hydraulic pressure in the central chamber, the reason being that under the continuous vibration the disturbing influence of friction is eliminated. There are, however, two points which require special attention before the indications of the mercury gauge can be taken as a true measure of the turning moment. It is in the first place necessary to carefully ascertain the diameter of the central chamber, that is to say, the area on which the fluid pressure is exerted and the exact angle under which the feathers are placed. The diameter of the cylindrical chamber can, of course, be callipered with very high accuracy, and to find the angle it is best to scribe on the surface of the drum a line exactly parallel with the shaft, mark a point on the rim coinciding with this line, then turn the rim and measure the distance of advance and rotation on the surface of the drum. If the two be exactly equal the angle of the feathers is 45°; but if, as will generally be the case, they are not equal, a correction must be applied. Let R be the radius in which the pitch of the screw corresponds to an angle of 45° in the feathers, R^1 the radius of the drum, b the length of arc, and a the corresponding advance parallel to the axis, then $R = \frac{a}{b} R^1$.

In calculating the power, this radius must be used instead of the actual radius of the drum. In the next place a correction must be introduced for the variation in hydraulic pressure by centrifugal force as the liquid in the central chamber is being rotated. It is evident that centrifugal force will tend to displace the liquid towards the circumference of this chamber, and thus slightly increase the pressure at the circumference, as compared with that at the centre, from where the indication is taken. The reading of the gauge h is therefore wrong by the amount h^1 due to the sucking action of the centre of the chamber, and this must be allowed for in calculating the power. The mathematical investigation of the influence of centrifugal force is not a difficult matter; but, as it would occupy more space than we can afford, we shall limit ourselves to giving the actual result. Assuming the density of glycerine to be 1·26, and that of mercury 13·55, the inventor finds that the power is expressed by the following formula:—

$$\text{h.p.} = \cdot 594\, R r^2 n\, (h + \cdot 00259\, n^2 r^2).$$

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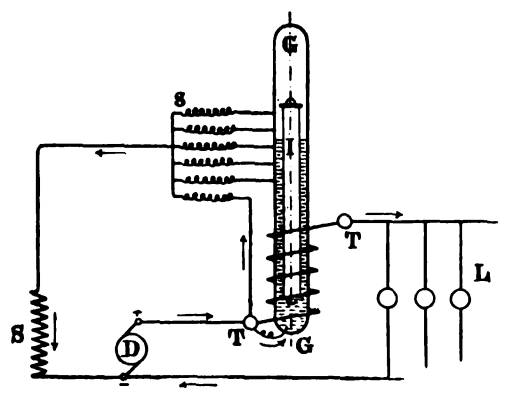
The meaning of the symbols used will be clear from the illustrations. The radii are to be given in metres, the gauge in centimetres, and the speed n in revolutions per minute. By making the chamber sufficiently small a very extended scale, with consequently a great degree of



accuracy in the readings, can be obtained. Oscillation of the mercury column, due to irregularity in the driving power of the engine, or inequality in the belt, can be avoided by throttling, more or less, the cock in the pipe which transmits the pressure to the gauge, whilst loss of glycerine can be compensated for by re-filling through the funnel when the apparatus is at rest, or with a force pump when working. The inventor suggests the use of this dynamometer as a permanent accessory to a dynamo room, so that the attendant may at all times see at a glance how much power is being consumed.

AUTOMATIC REGULATION OF DYNAMO MACHINES.

Now that the question of compound winding has been settled entirely in favour of the Brush Corporation, with the result that other dynamo makers have to pay a royalty for the use of the double exciting coils, other methods of making dynamos self regulating for constant potential are sure to receive the attention of manufacturers. In this connection it is interesting to note the method invented by Herr Wilhelm Lahmeyer, of Aix la Chapelle, which is described in our contemporary the *Centralblatt für Elektrotechnik*. Herr Lahmeyer dispenses with the main coils, and obtains regulation by an automatic device for



varying the resistance of the shunt circuit. Our illustration will explain the connections. D is the dynamo, preferably a purely shunt wound machine; S is its exciting coil; s represents a series of parallel resistances through which the exciting current passes; T T are the terminals of the dynamo, and L are the lamps, which may be at any distance. The problem is to keep the pressure at the lamp terminals constant, whilst the number of lamps alight is varied. The more lamps there are burning, the higher must be the pressure kept at the dynamo terminals, and this is done automatically by the simple device represented in our illustration. The main current is taken round the glass tube G, sealed at both ends, and partly filled with mercury, in which an iron core I floats. The shunt current is divided, one part flowing straight up to the first additional resistance s, and the other into the mercury. At the side of the glass tube are fused in platinum wires, connected with the shunt resistances s, and as the main current increases the iron core is sucked down, forcing up the mercury, and thus putting a greater number of these resistances into parallel circuit. By this means the total resistance of the shunt is decreased, and the e.m.f. of the dynamo accordingly increased. It will be noticed that with this arrangement it is quite feasible to obtain constancy of pressure at a considerable distance from the dynamo—that is to say, an ordinary shunt machine can in this way be made equivalent to a machine which is over compounded. The instrument has been in use at the electrical works at Aix la Chapelle and elsewhere for about a year and a half.

Notes.

A STEAM CANOE.

A STEAM canoe has recently been built for the Universities African Mission Society, by Messrs. Simpson and Strickland, of Dartmouth. She has been called the "Nyassa," after the lake on which she is intended for service. Delta metal has been used throughout her construction, and in her details and fittings no expense has been spared. The principal dimensions are: Length, 21ft.; beam, 7ft.; depth, 3ft.; and she draws 16in of water with her engine and boiler on board. On her trial trip she made seven miles an hour with the steam pressure at 100lb., and under sail she attained the speed of six miles an hour.

TRADE WITH SOUTH AMERICA.

GREAT stress is laid upon the importance of consulting the tastes of the South Americans if business is to be done. In a report by a United States Consul in Venezuela, he complains that American manufacturers will not do this, and states that by paying attention to the peculiar requirements of the market the Germans have gained a firm footing in the country. Three-fourths of the foreign mercantile capital in Venezuela is German, and German business houses outnumber those of all other countries combined. The quality of goods sent should be uniform, and the Consul mentions that trade has been partly spoilt owing to shipments of inferior merchandise being made after a profitable business had been established. Personal representation is strongly recommended.

COPPER ALLOYS.

M. G. A. FAURIE has recently announced to the French Academy of Sciences, that he has succeeded in preparing a series of valuable alloys of copper containing varying quantities of silicon. He has found that under suitable conditions an alloy containing 15 parts of silicon per 100 of copper can be obtained. The properties of these alloys are being investigated, as it is found that they vary considerably with their composition. The alloys of copper and silicon prepared by the Hensler process are known to possess great strength and ductility, and wires made from them have greater electric conductivity than ordinary copper wires, and castings made from these alloys are free from pores. M. Faurie's alloys are richer in silicon than those previously prepared in Germany, and the trials of their physical properties are awaited with interest.

TURKEY RED OIL.

THE Turkey red oil used in dyeing Turkey red is obtained by adding concentrated sulphuric acid to crude castor oil. Castor oil, or *oleum ricini*, is mainly composed of the glycerine salts of ricinic, ricinoleic, and ricinstearic acids, and also a small quantity of resinous matter. These substances are readily soluble in rectified spirit and absolute alcohol. The oil is expressed from the seeds of the castor oil plant (*ricinis comricinis*), which contain from 25 to 30 per cent. of the oil. This extraction is done either with or without heating. The "cold drawn" oil obtained in the latter case is of slightly less yellow colour than that obtained when heat is employed. The action of the sulphuric acid upon this oil has been recently studied by Benedikt and Ulzer, who find that the reactions which take place are similar in character to those which are known to occur when olive and other vegetable oils are similarly treated. From their experiments it is inferred that the acid of Turkey red oil is not a true sulpho-acid, but belongs to the class of acids of which ethyl-sulphuric acid is the type. When treated with hydrochloric or sulphuric acid it readily breaks up into sulphuric and oxystearic acids, thus:—

$$\underset{\text{Ricinic acid.}}{C_{18}H_{33}O_2OH} + H_2SO_4 = \underset{\text{Ricinol-sulphuric acid.}}{C_{18}H_{33}O_2OSO_3H} + H_2O \quad (1)$$

$$\underset{\text{Ricinic acid.}}{C_{18}H_{33}O_2OSO_3H} + H_2O = C_{18}H_{33}O_2OH + H_2SO_4 \quad (2)$$

Benedikt and Ulzer have also succeeded in isolating from the crude Turkey red oil prepared from castor oil, a small quantity of crystallised dioxystearic acid. The oils obtained by the action of concentrated sulphuric acid upon olive and cotton seed oil are also used in dyeing, and can be divided into a soluble and an insoluble part, the former consisting of a similar sulphuric ether to that obtained from castor oil, and the latter of oxystearic acid and its anhydride, and also small quantities of oleic acid and unaltered oil.

TOOLS AND IMPLEMENTS FOR CHINA.

IT is pretty well known now that there is little use in attempting to introduce into China tools and agricultural implements such as are in use in European countries, and the United States Consul-General at Shangai states that Chinese mechanics and farmers have strong prejudices in favour of the implements which have been in vogue for centuries. Experiments in placing American tools in the market have signally failed, with the exception of saws, pumps, and certain edged tools. The Consul, however, points out that there is no reason why tools and implements fashioned after their own models should not be imported, as they could be made better and cheaper by machinery than by hand.

THE MANUFACTURE OF GLASS IN CHINA.

A CONSIDERABLE quantity of glassware is turned out by the Chinese in Hong Kong, very inexpensive plant being employed, and the material used generally consisting of old glass re-melted. The United States Consul at Hong Kong states that the crucibles used are small, and rarely exceed 200lb. in capacity. These are set in a stove stoked from a small opening in the side, and about 3cwt. of coal is used in melting one crucible of glass. After being blown the glass is annealed in a small square pit containing ashes and straw, the latter being speedily converted into ash by contact with the heated glass. The moulds used are made of clay, and these, together with a small trowel-shaped iron tool and a few iron tubes, constitute the whole of the appliances used by the native glass blowers.

IMPROVEMENTS IN THE WESTINGHOUSE AUTOMATIC BRAKE.

WE are informed by the Westinghouse Company that they have recently improved the rapid action of their automatic brake to such an extent, that the velocity with which it is applied practically reaches that of sound. From experiments made at the works in Pittsburgh, it was found possible to apply the brakes on fifty vehicles in less than two seconds, the last car being 1900ft. from the engine. The speed of application has thus been considerably increased, in comparison even with the best previous records, in which five seconds were required to communicate the action of the brake from the engine to the last car in a train of fifty cars. The result of this acceleration will probably be to increase the average speed of urban trains, the percentage of time lost in stoppages being reduced.

THE METALLURGY OF BISMUTH.

MR. EDWARD MATTHEY, in a recent communication to the Royal Society, has drawn attention to the fact that metallic bismuth frequently contains a small quantity of copper, which very markedly affects the properties of the metal. The removal of these traces of copper by the usual analytical wet process is a tedious and costly operation; but Mr. Matthey has now succeeded in obtaining from cupreous bismuth the metal in a state of purity by a rapid and simple dry process. The metal is first purified from other metals, such as arsenic, antimony, lead, and tellurium, in the usual way, and is then fused with bismuth sulphide. By this means it is easy to remove all the copper, as the sulphur readily combines with the metallic copper present. Large quantities of alloy can be successfully operated upon, so that it is now possible to obtain commercially pure bismuth, wholly free from copper, from alloys containing ·1 to 1 per cent. of copper.

ELECTRIC SAFETY LAMPS.

MORE than two thousand electric lamps are now in use in the coal mines of this country, and we are informed that miners are in favour of the change, as they benefit considerably by the increased illumination. It is many years ago that it was suggested that our coal mines should be lit by electricity, but the use of portable lamps for this purpose has only recently been introduced. We hope that many companies will see the advantage of this method of illumination over the older and more cumbrous forms of safety lamp, and that an extended use of electricity in our coal mines may be a means of diminishing explosions. There is a disadvantage attending the use of incandescent lamps in mines, inasmuch as they offer no indications of the presence of fire damp. It has been found, however, by Mr. Liveing, that a red hot platinum wire glows more brightly in air contaminated with fire damp than in pure air, and this fact has been recently utilised so as to afford a convenient indicator for the presence of fire damp in mines. As the wire can be heated by the current from the same accumulator as supplies the lamp, no additional energy or expense is incurred, and we learn that from experiments with this apparatus, much better and more reliable indications are afforded of the presence of an explosive mixture than when a Davy safety lamp is the only guide employed.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

20th January, 1888.

877. Ashworth & Ashworth Carding engine cylinders.
878. Matthews, S. ..... Machine tools.
881. Ayres, P. P. ..... Safety apparatus for tram engines.
882. Sinkinson, H. H..... Mules.
884. Skipworth, G. P..... Weighing machines.
885. Otter, J. ..... Crane.
892. Briggs, A. H..... Spinning machinery.
904. Goolden & Atkinson... Method of working coal.
908. Ambjörn, P. (Comte de Sparre)..... Punching jacquard cards.
909. Southall, J..... Gas engines.
912. Purves, D., & others .... Boiler plates.
913. Mallinson & Speight.. Machine for splitting belting.
916. Lockerbie, T. ..... Slide valves.
926. Tomson, W. H..... Freezing machines.

21st January, 1888.

929. Fish, G. H..... Apparatus for forcing liquids.
930. Daltry, T. L..... Looms.
931. Hudson, J..... Washing machines.
934. Clegg, J. C. ..... Lineal measuring and registering blocking machines.
942. Blumrich, M. ..... Hydrocarbon engine.
943. Asbury, J. T. H. ..... Exhausters and pumps.
947. Buckley & Taylor..... Governing steam engines.
952. Tatham, R. .... Carding engines.
960. McGee & McGee..... Thread spooling machines.
972. Goüin, J. ..... Trussed girders.
973. Galloway & Beckwith Steam boilers.

23rd January, 1888.

993. Carter, H. W., & others Machine for charging bottles with aërated water.
998. Thomson, A..... Mechanical stokers.
999. Jones, E. J. ..... Calico printing machines.
1000. Hart, A. C. ..... Trollies.
1011. Bailly, J. B..... Sewing machines.
1014. Goolden & Atkinson .. Machinery for working coal.
1015. Barnes & Tangyes ..... Hydraulic duplex pumping engines.
1019. Robinson & Hanff..... Sewing machines.
1020. Anthon, H. T. ..... Apparatus for manufacturing wood wool.
1022. Tatham, R..... Preparing slivers of cotton.
1028. Carr & Carr..... Cable grips.

24th January, 1888.

1035. Thorp, T. ..... Speed and pressure indicator.
1038. Rankine & Hall..... Boiler furnaces.
1043. Irving, J. ..... Looms.
1053. Beal, W. H. ..... Mangling machines.
1054. Rankine, J..... Furnaces.
1056. Peddie, H. J..... Locomotive steam cut-off.
1074. Mills, B. J. B. ..... Warp machines (*Beer & Co.*).
1080. Lake, H. H. ..... Stop motion spinning machines (*Sanford*).
1081. Granger, A. P..... Crushing machines.
1084. Bintcliffe & Parkins.. Stamping, embossing, and printing in colours.
1087. Orlando, S. ..... Steam boilers.
1106. Stone, R. ..... Machinery for grinding.
1107. Tafel, P. ..... Roller mills.
1110. Leak & Wilson..... Travellers for ring spinning.
1111. White, M. H., & others. Spool finishing machine.
1112. Barbour & Berkeley... Spinning frames.
1113. Thomson, W..... Machines for corking bottles.
1114. Hall, B. G. ..... Digging and intrenching tool.

25th January, 1888.

1115. Douglas, G. C..... Driving gear for roller mangles.
1116. Payne, C. E..... Weighing machines.
1120. Michaelis, E., & others Gig mills.
1121. Tweedale, E. ..... Carding engine.
1123. Moseley, J..... Machinery employed in grinding needles.
1132. Betjemann, S. ..... Hansom cabs.
1137. Hunt, E..... Driving gear for twin screw propellers (*Henry*).
1147. Whitney, A..... Drilling machine.
1153. Greenwood, A..... Machines for the compression of gunpowder.
1160. Davey, H. ..... Steam boilers.
1162. Griffin, E. C. ..... Machinery for pulverising ores.
1168. Bell, T..... Superheating steam (*Niven*).
1170. Lake, H. H. ..... Machines for felting hat bodies (*Waring*).
1171. Dunbar, A. ..... Manufacture of casks.

26th January, 1888.

1179. Guest & Brookes ..... Winding frames.
1185. Monteith, J..... Rotary engines.
1188. Cutlan, J..... Manufacture of boots and shoes.
1191. Coster, J..... Ejectors for breech loading fire arms.
1200. Field, H. ..... Fusible plug for steam boilers.
1204. Walker & Heffer..... Range finding apparatus.
1206. Birks & Cropper ..... Embroidering machines.
1217. Durham, F. W..... Combing and carding machines.
1228. Walker, F. W..... Machinery for loading coals.
1229. Gustavus, Baron de O. Breech loading fire arms (*Fortelka*).
1230. Wolf, G. de..... Furnaces for roasting ores.

ELECTRICITY.

21st January, 1888.

932. Thomas & Warwick ... Batteries.
933. Bosshardt, F. ..... Electric clocks (*Bouchet*).
980. Balch, W..... Battery.
981. Spratt, C..... Electric "call."

23rd January, 1888.

984. Burleigh, W. F. ..... Controlling railway signal levers by electricity.
1009. Davies, J. H..... Dynamo-electric machines.
1016. Taylor, A. M. ..... Electrical transforming apparatus.
1024. Pyke & Barnett..... Electric coils.
1029. Wunderlich, A. ..... Rotary galvanic batteries.

24th January, 1888.

1055. Jones & Wright..... Electric safety apparatus.
1078. Bergmann & Dempster Electrical switches.
1100. Downing, G..... Electrical brazing (*Blass*).
1105. Webster, W..... Treating sewage by electrolytic action.

25th January, 1888.

1128. Fortin, A. A..... Galvanic batteries.
1173. Scheithauer, B. ..... Electric induction apparatus.

26th January, 1888.

1177. Mandeville, E. E. ..... Electric batteries.
1210. Andreoli, E..... Chlorine batteries (*Fichet and Nodon*).

CHEMISTRY.

20th January, 1888.

896. Kenyon, H..... Recovery of sulphur, cyanogen, and ammonia.
920. Overbeck, Baron de G. Production of the alkaline metals (*Hornung & Kassmuyer*).

21st January, 1888.

949. Thornton, J. E. ..... Flash lights for photographic purposes.

24th January, 1888.

1082. Weidig & Remmey ..... Absorption towers for the manufacture of muriatic or nitric acid.

25th January, 1888.

1158. Lennard & Eastick..... Purification of anthracene.
1174. Farquharson and Gubbins ..... Removing the tin from tin scrap.

MISCELLANEOUS.

20th January, 1888.

879. Blakeney, W. H..... Gas and oil burners.
883. Adams, S. H..... Ventilating sewers.
886. Whatley, E. B. ..... Regulating by pass cock.
887. Howard, R. T..... Colliers' picks.
889. Fletcher, A. E. ..... Stoves for heating air.
890. Brett, E. P. ..... Ventilating apparatus.
893. Cadbury & Rollason... Locks and latches.
897. Marshall, J..... Dyeing cotton pile fabrics.
899. Morris, F. S..... Railroad chairs.
903. Putz, F. R..... Material for packing.
911. Gordon, T..... Gas lamps and burners.
914. Fisher, R. H..... Centrifugal beaters.
917. Easthope, A..... Bicycles.
918. Easthope, A..... Velocipedes.
921. Ransome, J. E..... Plough shares.
923. Tighe, C. ..... Fog signalling apparatus.
924–5. Lorrain, J. G..... Recording apparatus.

21st January, 1888.

927. Atwater, H. W. ..... Removable jaw for pipe and bolt wrenches.
928. Spencer, A. ..... Buffers for railway vehicles.
935. Turner, S..... Roof tile.
937. Porri, L. ..... Brake.
940. Muter, D. D..... Printing of colour blocks.
944. Rhodes, O. Y., & others Lamp.
946. Haythornthwaite, W.. Alarm apparatus.
948. Bullen, J..... Mouths of carboys.
950. Andrews, E. B..... Safety doors for hoists.
953. O'Reilly, G. J..... Gas burners.
954. Hart, D. R. ..... Screw drivers.
955. Rainey, C..... Winding bobbins for sewing machines.
958. Armstrong, R..... Railway chairs.
964. Craig, A. M..... Argand gas burners.
967. Wood, A. M..... Rubber compositions.
971. Imray, O. ..... Drawing aerated liquid from reservoirs (*Rowlands*).
977. Ashton, J..... Signalling upon railway trains in motion.
978. Benjamin, H..... Storing water in lifeboats.

23rd January, 1888.

985. Burleigh, W. F. ..... Interlocking apparatus for railways.
988. McNab, A..... Bleaching and washing textile fabrics.
989–90–91–92. Priestley, C. H. ..... Rolling boards for piece goods.
996. Allwood, A. R..... Sewing needles.
1001. Milnes, J..... Warming railway carriages.
1004. Wright, G. A. ..... Brick block or slab for building.
1005. Hunnable, A..... Velocipedes.
1006. Barker & Andrews..... Cartridges.
1007. Stone, J. H. ..... Fittings for hose pipes.
1010. Junge & Junge..... Differential screws.
1013. McEvoy, C. A. ..... Projectiles.
1018. Herzog, C..... Carburetting air and enriching gas.
1021. Davies, A..... Automatic lock.
1023. Holliss, C. P. ..... Axletrees.
1027. Lake, H. H. ..... Permutation locks (*Kromer*).
1031. Pain & Craig ..... Signal lights for use at sea.

24th January, 1888.

1036. Lyon, J. S..... Automatic form of "Clements driver."
1040. Irving, J. ..... Appliance for examining the underside of cloth when being woven.
1045. Rose, G..... Lamps.
1050. Whitehead, G..... Lamps.
1059. East & East..... Taps, valves, and hydrants.
1061. Thompson, W. P..... Valves (*Barnett Brass Co.*).
1063. Cottrell, J..... Velocipedes.
1064. Lindon, H..... Bale band fastenings.
1065. Halliday, C..... Oil lamps.
1066. Dölberg, R. ..... Switches for field railways.
1068–9. Dölberg, A. ..... Joints of rails for field railways.
1071. Bowley, A. S..... Improved clutch.
1072. Cory, E., & others ..... Travelling circular saw benches.
1076. Asher, G. M..... Drawing pens.
1083. Don, A. ..... Consumption of smoke.
1085. Newton, H. E..... Chain bolts (*Cleveland*).
1091. Aird, A..... Counting mechanism.
1092. Simpson, W. S. ..... "Sighting" from torpedo boats.
1093. Edwards, J. ..... Supporting pottery during baking.
1094. Purnell, P. ..... Velocipedes.
1095. Ransome & Garrard... Horse rakes.
1098. Albone, D..... Velocipede.
1101. Wallace & Ward ..... Anti-corrosive compositions for submerged surfaces.
1103. Daley, P. ..... Signals on railway trains.

25th January, 1888.

1109. Prescott, G..... Light giving apparatus.
1117. Masters, J. ..... Circular wire brushes.
1118. Galloway, J. J. ..... Packing for stuffing boxes.
1119. Quick, G..... Cartridges.
1122. Campbell & Pomphrey Manufacture of woven gloves.
1124. Moore, G., & others..... Barrel bolts.
1125. Rogers, S. A..... Cellular rubber sheets.
1126–29. Carter, J. E. ..... Gas heating apparatus (*Böhm*).
1130. Freeman & Bunn..... Alarums.
1134. Kuhnt & Deissler..... Gas burners.
1135. Clery, A. ..... "Metallic cement."
1136. Sargeant, T. C. ..... Belt fastener.
1138. Rankin, A. N. ..... Tools.
1146. Hawke & Ford ..... Apparatus for producing water mark on paper, &c.
1148. Rose, S. J..... Safety bicycle.
1149. Rieth, H. P..... Drying the interior of casks.
1154. Eggiman, A. ..... Hollow tiles.
1156. Grimes & Wakefield... Sight feed lubricators.
1161. Capron, A. J..... Purification of sewage.
1163. Stockheim, H..... Filtering beer.
1165. Schütz, A., & others..... Screws.
1167. Lorenz, W..... Cartridge cases.
1169. Saxby, J., & others ..... Interlocking railway levers.
1175. Arnold, J..... Deodorising sewer gases.

26th January, 1888.

1178. Kennedy, R..... Perforating attachment.
1180. Jevon, A. P. ..... Rack and catch.
1181. Anderson & Anderson. Screw cramp.
1192. Erskin, J..... Lamps.
1195. Williams, J. T..... Treating small anthracite.
1196. Rettie, J., & others .... Utilisation of water power.
1197. Brook & Brook..... Catch for securing corves.
1198. McKenzie, P..... Automatic brake.
1199. Brown, A..... Ventilator.
1202. Bagnall & Heath ..... Railway sleepers.
1203. Jackson, T..... Safety lamp.
1205. Wells, J. S. ..... Warp lace fabrics.
1207. Mills, G. ..... Wet gas meters.
1208. Martins & Rocha ..... Railway switches.
1212. Stevenson, J. ..... Winding bobbin (*Lallemand*).
1214. Werner, J. ..... Gauge glasses for steam boilers.
1216. Truffault, J. M. M.... Tricycles.
1219. Stevens & Cunninghame ..... Velocipedes.
1223. Ibbotson, A. B. ..... Railway buffers.
1226. Gower, S., & others ... Oil lamp.
1232. Gosling, C. H..... Artificial fuel.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

28th January, 1888.

988. Lake, H. H. ..... Reversing steam engines (*Knott and Knott*).
1315. Bergh, W..... Centrifugal apparatus for separating fluids.
1350. Roger, G. ..... Cutting piled fabrics.
1526. Bullough, J..... Grinding carding engine cylinders and flats.
2206–7. Scott, D. ..... Cutting the pile of velvets.
2208. Roger, G. ..... Cutting piled fabrics.
2325. Dorman, W. H..... Circular knitting machines
2585. Catlow, C..... Dobbies for looms.
2923. Kershaw, J..... Machines for cutting mouldings
2953. Hawkins, C. ..... Wind motors.
3750. Copeman, E. S..... Life saving rafts.

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3964. West, H. J. ..... Refrigerating machines.
3970. Dixon & Simpson..... Cartridge loading machines.
4058. Thompson, J..... Manufacture of paper.
4073. Rogers, H. J. ..... Manufacture of paper.
4117. Cowburn & Peck..... "Taking up motions."
4328. Knox, R..... Propulsion of vessels.
4343. Lambert, T..... Rotary engines.
4361. Wood & Smith..... Cutting steel wire.
4403. Ross & McDowall ..... Rotary engines.
4419. Jardine & Crawley ... Jacquard needles.
4429. Lewis & Hunter..... Shipping coal.
4432. Pilcher, C..... Apparatus for giving first motion to tram cars.
4454. Lister & Carter..... Looms.
4513. Drury & Smith ..... Road vehicles.
4528. Taylor & Struvé ..... Metal plates coated with tin.
4550-1. Daniels, F. H..... Rolling mills.
4595. Lefert, J..... Balancing two wheeled carriages.
4612. Perkins & Cotton ..... Journal for driving shafts.
4663. Thompson, W. P..... Steam engines (*Smith*).
4693. McQuaker, G. W. ..... Pistons.
4799. Binns, C..... Raising yarns, wool, or cotton.
4811. Hawkins, C..... Wind or fluid motors.
5143. Haddan, R. ..... Sewing machines (*Felix Engel*).
5151. Ford-Smith, W. ..... Grinding twist drills.
5672. Woolley, J..... Warp lace machines.
6176. Husband, A., and others Adjusting the pumping load of a Cornish engine.
11186. Brenton, W..... Mowing machines.
12741. Mullins, G. G..... Puddling.
12813-14. Dampier Hickman, J. Rudder attachment.
14400. Sherman, J. ..... Screw propeller.
15626. Kerr & Kerr ..... Wood working machinery.
16405. Fox & Lombard ..... Machines for moulding boot stiffeners.
17384. Boult, A. J. ..... Magazine guns (*Hartley*).
17573. Arnodin & de Palacio. Transporting loads.
17653. Vine, J. W., & others ... Rag tearing machine.
17793. Thompson, W. P..... Apparatus for extracting the juice from cane (*Man*).
17808. Stratton, E. P. ..... Steam separators.

ELECTRICITY.

28th January, 1888.

747. Wynne, F..... Electric motor.
949. Percival, G..... Electrical switch.
2419. Bosshardt, F. ..... Dynamo-electric machines (*Hillaire-Deshois*).
4546. Abel, C. D..... Dynamo-electrical machines (*Siemens & Halske*).
4553. Dickenson, W..... Electric telegraph.
4914. Smillie, R. D. ..... Electric switches.
7530. Statter, J. G..... Electrical transformers.
15858. Main, W. ..... Dynamo-electric machines.
16032. Main, W. ..... Electromotors.

CHEMISTRY.

28th January, 1888.

4201. Taylor, J..... Nitric acid.
4228. Netto, C. ..... Extraction of aluminium.
4241. Baum, H..... Pyro-sulphates.
4397. Walker & Patterson.. Refining sugar.
4430. Brock, J..... Sulphuric acid (*Lunge*).
15265. Thomas, G. ..... Dye matters (*Schulz*).

MISCELLANEOUS.

28th January, 1888.

704. Hall, H. ..... Coating sheets of iron.
2386. Press, W. B. ..... Cistern valves and water taps.
2776. Crastin & Cunningham Lamps.
3027. Tuteur & Goulborne Leather compositions.
3060. Fines, T. W. ..... Swivel and pivot for leather backbands.
3578. Thorpe, J. E. ..... Velocipedes.
3610. Partridge, E..... Clips for axles.
3834. Webb, A. E., & others... Incombustible wicks.
3855. Berg, J. A. ..... Coupling apparatus.
4029. Barton, C. C. ..... Fluid meters.
4067. Onions, J. T. ..... Utilising waste metal tubing.
4161. Rippingille & Rippingille ..... Lamp stoves.
4250. Rylands, D. ..... Bottles for aerated liquids.
4296. Phillips, R. E..... Velocipedes (*Overman*).
4301. Ribbans, E. C..... Petroleum lamps.
4364. Barrow, E. ..... Bale fastenings.
4386. Bordenave, J. ..... Pipes, tubes, and culverts.
4415. Latham, T. ..... Locks and bolts.
4457. Archer & Wilson ..... Relieving the strain upon ropes.
4509. Sutcliffe & Sutcliffe Bleaching and dyeing textile materials.
4512. Marshall, T. ..... Miners' lamps.
4547. Chadwick & Chadwick Dyeing yarns.
4607. Collingham, R. M..... Manufacture of black lead.
4643. Turner & Douglas ..... Snatch or notch blocks.
4796. Low, R. ..... Projectile for throwing lines.
4845. Rössler & Reinhard... Removing roots from malted grain.
4886. Wybauw, J. ..... Heating by means of gas.
4940. Wallwork, R..... Lubricator.
5150. MacNaught & MacNaught..... Scouring and washing wool.
5255. Priestman & Priestman ..... Manufacture of vapour.
6053. Ridgway & Ridgway... Transfer paper.
6203. Alexander, H. McC. ... Spades.
12620. Rofe, S. J..... Locking railway carriages.
13169. Roberts, J. ..... Oil lamps.
13564. Horn, W. W. ..... Nut lock (*Sylvester*).
13779. Emerson & Midgley ... Belting of woven wire.
13896. Boult, A. J. ..... Dyeing of wool tops (*Alexander*).
15396. Brierley, W. ..... Starting of tram cars (*Jeenel*).
16123. Dobson, J. D. ..... Oil lamps.
16797. Boult, A. J. ..... Wire grips (*Evans*).
17042. Cloud, J. W..... Axle boxes.
17237. Drummond, D. ..... Signal alarums on trains.
17392. Davis & Turner ..... Gas burners.
17400. Struck & Baldwin..... Thill coupling.
17515. Haddan, H. J. ..... Regulating gas burner (*Jackson*).
17524. Pitt, S. ..... Belts (*Mellor & Mellor*).
17646. Macnee, D. ..... Axle boxes.
17683. Harper, T..... Needles.
17737. Bosch, J. A. ..... Car coupling.
17764. Lockwood, W..... Packing rings of pistons.
17783. Lorsewitz & Maass ... Lubricators and dust guards.
17794. Thompson, W. P..... Hinges (*Strachan*).
532. Imray, H. ..... Gas lighting for railways (*Picard*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 21st October, 1887, inclusive.)

Year 1883.

4896. Mathieson, J..... Torpedoes.
4905. Clapp, W. J. ..... Treatment of paper for checks.
4906. Fiechter, E. ..... Centrifugal machines (*Fiechter*).
4910. Fletcher, W. ..... Motive power apparatus.
4912. Clark, A. M. ..... Pipe wrenches (*Taylor*).
4916. Boult, A. J..... Wood turning machines (*Gerry and another*).
4920. Sonstadt, E. ..... Destruction of bacteria, &c.
4925. Coates, J. I..... Signal lamps.
4926. Reddie, A. W. L..... Transmitting electrical impulses (*Tommasi*).
4927. Gabriel, J. S. ..... Paving streets.
4930. Gadsden, H. A. ..... Obtaining aluminium from its ore (*Foote*).
4931. Alexander, E. P. ..... Buckles (*Clough & another*).
4938. Ellis, T. L., & another. Shaft couplings.
4946. Cullen, W. H..... Vacuum pumps.
4950. Dewrance, J. ..... Treatment of asbestos.
4951. Kenyon, H. ..... Illuminating and heating gases.
4953. Gallwey, E. J. P. ..... Indicators of speed.
4964. Brookes, A. G. ..... Transmitting sounds, &c. (*Vail*).
4968. Defty, H..... Heating fluids, &c.
4969. Hinrichsen, S., & ano. Fabrics for lining clothing.
4970. Thompson, W. P. ..... Underground electric wires (*Martin*).
4976. Price, A. P. ..... Extraction of precious metals from their ores.
4980. Hill, E. ..... Anhydrous sulphide of zinc (*Macfarlane*).
4984. Vining, R. W. ..... Checking apparatus for tram cars, &c.
4987. Allen, J. J. ..... Gumming, &c., sheets of paper.
4990. Holmes, G. C. B., & ors. Galvanic batteries.
4991. Somerville, J. ..... Gas.
4995. Parkin, W. H., & ano. Velocipedes.
4996. Knowles, T. ..... Lawn mowing machines.
4999. Ollard, F. S. ..... Fastenings for packing cases.
5001. Allison, H. J. ..... Telegraph insulators (*Hinsdale*).
5002. Allison, H. J. ..... Exhausting air, &c., from suction boxes (*Lord*).
5003. Burghardt, C. A. ..... Reeds for looms.
5008. Lake, W. R. ..... Telephonic systems (*Cederqren and another*).

Year 1882.

4919. Lund, J. A. ..... Synchronising clocks.
4956. Hardingham, G. G. M.. Steam boilers.
4988. Serraillier, A. ..... Electric arc lamps.
4991. Liardet, J. E., & ano... Secondary batteries.

Year 1881.

4592. Millar, A..... Generating electricity.

Year 1880.

4200. Justice, P. M. ..... Explosive compounds (*Prodhomme*).
4206. Worth, T. B..... Velvet pile carpets.
4224. Thompson, W. .... Looms for weaving.
4230. Mackie, S. J..... Explosive compounds.
4244. Cook, R..... Grinding machinery.
4286. Briggs, I. ..... Doubling frames.
4290. Parsons, P. M..... Casting articles in copper, &c.
4291. Swinburn, J. F. ..... Breech loading small arms.
4292. Dawe, D. S. W..... Portland cement.
4298. Gibbons, J. ..... Propelling navigable vessels, &c.
4300. Smith, E. ..... Mowing & grain cutting machines
4304. White, W..... Locks or latches.

Year 1879.

4239. Cook, S., and another... Sizing heralds, &c.
4241. Davison, T. ..... Steam hoisting machinery.

Year 1878.

4148. Stevenson, J. C. ..... Alkali.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Welding Steel.—*W. B. Middleton, Lancaster, Pennsylvania.*—The inventor proposes to weld pieces of steel together by first applying to them a solution of silicate of soda. The pieces thus treated are then heated and passed through the ordinary welding rolls. One claim is made for this process.—No. 15257. November 8th, 1887. 4*d.*

Warping Machines.—*W. G. Bywater & T. B. Beanland, Leeds.*—The purpose to which this invention is adapted is for winding the warp on each section of the complete warp with the same tension, and so obtaining more perfect uniformity in its building. Fig. 1 is a side elevation, and Fig. 2 a front elevation of the mechanism. The warp is wound on to the section B at a uniform speed by means of the friction plate C and the movable friction pulleys C^1, the movement of the pulleys on the plate corresponding with the movement of the presser pulley C^2, which is operated on by the warp as it is being wound on B. The rollers D draw the warp from the bobbins. A horizontal roller E is supported in bearings E^1, which are fastened to endless chains F carried on chain wheels G. These wheels

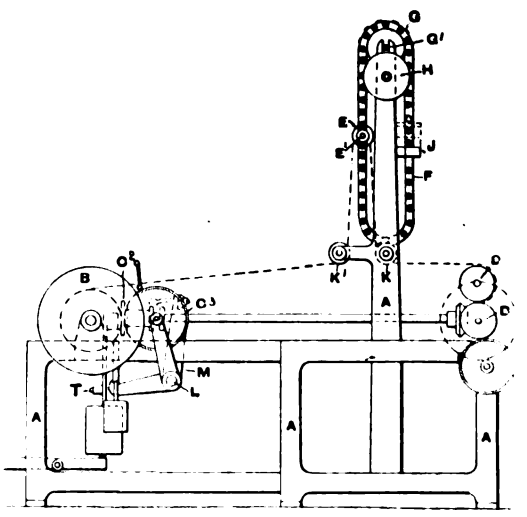


Fig. 1.

are fastened to a shaft G^1, the ends of which rest upon pulleys H. Thus the shaft G^1 is free to revolve, and the chains F and roller E to move up and down. A variable weight J is fastened to each chain. The warp is passed under the roller K, in a vertical direction to the roller E, back again to K^1, and thence to the section B. The warp is subjected to an outward pull between K and K^1, corresponding to the weights J. In order to make the speed of B correspond to that of D, a mechanism is arranged as at L M T. The arm M is fastened to the pressure shaft L, and carries a wheel at its upper extremity; and the other arm, which works loosely on L, is connected to the arm M by a screw, as shown. The other arm

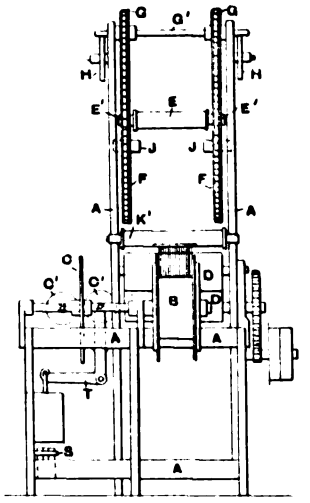


Fig. 2.

also carries a runner stud, engaging between the flanges of the pulleys C^1. By turning the wheel on the arm M, the position of the friction pulleys C^1, on the plate C, may be altered without changing the position of the presser pulley C^2. The inventors claim the application of the movable weighted roller in such a manner as to give a constant uniform tension to the warp.—No. 2140. February 11th, 1887. 8*d.*

Pulverising Machinery.—*W. Boulton, Burslem.*—In accordance with this improvement the machinery is so constructed that the combined effects of centrifugal impulse and impact on the fixed parts of the apparatus shall disintegrate the substance. Through the centre of the feeding hopper extends a vertical shaft, which is driven by a worm gearing at its upper extremity, and which is provided with a series of knives. This shaft and its accessories cause a constant downward feed of the material through a grated bottom, and a lateral delivery of the material which passes through that grating into the pulverising chamber. The upper part of this chamber is made of an eccentric form relatively to the lower part thereof, and is fitted with a removable hard part, which is so disposed that the material flies violently against it on escaping from the limited space between the rapidly rotating arms or beaters and the narrower part of the chamber. The impact thus imparted to the material is effective of pulverisation, and the powder is pressed by the arms through a grating at the bottom of the chamber. The arms or beaters are fastened to a shaft which is driven by a pulley gearing. When hard substances such as flint are operated on, the arms are slotted at their outer ends, and are provided with

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rollers which carry the material round and exert more force on it. When used for grinding a friable substance, the arms consist of a series of depending fixed studs. The inventor makes three claims for the construction of the rotating parts and the case, and for the feeding motions.—No. 2767. February 22nd, 1887. 8*d*.

Manufacture of Iron Bars from Scraps.—*J. Butler, Neath, Glamorgan.*—The object of this invention is to provide machinery for compressing iron or metal scraps, thick or thin, cold or otherwise, for the manufacture of bars. Fig. 1 represents a longitudinal vertical section, and Fig. 2 a plan of the proposed machine. AA are the boxes in which the bundles of scraps are placed, and B^1 B^2 B^3 B^4 are the four plunger heads which, when brought into

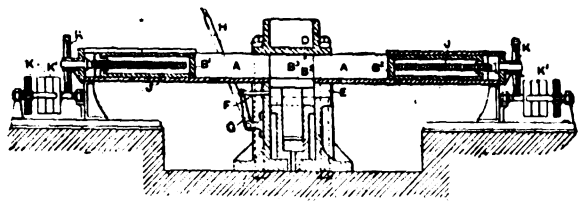


Fig. 1.

position, form the four side walls of the press chamber. B^5 is the lower ram, and E is the aperture through which the compressed blocks are ejected. The ejecting mechanism consists of a sliding bolt F, which is actuated by the lever arm G, and by the hand lever H. The scraps are placed in the receptacles AA, and are driven into the press chamber D by the rams B^1B^2, the ram B^5 being in the position shown in the figures. The motion

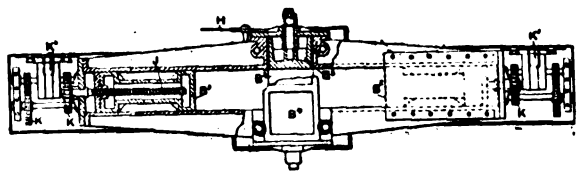


Fig. 2.

of the rams may be effected by the screws J, which are actuated by double purchase gearing K, and driven by belt pulleys K^1. The rams B^3B^4 then come into operation, whilst the motion of B^1B^2 is arrested, and the final pressure is given by the ram B^5. In withdrawing the resulting block of metal, the ram head B^5 is lowered into the position indicated by the dotted lines in Fig. 1, and the block is carried down with it, the hand lever H is operated, and the sliding bolt F performs the ejectment. It is also allowable to use hydraulic or other power for the compression instead of the screw mechanism made use of in this particular case. The inventor claims the employment of the machinery as described, and the combination of rams and screws, and the arrangement for ejectment.—No. 13560. October 6th, 1887. 8*d*.

Loose Reed Motions.—*H. Preston & J. Bennett, Withnell, and J. Lewis & F. W. Jepson, Blackburn.*—The object of this invention is to simplify the construction of the apparatus used for releasing the reed when the shuttle is trapped or caught in the shed. Attached to the stop rod of the loom are two or more projecting fingers, which, when the slay is forward for the beat up, come opposite to and in contact with projecting lugs on a shaft extending across the loom under the breast beam. A partial rotary motion is imparted to this shaft by the slay swords, so that the lugs are turned opposite the fingers on the stop rod at the time the slay is up for the beat. If the shuttle is caught in the shed, the slay sword will not have operated the cross beam, consequently there is nothing to prevent the reed swinging on its cap, the fingers and the lugs passing clear of one another. One claim is made.—No. 1215. January 26th, 1887. 8*d*.

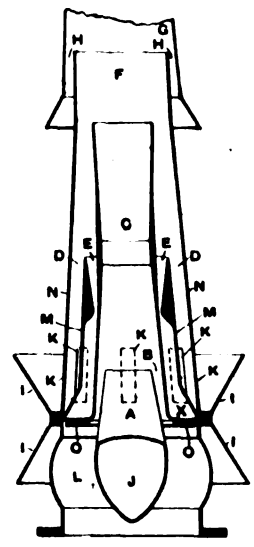
Hydraulic Presses.—*L. R. Bodmer, London.*—According to this invention the hydraulic cylinder and ram are constructed in such a manner as to allow of the renewal of the ram leathers without the removal of the ram from the cylinder. The cylinder is lengthened so as to permit of the ram being lowered from its normal working position sufficiently to expose the leather. A slot is formed in the lower end of the ram, and a stop plate secured to the bottom of the cylinder is formed to fit into the slot. In the normal position of the ram the slot is at right angles to the stop plate; but when the ram is required to be lowered it is turned through a quarter of a revolution, and the slot and stop plate then allow it to sink. A modification consists in raising and lowering the ram from a loose ram top by means of a headed screw spindle screwing into the body of the ram; in this case the slot at the bottom of the ram and the stop plate are dispensed with. The invention also includes a method of removing the damaged leather. A stud which passes through the side of the cylinder is forced inward by a set screw working in a screwed plate; this action presses forward the leather, which can then be removed by a tool. The inventor claims the several ways of lowering the ram for the purpose described, and the method of removing the leathers.—No. 2434. February 16th, 1887. 8*d*.

Smelting Iron Ores.—*H. Gardner, London.* (*R. J. Henderson, Oswego, New York.*)—The object of this invention is to reduce iron ores in such a way as to obtain a malleable metal free from graphite at the first casting. All solid fuel is dispensed with in this process, and the reducing agent employed is pure protoxide of carbon. This gas first reduces the ore, and, afterwards, its combustion with oxygen melts the metal. The apparatus made use of is a form of blast furnace, at the lower end of which are two rows of tuyeres. Into the upper stage of tuyeres carbonic oxide vapour is introduced; the metal produced by this process falls, and is subjected to the action of the blast of oxygen and carbonic oxide from the lower tuyeres, which is sufficient to melt it. The inventor makes four claims for the arrangement of furnace, and for the employment of the particular gaseous agents.—No. 2834. February 23rd, 1887. 8*d*.

Curvilinear Planing Machines.—*B. C. Tilghman & G. Richards, Altrincham, Cheshire.*—The appliance here invented is adapted for combination with a side planing machine, of the kind described in Richards' patent, No. 2260 of 1882. A radius bar is fitted to the machine in such a manner that the tool which is fastened to its end receives its longitudinal motion and cutting force from the overhanging arm, and at the same time the tool is free to slide in the arm, so that it may be made to traverse a curved path by the combination of these motions. The tool post is fastened to the radius bar in a way which allows the tool to retain the proper angle of clearance with the work during the whole stroke. Different degrees of curvature are obtained by varying the distance of the pivot of the radius bar from the tool, and by sliding the radius bar on the pivot box. By giving the radius bar two pivots, which move in slots placed at an angle with each other, the tool may be made to describe ellipses and other curves. The vertical and horizontal feeds may be automatic or given by hand. The inventors make one claim for this combination.—No. 2930. February 25th, 1887. 8*d*.

Shearing Machine for Cutting Hot Blooms.—*J. H. Wicksteed, Leeds.*—This invention relates to vertical shearing machines constructed with a series of live rollers for conveying the bloom from the cogging mill to the shears. The improvement embodied in this invention consists in arranging the face of the shears at 180° relatively with the feed and the delivery rollers, and in feeding the bloom into the shears on the side where there is no obstruction from the fixed bolster. The feeding rollers may therefore be brought close enough to the line of cut to convey into the shears the short remaining piece of the bloom after the longer portion has been severed from it. The roller frame which feeds the bloom is hinged and balanced, so that it will dip as the upper steeling of the vertical shear descends, and recover its level upon its ascent. The gauging stop is disposed on the same side as the fixed bolster, and can be more readily made to reach close to the line of cut when gauging short pieces. Claim: A vertical bloom shearing machine, served by live rollers, in which the bloom is fed into the machine on the side opposite to the fixed bolster.—No. 3340. March 4th, 1887. 8*d*.

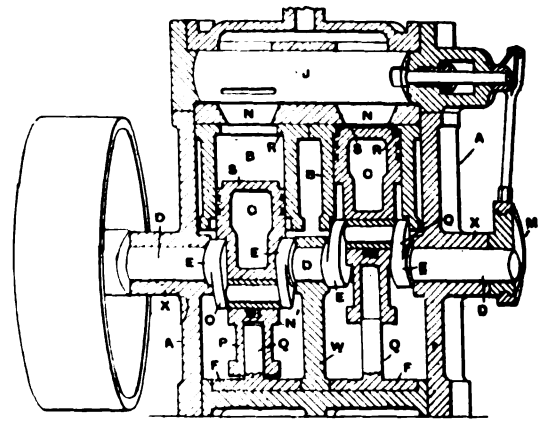
Blast for Locomotives.—*J. V. Smith, Doylestown, Pennsylvania.*—The object of this invention is to prevent the back pressure on the piston caused by the blast, and to secure a means of regulating the draught produced in the flues. The accompanying figure represents a section of one form of apparatus described in the specification. A is the central air passage communicating by induction passages J with the space surrounding the apparatus, B the annular steam space communicating with the steam supply, C the confining flue into which the blast of steam from B is delivered. A confining passage F surrounds this inner ejector A B C, and between C and F is arranged a second ejector, which includes an air inlet D and an annular



steam passage F. The products of both ejectors are delivered into F, whose exit opening is within the third confining chamber G, between which and the flue F a space is formed constituting the air inlet H. The steam issuing through the nozzles B and E operates to draw the air and gases through the passages A and D, and the mixture takes place in the passage F. The tube M is enlarged or tapered at its bottom, and provided with a flange and secured to the base L, and the outer casing N is provided with a series of inlet openings K. The chamber E at its lower end is free from obstruction, and opens directly into the base L; and in like manner the air space D is unobstructed, and opens through the ports K to the space surrounding the apparatus. An annular valve O for regulating the draught is mounted on cams, to which the valve is connected by links, so that when one or more cams are oscillated the valve will be caused to reciprocate laterally and vertically, and will be brought against its seat with a rubbing movement. The valve is prevented from sticking by a mixture of steam and oil, the corrosive nature of this compound being obviated by coating the sliding surface with asbestos or glass. The inventor makes twenty-five claims for the various combinations and modifications.—No. 15573. November 14th, 1887. 11*d*.

Injectors.—*J. Thiry & G. Chantrenne-Soiron, Brussels.*—This invention consists of certain improvements which enable an injector to be brought into operation by a single device. The plug of the steam jet is formed of a conical plug and of a valve. The conical part has an axial bore, and is extended below in the form of a hollow cylinder. The valve slides in this cylindrical portion, and its travel is limited by suitable guides. The valve carries at its forward end a plug of conical form adapted to close the axial bore. The central portion of the valve consists of a toothed rack, and its lower end forms a tongue sliding in a suitable guide in the casing of the injector. A toothed pinion mounted on a shaft operated by a hand lever gears with the rack and gives the required motion to the valve. When the plug is set firmly in the steam nozzle the lever is turned for a short distance, by which means the valve is drawn back and the steam is enabled to pass through the central bore in the plug; when the action of the injector commences the lever is turned further until the valve arrives at its rearward limit in the cylindrical extension of the plug; the continued motion of the lever then draws back the whole of the plug, and the injector attains its full action. The inventors make two claims.—No. 2827. February 23rd, 1887. 8*d*.

Steam Engine.—*D. D. Hardy, Chicago.*—This invention relates to direct acting steam engines, and its special object is the balancing of the parts. The diagram represents an oblique vertical section through the axes of both the cylinders. The two cylinders B are formed in such a way that they may slide horizontally in the casing A. The sliding plates F are connected by pillars and springs with the cylinders, and participate in their motion; and the pistons C take hold of the crank pins directly without the intervention of a connecting rod. The caps N^1 of the pistons carry springs, which press the journal box to the crank pin, thus preventing pounding at high speeds. The caps N^1 are also elongated to contain guides P, which slide



in the standard Q. The simultaneous reciprocations horizontally and vertically of the cylinders and pistons permit of the revolution of the cranks. The springs in the standards which connect the cylinders with the plates F tend to force the cylinders against the surface of the casing, and thus a steam tight joint is maintained between the two. Also the shoulders R are formed in the top of the cylinders to reduce the area of the opening of the cylinders at the ends, thereby producing an upward pressure when steam is in the cylinder, tending to force the cylinder against the casing. The cranks are placed 180° apart, and the weight of the pistons thus balance each other in all positions. The weights of cylinders are to be equal, and also the parts of the pistons above and below the crank pin. The plates F and standards are also proportioned to balance the cylinders. The valve gear consists of an eccentric which causes the cylinder J to oscillate and admit exhaust steam in a well known manner. The inventor makes six claims for the several methods and combinations.—No. 15673. November 15th, 1887. 8*d*.

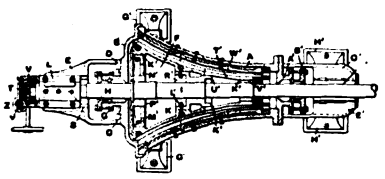
Utilisation of Iron Stone Waste.—*L. A. Brode, Glasgow.*—The object of this invention is the utilisation of iron stone waste and similar ferruginous material by preparing briquettes of the waste material for use in the smelting furnace. The waste is thoroughly mixed with Armenian bole, which contains a silicated oxide of iron. This mixture is rendered cohesive by a liquor formed by boiling ground rice in water, together with a small quantity of silicate of soda. This plastic mass may then be moulded into briquettes, which are suitable for smelting in an ordinary blast furnace along with the ordinary ore. There is one claim for the process described.—No. 2999. February 26th, 1887. 4*d*.

Boiler Flues.—*E. Earnshaw, sen., E. Earnshaw, jun., & T. Davies, Heywood, Lancashire.*—This invention relates to the flanged circular seamed joints of steam boiler furnaces and flues, and its object is to reduce the liability of the flues to collapse. The two flanged edges, together with the strengthening ring, are to be welded together into a solid joint. The joint thus obtained will be stronger and more perfectly steam tight than the riveted joint hitherto employed, and there will, moreover, be no rivets to get out of order. The inventors make one claim for this construction.—No. 3010. February 26th, 1887. 6*d*.

Hydraulic Motors.—*E. Pombas, Rheims, France.*—This invention relates to mechanism employed in the utilisation of water currents for the propulsion of boats or other purposes. The device is based on a system of four rods arranged in the form of a parallelogram. Let A B C D represent the four rods, A and C being equal and greater than B and D, and generally assuming a vertical position, while the plane of A B C D is always vertical. In one point of its length the rod C is pivoted to the frame work, and the rod A extends downwards to the water, its lower extremity being provided with a float. The arm D is also extended, and forms a connecting rod by being jointed to a crank. The action of the mechanism is begun by the float descending and coming in contact with the current of the water. The float thence obtains a longitudinal motion, which is communicated through the system of rods to the crank. The revolution of the crank supplies the motive power for the purposes mentioned. As the propelling force only strikes the float at one part of its path, it is necessary to have a series of floats and parallelograms arranged in a row, or side by side, in such a manner that no dead points shall occur in the revolution of the propelling shaft on which the cranks are fixed. An adaptation of the mechanism is applicable to the steering of the vessel. The inventor makes three claims for the mechanism and its adaptations.—No. 15786. November 17th, 1887. 8*d*.

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PULP ENGINES.—*W. W. D. Jeffers, Ticonderoga, New York, U.S.A.*—The inventor's method of constructing and adjusting the grinding rollers is illustrated in the accompanying diagram, which represents a horizontal section of the machine. The rotary grinder F is of conical form, and of separate sections, which are bound together by the bolts L¹. The axle upon which the hub P¹ fits is slightly larger than the part of the shaft upon which R¹ fits, so that the first can be slipped on over the smaller part by shrinkage, and the hub R¹ afterwards similarly fitted and shrunk on. The section T¹ is composed of one piece, and fits upon shoulders U¹. It is confined in its place by a ring V¹, which is shrunk on the part of the shaft which is less in diameter than the other parts. The surface of the grinder is



provided with parallel longitudinal teeth, which co-operate with similar teeth on the removable sections secured in the shell. The adjusting mechanism is supported by the semi-tubular extension E. The end of the shaft is provided with a series of annular grooves, which fit inside similar grooves in the box L. The extension E is provided with longitudinal ways S at each side, in which slide the lateral flanges of the box L so as to guide the box longitudinally as it is moved by the adjusting mechanism. The handle shown in the figure turns the worm wheel, which causes the gear V to revolve. This motion imparts a sliding movement to the box L, and thereby to the shaft I. A wheel Z serves to clamp the worm wheel after the correct adjustment has been made. The inventor makes three claims for the removable sections of the shell, for the grinder, and for the adjustment of the grinder.—No. 15543. November 14th, 1887. 8*d.*

ELECTRICITY.

INDICATING THE SPEED OF SHAFTS.—*R. P. Fuge, Youghal.*—This invention is applicable more particularly to the shafts of marine engines, and serves to indicate the direction and speed of revolution. A dynamo is driven from the shaft by means of belt gearing, and the two poles of the generator are connected with the terminals of the indicating device. This indicator is some instrument such as a voltmeter, which measures the strength of the current generated by the dynamo. The movement of the index on the dial plate of the voltmeter thus indicates the varying speed and direction of the rotation. The inventor makes one claim for this application of generator and indicator.—No. 15977. November 21st, 1887. 6*d.*

DYNAMO-ELECTRIC MACHINES.—*R. E. B. Crompton & J. Swinburne, Chelmsford.*—In dynamos a large proportion of the magnetising force is spent in overcoming the air resistance between the armature and the poles of the field magnet, and when this space has been reduced, the poles often become heated. This invention provides a means for reducing this space, so that a very small magnetic force on the field magnets is necessary to magnetise the armature nearly to saturation. In the case of the cylinder armature in the "Crompton" dynamo, a space is allowed between the outside of the armature and the pole pieces sufficient to admit of the requisite amount of wire being wound on. In this invention the field magnets are relatively small, and the wire is not wound on the outside of the armature, but passes through holes which are punched through the discs near the outside edges. These holes are punched at such distances apart that there is enough section of iron remaining to admit of the induction due to the field magnets. Another form of machine made according to this invention is a ring armature of square section. The field magnets take the form of thick slabs, which cross the sides of the ring so that the axle goes through the centre of the magnets. In this case the wire of the armature passes through holes bored radially in the ring. The wire that comes out at one hole passes round the periphery of the ring, and then passes in at another hole, crossing over inside to the first hole again, and so on. This invention is also applicable to a very large number of types of armatures. The inventors make ten claims. —No. 17120. December 31st, 1886. 8*d.*

INDICATING SPEEDS AT A DISTANCE.—*J. G. Statter, London.*—The object of this invention is to improve the apparatus for determining speeds, which consists of a transmitter and an indicator connected by an electric circuit and battery. The invention is based on the fact that when a dynamo-electric machine is run at varying speeds on an open circuit, it generates a current whose electromotive force varies with the angular velocity of the armature. The speed of rotation can thus be indicated by measuring the electromotive force. The shaft whose rate of revolution is required to be ascertained is coupled by belt gearing to a dynamo, and the current thereby generated is led by a circuit to a voltmeter, which serves to indicate the electromotive force and hence the speed of the revolving piece. By this method the closing push operated by hand and the winding up of the springs are dispensed with. The inventor makes three claims for the application and combination of the dynamo and voltmeter for the purpose described.—No. 2990. February 25th, 1887. 6*d.*

CHEMISTRY.

EXTRACTION OF GOLD FROM ORES.—*C. T. J. Vautin, London.*—The invention here described consists of improvements in the process and apparatus described in the specification of Patent No. 4609 of 1887, granted to the same patentee, in conjunction with J. C. Newbery. The pulverised auriferous material is treated with chlorine, applied as gas or in solution, under a pressure greater than that of the atmosphere. This process is carried out in a closed chamber, which is caused to agitate its contents by rotation. The chamber is connected with an air force pump, and is otherwise capable of being hermetically sealed. After the material has been exposed sufficiently to the action of the chlorine solution the chamber is tipped, and its contents emptied into a filtering vessel. Here the auriferous solution is drawn through the filtering medium by means of suction produced by a suction pump, which is so constructed as to produce in every stroke a partial reflux through the filtering medium of the withdrawn liquid charge. The filtering medium is thus cleansed and kept free from choking. From the suction pump the auriferous solution is discharged into a suitable vat, through which air or steam is passed, and afterwards is allowed to penetrate successive beds of charcoal. The solution is here rapidly decomposed, and the gold is deposited on the charcoal. The inventor makes six claims for the combination of air compressor and hermetically sealed rotating vessel, with the filtering vessel and reflux suction pump, and the beds of charcoal, as described.—No. 15574. November 14th, 1887. 8*d.*

KIESELGUHR DYNAMITE.—*E. Grüne, Unterlüss, Hanover.*—When kieselguhr dynamite comes in contact with water, the nitroglycerine is violently expelled from the kieselguhr. In order to obviate the inconvenience and danger arising from this circumstance, the inventor mixes certain quantities of vegetable or animal carbon with the kieselguhr, or carbonises such substances as starch, sugar, glue, &c., in kieselguhr. It is found that this mixture is not affected by its contact with water, and that the frozen cartridges may be thawed in warm water. It is possible with kieselguhr carbon to blast under water without surrounding the cartridges with any case, and the loaded blast holes may be rammed with water. There is one claim.—No. 16116. November 23rd, 1887. 4d.

FLUORIDES OF MAGNESIUM, STRONTIUM, AND BARIUM.—*A. Feldmann, Hanover.*—The production of these fluorides is effected by treating the chlorides with the fluoride of calcium during the application of heat. The process may be carried out in either the dry or wet way. Instead of using the anhydrous chloride of magnesium, it is more economical to employ the double chloride of magnesium and potassium. The inventor makes two claims for the dry and wet process respectively.—No. 15295. November 9th, 1887. 4*d.*

MISCELLANEOUS.

PULSOMETERS.—*A. G. Brookes, London.* (*M. Greeven & Co., Düsseldorf.*)—The first part of this invention relates to the valves of the steam vacuum pumps known as pulsometers. Fig. 1 represents a vertical section taken through the pump chambers P. The valves L I are fitted in the cases L¹ I¹ respectively, and the lever J has at each end a link J¹, which

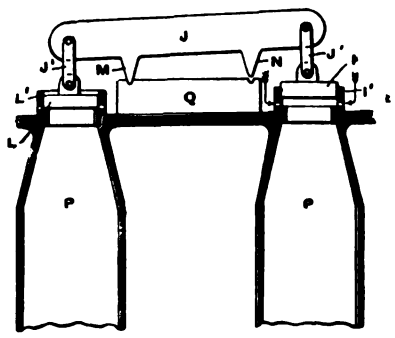


FIG. 1.

serves to lift and lower the valve. Two pegs M N are provided on the under side of the lever J, and they alternately act as fulcrums for the lever whilst it lifts the valve L or I. The second part of the invention is connected with the main forcing chamber of pulsometers. The liquid is first caused to pass through a forcing chamber worked by steam before entering the pump chamber. Fig. 2 shows an arrangement of parts designed in accordance with this invention. A is the first chamber and B the pump chamber, C the suction pipe, D the valve to the suction pipe C, and E the valve controlling the

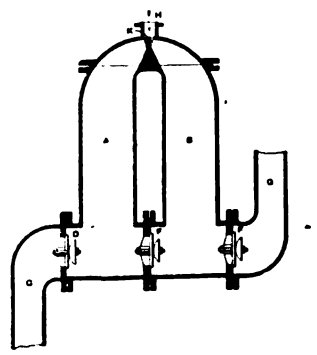


FIG. 2.

passage of communication for the pumped liquid between the chambers A and B. The valve F controls the passage of liquid through the discharge pipe G, and H supplies the steam for forcing and condensation; K is the valve for distributing the steam. If the chambers A B are filled with water, and if K be in the position shown, the water will first be driven by the steam from the chamber B into G until the condensation takes place. The valve K then changes its position, and the steam is allowed to force the water from A into B. When the condensation takes place in A, the valve K changes position again and opens communication afresh with B, and the water is forced into the discharge pipe G, whilst A receives a fresh supply of water through C. This completes the cycle of operations. The inventor claims: (1) The rocking lever; (2) the parts and combinations of parts of the lever; and (3) the arrangement of the chambers A and B.—No. 3151. March 1st, 1887. 8*d.*

WASHING TEXTILE FABRICS.—*E. B. Petrie, Rochdale, & R. Wild, Littleborough.*—This invention consists of the manufacture of a mixture for washing and scouring all sorts of textile fabrics. This mixture is composed of sub-borate of soda, soda ash, chloride of soda, soap, phosphate of soda, caustic soda, and hyposulphite of soda, in certain proportions. In the bleaching process the inventors make use of a somewhat similar mixture; and modifications are introduced into the composition of the mixtures, to adapt them for household use. Four claims are made.—No. 7550. May 25th, 1887. 6*d.*

SPINNING MACHINERY.—*T. Bentley & S. Makin, Oldham.*—This invention relates to improvements in apparatus described in Patent No. 5319 of 1883, and has for its object the simplification of the said apparatus and the counterbalancing of certain parts in order to reduce the strain on the sliver yarns. In the accompanying drawings, Fig. 1 is a cross section of part of a

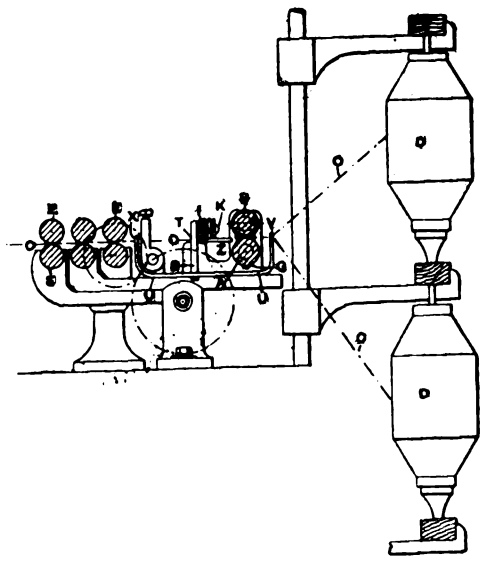


FIG. 1.

slubbing frame, and Fig. 2 is a plan view of the same machine on a larger scale. A shaft A supports another roller B, and between these two the sliver yarns pass as they come from the bobbins D. Longitudinal projections G are formed upon the periphery of the roller A, and to accommodate such projections the roller B is reduced in diameter where necessary. The extensions Y and Z of the arms I thereby permit of shortening. For the counterbalancing of these arms I, two sets of such arms are now employed, and are mounted upon a single stud K at the back of the bars T. Instead of bars extending the length

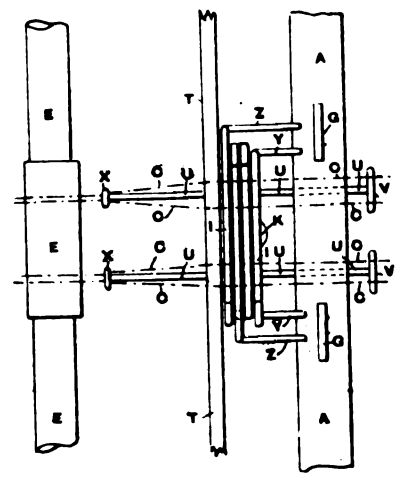


FIG. 2.

of the frame behind the drawing rollers, the inventors substitute a bracket S, secured to the under side of the remaining bar T and provided with a pair of arms U, one projecting backwards to the rear of the shaft A, and there provided with a pair of eyelets V to receive the two separate yarns C, and the other projecting forwards and provided with a single hole X to conduct the two sliver yarns together to the drawing rollers E. The inventors make three claims, for the longitudinal projections on the back roller, for the counterbalanced arms, for the arrangement of the bracket and eyelets, as described.—No. 4674. March 29th, 1887. 8*d.*

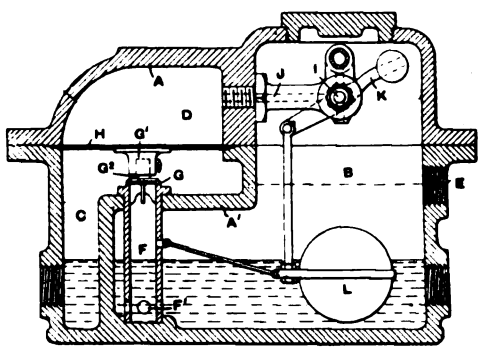
REFRIGERATING MACHINES.—*A. Conacher, Augusta, Georgia, U.S.A.*—These improvements refer to refrigerating machines, in which cold is obtained by exposing water to a high vacuum, and by passing the vapour from the water over the surface of sulphuric acid, as described in Provisional Specification No. 1181 of 1887. The acid vessel is made of iron, provided with an inner coating of enamel or aluminium. A furnace is placed beneath this vessel for the concentration of the acid after it has been weakened by the watery vapour. The vessel is so arranged that the acid is never removed from its container for the purpose of

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re-concentration, and one supply of acid may thus be used for a considerable time. The acid is divided by a central partition, to assist in the agitation of the acid during the absorption of the water, and to prevent the formation of a thick upper layer of weak acid, which would retard the freezing operation. Pipes connect the two divisions of the liquid, and are placed in a slanting direction away from the partition; they are closed at their ends, and are provided with perforations, so that when one end of the vessel is raised the acid from the lower part of the raised end may be carried up into the other compartment, and through the perforations drop on to the surface of the upper layer of acid in that compartment. At each end of the vessel are domes, which are the continuations of the vessel, by which flexible pipes are connected with the pump and freezing vessel respectively. The pump is fixed to the upper part of the framing of the machine, and the acid vessel is underneath the pump. The valve plate is formed with annular apertures, and intermediate grooves, so as to reduce the bearing surface of the valve disc thereon. The inventor makes three claims: For the coating of the acid vessel, for the application of the rocking acid vessels to refrigerating machines, and for the construction of the rocking vessels.—No. 2319. February 14th, 1887. 8*d*.

Manufacture of Textile Threads.—*A. M. Clark, London.* (*M. P. E. Gérard, Paris.*)—In producing textile threads from viscous and pasty materials, such as gelatine, by forcing them through holes in a cylinder, the chief difficulties to be overcome are the agglomeration of the material round the orifice and the disinclination of the material to coagulate after the operation. The present invention has for its object the obviation of these hindering circumstances. The medium in which the operation is conducted is to be water or some gas depending on the nature of the material. The substances which the inventor more particularly makes use of are those which have a base of gelatine and gun cotton. The medium in this case may be superheated steam or ammonia. The inventor makes three claims: (1) For the general process of using a gaseous medium for the purpose described; (2) for the application of superheated steam; and (3) for the use of ammonia as described.—No 2695. February 21st, 1887. 6*d*.

Steam Traps.—*P. Fyfe, Glasgow.*—This improvement renders steam traps intermittent in action as regards the discharge of the accumulating water. A longitudinal vertical section is shown in the figure. The casing A is divided by means of a web A¹ and a disc H into three compartments B C D. To the main compartment B, the water and steam from the vessel to be drained is admitted by an inlet E, while the compartment C serves as an outlet for the water discharged from B; the compartment D is intermittently and automatically placed in communication with the steam space of B. A tube F extends into



the compartment C, and forms the seating for a valve G, through which the water is discharged from B when at a sufficient height. Upon the admission of steam to the vessel D, the disc H bears down on a flanged piece G¹, screwed to the upper end of the valve spindle G², and thereby closes the valve, whilst upon discharge of the steam from the compartment D, the pressure is relieved, and the valve is raised by the steam above the water in B. The alternate admission to and discharge from D is effected by a three-way cock I, placed in the pipe J, which forms the connection between B and D. The lever K and float L serve to operate the cock. When the water level in the trap is low, and the float in the position in the figure, the chambers B and D are connected by the pipe J. When the water rises to the dotted level, the cock is turned into a position which closes communication between B and D, and opens D to the atmosphere by means of another tube connected to the cock I. The pressure on H is thus relieved, and the valve G is opened, and the water forced out of the trap until the level is reached at which the float turns the cock to its previous position. The inventor claims the combination of discharge valve, pressure chamber D, diaphragm, three-way cock, and float.—No. 15345. November 10th, 1887. 6*d*.

Refrigerating Materials.—*G. Downing, London.* (*H. T. Baeschlin, Montpellier, France.*)—The refrigerating materials are manufactured in a form so that they may be kept ready for use at any time. A non-conducting absorbent substance, such as cotton wadding, felt, jute, &c., is caused to absorb by pressure a mixture of refrigerating salts, for example, ammonium nitrate or sal ammoniac. The crystals of these salts may be either produced within the fibres after the latter have been immersed in a solution of the salts, or several layers of the material may be impregnated with solutions and the water subsequently evaporated. In the latter case the crystals assume the form of a crust, which is then distributed uniformly by means of mechanical pressure. In applying these refrigerating materials medically, one side of the compress is wetted. The imbibed water gradually penetrates the material, producing a continually increasing cooling action. The inventor suggests the advantage of a comparatively dry cooling process here obtained over the usual method by the application of ice; and a perfectly dry cooling effect may be produced by the interposition of an impermeable fabric. There are two claims.—No. 3843. March 14th, 1887. 6*d*.

GERMAN PATENT ABSTRACTS.

Safety Lamp.—*Julius Jaff, Vienna.*—This invention relates to the improvement of safety lamps for miners. The sides and upper parts of the wire gauze D are provided with a cover E, made by coiling a string of hollow iron or steel beads A round D. This string is shown in Fig. 2. The object of this cover is

Fig. 1.

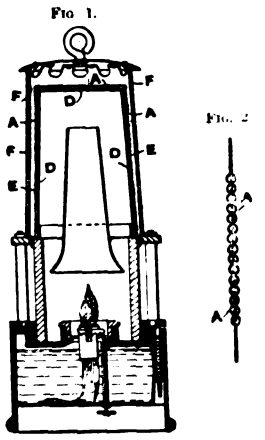


Fig. 2

to prevent the flame of an explosion inside the lamp from being communicated to the surrounding gases. The access of air to the inside of the lamp can be prevented by shutting the slides F.—No. 41755. May 21st, 1887.

Compressors.—*C. Hasemann, Berlin.*—This invention relates to an automatic valve gear for compressors. The inventor uses slide valves, which are adjusted by means of a link. The difference of pressure of the compressed air in the valve casing, and

Fig. 1.

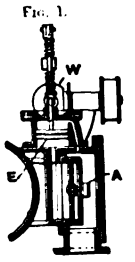


Fig. 2

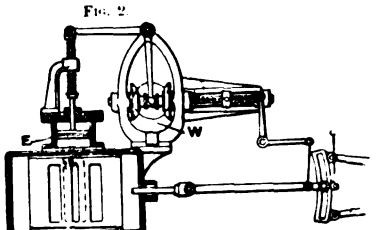
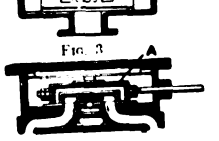


Fig. 3



in the cylinder, is used for moving the piston E, which actuates the slide valve A, thereby regulating the degree of compression. In small compressors the motion of E is directly communicated to A, but in larger machines a gearing W driven by an engine, and a combination of levers, is arranged for that purpose.—No. 41681. March 8th, 1887.

UNITED STATES PATENT ABSTRACTS.

Manure Distributor.—*M. P. Faris & H. A. Falls, Bethany, South Carolina.*—This apparatus is in the form of a wheelbarrow upon three wheels. The hopper in which the manure is placed has one of its ends made adjustable, so as to regulate the rate of distribution. The two large wheels are connected by an axle, which passes through the hopper near its bottom. The axle carries a central distributing wheel, which consists of a series of radial knives fastened to the axle. As the carrying wheels rotate, the central wheel feeds the manure out of the hopper on to the ground.—No. 375807, dated 3rd January, 1888.

Hinge.—*F. P. Bailey, Indianapolis.*—The hinge is composed of two end plates, which are fastened to the ends of the two pieces of wood to be jointed. The corners of these plates, which form the centre of rotation, are rounded off, and in each plate is a pivot pin. A link is pivoted to the plates by means of these pins, and other pins one in each plate slide in circular slots which are formed in the link concentrically with the pivot pins. This method of forming the hinge tends to reduce lateral strains in the screws which hold the plates to the wood.—No. 375792, dated 3rd January, 1888.

Harvesters.—*L. Miller, Akron, Ohio.*—The modifications in the self binding harvesters introduced by this invention include a needle arranged to operate in a vertical plane oblique to the grain carrier movement, a system of packers whose path of motion is oblique to that of the grain delivering apparatus, and a mechanism for turning the grain and delivering it to the packers. Other parts made use of in this machine are described in the specifications of Patents No. 276448, 290459, and 293345. There are twenty-two claims.—No. 371698, dated 18th October, 1887.

Fish Trap.—*J. Brosch, St. Louis.*—This invention consists of an illuminated bait receptacle for submergence in water. A lamp is encased in a water tight glass globe, and two vertical concentric chimneys rise up over the globe for the purpose of supplying air to the lamp, and of taking away the products of combustion. Outside the lamp globe is another transparent casing, between which and the globe is suspended the bait. This apparatus is designed for use in the night fishing industries. The inventor makes six claims for the combinations.—No. 373333, dated 15th November, 1887.

Machine for Screw Threading Tubes.—*A. Saunders, Yonkers, New York.*—Fig. 1 represents a partial sectional view of the machine embracing this invention, and Fig. 2 shows a vertical transverse section, in a plane at right angles to that of Fig. 1. In the standards C are horizontal grooves C¹, in which are fitted the splines D¹. These splines are on the side of the cage D, which carries a chuck. The tube to be operated on is placed within the sleeve B¹, which is shown in Fig. 2. The vertical guides F² fit into grooves in the edge of a frame E, which holds the upper and lower gripping jaws E¹ and E² of a gripping chuck. The upper jaw E¹ is suspended by a screw A², which extends downwards through the central space of a double nut. The screw bolt I¹ is turned by a hand lever passing through its head, and the revolution of this screw tends to raise the frame E and the jaw E², and at the same time to lower the jaw E¹ in the frame. This mechanism is intended to improve the method of gripping the tube. The externally threaded sleeve B¹ extends forward into the rearmost part of a sleeve F, which is provided on the rearmost side of a face plate F¹. At the inner

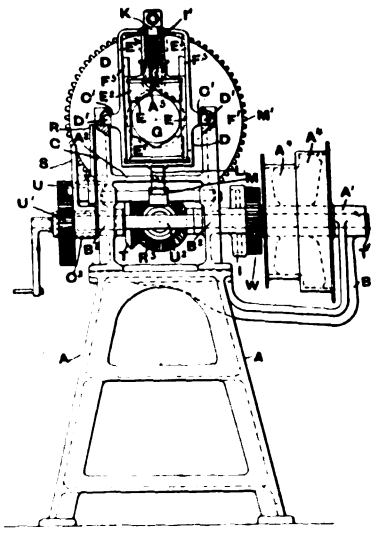


Fig. 1.

end of the sleeve F are rectangular sockets, in which are placed the parts of a sectional nut H¹. The inner surfaces of the sections are threaded to act in connection with the screw thread of the sleeve B¹, and are fastened by means of bolts to the cam ring G, which may be turned round the axis of the tube by a lever. The rotation of the cam ring depresses the nut sections, and makes them gear with the thread B², and thereby enables the sleeve B¹, together with the chuck, to be moved inward or outward by the rotation of the sleeve F. The tube to be operated on being thrust between the chuck jaws, and any suitable screw threading mechanism being secured upon the

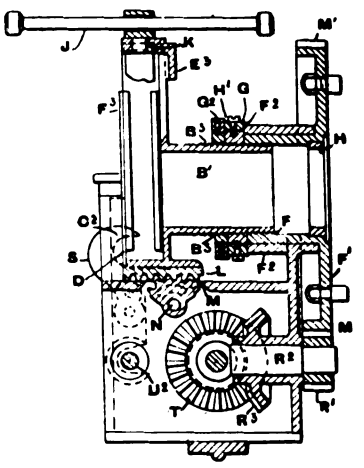


Fig. 2.

face plate F¹, the rotation of the face plate F¹ causes the nut sections to feed the sleeve B¹, and, consequently, the tube to be threaded. The motion of the face plate is communicated to it by the cogs M¹, which gear with shaft R¹, and the gearing R² R³ T T¹ drives this shaft. In order to move the sleeve B¹ inward or outward, the rack L is provided at the bottom of the cage D, gearing into a toothed quadrant M, the shaft N of which carries an operating lever R. The shaft may thus be rocked, and its motion causes the longitudinal movement of the sleeve B¹. The inventor makes twelve claims for the combination of face plate, sleeves, nuts, jaws, and their respective feed motions. —No. 372490, dated 1st November, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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HIGH PRESSURE TURBINES.

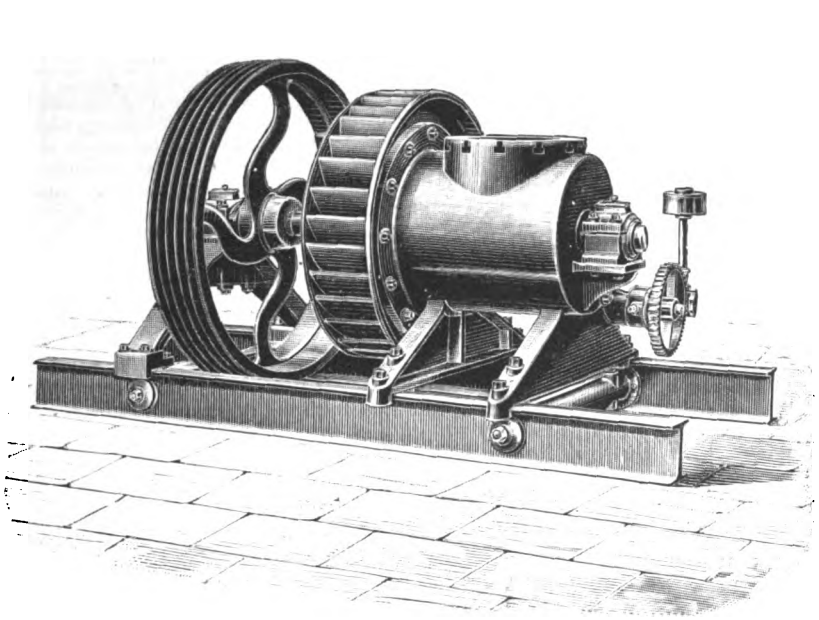


Fig. 1.

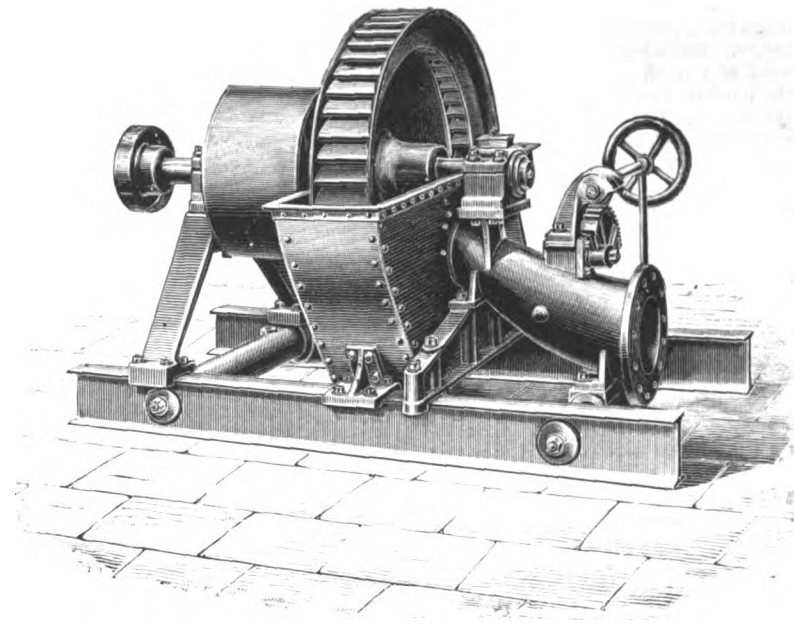


Fig. 2.

HIGH PRESSURE TURBINES.

For a high fall, the Girard turbine has the advantage of a comparatively low speed, due to the fact that the diameter of the wheel can be made as large as desired. The water issues from the guide blades with the full velocity due to the fall, but without pressure, and thus partial admission is possible. This type also admits of perfect regulation without materially reducing the efficiency of the machine. Lastly, its position above the tail water is an advantage, because it facilitates examination and repairs when necessary. The two horizontal shaft turbines shown in our illustrations are of the Girard type, with partial admission, and have been constructed by Mr. Charles L. Hett, Turbine Foundry, Brigg. Fig. 1 is a turbine recently forwarded to Mexico for driving a cotton mill. It is designed to work under a medium fall of 48ft., the water being supplied by a 15in. pipe, and admitted into the horizontal cylinder shown on the right of the turbine wheel. In this cylinder, and within the wheel, are the distributing ports, which are covered by a segmental gun metal valve, with cogs cast on its back. A pinion, driven by the worm and wheel shown on the right, gears into these cogs and regulates the flow of water through the wheel. The regulating gear is controlled by a governor. This governor is placed on the floor above the turbine, and only the lower part of the regulating rod, with a coupling ready for connection to the length above, is shown in the engraving. Hand gear is also added for regulating purposes. The diameter of the turbine wheel is 2ft. 8in.; it runs at two hundred revolutions per minute, and develops 40 h.p. The water outlet is directly under the wheel, the turbine being fixed a few inches clear of the tail water level. To protect the turbine, and to keep the cotton ropes, which transmit the power, free from water, the whole is boxed in with a wood casing, not shown in our illustration. The power is taken off, by cotton ropes, from a 4ft. grooved pulley, and transmitted to a 5ft. 4in. pulley on a lay or intermediate shaft. The turbine is fixed on a pair of wrought iron rolled girders, as shown, the ends of which will be built into the masonary walls of the turbine well.

The turbine shown in Fig. 2 is another example of a partial Girard turbine, supplied for working mining machinery in Bolivia, under the exceptionally high head of 440ft. All parts are therefore very strongly made. The distributor, valve, and turbine wheel are of specially tough gun metal; the main shaft is of steel, with extra long gun metal bearings. The pulley is of wrought iron, and is 24in. diam. and 15in. wide, with two sets of arms. This turbine is one of a pair which are to work together, the ends of the shafts being coupled together by the flange coupling shown on the left. Each turbine is supplied by a 14in. pipe, and runs at a speed of 577 revolutions per minute, developing 80 h.p. The diameter of the turbine wheel is the same as that of Fig. 1. Also in this case the turbine is fixed to wrought iron beams built into the wall. The turbine is protected by a wrought iron casing, of which only the lower half is shown in our illustration. The regulating gear is worked by a hand wheel through a worm and segment. As an approximate rule for the speed of Girard turbines, it is customary to reckon that the wheel has about half the circumferential speed of that which a body would acquire when freely falling from a height equal to the head of water. In the present cases, the circumferential speeds of the wheels at the entrance to the buckets are 27·9ft. and 80·2ft. per second, the speeds of a falling body being respectively 55·5ft. and 168ft. In the first case the ratio of circumferential speed is therefore about ·50, and in the second case ·48, thus showing that the above approximate rule is well borne out in actual practice.

UNIVERSITY EXTENSION AND TECHNICAL EDUCATION.

By Henry Dyer, C.E., M.A.

III.

(Concluded from page 105.)

The West of Scotland affords opportunities for the practical study of almost every industrial art, profession, or trade. Glasgow and neighbourhood, with its immense engineering establishments, shipbuilding yards, and manufactories; Lanarkshire and Ayrshire, with their coal, iron, and steel industries; Paisley, with its artistic textile productions, and many other districts with specialties, all afford opportunities for gaining practical experience, such as are not elsewhere to be met within such a small compass; so that if we had an organisation similar to that which I have suggested, we might do much not only to maintain and extend our manufactures, but also afford to the world an example of the training which is best suited in all departments of industrial art. Organisation, however, must be looked upon simply as a means, not as an end: it must be arranged to assist and guide local effort, not to cramp it or supersede it. The greatest possible liberty, consistent with the general object in view, must be left to the local bodies and institutions, and even to individuals, so that originality may be encouraged and diversity of training produced. Science shows that all progress is from the homogeneous towards the heterogeneous, and the greatest fault of all modern educational methods is that they attempt to reverse this, and produce a dull level of uniformity; and this tendency, if not checked, will end in intellectual stagnation.

Agricultural education is not usually included under an ordinary scheme of technical education; but there are no reasons why it should not, as the subjects to be taught and the methods employed are very similar to those required in what are usually considered industrial departments. In the Glasgow and West of Scotland Technical College we have therefore arranged a course of study for agricultural students, and the classes this session are, I believe, the largest in the United Kingdom. If we had local classes in the different districts for training students in the elements of the subjects, and a few bursaries in each parish to bring up some of the best scholars to the day classes of the College for a session or two, and, lastly, if our most distinguished students could obtain a University degree, I believe that in a very short time there would be a marked improvement in agriculture throughout the country.

We have heard a great deal about the necessity for improved commercial education recently, and I believe that there is as much need for it as for that which is usually considered technical. It *is* technical, and should form part of every scheme of technical education, as many of the scientific classes would be of great use to merchants and others. In the Glasgow and West of Scotland Technical College no special courses of instruction have as yet been arranged for commercial men, although many of the classes are taken advantage of by those who either are engaged or intend to engage in commerce. As the College develops and means increase I have no doubt, however, that arrangements will be made for the systematic education of merchants, either in the College itself, or in an institution affiliated to it and the University. Sir Philip Magnus, in his recent paper on "Schools of Commerce" (*Contemporary Review*, December, 1887), has shown how our existing educational machinery may be modified to meet the demands of commercial education, so that I need not enter into this part of the subject, beyond remarking that the place occupied by many of the special schools on the Continent might be filled to a large extent by the recently founded University Colleges, or by such institutions as the Glasgow and West of Scotland Technical College. The Governors of the latter College have no wish to create a large monopoly under their charge, and are anxious to utilise the work done by any institution when that is of a high order. For instance, in Glasgow we have the School of Art and Haldane Academy. That institution has governors of its own, but arrangements have been made for the recognition of its classes in those parts of the College curriculum where art subjects are necessary, so that, while retaining its independence, it is for all practical purposes a part of the College.

Hitherto the subjects included under any of the university extension schemes have been chiefly of a literary or purely scientific nature, and I trust that those will be continued and extended. An exclusively technical system of education would soon lead to disastrous results. Men would become keen machines for cutting down prices to the last farthing, and what Walter Besant calls the "law of elevenpence ha'penny" would become universal. Pure science, literature, and social politics must always form an essential part of every man's education, so that he may raise himself above his mere selfish interests, and be able to look around on his wider interests as a citizen and a member of the State. Professor Huxley, in his recent address at Manchester, touched on this aspect of the question with his usual sound common sense. After pointing out what was required from a technical point of view, he said: "We have to consider what other matters there are for us to attend to, what other arrangements have to be kept carefully in sight in order that pursuing these ends we do not forget that which is the end of civil existence, that is a stable social state—without which all other measures are merely futile modes of going faster to ruin;" and after entering into details of several parts of the subject, he added: "There comes yet one other question which, I think, is of profound importance, perhaps of more importance than all the rest, and on which I earnestly beg to be permitted to say some few words, and that is not in the strict sense of the word an educational question. It is the need, while doing all these things, of keeping an eye—an anxious eye—upon those measures which are necessary for the preservation of the stable condition of the population, which is the

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object of all education. You will all recollect that some time ago there was a great scandal, and a very great outcry, about certain cutlasses and bayonets which had been supplied to our troops and sailors. These warlike implements were polished as bright as rubbing could make them; they were very well sharpened; they looked lovely. But when they were applied to the test of the work of war, they broke and they bent, and rather hurt the hand of him that used them than did any harm to the enemy. Let me apply that analogy to the business of education as a sharpening and polishing process. You may develop the intellectual side of people so far as you like, and you may confer upon them all the skill that teaching and instruction can give; but if there is not underneath all that outside form and superficial polish the firm fibre of healthy manhood and earnest desire, your labour is absolutely in vain."

If people would only free themselves from the fetters of mere words, and look at actual facts, conditions, and requirements, much more rapid progress would be made. If they looked upon a university, not simply as a building in which certain professors taught, but as a national institution or organisation for the advancement and spread of useful knowledge of all kinds, in which, while high positions were secured for men of great ability, willing workers of all kinds would be cordially welcomed, for the work to be done is certain to increase largely, and to be very varied both in nature and standard; if they considered "technical education" only as a small part of the work of that organisation, which ought to be developed in due proportion to the other parts, then we might have more logical efforts, and consequently more efficient results. In these articles I have sketched in outline a scheme which in my opinion would meet the demands of the times, and to show that it is no mere fancy, I have explained what is being attempted in Glasgow and the West of Scotland, in order that it may become a reality for that district, and which, with slight modifications, will be applicable to any part of the United Kingdom.

INSTITUTION OF MECHANICAL ENGINEERS.

The forty-first annual general meeting of this Institution was opened on Thursday, the 2nd inst., at the Institution of Civil Engineers; the president, Mr. Edward H. Carbutt, occupying the chair. From the annual report of the Council presented to the meeting, it appears that the membership at the end of 1887 was 1741, as compared with 1674 at the end of the previous year. The receipts during the year amounted to £5,753. 15s. 7d., and the expenditure to £4,787. 10s. 8d., leaving a balance of £966. 4s. 11d. The capital of the Institution amounts to £20,501. 3s. 2d. The report stated that the further series of experiments arranged by the research committee on friction, for determining the friction of a collar bearing, have now being carried out, and the report prepared. A report is in course of preparation in connection with the research upon riveted joints. Some progress has also been made by the research committee appointed to draw up a standard system of marine engine trials, and preliminary work is being done by the committee appointed to inquire into the value of the steam jacket.

The President, in commenting upon the report, congratulated the Institution upon the net gain of sixty-seven members, and upon the value of the papers read during the year. He specially referred to Mr. Wyllies' paper on "Triple Expansion Marine Engines," and stated that a number of steamers were now being altered to triple expansion which had previously been idle. He also called the attention of the meeting to the important recommendations of Lord Morley's committee on guns, which were to the effect that the mechanical work of the Government should be placed in the hands of trained mechanical engineers, instead of leaving it under the entire control of military men. As a member of Lord Morley's committee, he was strongly convinced of the necessity for this change, and he intended to urge it upon the Secretary of State for War.

The first technical business of the meeting was the discussion on Mr. John Richards' paper on "Irrigating Machinery on the Pacific Coast," which was read at the previous meeting of the Institution on the 30th September, 1887, and an illustrated reprint of which will be found on pages 3 and 27 of our current volume. The discussion on this paper was short, and considering the large amount of practical information which the author had placed before the Institution, of comparatively little importance. One of the most interesting facts brought out during the discussion at the previous meeting was that adduced by Professor Unwin, who showed how hydraulic pressure could be used to balance the weight of a heavy vertical spindle, such as is required in centrifugal pumps when placed in a pit (see Fig. 2 on page 4). The author had made use of the one sided thrust on a shrouded wheel for taking part of the weight; but Professor Unwin showed how the weight could be taken by a kind of hydraulic footstep, consisting of a cylindrical cast iron box filled with water, and through which the spindle passes. The box is divided by a circular disc on the spindle into two compartments, and the water in the lower compartment is prevented from revolving by radial plates fixed to the bottom and sides. Similar radial plates are fixed to the disc, and thus when the shaft is in motion the water above the disc is rotated, whilst that below remains stationary. Owing to the action of centrifugal force, unequal pressure is therefore exerted on both faces of the disc, and by suitably choosing the diameter of the disc any desired upward thrust could be produced. To show how powerful this arrangement is, Professor Unwin stated that with a box only 18in. diam. an upward thrust of 1½ tons was obtained. The friction is only about half that of an ordinary footstep. Professor Unwin also drew attention to the fact that the centrifugal pump is simply a reversed turbine, and as turbines show the same efficiency at higher heads as at lower heads, it was reasonable to expect centrifugal pumps to be equally efficient for high and low heads; but the fact was generally overlooked that no single machine could be adapted to great variations of conditions, and therefore centrifugal pumps should be constructed specially for each case. He considered that the low efficiency of the centrifugal pump had arisen chiefly from two causes. The first was that the pump was expected to adapt itself to the motor, instead of the motor being adapted to the pump. The efficiency of the centrifugal pump was very closely connected with the diameter of the pump; and the friction of the pump increased something like as the fifth power of the diameter; whence the waste of work, which was almost entirely friction in the pump, increased very fast if the pump was made of too large a diameter. The second cause of low efficiency was the absence of proper arrangements for utilising the kinetic energy of the water leaving the pump disc. In pumps with shrouded vanes the water between the stationary casing and the pump wheel was put in rotation by the friction of the outside surface of the revolving pump wheel. Consequently the ordinary proportion of pressure or head at the joint round the inlet orifice was only one-fourth what it was at the outer circumference of the wheel; and therefore, although there might be a slight gap at the joint, any leakage at that point he thought was not really a very serious matter.

To these remarks of Professor Unwin, the author of the paper replied by a letter, which was read by the Secretary, and in which he pointed out that in the case of a single inlet pump shrouded wheels caused an axial thrust equal to the area of the inlet multiplied by the discharge pressure. When two or more such wheels were compounded the rotation of the water outside the wheels had to be prevented by baffling vanes or fixed guide blades, in order to destroy centrifugal effect, and so permit the water to return to the centre of the second wheel. The axial thrust of the pump discs was not well understood. A wheel of 24in. diam., without the vanes on the back, would, when working against a head of 40ft., sustain an axial pressure on the back of more than 7000lb. This was opposed by less than one-half as much pressure on the front face, leaving what might be called a destructive force pulling the wheel and spindle towards the front of the inlet face. The pressure resulting from the impact of the entering water on the front of the receiving face, and the gradually increasing pressure on this face from the central inlet to the circumference, were subjects well deserving attention from a scientific point of view; as was also the pressure at different points of the pump casing from the central axis to the circumference, which, so far as Mr. Richards knew, was a matter not yet treated in any literature upon this subject.

Mr. Davey thought that the centrifugal pump (Fig. 5) could not give a high efficiency. Such a pump should have a free vortex; but in this case the water was baffled with the object of compelling it to leave the first pump and go to the second, and then it was baffled again to go from the second to the third. Guide vanes had been put in pumps with the object of utilising the energy in the vortex; but unless properly disposed, they did more harm than good. Guide vanes were useful if they were above the free vortex, and not too many were put in. With regard to the collar bearing, he did not consider it suitable for carrying heavy weights. When bearings of that kind had failed he had used the "onion" bearing, introduced by Messrs. Easton & Anderson, which was entirely submerged in oil, and being free did not bind the spindle in any way. It was not so with an ordinary collar bearing, which had to perform two functions, viz., support the load, and also centre the spindle. In one case he took out a thrust block that had given trouble and substituted an onion bearing of only a third the surface, and he never had the slightest trouble with it afterwards. The principle of balancing the weight of a centrifugal pump wheel and shaft by one sided water pressure was by no means new, having been introduced by Messrs. Easton & Anderson in one of their earliest designs, in which the wheel was hung from the onion bearing attached to the overhead girders; and to the same girders were attached the suspension rods of a circular disc covering the upper surface of the wheel, with just sufficient clearance round the rim to prevent excessive leakage. Thus the pressure was taken off the top of the wheel, and whatever small quantity of water leaked into the disc was allowed to escape to the inlet of the wheel through the openings near the shaft.

Mr. Mair, after pointing out that the diagram criticised by Mr. Davey referred only to a proposed pump, and not to one actually constructed, drew the attention of the meeting to the comparative efficiency of reciprocating and centrifugal pumps as affected by the lift. On a lift of 22ft. the efficiency of a reciprocating pump might be taken at 55 per cent.; but for higher lifts up to 100ft. the efficiency increased very rapidly, whilst for lower lifts than 20ft. it was very low indeed. On the other hand, the efficiency of the centrifugal pump was high at moderate lifts, and decreased rapidly for high lifts. If the curves of efficiency be plotted as affected by the lift we obtain two curves, the crossing point of which indicates that lift for which both kinds of pumps are equally efficient. Speaking from memory, he thought that this lift is about 35ft., but the point is also affected to a certain extent by the consideration that with a reciprocating pump we must have an engine of low piston speed which in itself may be less efficient than the high speed engines usually employed with centrifugal pumps. The speaker, however, did not say what was the size of pumps which he compared, and as it is obvious that the efficiency of a centrifugal pump does not only depend upon the lift, but also upon the quantity of water to be raised per minute, his limit of 35ft. can hardly be considered as universally applicable. He also pointed out that for very low lifts of say about 10ft., centrifugal pumps become again less efficient, and that the best machine for raising water is then a scoop wheel, preferably of the form devised by Sagebien, the celebrated French engineer. The efficiency of these wheels may reach 80 or 82 per cent.

Mr. Richards, the son of the author of the paper, drew the attention of the meeting to the way of balancing the weight of the pump by water pressure, and asked whether similar arrangements had been previously used. To this question Mr. Schoenheyder replied by saying that Mr. David Thompson, twenty-five years ago, had already employed this principle, not only to balance, but even to overbalance the weights, so that there was an upward thrust on the collar bearing.

Mr. Wm. Geipel then read a paper on "Prospects of Electricity as applied to Engineering," which we reproduce on page 146, and the discussion on it was opened by Mr. Fearfield, of Stapleford, who reminded the members that before long they would have to take up the subject of electrical engineering as one of the regular branches of their profession. He himself had already devoted considerable attention to electric lighting and transmission of energy, and had found that electricity possessed all the advantages claimed for it in Mr. Geipel's paper, but that the author had neglected to point out one important matter, which in certain cases might seriously counterbalance the advantages, viz., the cost of repairs to electrical machinery, and especially to the armature and commutator. He had several dynamos running in his own works, and found that the commutators wore and required renewing, the cost of repair being £4 to £8, and in one instance even £10 per armature, which originally only cost £18. It was important not to oil the commutator too much, so as to avoid its flashing round; whilst on the other hand, if allowed to run dry, the copper dust would find its way into the armature and destroy the installation. In his experience the cost of electric lighting depended entirely on the size of the installation. In Nottingham the Corporation supplied gas at 2s. 4d. per thousand cubic feet up to a distance of nearly eight miles from the gas works, and the electric light might be either slightly cheaper or very much dearer than gas light, according to the number of lamps installed in each works. In some large installations it was cheaper, and to obtain an equal amount of light from gas at the same annual expenditure, the gas would have to be sold at 2s. 1d. per thousand; whereas in the smallest installations the expenses increased rapidly, making the equivalent in gas nearly 7s. per thousand. He found incandescent lighting specially suitable for his lace factories, where, besides conducing to the better health of the work girls, there was the absence of dirt, a better light, and a saving of spoilt stock, on account of the absence of dust on the lace. To show how easily and quickly electric lighting apparatus can be fixed, the speaker mentioned that when on the occasion of a party given in a house adjoining their factories some electric lights were required, two men ran the leads and fixed twenty-four glow lamps in the garden in front of the house within two hours. The lights were worked for two nights, and were taken down afterwards within the space of an hour and a half. Mr. Fearfield also referred to the question of safety, and criticised adversely the statement in the paper that 600 volts is the

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upper safe limit of pressure for electric tram cars. He thought the day had already gone by when electricians considered 2000 volts an excessive pressure, and that currents of 10,000 volts will in future be looked upon as perfectly safe. It was, in fact, very much the same as with steam. In the early days of steam engineering a pressure of 10lb. per square inch above the atmosphere was considered high, but now they work with 160lb. and 200lb. in perfect safety.

On Friday, before resuming the discussion, the Secretary read some letters received on the subject. Among these was one from Mr. Albion Snell, in which he criticised the author's statement that 70 per cent. efficiency had been obtained in the Kriegstetten-Solothurn transmission plant. In his opinion the actual efficiency should only be taken at 50 per cent. Another letter from Mr. Thomas Urquhart described the electric welding process as carried on at Dr. Bernardos' works in St. Petersburg. As we have already described this in our columns we need not reproduce this letter, but would simply state that some of the specimens shown to the meeting could by no means be called samples of good welding. The two pieces of metal were simply fused together on the surface. An interesting application of cutting metals by Dr. Bernardos' process was, however, mentioned. This referred to a proposal to cut up an iron bridge which had fallen into a river, so that the separate pieces might be lifted. It appears that by passing the carbon pencil under water, along any metal surface, the latter can be cut by fusion, and thus the whole bridge could be cut up into manageable pieces.

The discussion was opened by Mr. Shoolbred, who indorsed the author's statement that the electric power business will in the near future become of greater importance than the electric light business, and he contended that for this reason local authorities, if they establish electric lighting stations, have no right to adopt any system which precludes the use of electricity for motive power purposes. In making comparisons between the cost of electric and gas lighting, the circumstance was generally overlooked that hitherto the former was carried out on a comparatively small scale, whereas the number of lights supplied from a gas works was hundreds and thousands of times larger than those in an electric installation. If they found that even under such disadvantages the electric light supplied from isolated small installations became comparable in price with gas lighting, it is only reasonable to suppose that if all these separate installations were concentrated in one central establishment the cost of lighting would be reduced below that of gas. The author had mentioned Messrs. Jagers' sugar manufactory, and Mr. Shoolbred wished to draw attention to the large installation which is now in use at Messrs. Tait's sugar works in the east of London. This had grown from a small beginning eight years ago, when only a few arc lamps were used, to its present dimension. The incandescent lamp is employed throughout the works, and no gas at all is used, although the works are close to the Beckton gas works. Messrs. Tait employ about 1000 men in their London works, and so satisfied were they with the economy and convenience of the electric light that they erected a similar installation in their Liverpool works, where an equal number of hands is employed.

Mr. Magnus Volk asked the mechanical engineers not to look upon electricity as though it were a rival, but rather to regard it as a useful adjunct to the forces which form the basis of engineering. Electricity simply serves to transmit power from one place to another, but can in nowise generate power. Electrically propelled trains could climb steeper gradients than those drawn by a locomotive, and the cars on a downward slope would return power to the system to assist cars on the upward slope. On his own line at Brighton, which is nearly a mile long and contains some heavy gradients, the motors were put under the floor of the car, and the power was transmitted by leather link belts. The repairs were trifling. The first motor which began running, in April, 1884, had only one set of new bushes after three years, and the life of a belt is about four years. He considered that 10 per cent. would cover depreciation, renewals, and repairs. On this line gas engines are used for driving the generators, and the actual working expenses during the past four years, including gas, oil, and waste, amounted to £430. 13s. 7d. The repairs to the gas engines (refacing of slides, packing, &c.) amounted to £16. 7s. 5d., and repairs to the dynamos and motors amounted to £64. 5s. 6d. The total mileage of the cars for the last four years was 94,000 miles. The working cost per car mile is 2·1d., including 1·02d. for gas, oil, and waste, ·04d. repairs to engines, ·16d. repairs to dynamos and motors, and ·7d. wages.

Mr. Holroyd Smith objected to the author's statement that in America the practice and in England the science of electrical engineering are further ahead. He thought that both in science and practice the Americans led the way. An American would generally accept the first solution of a problem and carry it into effect without loss of time, whereas an Englishman would always seek for some better solution, and end by not doing the work at all. Another reason why electrical engineering is progressing much faster in America was the tolerance of the people towards new enterprises, which in England would meet with continual opposition on the score of unsightliness or inconvenience. He thought that the colossus Brush machine used in the Cowles aluminium process was a striking example of the perfection of American engineering, and when last in New York he was shown a closed box, which the owner assured him would without application of power or batteries transform high tension continuous currents into low tension continuous currents. He could not say how this was done, but it had certainly not been done in England. He also thought that the Thomson welding process was far better than that devised by Dr. Bernardos, which would prove an absolute failure. Referring to his electric tramway at Blackpool, Mr. H. Smith wished to correct the statement of the author that his cars were driven by worm gearing. As a matter of fact he had only employed worm gearing on a car which was sent to France, but on the Blackpool line the first motion was by internal spur gearing, and the second motion by chain gearing. To tighten the chain the internally geared wheel could be shifted round on a centre coinciding with that of the armature spindle, and the jerk at starting was taken off by a spring connection between the chain wheel and its spokes on the car axle.

Dr. Hopkinson described his system of overhead conductors, to which we made reference in our article on the Lineff tramway. He also pointed out that the property of self regulation on a shunt wound motor was not peculiar to the Victoria type of machine, but was shared by many others. The reason why the machine was self regulating was not only on account of the low resistance in the armature, but also because the brushes had to be set with a backward lead, and as the current increased the strength of the field was slightly decreased, which was the very condition required for obtaining constant speed under varying loads.

Sir James Douglas thought that electrical engineering had not progressed so slowly in this country as was made out by the previous speakers. In his own experience the weak point of installation was rather with the motor than with the dynamo, and this tended to delay progress. His work had been in the development of electric light for lighthouses, and it appeared that the light had a power actually beyond what was required, and the only thing that mariners complained about was that at times they had too much light.

Mr. Crompton strongly opposed the views put forward by Mr. Holroyd Smith with reference to the comparative merits of English and American practice. All the great improvements in dynamo machines had originated in England. The largest dynamo in the world had been made by himself, and unlike the Brush colossus, which was designed to develop 400 h.p., but only developed 200 h.p., his own machine had actually developed the 500 h.p. for which it was designed. The first time he had used an electric furnace, he could hardly believe that such intense metallurgical action was going on in the small box he had before him; but when the operation was finished, they found that direct from the charge of corundum they had obtained a large ingot of aluminium bronze, containing about 50 per cent. of aluminium. He thought mechanical engineers were hardly aware of the enormous future which was before the new industry of electrical engineering.

Mr. Cochrane directed the attention of the meeting to the beautiful and ingenious turbo generator devised by the Hon. C. Parsons, and of which a description appeared in our issue of 13th January.

Mr. Thomas Gower referred to the electrical service on the North Metropolitan Tramway, where during six months 30,000 car miles had been run, and over 300,000 passengers carried. He was not prepared to give the cost per mile, but he thought that as accumulators became improved the cost would not stand in the way of electric traction. From any depôt in which they could put a dynamo, and a steam engine or a gas engine, they could run storage cars, whereas with any system of conductor they would first have to specially prepare the road and conquer the prejudices of the local and central authorities.

Mr. Kapp confirmed the author in his statement regarding the efficiency obtained in the transmission plant at Solothurn, notwithstanding Mr. Snell's letter. The discrepancy was due to a misconception on the part of Mr. Snell. When measuring the commercial efficiency of a system of transmission it was unfair to take as a basis the power which the turbine could give. They must take the power which the turbine actually did give, and compare it with that actually obtained at the other end of the line. The experiments were carried out by a committee of scientific men, and from an advanced proof of the report which had been sent to him by a member of the committee, he found that the commercial efficiency of the plant was not 70 per cent., as stated by the author, but actually 75 per cent. Referring to the very mysterious apparatus which Mr. Holroyd Smith had seen in America, Mr. Kapp thought it was probably a continuous current transformer of the type originally invented by M. Gramme, and lately taken up on a large scale by an English firm of electricians. He had himself tested this apparatus and found the efficiency to average 90 per cent. Referring to Dr. Hopkinson's ingenious system of overhead conductors for tramways by which the difficulty of crossings was overcome, Mr. Kapp pointed out that quite recently an underground system had been developed which has the same advantages. This was the invention of Mr. Lineff, who had laid down an experimental line at the Chiswick depôt of the West Metropolitan tramways. As we described this in our issue of last week, we need not report Mr. Kapp's explanation of the system.

Mr. Henry Davey objected to the use of electricity for underground pumping, partly on account of the difficulty of reducing the speed from the fast running motor to the slow running pumps, and partly because such pumps must often work when completely submerged. For this reason he preferred the application of hydraulic power. He thought that electric transmission of energy would come into extensive use only in such cases where the distance was great.

Mr. Mordey said that although at the present time electricians generally are aware that a shunt wound dynamo makes a self regulating motor, when his curve was published very conflicting views were held by electricians on this subject, and only a week previously Dr. Frölich had published an investigation on self regulating motors, in which he completely missed the most important point. For a long time a theory advocated by Professors Ayrton and Perry was current, according to which in a motor the armature should be very large, and the field magnets small and weak. This theory he considered now exploded, the best dynamos making also the best motors. He thought that English electricians always made inventions, but seldom utilised them. This was left to American electricians, who thus reaped the benefit of our own scientific progress.

After a few remarks from Mr. Shippey on the use of fire damp as a source of motive power, the discussion terminated.

Mr. Geipel, in his reply, thought that Mr. Fearfield must have been particularly unfortunate in his dynamos, in which the armatures were continually scrubbing, the commutators wearing, and the brushes sparking. He had experienced none of these difficulties in the many installations which had come under his own care from time to time; in which the attendants were not even skilled mechanics, but only labourers. He did not think the size of an installation above a certain minimum had so much to do with the working expenses as the number of hours the light was required annually. If the time of lighting exceeds one thousand hours, the cost per lamp hour is fairly low; but when the lights are only required for a few hundred hours, the cost became very great. The advantage an electric motor has over the steam engine is that it can exert a very much greater static effort when the load is suddenly increased. With a steam engine, the turning movement on the crank shaft is limited by the dimensions of the cylinder and the steam pressure; but with an electromotor there is practically no limitation, provided there is a sufficient supply of current on the mains.

The President, in proposing a vote of thanks to the author, congratulated the meeting upon having listened to a paper which was a fairly complete *résumé* of the present position of electrical engineering, and he thought that the advances made in electrical science would put abundant work into the hands of mechanical engineers, and thus benefit their profession.

NOTES ON FOUNDRY WORK.

By the Author of "Pattern Making."

(Continued from page 85.)

XII.

Flasks.—Foundry flasks or moulding boxes are stout frames of cast iron for enclosing the sand in which the moulds are made. They are therefore of every conceivable shape and size, but they may be divided into two main classes, viz., boxes for general use and boxes for special use. The first ones are mostly made of rectangular shape, both square and oblong, and of different dimensions. The depth is approximately proportional to the area, and is rather small in comparison to some of the work moulded in the boxes. Thus, when deep castings have to be made, the necessary depth is usually obtained by the superposition of several shallow "middle parts," two, three, or four of them being usually kept in stock for each top and bottom part. The "top" or "cope" A (Fig. 67), is always made with vertical "bars" or "stays" A^1, the "bottom" or "drag" B (Fig. 67), with flat bars A^1, the "middle" C (Fig. 67), without bars, but having a fillet B running round the internal bottom edge, and sometimes also round the top edge. The relative position of the flasks when the mould is complete is as follows; B is

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NOTES ON FOUNDRY WORK.

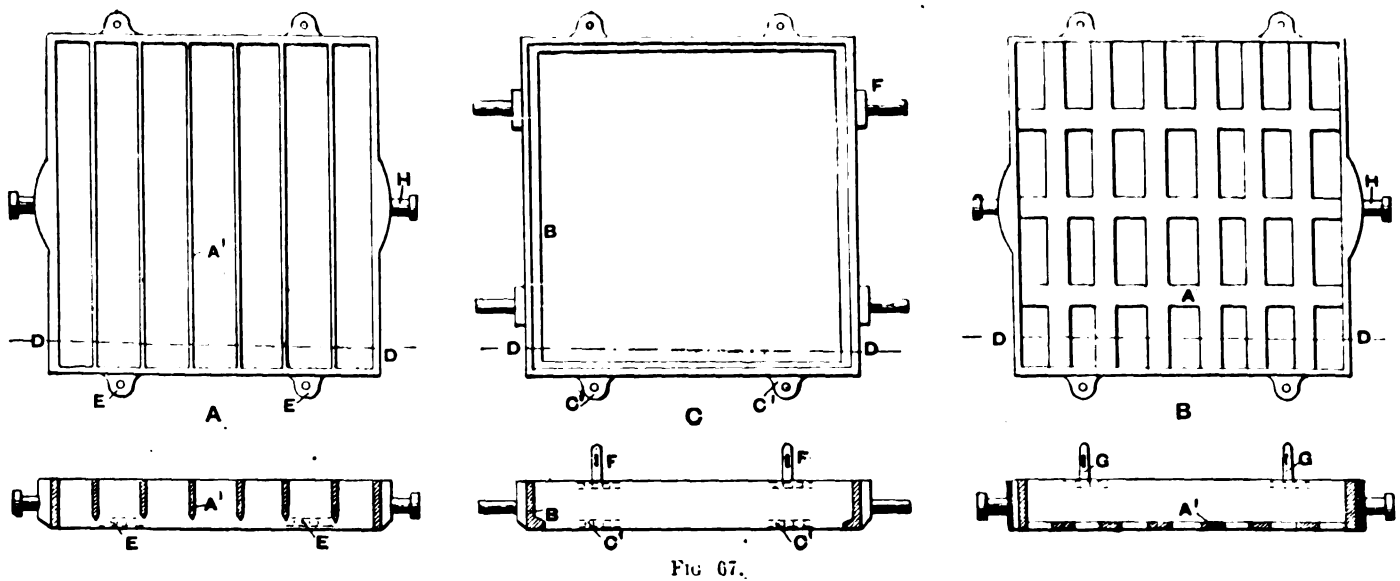


Fig 67.

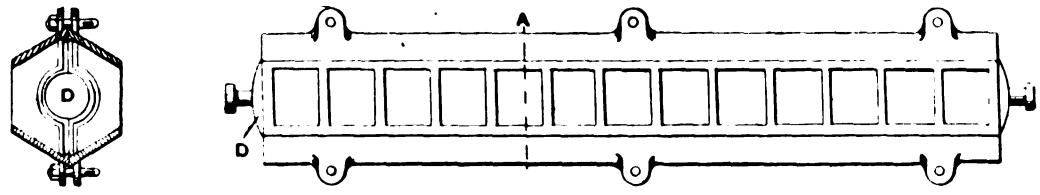


Fig 68

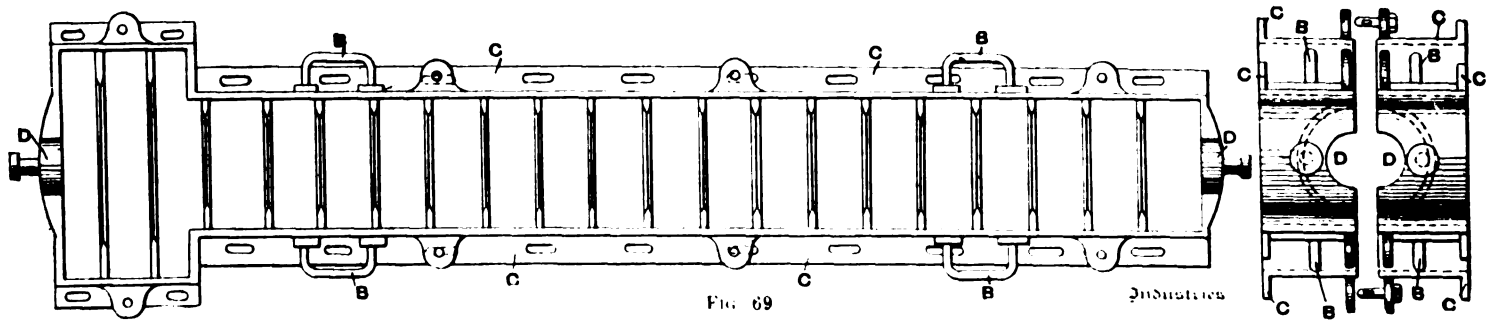


Fig 69

resting with the flat bars A¹ on a level bed of sand; C rests on B, the holes C¹ over the pins C¹ fastened in the lugs of B. Flask A is laid upon C, the holes E fitting over the pins F of flask C. If the middle box C admits of bars being used they are put in temporarily. Often, however, iron rods are driven in, and give support to the lifters, binding the sand together and preventing a "drop out." Fig. 67 therefore illustrates the usual type of "three parted" flask employed for general work. Special boxes, on the other hand, are made shallow or deep as required, the bars are cut to the outline required, the joints are sometimes bevelled and if needs be curved, while the sides are made to follow the outline of the pattern sides, in order to economise sand and labour in ramming. Such special flasks are often broken up after they have served their purpose, so as to keep all available space and capital for standard boxes. The regular flasks will range from 6in. square upwards to say 12ft. square; or if oblong, from 1ft. or 2ft. long to 20ft. in length, the dimensions of course depending on the general character of the work which is done in a particular foundry. The considerations to be regarded in making moulding boxes are not so much strength, which is almost always in excess, as stiffness. A box which springs will always give much trouble through the dropping out of sand and the crushing of moulds. It is poor economy to stint the metal in moulding boxes, since iron is always worth its first cost. But, on the other hand, flasks made too heavy involve more labour in carrying when of small size, more strain on the cranes if of large dimensions; therefore the boxes ought not to be made heavier than absolutely necessary. If the boxes be stacked out of doors, something ought to be allowed for annual loss due to rust. We illustrate in the succeeding figures some flasks of different shapes, and as all the parts are drawn proportionately, a good idea may be obtained of the relative dimensions.

The cope A and drag B (Fig. 67) have straight bars, but standard boxes for columns and pipes are necessarily fitted differently, as they have no middle, but only drag and cope, which are both alike, as shown in section in Fig. 68 and end view in Fig. 69. To save sand space the sides of such flasks are often sloped, as shown in Fig. 68, or a pocket is provided in cases where a large flange or a base has to be cast at one end of a pipe or column, as shown at the left hand of Fig. 69. The holes D at the ends of these boxes are made to receive the ends of core bars. Circular flasks like Fig. 70 are made with cope, drag, and middle like Fig. 67. Small hand flasks like Fig. 71 are made from 6in. to 10in. or 12in. square, and others, like Fig. 72, from about 12in. to 20in. square. There are some essential points of detail about these boxes which should be borne in mind. As regards the patterns, there ought to be plenty of taper everywhere. This is necessary to facilitate moulding, and rough flasks will not pay for the time spent in mending up. There should be given not less than $\frac{3}{16}$in. of taper per foot of depth to the sides, and $\frac{1}{4}$in. to the bars. The bars are to be chamfered to about $\frac{1}{8}$in. in thickness at the edges, as shown in A A¹ (Fig. 67), and in Fig. 69. This chamfering allows the sand to be rammed close around the pattern, without leaving soft unrammed spaces underneath the bars. All the boxes' sides and bar faces ought to be left rough, in order to take the clay water which is poured over, and to cause the sand to adhere thereto. It is a not unusual practice to roughen the vertical faces of the flasks by thrusting a stout vent wire between the flask pattern faces while yet in the mould, and the abutting sand, so that after the pattern is drawn, and the metal poured, the faces present a ridged and rough surface. With pipe and column boxes it is often the practice to diminish the total number required for stock by making "pockets" A (Fig. 73), to bolt on the ends of the actual boxes B. Thus a 12ft. box could be extended to 16ft. by bolting a 4ft. pocket on the end. A pocket can also be put on the side of a flask to receive the branch piece of a pattern, or any similar lateral extension; but an opening must be cut in the side of the box at the place where the pocket abuts. When the latter is not required for present use the opening is closed with a piece of plate bolted against it. The cutting out of the side of a flask in this fashion tends to impair its rigidity, and should only be adopted to a limited extent. Pockets are fastened in any manner most convenient. If provision is made beforehand for them, flanges are cast on the flask ends C (Fig. 73); but if no flanges are provided a pocket can always be put on by extending its sides to embrace the sides of the flask. Where a box like Fig. 73 is required of its normal length only, the piece A is removed, and an end plate is bolted in its place, as shown in Fig. 74.

For common and jobbing work the joints of the flasks are left rough, just as they come from the sand; but in order to obtain the best results, as in repetition and certain other classes of work, their joints are, or should be, planed, to make a close fit with each other. In some works they plane all or nearly all the box joints, while in others the practice is exceptional. For common work it is not necessary, but in cases where patterns are jointed—more especially if they are long and slight, and likely to become curved or twisted in their joint faces—there is a decided advantage in having planed joints for the flasks. Then the sand can be strickled off level, thereby giving a perfectly true face to lay the pattern joint on for ramming up. In the case of deep moulds poured vertically there is also less risk of the boxes becoming strained and started under pressure, and of the metal finding its way out of the joint. And beyond these instances of acknowledged advantage, I think that in a shop doing good work it is always wise economy to plane the joints of all the standard flasks—that is, those which are in regular use.

It is often convenient to utilise a middle part as a cope for some special purpose by making loose bars, and bolting or wedging them in, as shown in Figs. 75 and 76 respectively. And by means of such loose bars a column box, both cope and drag parts, can be used for columns of different diameters, and having caps and bases of different shapes and sizes, by substituting one set of bars for another. The practice of using loose bars is in such cases capable of effecting a considerable saving in the weight of boxes kept in stock in a jobbing shop. Another makeshift plan is to use wooden bars for temporarily arranging flasks to stand a few rammings. This is a handy and convenient method, because the bars can be cut to match the outlines of the pattern, and if spruce deal or slab is used the cost is trifling. In some out of the way shops flasks made entirely of wood are employed; but considering their fragile character, and the certainty of becoming cracked and burnt, it is difficult to see wherein their economy lies. They are used more in America than with us.

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A middle part can be utilised as a drag by using a latticed plate A (Fig. 77) as a substitute for bars, and bolting it to the middle part B. Many of the larger and heavier rectangular flasks are economically made by forming sides, ends, and cross bars in separate pieces, and bolting them together, the advantage being that they are cheaper to make in the first instance, and by the substitution of new sides, or ends, or cross bars, the size of the flask and the shape of the bars can be modified to suit patterns of different dimensions and outline. This is only an extension of the method of using loose bars.

For uniting flasks, lugs and pins are provided, as shown in the illustrations. These pins may be differently fitted. First, they may be roughly forged, and drop loosely in their holes, or they may be turned pins, closely fitting; and in either case they may be short or long. Where good work is expected to be done, they should always be long turned pins (Fig. 78), fitting closely, yet freely, into drilled holes. The evil of using badly fitting pins is that the moulder cannot trust to them for the adjusting of his box parts truly to one another, and so prevent lapping joints, since the flasks may have as much as $\frac{1}{8}$in. or $\frac{1}{4}$in. of play on their pins, causing the risk of lap to that amount. He has therefore to rely entirely on the correspondence of the trowel marks which he makes on the whitened sides of the flasks. Short but well fitting pins are suitable enough for flat work; but in cases where there are deep vertical sand joints, or cores standing up, and entering into deep prints, these joints and prints may, and often do, become crushed during the lowering of the upper flasks before the pins can enter their holes. Long and truly turned pins ought therefore to be provided which enter their holes some time before the box joints come into contact, so that for a distance of from 2in. to 4in. before any sand faces come into contact the flasks are being closed by the guidance of the pins alone. These should therefore measure from about 7in. to 10in. in length, according to requirements, and be turned parallel throughout, never tapered—a rounding off of the points only being permissible. They are attached to their lugs in the manner shown in Fig. 78.

Flasks are cottared, bolted, clamped, or weighted. Cottaring is the simplest plan, and is as safe as bolting, as there is no bother with burred threads; but the cottars should be deep, or they will probably be broken off. Bolts are often used for work cast vertically in the pit, cottars being liable to become knocked out during the ramming of the sand around the flask. Weights are used for bedded in work, and clamps generally instead of cottars and bolts. But the wedging of clamps is not so secure as the fastening of cottars and bolts; yet it often supplies a ready mode of union, and is therefore often resorted to.

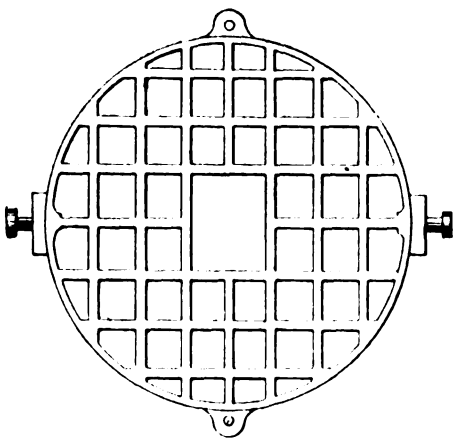
Various attachments are provided for moving the boxes. All flasks have to be turned over, either for moulding or for cleaning up. The smallest of all, say those under 12in. square, are often made without handles, like Fig. 71, the sides of the boxes being grasped by the hands. Flat lips or handles may be cast on, standing out from opposite sides. Boxes measuring from 12in. to 18in. or 20in. square are often provided with handles made of wrought iron rods, like Fig. 72. But most flasks above these sizes up to the largest have handles of cast iron or of wrought iron cast in, shown at F (Fig. 67), the latter being preferable, because less liable to break off. Large flasks are provided with swivels made of wrought iron, and cast in, shown at H (Fig. 67) and D (Figs. 68, 69), the metal being thickened around them to give sufficient hold. That portion of the swivel around which the metal is poured is made square, and jagged (see Fig. 79), square to prevent the possibility of its turning round, and jagged to better hold, and prevent loosening under stress. A pocket print is put on the pattern for each swivel (shown dotted in Fig. 79, section). The sand is dug away beyond the print thickness, in order to allow the neck of the swivel to bed down into the print. When in place, the sand is stopped over it, leaving the square jagged portion projecting into the space which the metal will ultimately fill.

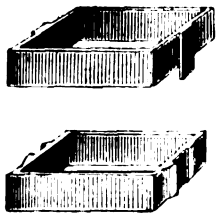
But swivels only serve the purpose of turning over in the crane slings, with the boxes in even balance, but form no point of attachment for applying the force necessary for turning a set of heavy flasks over, or for lifting or lowering them into the foundry pit. The loop handles B (Fig. 69) are used for these purposes, sling chains and hooks being attached to them. The straight handles on boxes like Figs. 67 and 77 are also employed for turning the flasks over.

When casting deep work in the foundry pit, back plates are bolted on the flasks to prevent the pressure of the liquid metal from forcing out the sand. Flanges C (Fig. 69) are therefore cast on many boxes, to afford a surface of attachment for the clamps or the screw bolts used for that purpose, the latter passing through the slot holes in the flanges C.

The method of making flasks was partly described in the article on moulding in open sand, in *Industries*,

NOTES ON FOUNDRY WORK.


Fig. 70.


Fig. 71.

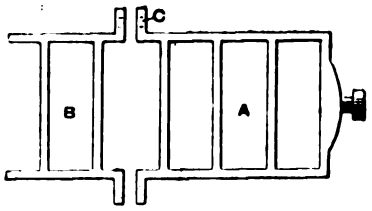
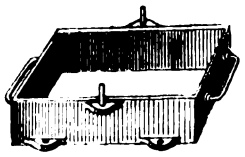
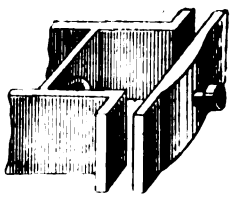
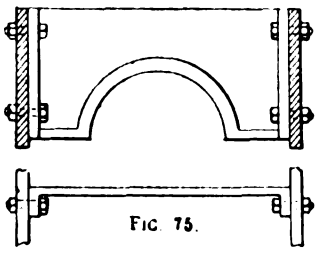
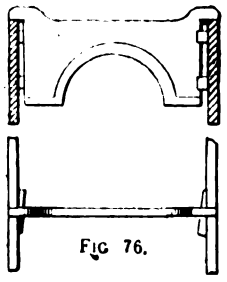


Fig. 73


Fig. 72.


Fig. 74.


Fig. 75.


Fig. 76.

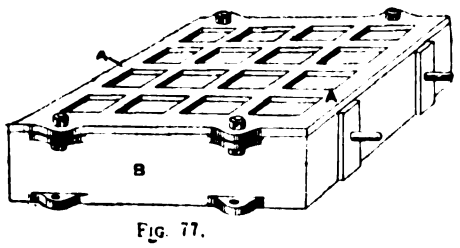
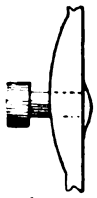
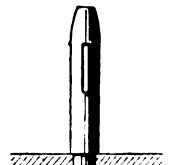


Fig. 77.


Fig. 79.


Fig. 78.

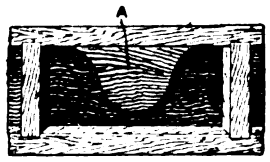
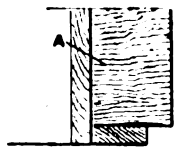


Fig 80





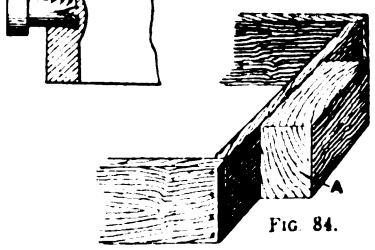
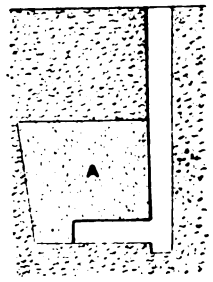


Fig. 84.


Fig. 81.

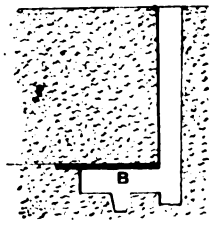


Fig 82

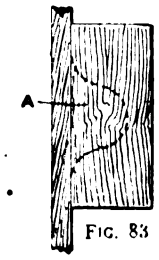
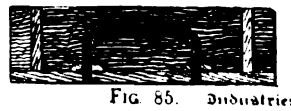


Fig. 83


Fig. 85.

Vol. III., page 56. Some of the minor details will therefore only be noted now. Swivels are cast in the pocket prints; so are also plain handles like those in Fig. 67. Handles like B, in Fig 69, require that two prints be put on at the centres where they enter the box sides, and the sand without is cut away to clear the looped portion. Lugs may be put in variously. When they are wanted only in the bottom or in the top, they are best made in a core box like A in Fig. 80, which shows the lug. The lug centres being then marked on the edge of the pattern, the sand in the vicinity is dug away, and the cores bedded in, a centre line on the core being brought to correspond with the centre line on the box. Fig. 81 shows such a lug core A in place, and the sand made good over it to the edge of the mould. Another method is to dig out the sand, lay in, and mould a lug pattern, with or without a round print for the pin hole, shown in Fig. 82, then to withdraw it, and cover over the space left with a piece of slate B, or with a piece of loam cake, and finally ram the sand above it. If a number of standard flasks are required it pays to put the lugs in the pattern with prints above them, and make plain cores simply to fill the prints. Fig. 83 shows the relations of the lug, print, and pattern side. In middle parts two lugs will often come over one another on opposite edges; then, the mould being in open sand, the top lug cannot be left as when a cope is used, but must be put in a core box. In that case, as in Fig. 83, the rectangular core A fitting in the print would have a lug formed in its top face. Handles cast in circular bosses, as in Fig. 72, would be carried in a core, whose print is shown in A (Fig. 84), and its core box in section, in Fig. 85, the handle being rammed up in the core, the jagged portion, which is cast in, passing through holes cut in the pattern bosses and bottom board.

Weak flasks get sometimes broken at the corners through rough usuage, and straps of wrought iron are conveniently used for their repair. If broken in several places, or thinned and greatly weakened by rust, it is cheaper to break and melt them up than to continue patching. If bars require to be cut out for clearing parts of patterns, they are nicked with a cold set, and struck with a hammer, a sledge being held against the side opposite to which the blow is struck, to prevent jar and extension of the fracture, or numerous holes are drilled through the bars to facilitate their separation. When copes are shallow and weak, stiffeners or binders, consisting of rigid bars of cast or wrought iron, are bolted on the top to increase their rigidity. When the area of a mould is such that the largest cope in stock is not sufficient to cover it, two or even three copes are placed end to end, leaving a space of $\frac{1}{4}$in. or $\frac{3}{8}$in. only between them, which is filled in with loam or sand.

These remarks embrace the essential features of flask making generally, though, as was remarked at the commencement, special work demands flasks specially adapted thereto.

(To be continued.)

PETROLEUM.—The fact that small springs of petroleum, together with certain gases, have been met with in the course of boring the Suram tunnel, have given rise at Baku to the opinion that large supplies of petroleum probably exist in the interior of the Caucasus. A large petroleum field has been opened on the shores of the Black Sea, in the Government of Kutaisk, on the estate of Prince Gourieli. It has been taken up by some large capitalists. The great petroleum fountain at Baku has at last ceased to spout, although the oil in the well is still agitated.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 7TH FEBRUARY, 1888.

THE IRON MARKET.—Though the business in iron is not animated, the general situation is to be regarded as satisfactory. The fear of competition in the Paris market between the Centre and the North has subsided, a complete understanding having been arrived at between the contending parties. The market, which for a moment became disorganised, has consequently regained its former strength. Business is fairly active, and there is no question of lower prices. There is a strong feeling among the iron masters against rushing up prices in the way the Germans have done, and it has to be borne in mind that one effect of the hard times through which we have passed has been to cheapen production, so that a small advance will be sufficient to give a fair margin for profit. The wire syndicate has announced a rise of from 2fr. to 3fr. a ton. The difficulty experienced in renewing the Treaty of Commerce with Italy has had a disturbing influence on the iron market.

THE METAL MARKET.—Copper is so completely in the hands of the syndicate that its fluctuations in price are in no degree dependent upon commercial conditions, and it is impossible to predict its movements. Little or no genuine business takes place, consumers holding off in the hope of a relapse. The syndicate is now endeavouring to bring about a combination of the principal mine owners to keep up the price of copper. If they succeed in their attempt, the present high rates will be maintained till a greatly reduced consumption has modified the conditions of trade. The over-inflated tin market shows signs of collapsing. Prices fluctuated between £98 and £105 in the first nine months of last year, and then ran up to £165 before the end of December. But the stocks were considerably greater at the end of 1887 than at the end of the preceding year, and they have increased since. Present prices are thus out of accord with the condition of trade, and, like those of copper, are wholly dependent upon the "rising" of speculators who have "cornered" the market. In this case, however, the end appears to be near. Spelter, which at present moves in a sure market, is still in strong demand at full prices.

FOREIGN COAL IN FRANCE.—The consumption of coal in France in 1887 was considerably greater than in the previous year. Not only has the larger home production been absorbed, but increased imports have been called for. The Customs returns show that the total purchases of foreign coal delivered for consumption in France amounted to 8,473,473 tons in 1887, against 8,366,239 tons in 1886, and 8,811,489 tons in 1885. Of last year's quantity, 41·58 per cent. was derived from England, 48·15 per cent. from Belgium, and 10·24 per cent. from Germany. There were also imported 1,065,771 tons of coke, against 1,058,756 tons in 1886, and 1,131,980 tons in 1885. Of last year's imports, Belgium furnished 72·72 per cent., and Germany 25·30 per cent. The home production of coke was in 1887 considerably above that of the previous year.

HOURS OF LABOUR FOR WOMEN AND CHILDREN.—M. Richard Waddington has presented to the Chamber of Deputies his report on the hours of labour of women and children. He recommends the following modifications of, or additions to, existing laws, which, if adopted, will tend to increase the cost of production in all industries: (1) Extension of the system of Government inspection to all public schools and to shops; (2) the abolition of the practice of half time, and the raising of the limit of age from twelve to thirteen years; (3) the institution of a certificate of fitness for all children under sixteen; (4) the reduction of the working day to ten hours for all under eighteen years of age, and to eleven hours for women; (5) the prohibition of night work for women and all under eighteen years of age; (6) the prohibition of Sunday labour for the same classes of persons; (7) the temporary prohibition of all work for women after child birth; (8) the raising of the limit of age to fourteen for boys employed in mines.

BERLIN, 6TH FEBRUARY, 1888.

THE IRON MARKET.—Some little flutter has been caused in the German iron market by the new French law, according to which the existing traffic in *acquits à caution* has been abolished. German crude iron may still be imported into France duty free under special permits, but the latter are henceforth not negotiable. The German iron market continues firm. In Upper Silesia there are twenty-eight blast furnaces at work, the production of which is estimated at 35,000 tons per month. Of this quantity 26,000 tons is forge pig, 2000 tons foundry pig, and the rest Thomas, Bessemer, and other special brands. The demand for crude iron continues brisk, and blast furnace owners have no chance of accumulating stocks. The present ruling prices at the works are 50s. for forge pig, and from 56s. to 58s. for foundry pig. Rolling mills in Upper Silesia are well supplied with orders, which will last them over the present quarter. The demand for wire and French nails continues exceedingly brisk, dealers anticipating a rise as the result of the formation of the syndicate of wire nail makers. Recent tenders asked for by the Breslau Railway Board show that fairly remunerative prices are being obtained for finished iron. For round and flat iron the quotations varied from 142s. to 150s. at the works, and for square iron from 142s. to 177s. The Hanover Railway Board have recently ordered ten three-coupled tender locomotives. The cheapest offer was made by Henschel, of Cassel, at £880 on the rails at Cassel; the Vulcan Company, Stettin, asked £942; Egerstorff, of Hanover, £972; Schickau, of Elbing, £1,040; and Schwartzkopf, of Berlin, £1,150. Amongst the tenders for the supply of 670 tons of fire grate bars, the Peiner rolling mill obtained the contract at 94s. per ton, whilst for 515 tons of sheets, the Hörde Company were successful at 143s. per ton. It is interesting to note that amongst the tenders was one for the supply of 820 tons of rolled iron, for which the price of the rolled iron syndicate is now from 125s. to 129s.; but the order was obtained by an outside firm at 121s., thus showing that the syndicate is not so all powerful as might be supposed.

TEXTILES.—According to reports from Thuringia, the manufacturers of hosiery goods and fancy articles in that district are still well employed, and have plenty of orders on hand. Trade is very brisk, and many factories are working night and day in order to get out new patterns and samples. The favourable condition of this branch of the Thuringian industry is exciting competition from French, Belgian, and Austrian manufacturers, and some works in France are introducing the manufacture of knitting machines into that country. In Saxony, the most important district for knitted goods, business is also exceedingly brisk not only in the textiles themselves, but also in the machinery required to produce them. Within the last week or so there was quite a concourse of foreign buyers of textile machinery at Appolda, and orders have been booked from Spain, Sweden, Italy, Switzerland, and even Portugal. The agent of a Spanish firm has also succeeded in persuading some foremen and skilled knitters of that district to enter their works in Spain, and there develop that industry.

THE GERMANS IN ITALY.—German traders are seeking to turn to their own profit the block in the harbour of Genoa. The long delay in discharging a cargo, due to insufficient accommodation, has become a source of great irritation and annoyance to English ship owners, who have resolved to largely increase their rates till the evil is remedied. This circumstance affords an opportunity to German exporters trading by the way of St. Gothard, which will not be allowed to slip by unused.

EXPLOSIVES.—A new kind of explosive has been brought out by Messrs. Grüne & Co., of Unterluess, near Hanover. This firm has for a long time been engaged in the preparation of fossil meal for various industrial purposes, and they have now succeeded in effecting considerable improvements in the explosive known as fossil meal dynamite. Water is said to have no influence on this new explosive. Cartridges charged with it when placed under water still retain their explosive power; they can be placed without the slightest danger in warm water so as to prevent freezing, and frozen cartridges can also with equal safety be put into warm water to be thawed. Direct blasting under water is possible, even if the cartridges have been exposed for months to the influence of the water. The firm have patented a fossil meal cartridge in substitution of the usual cartridge case.

ALUMINIUM.—A factory has been erected in Upper Silesia for working Dr. Walter's patent for the manufacture of aluminium from silicate of alumina by means of electrolysis in cold solution (not in the electric furnace, as on Cowles' plan). It is expected that this process will bring about a considerable reduction in the price of aluminium.

VIENNA, 6TH FEBRUARY, 1888.

THE COAL MARKET.—The condition of the coal market during the past week has not been very active, this being partly due to the warmer weather. It is very probable that the winter coal season will not terminate very satisfactorily, since the sugar campaign was short, and other industries in which large quantities of coal are generally used have greatly suffered through the war scare and the interruptions of railway traffic.

THE IRON MARKET.—There has been no important change in the condition of the iron market during the past week, and the fluctuations in the prices of other metals, and particularly of copper, do not influence that of iron; the price of copper, however, has slightly decreased. The stocks of iron in Austria-Hungary are small, and orders are expected to be booked shortly. In Hungary the unfavourable weather has greatly interfered with business, whilst in Bohemia the market is quiet, and the sale of cast iron goods and enamelled ware is less than what had been anticipated. Nevertheless, manufactories and works are well employed, the articles most in demand being weighing scales and weights, which are being manufactured in large quantities in consequence of the new law regarding periodical revision of weights and scales. The formation of a union of wire nail makers is very probable, whilst the axle tree union has been prolonged to the end of 1889. The balance sheets of the large iron works and companies for the past financial year have not yet been published, but it is hoped that the results will be more favourable than in 1886.

TEXTILES.—The condition of all branches of the textile industry during the latter half of January was more unfavourable than in the first half. Purchases were only made for immediate requirements, in consequence of the unsettled political circumstances, and wholesale merchants, in spite of the peaceable assurances of the Ministry, limited their transactions. The business in bleached cotton yarns, shirtings, &c., is not very brisk; but in printed cotton goods trade is somewhat better, and fairly large sales are taking place in woollen goods and prints. Considerable transactions are expected to take place in the cloth branch, and particularly for military purposes, as soon as navigation is resumed on the Danube, when the buyers from Southern Hungary appear in the market.

A NEW MICROPHONE TRANSMITTER.—Messrs. Siemens and Halske, of Vienna, have just patented a new microphone transmitter, in which the loose contacts consist of hollow carbon cones placed within each other. The object of this arrangement is to facilitate a change of the surfaces in contact, and prevent deterioration under the influence of the current.

THE NEW AUSTRIAN PATENT LAW.—Although improvements in the law for protecting inventions are very badly wanted in Austria, it will yet be some time before the law is altered. The Patent Office is under the control of the Ministry of Commerce, where the project of a new patent law has been elaborated; but before it can come into Parliament the Ministry of Justice must pass and if necessary amend it, so that the new law shall not cause difficulties with existing Acts and with the general principles of the law. After the two Ministries have thus elaborated the Bill in Austria, it must be sent to the Hungarian Government, where it will again be amended, so as not to clash with the different regulations referring to Customs tariffs and trade between the two sections of the empire. The process of transfer and amendment between these various authorities is likely to be a long one, so that English inventors should not place too much confidence in the prospect of speedily enjoying the benefit of a better Austrian patent law.

BRUSSELS, 7TH FEBRUARY, 1888.

THE COAL MARKET.—There is a good deal of business being done in the coal market, which is still firm. Unscreened household coal has risen slightly since my last report, the rates now being from 8s. 9d. to 10s. 5d. Coke is in good demand. The collieries of Sars-Longchamps, of La Louvière, and of La Paix have amalgamated, whereby their interests will be considerably advanced. The profits of the Unis Ouest de Mons Collieries for the past year amount to £28,000. The Produits du Flènu Colliery have renewed some important contracts at an advance of 10d. per ton. The briquette industry has been making great headway since it was first introduced at the Pâturages-Wasmes Colliery, with the object of utilising refuse coal. The machinery employed in Belgium for making briquettes allows of their being manufactured in any form. The Société de Gilly have now installed one of these machines, and Messrs. Zimmermann & Henrez are erecting an additional one.

THE METAL MARKET.—There is little change in the iron market, and the following rates are being quoted: Girders, 96s. to 100s.; angle iron, 104s.; merchant bars, 89s.; No. 2 sheets, 116s.; No. 3, 132s.; No. 4, 176s. The price of pig iron is maintained. Some of the works are busy pushing forward material for the Exhibition. The result of the last State railway contracts is that La Métallurgie gets ten first and second class carriages at £2,754, and £2,670 respectively, and fifteen light carriages at £4,016; La Franco-Belge, twenty third class carriages at £2,060; Nicaise & Delaive, twenty third class carriages at £2,056; Morlanwelz, twenty third class carriages at £2,052; and Seneffe twenty third class carriages at £2,059. The contracts of the economic railways have resulted in Halot Frères, of Louvain, obtaining thirty trucks at £74 each; La Franco-Belge, seventeen luggage vans at £147 each, and five at £149 each; La Dyle, seventeen luggage vans at £147; and Verhaegen twenty first class carriages at £204 each. Important orders have also been given to Hiart, Bailly, and Germain.

THE GLASS TRADE.—The market continues very quiet. The convention for England having ceased to exist, the rates for the market are 19s. for coarse, 21s. for fourth, and 23s. for third quality. The attempts at conventions have merely served to place the trade in a worse plight than it was in before. The accounts which have been published in England respecting bottle making by machinery have caused a good deal of interest in the Charleroi district.

SYNDICATE OF ELECTRICIANS.—It is proposed to establish an electrical syndicate here, but there will be some difficulty in arriving at a proper understanding as to the share each firm is to have of the business which comes in. One of the main objects for which the syndicate is being formed is to light the town by electricity, and in order to do this it is proposed to buy up the gas works. Failing this, which would cost some millions of francs, a central station would be established to supply the electric light to the principal establishments in the business part of the town. The syndicate also intends to acquire the most important electrical patents, so as to put down outside competition. The project is very good on paper, but whether it can be realised is another matter.

THE DEVELOPMENT OF THE TELEGRAPH IN BELGIUM.—The first telegraph line in Belgium was established in 1846, between Brussels and Antwerp, and was worked by Messrs. Wheatstone & Cooke, under license from the Government. There were offices for the public at Brussels, Malines, and Antwerp. The line was taken over by the State in 1850, in which year a law was passed making telegraphs a State monopoly, and authorising the establishment of telegraph communication on all the railway lines.

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On the 15th March, 1851, State telegraph offices were opened to the public at Brussels, Malines, Antwerp, Ghent, Ostend, Liège, and Verviers, and the Belgian lines were connected to those of the Austro-German Telegraph Union. On the 6th May, 1853, communication with England was established. At the end of 1853, there were in Belgium 406 miles of lines, comprising a total of 1350 miles of wire, and forty-two telegraph offices; while 52,050 telegrams were transmitted in the course of the year. Since that period the whole country has been covered with a network of wires, the number of offices open has risen to 870, and the annual number of telegrams to over 4,000,000.

DÜSSELDORF, 6TH FEBRUARY, 1888.

THE IRON MARKET.—The characteristic features of the iron market are still great activity and rising prices. The tendency of crude iron to advance in price persists, in spite of influences which might be expected to operate strongly against it. Forge pig is much sought after, and from 1s. to 1s. 6d. a ton above syndicate prices is willingly paid for it. Other sorts are in strong demand. The spiegeleisen syndicate has fixed the rate for 10 to 12 per cent. manganese at 58s., but 59s. has been paid this week on the Siegen exchange. A brisk business is being done in Bessemer and basic steel pig at rising prices. Dealings have taken place for delivery at the end of June. Thus the business of the crude iron makers is assured for the first half of the current year. The home demand for finished iron and steel exhibits no tendency to abate; but the export trade, thanks to the high prices, is steadily shrinking. Such business as is transacted yields but little profit. Home consumers are growing alarmed at the aspect affairs are assuming, and there is talk of invoking the authority of the Government to aid in putting an end to the syndicating process, which threatens to involve every branch of the industry. The latest Cologne prices are as follow: Spiegel pig, 58s.; Rhenish-Westphalian forge pig, 53s. to 54s.; Bessemer pig, 53s.; Luxemburg white forge, 38s.; German foundry pig, No. 1, 57s.; merchant bars, £6. 2s. 6d. and £6. 5s., according to quantity; angles, £6. 12s. 6d. and £6. 15s.; joists, £5. 18s. and £6; boiler plate, £8; Siegen II K plate, £7. 8s. and £7. 11s. for three months bill, or with 1½ per cent. discount for cash.

THE EXPORT IRON TRADE.—The Customs returns just issued will afford German manufacturers matter for serious reflection. Merely comparing the total amount of business transacted with foreign customers in 1887 with that of the preceding year, we arrive at a satisfactory result, for there is an increase of over 4 per cent.; but when the business of the year is reviewed month by month, there is abundant cause for regret and apprehension. Thus, for example, the exports of iron in the first quarter of the year were greater than those of the corresponding quarter of 1886 by 13·86 per cent. By the end of the second quarter the increase revealed a tendency to shrink, being at that date 12·05 per cent. The contraction proceeded more and more rapidly, so that the increase appeared at the end of the third quarter as 8·18 per cent., and at the end of the year as 4·14 per cent. only. This shrinkage corresponds with the rise in prices, of which it is doubtless an effect. The later months of the year compare unfavourably with those of 1886. The life and vigour which characterised the trade of the early months appear to have died out. There is a clearly marked tendency to further shrinkage, which renders the prospect cheerless. The following are the quantities exported in 1887, compared with those of 1886: Pig iron, 212,294 (250,681) tons, a loss of 15·3 per cent.; scrap iron, 60,548 (52,236) tons, a gain of 15·9 per cent.; half finished iron and steel blooms, ingots, puddle bars, &c., 40,135 (42,401) tons, a loss of 5·3 per cent.; finished iron and steel bars, angles, plates, &c., 292,099 (251,192) tons, a gain of 16·3 per cent.; wire, 242,553 (238,498) tons, a gain of 1·7 per cent.; rails, 174,226 (163,222) tons, a gain of 6·7 per cent.; other railway iron, 42,000 (35,417) tons, a gain of 8·6 per cent.; and manufactured goods, other than machines, 196,441 (176,515) tons, a gain of 11·3 per cent.; total exports of iron of all sorts, 1,260,296 (1,210,162) tons, a gain of 4·14 per cent. The trade of the last month of the year shows, compared with that of November, an increase in wire, plates, wrought iron pipes, and scrap; but in all other goods there has been a falling off.

LINEN YARNS.—The latest report received from Bielefeld describes the market as very animated for tow yarns and linen yarns. A large amount of business has been transacted at full prices.

LILLE, 7TH FEBRUARY, 1888.

TEXTILE MANUFACTURES.—The week just ended has been a period of great activity in the linen trade of this locality. A hopeful feeling has shown itself among manufacturers at Armentières, who have received with pleasant surprise renewed orders from customers who had bought largely at the beginning of January. The prospect is steadily improving all round. If weavers could get a substantial advance in prices, now more than ever needed since yarns have become dearer, the situation would be fairly good. There is a little more animation in the foreign trade, and hopes are entertained that the demand for export will now increase. During the year 1887, the export trade in linen and hempen goods fell off heavily, the total declared value for that year being only £318,840, against £532,160 in 1886. The value for the year 1880 reached £1,119,880. At Roubaix business is slowly reviving. The market is quiet for combed wool, and prices remain unaltered at about 5 francs per kilogramme for South American; but there is a brisk demand for "noils" at full prices. There is more animation in the market for woollen fabrics, a steady course of business giving rise to hopes of continued activity. Dulness is the characteristic feature of the market for raw silk at Lyons. Silk stuffs exhibit scarcely more animation. The business done is chiefly on Paris account. London agents have bought smooth black stuffs, but only after much bargaining over the prices. There is nothing doing on American account. The Calais tulle trade is beginning to revive. American orders in this line come to hand freely, and as the season has commenced a month earlier than usual, the prospect is cheering. The Calais manufacturers are making arrangements to provide an imposing display of their goods at the great Exhibition next year.

FLAX AND YARN MARKETS.—For flax the general situation has not changed since my last report. Home grown remains in strong demand, and a large amount of business has been done at full prices. A considerable shrinkage has, however, taken place in Russian flax, consumers having provided sufficiently for present wants. Our market here is still favourably influenced by the strong tone of affairs at Ghent, where Irish buyers are dealing largely in home grown flax. There is not much doing in Russian tows, but French, Belgian, and Dutch are in good demand for export. Business in yarns continues active, and prices are very firm, the finer numbers being scarce. The foreign demand is brisk, but not quite so strong as it was a few weeks ago. The total value of the exports of flax and hemp yarns in the year 1887 amounted to £412,360, against £242,400 in the previous year. The demand for jute yarns remains unabated.

WINTERTHUR, 6TH FEBRUARY, 1888.

STEAM AND HYDRAULIC POWER IN SWITZERLAND.—In one of my previous letters, I gave details of a scheme elaborated with a view to obtain additional water power from the river Limmat, by the erection of a weir near Baden. This scheme has been opposed by the Cantonal Government of Zürich, on the ground that it would interfere with navigation and injure existing fishing rights. During the discussion of the project, some interesting figures have been brought forward with reference to the total amount of mechanical power now in use throughout Switzerland. It appears that there are 3500 workshops or mills coming under the Factory Act. The total number of hands employed in these is 150,000, and the total power 68,000 h.p., of which 18,000 are supplied by steam and the rest by water. There are throughout Switzerland about 2600 stationary steam boilers. In addition to the stationary engines and boilers, there are six hundred locomotives, representing a total of 175,000 h.p., and the annual consumption of coal and coke in Switzerland is about 787,000 tons. The satisfactory result of the trials recently made with the plant for transmitting water power from Kriegstetten to Solothurn has given a further impetus to electrical engineering, and caused quite a number of projects to be put forth for utilising some of the water power now running to waste.

THE MANUFACTURE OF ALUMINIUM.—Since the original project for the establishment of a large aluminium factory on the Rhine near Schaffhausen was abandoned, owing to a universal protest throughout the country, the promoters are now coming forward with a scheme on a reduced scale, and a company has been formed under the title the Swiss Metallurgical Company of Neuhausen, with the object of establishing works in the town for the electrical production of aluminium and other metals. The total share capital is only £8,000, divided into forty £200 shares.

MADRID, 6TH FEBRUARY, 1888.

IRON ORE MINES.—Some English speculators lately examined the iron ore mines of the Pedroso Company, but came to the conclusion not to enter into a contract to carry on the working of the mines. The company has since then stopped payment. It was established in 1817, but never proved remunerative to the shareholders, all the profits having been devoted to fresh purchases of land and plant. The liabilities amount to nearly £240,000, while the assets, including 35,000 acres of land, are estimated at about £70,000, exclusive of the value of the mines and stock. Most of the shares of the company are held by a well known Seville house, which has, in consequence, stopped payment also.

THE CADIZ ARSENAL.—La Carraca Arsenal, in the Bay of Cadiz, will probably be transferred by the Government for twenty-five years to a private company, which is to be formed under the auspices of the well known Barcelona company, La Maquinista Terrestre of Maritima. The terms suggested are very favourable to the Government. It is proposed to make considerable improvements in the arsenal, which will be left for the benefit of the Government on the expiration of the period of the contract, on condition that a ship is to be ordered from the company whenever one is built at the Government establishments at Carthagena and Ferrol. Ships will be built by the company at the estimated cost of similar ships built simultaneously in the Government yards.

TIN PLATE WORKS.—Although it is only a few months ago since Messrs. Goitia & Co., of Beasain, started the first tin plate works in Spain, they intend establishing another at Bilbao. They will manufacture at Beasain real charcoal plates of superior quality, and a cheaper article at Bilbao. A high duty is payable on tin plates; but the home market is too small even for only two works, so that it looks as if the firm had some hopes of being able to do an export trade to neutral markets at present supplied by English makers.

NEW YORK, 28TH JANUARY, 1888.

THE COAL MARKET.—The condition of the anthracite coal market is practically unchanged. There has been no progress made towards settling the miners' strike. One of the latest signs of the intentions of the Reading Railroad is that President Corbin will in a few days issue a statement of the business of the Reading Company covering several years, the object being prepared to convince the public that too much of the money received for the coal goes to the miners. This indicates that the officials will insist upon the acceptance by the miners of the 10s. basis of wages. The general opinion is that the strike will be an extended one. Much pressure is being brought to bear upon the Reading officials by business men of Reading and Pottsville to submit the difference to arbitration, but with little if any effect. Meanwhile the Wyoming collieries are being worked to their utmost capacities. Eighty-five per cent. of the present production of anthracite is from the Wyoming region, which has nearly doubled its output as compared with last year. A report is current that the railroad company proposes leasing its collieries to a powerful syndicate, by which means the two businesses would become separated, and harmonious relations might be more easily preserved.

THE METAL MARKETS.—Manufacturers of steel rails continue to report a scarcity of business, but a considerable improvement is expected soon. The price at present is about £6. 10s. There has been considerable activity in copper for March and April delivery, sales from 200,000lb. to 300,000lb. being at 16¾ cents (8¼d.), the total transactions amounting to about 900,000lb., mostly for export. The total production for 1887 was 182,500,000lb., of which about 45,000,000lb. has been exported, and a home consumption of 140,500,000lb. leaves in stock about 27,000,000lb. on January 1st. It is expected that the Calumet and Hecla mine will probably open by February 1st. This means the addition of about 2¼ million pounds of ingot copper per month, and the completion of the three new stamps of the company after March 1st would increase the output to about 5,000,000lb. Should these events come to pass, the output of the mine for 1888 should be 56,000,000lb., as against 45,500,000 for 1887. The most significant point is that the managers would become aggressive opponents of the "bull" speculators. It is not to be expected that prices will fall quickly to the normal figures, and those who are best conversant with the business do not expect an appreciable decline for some time to come. The tin market has been stronger, with a tendency for prices to increase for future delivery. There has been a moderate demand for spelter. Sheet zinc is scarce. There has been very little business in antimony.

LEAD.—The lead produced in the United States in 1887 reached the enormous total of 160,000 tons, but stocks of bullion and refined lead have not increased. The returns from most producers and refiners show that the stocks on hand are small, and including the foreign lead now in store in New York, about the same as at the end of 1886. Manufactured lead stock has probably increased, but is widely distributed. Of this production only 20,000 tons come from non-argentiferous regions. The increase in the production of lead from silver bearing ore is not due so much to the development of any great find as to using a lower grade of ore, this being made possible by improvements in processes and machinery, and to lessening the cost of transportation, smelting, &c. The recent discovery of some promising silver deposits will add more and more to the output of lead during the present year.

ALUMINIUM BRONZE.—At a series of comparative tests of common and aluminium bronze at the Watertown Arsenal, the results were as follow: Ordinary bronze showed a tensile strength of 24,500lb. per square inch, with an elongation of 8·2 per cent. Aluminium bronze, known commercially as "A 3," cast in sand, showed a tensile strength of 53,000lb., and an elongation of 6·2 per cent., while the same metal cast in chilled moulds resisted a strain of 67,600lb. to the square inch, with an elongation of 13 per cent. In the opinion of naval experts it is thought that steel and wrought iron will be displaced to a considerable extent by this metal.

PHILADELPHIA, 28TH JANUARY, 1888.

THE MELBOURNE AND PARIS EXHIBITIONS.—A resolution has been introduced in the House of Representatives to appropriate £40,000 for necessary expenses connected with the representation of the United States in the Paris Exhibition of 1889. While the amount asked for will probably be cut down, the United States will be creditably represented. A Bill to appropriate the amount necessary to represent the United States at Melbourne has passed the House.

EMMENSITE.—Tests of this new explosive have been lately made on the Croton Aqueduct, and by the Delaware, Lackawanna, and Western Railroad, with very satisfactory results as compared with dynamite and other explosives. A large piece of the explosive was put through a stone breaker and reduced from the condition resembling a bar of sulphur to a powder, and a revolver fired into a pile of the powder failed to explode it. It can readily be exploded by a fulminating cap, and is said to have four times the effect of dynamite.

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HEALTH IN ENGINEERING WORKSHOPS.

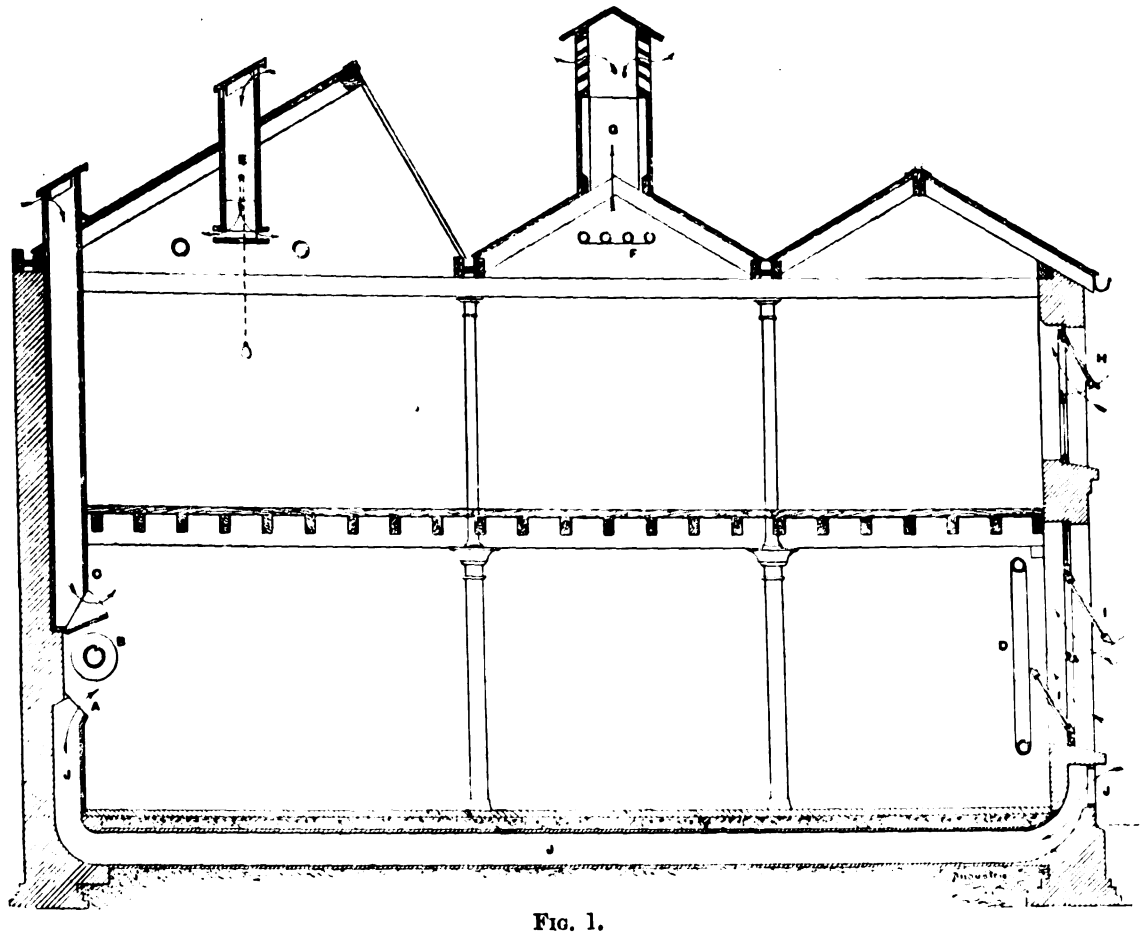
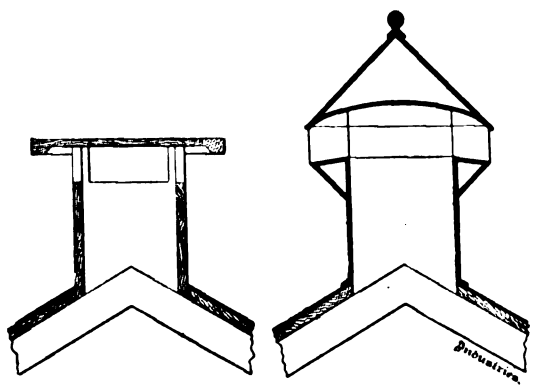


FIG. 1.

THE ECONOMY OF HEALTH IN ENGINEERING WORKSHOPS.*

THE author of this paper, in commencing, referred at some length to the importance, even on the ground of the self interest of the employer, of a workman being kept in good health, and said that the healthier workman is the more contented workman, that the healthier workshop is the more comfortable workshop, and therefore that a workshop which gets a repute among workmen for being more comfortable than others, and filled with more contented men, will always be sought after by the most thoughtful and valuable hands, so that the employer can have his choice of men without paying more than standard wages. He divided the subject into four departments: (1) Ventilating and Heating; (2) Lighting by Daylight or Artificial Light; (3) Water Supply, Dining Rooms, &c.; (4) Sewering and Waste Appliances. He stated



FIGS. 2 AND 3.

that each man should have at least 25 sq. ft. of floor area and at least 400 cub. ft. of space for comfortable ventilation. The volume of fresh air required per man per hour is not less than 1000 cub. ft., even in cold weather and with inactive employment, and four to ten times this amount is required for laborious work in warm weather. This minimum ventilation would have to be increased in warm weather, say by opening a window. In hot weather both window and door might be widely opened, and a moderate breeze through them would feel perfectly pleasant. It was pointed out that dependence on the wind or the rise of temperature in the room was fallacious, and that the whirligigs and cowls worked by the wind were most active when least wanted, and *vice versa*. For the purpose of being independent of the wind, all vent shafts should be well raised above the roofs like chimneys, and be roofed over and protected from rain, either by louvres on all sides, a flat top with side openings, or a circular double cone outlet, as shown in Figs. 1, 2, and 3. Each form mentioned allows the wind to blow through without materially affecting the draught. One important rule as to outlet ventilators is to have only one for each room, unless for rooms of great size; because if there are two or more outlets some of them will at times act as inlets, and thus reverse the intended currents. But even with one outlet there are circumstances which will reverse the current sometimes, so it is well to arrange for preventing back draughts causing inconvenience by a screen board arranged as at F (Fig. 1). No specific rule can be given for the size of outlet ventilators, but it may be stated that at least 12 sq. in. per man should be provided, and for hot work much more; the inlets being of similar area. Air inlets should be as numerous as circumstances permit, and arranged to disperse their draughts as widely and gently as possible. Of course windows offer the readiest means of inlet, and they should have many small opening casements hung so as to turn their draughts upward; several small casements causing less apparent draught than one large one, by their small currents dispersing into the air more readily. In Fig. 1, H and I show some good forms of casement, and in all such it is well to fix stop chains, or have short racks to prevent their being opened to more than about 30° pitch, for if opened more they often cause down draught. Air inlets through walls should always have deflectors to disperse their draughts. If no men work close to them, the best plan may be a simple flat board or plate fixed a few inches off the wall, so as to turn the draught out at all sides, as at M, in Fig. 5, the draught being turned from the face of the wall by a taper shaped casing. Where external appearance is no great object, the best weathering for an air inlet is simply a piece of glazed tile pipe, built with a slight outward slope into the wall, and projecting a couple of inches, as at O (Fig. 5); but the most efficient and neatest arrangement, where available, is to have a projecting shield, as at K, with openings on all sides of from 1¼in. to 3in. wide, not liable to get choked with dust; the shield protecting the inlet from gusts of wind. All these forms of inlet should have regulators, to fix them open more or less, or to close them. Sometimes it is well to have fixed ventilators giving the proper minimum amount of inlet and outlet, and have also supplementary openings for increased ventilation when desired. For extensive top lighted rooms, similar to loom sheds, it is necessary to bring in the fresh air from the roof, so as to reach all parts of the room. This can best be done by air tubes hanging down a few feet below the roof, and with dispersing boards below them, as at E. In dealing with a very broad room with other rooms over it, the equalisation of the air can best be effected by having the air outlet at the centre and the inlets round the sides, and some of these inlets may be brought down, as shown at C, through an upper storey; but as this plan tends to induce reversed currents, it is better, where possible, to bring the air by large tubes J below the floor from the nearest convenient open area. Air can be led up or down, round corners, or through big or little holes, in fact in any imaginable way, if a balance of tendencies in the required direction be arranged. In workshops such as are used for smith's work, with raised louvres along the ridges of each roof, the best means of regulating the ventilation is by light wooden doors, hung so as to close, or partly close, the opening just below the raised louvres, as shown at P, Q, and R, in Fig. 4. Such doors are cheaper than pivoted louvres. Smithy doors are often made in two heights, to aid ventilation; but a better plan is to have a second door hung just within the room, formed entirely of ventilating louvres, so as to turn the draught upward. A screen board may be hung over the lower part of the door when only moderate ventilation is required. Having referred to outlets depending on the heat of the room or the wind for their action, artificial means of ventilation was next dealt with. Heat applied in some suitable manner is the most constantly available power for artificial ventilation. It can be applied by a fire or gas burners; but a much safer plan is to put a coil of steam or hot water pipes below the up cast flue, as at F (Fig. 1), so that the most heat may be supplied in hot weather, and the least in cold weather. The best of all known means for inducing and regulating the ventilation of workshops are fans driven by power, which are easily applied; 1 i.h.p., under favourable conditions, will drive 12,000 cub. ft. of air per minute, or 720,000 cub. ft. per hour, in and out of a workshop. There is now no excuse for ill ventilated workshops, for all the risk of back draught, and the irregularities and contrarieties of wind ventilation, are overcome by the power fan, which will give as much or as little air as required by the

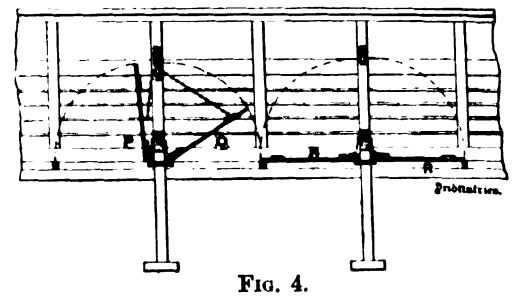


FIG. 4.

simple regulation of its speed. The fan should be fitted to the outlets, which should be of the form described and vertical. The speed of the fan may be regulated by stepped pulleys, like a lathe, or by cone pulleys and belting, or by curved cone friction pulleys, like a potter's wheel. In selecting a ventilating fan, the specially light work should be remembered, the best forms having very large airways throughout, with little frictional surface, fine cutting edges, and truly curved vanes, so as to lightly pass a great bulk of air, the Blackman propeller being one of the best for this purpose. Steam or air jets drawn from steam or air pipes can be used, and although the outlets need not be so large as those recommended for natural ventilation, it is well that the sizes of outlets and shafts, &c., should be arranged for an air speed not exceeding 600 lineal feet per minute. The inlets should, if convenient, be arranged for a speed of about 200ft. per minute, to avoid strong draughts. So far as heating apparatus is concerned, hot water or steam pipes of large diameter, or steam pipes of small diameter, could be used; but the heating pipes should be looped or fitted with "gills" or flanges, as at B (Fig. 1), and it is well to counteract the cooling effect of large windows by loops of heating pipe round them. The author advocated ample light for shops, and recommended either thick sheet or rough plate glass for daylight lighting; and pointed out that good gas burners were essential, alike on account of the better combustion

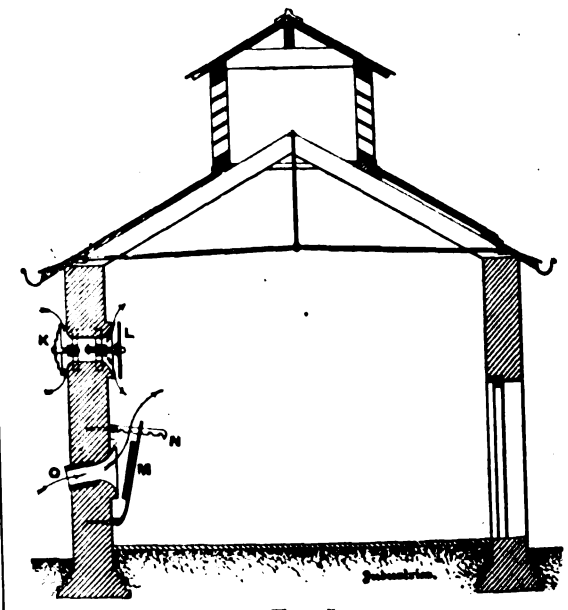


FIG. 5.

and of the effect of bad light on the sight. If each man has one gas burner, five-fold ventilation should be used whenever the gas is lighted. The electric glow light seemed to be the best for nearly all lighting purposes, the arc light being as yet too unsteady for long continued use. The author recommended that better attention should be given to the question of providing a comfortable dining room, and thought the provision of washing accommodation was also advisable. He then pointed out how badly kept the sanitary conveniences were in most workshops, and thought the right policy was to encourage habits of cleanliness and decency everywhere, and not risk a man's health and offend his decency through having defective closets. If tub closets are used, care should be taken to avoid leaky tubs, and to fit them closely up to the seats. The floor of cement or flagging should be well sloped to a gutter, and the partitions should be kept 6in. above the floor, to facilitate washing. Trough closets are the cleanest and best apparatus where sewers are available. Those made of strong earthenware, with seats like thick rounded pipe ends, and with self discharging syphon flushing cisterns, are thoroughly satisfactory, and give little trouble. Privies with middens are unsuitable for works, but where used should have the midden protected from rain and drained, so as to be as dry as practicable, and thus prevent

* Abstract of a paper read before the Manchester Association of Engineers, by Mr. J. Corbett, 25th January, 1888.

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putrefaction. The walls of all such places should be lined with brown salt glazed bricks, or else well painted in dull colours. Glazed white bricks are better, but fully twice the cost. Ample light and ventilation, without due exposure to the weather, are, of course, needful for health and comfort. Urinals are best faced with slate, on account of its impervious and smooth surface. Flags or brick walls should be well coated with pitch, laid on hot, to form a good surface, and this can easily be renewed when necessary. The waste grids and surface water grids should all be set in stone or earthenware dishes, with glazed earthenware "gullies" or traps underneath. Iron traps are objectionable on many grounds. Of course, no sewer opening at the surface should be left untrapped, for if so, dangerous gases may escape and do injury. Other points were dealt with, after which the author said that by proper attention to health in the workshop any man now working in an uncomfortable and unhealthy shop might be made at least 1 per cent. abler, more active, and more efficient in his work. Taking an average workman to be worth £100 a year to his employer, this at 1 per cent. is £1 per year, or equal to £20 of capital; and as all that had been suggested would not cost £20 per man—in most shops not £5 per man—on the low ground of mere money value, and on the high ground of duty, employers must be convinced that the subject of his paper was truly called "Economy of Health in Workshops."

ENGINES OF THE S.S. "CITY OF BERLIN."

On page 140 of our present issue, we give an engraving illustrating the triple expansion engines recently constructed by Messrs. Laird Brothers, engineers and shipbuilders, Birkenhead, for the s.s. "City of Berlin," belonging to the Inman and International Steamship Company, Limited. This vessel, which was built in 1874 by Messrs. Caird and Co., of Greenock, has had not only new engines and boilers fitted, but has been completely renovated throughout. This vessel has the following dimensions: Length over all, 510ft.; length between perpendiculars, 488ft.; moulded width, 44ft.; depth to spar deck, 37ft.; depth to tonnage deck, 19ft. The vessel is four decked, with a gross measurement of 5490 tons, and a registered tonnage of 3139 tons. The new engines, which we now illustrate, are, as we have said, of the triple expansion type, with cylinders having diameters of 41in., 65in., and 101in. respectively, the stroke of each piston being 66in. A trial trip was made on the 22nd and 23rd December last, when the following satisfactory results as regards the engines were obtained: With the boilers working under natural draught, and the steam pressure 129lb. per square inch, the engines indicated, when running at 58½ revolutions, 4171 h.p.; under forced draught, while the steam pressure was easily maintained at 152lb. per square inch, the engines indicated 6025 h.p., while running at 66½ revolutions per minute, and with a vacuum of 25½in. As deduced from the indicator diagrams, the total horse power was proportioned between the three cylinders as follow: High pressure cylinder, 1963 h.p.; intermediate cylinder, 1885 h.p.; low pressure cylinder, 2177 h.p.; making a total of 6025 h.p. The total space occupied by the engines does not exceed that taken up by the old engines, although the power is now increased by over 20 per cent. The steam is supplied by eight boilers of the cylindrical return tubular type. They are of steel, and have an ordinary working pressure of 150lb. per square inch. Each boiler has three furnaces, and has been tested in conformity with the Board of Trade requirements to 300lb. per square inch. The total grate surface is 324 sq. ft., and the total heating surface 14,616 sq. ft. This gives a ratio of 18·6 i.h.p. per foot of grate surface, and ·413 i.h.p. per square foot of heating surface. An evaporator is fitted in the engine room to provide for waste, which is capable of producing 15 tons of fresh water per twenty-four hours. The crank and propeller shafts are of Whitworth's fluid compressed steel. The space taken up by the boilers is so much less than that formerly occupied by the old boilers that a gain of six first class state rooms on the main deck, and officers' cabins on the upper deck, have been obtained, besides an additional space for cargo. The consumption of fuel being smaller per horse power, less space is, of course, required for coal bunkers. Howden's system of forced draught is used, the air being supplied by four centrifugal fans, driven by independent engines. Circulating water for the condensers is supplied by two Tangye pumps, which are worked by a separate pair of engines. There are also fitted Worthington engines and pumps to feed the main boilers, and to supply water for fire and sanitary purposes. The vessel is illuminated throughout by means of electric lamps, electricity being supplied by a duplicate set of Messrs. Clarke, Chapman, & Parsons' engines and dynamos, each set being capable of supplying the whole of the lighting, so that there is no possibility of failure. The heating and ventilating arrangements of the ship have received special attention, fresh air being brought into every division by cowl ventilators from above, which communicate with fore and aft trunkways. Utley's patent ventilating side lights are also used, and can be opened in all weathers. The heating arrangements consist of an elaborate system of radiators. The steam for heating purposes, after passing through the various compartments, is conveyed back to an auxiliary condenser, and the water is returned to the boilers. The ship's hull has been thoroughly overhauled, and the upper and main decks plated. Additional water tight bulkheads have also been fitted. The rig has been altered from the old ship rig of the Inman Company to that of a three-masted schooner, which gives the vessel a much lighter appearance as regards her rigging. In addition to the number of boats required by the Board of Trade, three collapsible boats have been fitted, two made after Berthon's and one after Chambers' patented principles, each being capable of accommodating about one hundred passengers. Fire extinguishing apparatus is also supplied throughout the vessel. With the extensive alterations that have been made, the owners consider that the vessel is now not only faster and handsomer, but also much stronger than when first built.

Notices of Meetings.

THIS WEEK.

Society of Arts.—Friday, 10th February, 8 p.m. Indian Section. Paper to be read on "The Work of the Afghan Frontier Commission," by Captain Manisfold, R.A.

Royal Institution of Great Britain.—Friday, 10th February, 9 p.m. Lecture on "Safety Lamps in Collieries," by Mr. W. H. Preece.—Saturday, 11th February, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

Royal United Service Institution.—Friday, 10th February, 3 p.m. Paper to be read on "The Practical Value of the Kriegspiel," by Captain H. S. Wilkinson.

Physical Society.—Saturday, 11th February, 3 p.m. Paper to be read on "The Limit of Refraction in Relation to Temperature and Chemical Composition."

NEXT WEEK.

Society of Arts.—Monday, 13th February, 8 p.m. Cantor lecture on "Yeast: its Morphology and Culture," by Mr. A. Gordon Salomon, F.I.C., F.C.S.—Tuesday, 14th February, 8 p.m. Applied Art Section. Paper to be read on "Principles of Design as Applied to Bookbinding," by Mr. Henry B. Wheatley.—Wednesday, 15th February, 8 p.m. Ordinary meeting. Paper to be read on "Type Writers and Type Writing," by Mr. John Harrison.—Thursday, 16th February, 8 p.m. Special lecture on "Etching and Mezzotint Engraving," by Professor Hubert Herkomer, A.R.A.

Institution of Civil Engineers.—Tuesday, 14th February, 8 p.m. Ordinary meeting. Paper to be read with a view to discussion, "The Economic Use of the Plane Table in Topographical Surveying," by Mr. Josiah Pierce, jun., M.A., Assoc.M.Inst.C.E.

Royal Meteorological Society.—Wednesday, 15th February, 7 p.m. Papers to be read on "Electrical and Meteorological Observations on the Peak of Teneriffe," by the Hon. Ralph Abercomby, F.R.Met.Soc.; "Rainfall of South Africa, 1842-1886," by W. B. Tripp, M.Inst.C.E., F.R.Met. Soc.; and "Some Methods of Cloud Measurements," by Nils Ekholm.

Civil and Mechanical Engineers' Society.—Wednesday, 15th February, 7 p.m. Paper to be read on "Sea Water for Street Watering," by Mr. S. Hardy Terry, M.Inst.C.E., M.Inst.M.E.

Royal Institution of Great Britain.—Friday, 17th February, 9 p.m. Lecture on "The Development of English Pottery," by Sir H. Doulton.—Saturday, 18th February, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

Architectural Association.—Friday, 17th February, 7-30 p.m. Ordinary meeting. Paper to be read by Mr. W. H. Bidlake, M.A.

Royal United Service Institution.—Friday, 17th February, 3 p.m. Paper to be read on "The Advantages of a Simple Drill Nomenclature Consistent for all arms, apropos to an incident of the Battle of Tel-el-Kebir," by Colonel J. F. Maurice, R.A.

PRICES CURRENT, 9th February.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/-	Cash
Scotch Warrants, m/n		39 6½	"
Hematite Warrants, m/n		41/11	"
Stocks in Stores. Scotch	945,016—Inc. for week,	1097	Tons
Middlesbro'	347,759—Dec. "	483	"
Hematite	213,226—Inc. "	393	"

Exclusive of stocks in makers' yards.

Market very weak.

Scotch shipments 7227 tons, against 5667 tons for same week last year.

	No. 1.	No. 3.	
Coltness	50/-	42/6	f.o.b. Glasgow.
Gartsherrie	46/-	42/3	" "
Dalmellington	42/-	40/-	" Ardrossan
Eglinton	41/-	39/-	" "
Glengarnock	46/-	41/6	" "
*Derbyshire	—	38/-	f.o.t. Works.
*Lincolnshire	—	33/-	" "
*Lancashire	—	38/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 17 6	£....	5 7 6	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 5 0	.....	5 15 0	Manch'r.
" Angles	5 15 0	.....	6 5 0	"
Crown Sheets	6 15 0	.....	7 0 0	"
" Hoops	5 10 0	.....	5 12 6	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 15 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	0	0	to	£19	10	0
Copper: British Cakes and Ingots	80	0	0	"			
" Chili Bars	76	10	0	"	76	12	6
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	0	0	"	15	10	0
" English Sheet	16	0	0	"			
Tin: Straits	169	10	0	"	170	0	0
" Australian	170	10	0	"	171	0	0
" English Ingots	161	0	0	"	163	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—We have very little new to report. Chili bars have been sold during the week at £74. 2s. 6d. to £76. 12s. 6d. for sharp cash parcels. Quotations for manufactured are unaltered, and very few orders are coming forward.

Tin.—The advance has been maintained, and at £170 per ton a fair business has been done in Straits sharp cash parcels; for forward delivery £145 is quoted.

Lead is much firmer and higher prices ruling.

Spelter.—Quotations are easier, with very little business doing.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	28	0	0
" Ceylon	"	24	10	0
Cottonseed	"	20	15	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	19	0	0
Palm, Lagos	"	22	0	0
Rapeseed: English	"	25	15	0
Seal: Pale	"	23	0	0
" Brown	"	17	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6½
" Spirit	"	0	0	7½

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6½	—	0	1	6¾
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	12	5	0	—	12	10	0
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	10	0	—	7	12	6
Bisulphide of Carbon	"	13	0	0	—	.....		
Borax	"	28	0	0	—	.....		
Benzole (90%)	gal.	0	3	9	—	0	3	10
" (50/90%)	"	0	2	9	—	0	2	10
Copper Sulphate	ton	22	0	0	—	22	10	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	24	0	0
" White Sugar	"	28	0	0	—	29	0	0
" Brown "	"	23	10	0	—	25	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	6½	—	.....		
" Prussiate (Yellow)	"	0	0	7½	—	.....		
" Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1½
" Caustic (White, 70%)	ton	7	0	0	—	.....		
" " (" 60%)	"	6	0	0	—	.....		
" " (Cream, 60%)	"	5	18	9	—	.....		
" Crystals	"	2	10	0	—	2	12	6
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	2	—	0	1	3
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

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HOME INDUSTRIES.

MANCHESTER, 9TH FEBRUARY, 1888.

THE ENGINEERING TRADE.—The engineers of the district are finding a little more work, principally on foreign account; but in almost every case they could easily undertake a great deal more if it could be obtained. Messrs. Goodfellow & Matthews, of Hyde, are very busy, and are in this respect better off than most of their neighbours. Millwrights are only moderately employed, and can hardly expect any great improvement until there is another move towards the extension of spinning concerns. Tool makers are finding both inquiries and orders more numerous, but the tendency is rather in the direction of orders for specialties than in that of ordinary workshop tools. Boiler makers continue to be well employed, almost without exception, and there is no prospect of a scarcity of orders at present. There is very little call for general iron foundry work, and constructional iron founders especially are poorly engaged. Makers of special soft castings are busy, but as this department supplies special customers, it is no indication of the general state of trade. Coppersmiths and brass founders are suffering largely from the effects of the excessive advance in the price of the raw materials used. For many purposes for which copper has been exclusively used other metals are being tried, and this tendency will have its effect shortly on the copper market. There is a very decided inclination not to use more copper than is possible, and a maintenance of present rates will result in a permanent diminution of the number of its uses. Almost without exception cotton machinists are well under order, and there is also a steady demand which keeps them fully supplied with work. In this department there will be, speaking generally, no lack of employment for some time to come. In spite of this undoubted fact, there is as much cutting down of prices as ever to obtain work, and there is such keen competition that makers are deriving little advantage from the prevailing briskness. Considering that the competition in textile machinery is a purely local one, some advantage ought to be obtained from the present large demand, and to a partial extent at any rate, the pressure of the excessively low prices should be relieved.

A NEW MULE.—Mr. Richard Threlfall, of Bolton, is just introducing a new cotton mule, patented by Mr. Henry Ashworth, which is constructed with two rows of spindles. One row is set so that the points are higher than those in the other, and the spindles are arranged so that there are two threads in 2in., which is equal to an inch gauge of spindles. Special provision is made for working the fallers, but otherwise the whole of the motions are from a headstock of the usual construction. The saving of space from this arrangement is equal to nearly 40 per cent. A further trial will be needed to enable a definite opinion to be passed, but the machine appears likely to succeed.

THE MERCHANDISE MARKS ACT.—The working of this Act has been attended with many inconveniences, and there have been one or two decisions on legal points which show that it is not yet fully understood. It is provided that an offence against the Act may be defined by reference to a trade custom, and as there exists some doubt about the exact operation of this rule, steps are being taken to bring about a meeting of merchants at which certain points should be discussed. In this way it is hoped that trade customs may be distinctly defined, so that it will be easy for the courts to define what is an offence and what is not. It is hoped that the formation of a strong committee will result in advantage to the merchants, by enabling them to protect each other from trivial and vexatious prosecutions, and also to combine for the prosecution of any persons guilty of fraudulent practices. The Chamber of Commerce is therefore to be presented with a requisition to appoint such a committee.

LONDON, 9TH FEBRUARY, 1888.

THE MONEY MARKET.—There is still a great difficulty in finding employment for money, and the absolute flatness of the Stock Exchange helps to retain the exceedingly low rates for loans and discounts, which have now prevailed for some weeks. The stock markets have been completely demoralised by the anxiety resulting from the political tension on the Continent. Last Saturday speculation and investment was absolutely dead, and on Monday the market still waited for Prince Bismarck's speech. On the strength of his pacific declarations prices mended a little, but a relapse set in again. Every species of security was depressed in sympathy with the foreign department. Home railways have mended a good deal, but the anticipated rise in Southern deferred stocks, consequent on the provisional treaty between the Brighton and the South-Eastern lines, has been interfered with by the prevailing depression. Southern railways are, of course, particularly susceptible to bad news from the Continent. Copper shares have not been so good, and the price for the metal itself shows a slight inclination to fall.

COMPANIES.—Since our last report the following new companies have been registered: Farmer, Robey, & Co., Limited, with a capital of £50,000, to purchase the engineering business carried on by Messrs. Farmer, Robey, Brown, & Co., Limited, at Trent Foundry, Gainsborough; Henry Mitchell & Co., Limited, with a capital of £450,000, to carry on business as brewers; the Exploration Company of Central South Africa, Limited, with a capital of £5,000; the Electrical Automatic Delivery Box Company, Limited, with a capital of £60,000; the Anglo-Colonial Syndicate, Limited, with a capital of £100,000, to work mines in Cape Colony, the Transvaal Republic, and other parts of South Africa; the Monte Christo Gold Mines, Limited (Queensland), with a capital of £150,000; Bishop's Creek Gold Mining Company, Limited, with a capital of £100,000, to work mines in Queensland; Ashley's Patent Machine-made Bottle Company, Limited, with a capital of £200,000; Swansea Oil and Grease Company, Limited, with a capital of £15,000; the Property Realisation Company, Limited, with a capital of £50,000; Weaver Hall Brine, Salt, and Chemical Company, Limited, with a capital of £150,000; the Aubriot Enamels Syndicate, Limited, with a capital of £11,000; the Colonial Ammunition Company, Limited, with a capital of £50,000; Heaton's Cloisonné Mosaic, Limited, with a capital of £5,000; William Wilkinson and Sons, Limited, with a capital of £5,000, to carry on business as shear manufacturers; the Manchester Mat Manufacturing Company, Limited, with a capital of £6,000; Ira Ickringill & Co., Limited, with a capital of £80,000, to carry on a wool combing and worsted spinning business at Keighley; Manila Railway Company, Limited, with a capital of £500,000; President Gold Mining Company, Limited (South Africa), with a capital of £52,000; Patent Hydraulic Freestone Company, Limited, with a capital of £10,000; and Plas Winter Halkyn Mining Company, Limited, with a capital of £12,000. A total of 212 companies, with an aggregate capital of £19,463,758, were registered during last month; the figures for January, 1887, being £7,433,270.

COAL.—The total imports of coal into London during January amounted to 1,172,109 tons, as compared with 1,143,124 tons in the same month of last year. The total exported was 274,473 tons, as compared with 240,862 during the same period of 1887.

COPPER.—The total stocks of copper in England and France on 31st January, together with the quantities advised from Chili and Australia, are stated by Messrs. Merton at 45,692 tons.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 29th January, amounted to £1,130,061, on 15,831¼ miles, as compared with £1,102,105 in the corresponding period of 1887, when the mileage was 15,706¾ miles. An increase is thus shown in the mileage of 124¾ miles, or 0·7 per cent., and in the receipts of 2·5 per cent.

THE PARIS INTERNATIONAL EXHIBITION.—The Council of the Telegraph Engineers and Electricians is taking steps to organise an English Electrical Section. A circular has been issued to the leading electrical firms in this country inviting them to attend a meeting at the offices of the society, 4, The Sanctuary, Westminster, on Monday afternoon next, to consider the measures to be adopted in connection with the Exhibition. The Paris secretary of the Society, who has been in communication with the Director-General on the subject, will be present to give all necessary explanations.

SOCIETY OF ENGINEERS.—The first ordinary meeting of this Society was held on Monday evening, when the president, Mr. Arthur T. Walmsley, delivered his inaugural address, in which he reviewed the work of last session, and drew special attention to the various works in progress which had been visited during the summer vacation. In speaking of the future prospects of the profession and of trade, he pointed out the necessity of a personal inquiry into the requirements of foreign markets.

TECHNICAL EDUCATION.—A special course of lectures, commencing on 16th inst., is to be given at the Finsbury Technical College, by Professor Perry, on the mechanical engineering involved in the design and manufacture of dynamo machines and motors. These lectures will be of a thoroughly practical character, illustrated by working drawings and dynamos actually constructed by leading makers. There will also be drawing office work in connection with the same subject.

GLASGOW, 9TH FEBRUARY, 1888.

PIG IRON.—The market is still extremely flat. A fall of about 5s. per ton in all has taken place during the last few weeks, and if the price has now reached its lowest point there seems no immediate prospect of permanent recovery. The revival occasioned by the placing of shipbuilding orders seems to have passed away, and no other elements in the economic situation suffice to afford any new impetus.

SHIPBUILDING AND ENGINEERING.—Messrs. Lees, Anderson, & Co. have secured an order for a set of triple expansion engines for a steamer to be built at Londonderry at the Foyle Shipbuilding yard of Mr. Charles Biggar. The steamer is intended for the Londonderry trade of Messrs. A. A. Laird & Co., of Glasgow. A considerable number of yachting contracts have been placed during the past few days. Four of these have been designed by Mr. G. L. Watson, one of which, a large racing yacht, is to be built by Messrs. D. & W. Henderson & Co., the builders of the "Thistle." Another is to be built by the Culzean Shipbuilding Company, Ayr, and two others are to be built by the well known yacht builders, Messrs. Wm. Fyfe & Son, Fairlie, on the Clyde. One of the latter is said to be designed as a centre board boat. Messrs. Fleming and Ferguson, Paisley, have been commissioned by Mr. Sholto Douglas, of Coatbridge, to build a 40-ton steel yacht. The same firm will fit the vessel with their patent quadruple expansion engines.

MINERAL SHIPMENTS.—The mineral shipments last week show an increase over those of the corresponding period last year. Pig iron shipments show a large increase—from 5646 tons during the same week of last year to 8367 tons last week. Freights are various and fluctuating from day to day. There seems a tendency in Bombay freights to fall off, though others remain firm.

THE MINERAL OIL TRADE.—An amalgamation has now practically been effected by the Scottish mineral oil companies. Prices have been fixed according to a scale agreed upon, and although all the companies have not yet given in their adhesion, the syndicate is so far definitely formed that no practical difficulty is anticipated.

PHILOSOPHICAL SOCIETY.—On Wednesday evening, by invitation of Sir William Thomson, the Philosophical Society met in the natural philosophy class room in the University. Prof. MacKendrick exhibited and explained Von Fleischl's spectro-polarimeter for the estimation of grape sugar, a gas pump for the removal of gases from the blood, and other mechanical appliances for the study of physiological physics. Sir William Thomson then read a paper upon "A new composite form of electric balance adapted to measure currents from $\frac{1}{10}$th of an ampère to 500 ampères." This instrument may also be used as a volt meter and watt meter, and forms an important addition to the series of electric measuring instruments which were described in *Industries* for January 27th.

THE TECHNICAL COLLEGE.—The Glasgow and West of Scotland Technical College has arranged for the delivery of a course of lectures upon "Navigation." This important feature will supplement the existing opportunities for instruction in the principles of navigation, and facilitate the studies of those who are preparing for Board of Trade examinations.

FORTH BRIDGE RAILWAY COMPANY.—The half yearly meeting of the company was held on Tuesday. The report presented by the engineers indicated a prospect of this undertaking being completed in October, 1889; and the adverse rumours lately circulated in some quarters were contradicted by the official report of satisfactory progress. A special meeting was subsequently held to authorise parliamentary proceedings for the raising of additional capital.

(From our own Correspondents.)

LIVERPOOL, 8TH FEBRUARY, 1888.

THE WATER SUPPLY OF LIVERPOOL.—An alarming statement was made by Alderman Anthony Bower, at the last meeting of the Water Committee, concerning the serious condition of the water supply at the present time. It appears that this time last year there were 3,700,000,000 gallons stored in the reservoir at Rivington, whereas at the present time there are only 1,015,000,000 gallons in stock. Liverpool, however, is not entirely dependent upon the supply from Rivington. A sub-committee has been formed to consider the question of obtaining a temporary supply from elsewhere, and the Water Committee had every reason to hope, that although the present supply was in such a serious condition, the precautionary steps they were now taking would prevent the possibility of a water famine taking place. At a previous meeting they had decided not to obtain the proposed preliminary supply from the Vyrnwy works, on account of the great expense.

LIVERPOOL UNIVERSITY COLLEGE EXTENSION.—An enthusiastic meeting of the governors, members of the senate, and friends of the University was held on Monday, to consider the question of erecting permanent college buildings, which are estimated to cost £35,000. A subscription list was opened, headed by Lord Derby, with £1,000; the same amount being also subscribed by the Mayor of Liverpool, Mr. George Holt, Mr. Henry Tate, Mr. Alfred Booth, and Mr. E. K. Muspratt. The building for the Walker Engineering Laboratory is progressing favourably, the sub-structure being completed. Mr. A. Waterhouse, R.A., is the architect for all the buildings in connection with the University, including the chemical laboratory completed, the engineering laboratory in course of erection, and the proposed new permanent buildings.

SHEFFIELD, 8TH FEBRUARY, 1888.

IRON AND STEEL.—The Sheffield trade continues to improve. Large quantities of iron and steel, particularly Bessemer, are changing hands, and the output is much more extensive than it was a year ago. Railway material is in growing demand, and rails for home and colonial use are being urgently inquired for. Several large orders have recently been placed with Sheffield houses for railway material at rather better prices. Messrs. Charles Cammell & Co. are very busy in their rail mills at Workington, turning out great supplies of steel rails for shipment to distant markets. Another well known firm near Sheffield has also secured good orders for steel rails of best quality. An interesting fact in connection with modern manufacture is that one local firm, largely engaged in making first quality railway material, pays no less than £2,000 a year for analysis alone. Engineers are still actively employed on good orders, and there is plenty of work at the rolling mills. Edge tool makers are tolerably busy, and both the cutlery houses and the silver-plating firms are doing a more satisfactory business.

LEEDS, 8TH FEBRUARY, 1888.

THE HEAVY TRADES.—The fall in the price of pig iron has had comparatively little effect upon local trade. There

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is little anticipation of a further drop, and makers think the present healthy prices will be maintained. The engineers are well employed on heavy machinery; and there is a more encouraging inquiry for locomotives, and various descriptions of railway material. A number of very large boilers have lately been turned out, and heavy work for shipbuilding is in better request. There are also a few orders on hand for steam tram engines. Whether these engines will ever be equipped with anything like the American cow catcher it is impossible to say. Perhaps something may be done to diminish the danger to children who so carelessly get on the track in some of our large towns. A good business is being done in machine tools, as has been done for some weeks past. Cut nails also find a ready market.

EXPORTS.—It is a significant fact that Leeds is greatly developing its woollen and worsted trade with the United States. Its exports in woollens, worsteds, and cotton, in January, 1887, amounted to £21,480; during the past month the exports have increased to £24,191. The value of metals and machinery sent to the States during the past month amounted only to £2,624, compared with £5,142 in January last year; £4,822 was the value of hair and wools exported from Leeds, compared with only £1,191 in the first month of 1887. For the first month of this year the total exports amount to £37,381, compared with £34,474 in January, 1887, showing an increase of 8½ per cent.

NORTH STAFFORDSHIRE, 8TH FEBRUARY, 1888.

NORTH STAFFORDSHIRE RAILWAY COMPANY.—The half yearly meeting of this company was held in London on Friday last. The report recommended a dividend of 4¼ per cent. on the ordinary shares, a balance of £2,346 being carried forward. The accounts showed an increase of £3,255 from coaching traffic, and £8,030 from minerals. The chairman suggested, in moving the adoption of the report, that the capital expenditure, which had now been brought down to something like £5,000 per annum, should in future be debited to revenue. Owing to the spirited policy pursued by the present traffic manager, Mr. W. D. Phillips, the value of this property has developed considerably, and the company are now able to provide a dividend about double that which was paid a few years ago. The increase in mineral traffic appears to point to an enlarged volume of trade over the past year.

THE POTTERIES.—Mr. W. H. Turner, of Tunstall, has patented a pottery printing machine which is likely to effect a considerable saving of labour and expense in printing on china and earthenware. It is already in operation at several large manufactories. The printing is done from coils of paper drawn over cylindrical plates on the principle of the machinery used in the printing of some newspapers. It produces good, regular, and even work, and in large establishments, where the demand for printed goods is great, its adoption would effect a large saving in labour. The first cost of the necessary arrangements for printing by this patent is much less than that required for the old method.

COAL MINES REGULATION ACT.—The provisions of this Act with regard to blasting are still causing great trouble in this district, the men refusing to comply with them except at an advance in the price of getting. The multiplication of foremen and other officials is having a detrimental effect on the cost of getting.

BIRMINGHAM, 8TH FEBRUARY, 1888.

THE IRON TRADE.—There is a slight lull in the local iron trade, which is rather of the nature of a failure to go forward than of an actual retrogression. Business is fairly steady, and prices remain unchanged. There is a tendency to increase the output of pig iron, and it is stated that there are now 30 blast furnaces at work in South Staffordshire, against 27 this time last year. The output of these is on an average about 220 tons per week, and a rather hopeful feeling prevails in this branch of the trade. The present crisis in Europe, however, is tending to unsettle matters somewhat. Unmarked iron is fairly active at £5 to £5. 10s., but the marked iron is not in good request at £7 for first and £6 for second qualities. The galvanisers are busy in the sheet departments, many having orders that will occupy them for a month or two. In the hollow ware and wire netting shops there is no pressure, but not much scarcity of work.

THE HARDWARE TRADE.—The revival in railway traffic is leading to a demand for locomotive tubes, carriage fittings, and general stores. The makers of agricultural implements, trowels, rakes, shovels, &c., are busy, many of these goods going to foreign markets. Australia, India, and South America are improving in this respect, and better prospects are apparent with regard to several European countries. The gun trade is better off than formerly, and the brass trades are fairly occupied, although still crippled by the dearness of copper. The makers of cycles or cycle parts for export are busy. Ammunition of the smaller sizes is not much in demand, but Messrs. Kynoch & Co. and the Small Arms and Ammunition Company are well engaged upon shells for machine guns. The works of the Aluminium Company at Oldbury are progressing rapidly. This company has a capital of half a million sterling, the works occupying 4½ acres of ground, and it is expected that the metal will be produced to the extent of 300lb. per day, at a cost of less than £1 per pound. Sodium will also be manufactured by Castner's process.

LEICESTER, 8TH FEBRUARY, 1888.

WOOL, SPINNING, AND YARN TRADES.—There has been very little alteration in business since the last report; whilst there is no diminution, there is not any increase. Prices remain unaltered, but, if anything, the tone of the market is firmer, and the recent London sales have tended to confirm the tendency. Growers and country dealers still hold out for full rates; but staplers are not inclined to buy, and hence it becomes a question of who can wait the longest. Staplers are not doing much, as spinners are not very busily employed, and their purchases are small and to cover present wants only. Spinners are experiencing considerable difficulty in keeping their machinery employed. It is stated that there are heavy stocks on hand of yarn, and that lower prices have been taken to clear them out. Yarn merchants are not doing very much business. Yarns generally are firm in price, and cashmeres especially so.

HOSIERY TRADE.—There is a slight improvement in most branches of the manufacture, but generally firms are not very busy. Plain hosiers are fairly well off, but manufacturers of specialties are the best employed, and it is likely they will continue so. Buyers are now moving amongst the various houses, and it is anticipated that there will shortly be a considerable accession of business.

SOUTH WALES, 8TH FEBRUARY, 1888.

CARDIFF DOCKS.—Rapid progress is being made in the matter of rendering these docks unrivalled for the quick dispatch of steamers loading coal. By means of Messrs. Lewis & Hunter's cranes an average of 250 tons per hour can be put into the ships' holds, but how largely this can be increased will be seen from the fact that for a portion of the time the steamship "Ambient" was loaded at the rate of 428 tons per hour—a feat quite unprecedented. The "Asama," a new steel steamer, is sailing with 9000 tons of coal on board—the largest quantity any ship has sailed with from Cardiff. The dock authorities are also engaged in a scheme to light their property by electricity. The first installation is to consist of twenty-two arc lights, each of between 2000 and 3000 c.p., which will be placed at the entrance of the docks and basins. The lights are to be carried in couples on poles about 40ft. high, and so arranged that by means of coloured lenses they can be used for signalling with ships lying in the Roads. The motive power is to be obtained from two of Messrs. Davy Paxman & Co.'s engines; the purely electrical apparatus having been supplied by Messrs. Crompton & Co.

PROPOSED SCHOOL OF ENGINEERING FOR CARDIFF.—On the first of this month a meeting of the Council of the University of South Wales was held to consider the report of the Principal on the above subject. The Principal recommended the recently established school in the Yorkshire College as an ultimate model; but at present the want of funds would preclude the possibility of establishing such a school in Cardiff. The scheme proposed for consideration under present circumstances involves an extension of the workshop already erected by the building of a fitting and pattern making shop, and the acquirement of some modern machine tools.

BARROW-IN-FURNESS, 8TH FEBRUARY, 1888.

MINING ENTERPRISE.—The Hodbarrow Mining Company have determined, subject to the approval of the Board of Trade, to construct an enormous sea embankment at the margin of their mines on the Duddon Estuary, with the object of preventing the sea getting into their workings. This will cost not less than £50,000, and is considered a necessary expenditure of money in view of the great value of the hematite ore found in this place. It always commands from 1s. to 2s. per ton more than any other ore in the district, by reason of the high percentage of metal it contains. The demand for iron ore remains steady, at from 9s. 6d. to 12s. 6d. per ton net at mines.

IRON AND STEEL.—There is a brisk demand for both iron and steel, although the markets are not buoyant. Pig iron is quoted at 43s. 6d. to 44s. for mixed numbers of Bessemer iron; but "bearing" operations are said to be responsible for the quieter tone which pervades the market, despite the evidences which are everywhere apparent of the activity which characterises all the industries which use hematite iron or Bessemer and Siemens-Martin steel. The quotations for steel are practically the same as last week.

MIDDLESBROUGH, 8TH FEBRUARY, 1888.

PIG IRON.—The market is very quiet, and prices have fallen, although they are but nominal. Makers have little or none to offer at present, and what little is done is amongst merchants. As low as 31s. 6d. per ton for No. 3 G.M.B. prompt delivery has been quoted by sellers, but even at this buyers are not to be had. Warrants are quoted at 31s. per ton cash for Connal's No. 3 G.M.B., and Connal's No. 1, 2, and 3 hematite at 42s. 6d. per ton.

SALT.—The boring for salt at Seaton-Carew has turned out a failure, after having been carried down for 1200ft. without finding salt. The geological indications have induced the company to continue their boring in the hope of finding coal.

IRON MASTERS' RETURNS.—These returns, which have been looked forward to with considerable expectation, have turned out more favourable than anticipated. There has been an increase of 6599 tons added to stocks during the month of January. The increase was expected to be 10,000 tons. There has been an increase in the make of pig iron amounting to 2208 tons, and a decrease in the shipments of 4873 tons, as compared with those of December. There has been an increase in the make of Cleveland iron, amounting to 2380 tons over December, and a decrease in the make of hematite, &c., of 172 tons.

NEWCASTLE, 8TH FEBRUARY, 1888.

SHIPBUILDING.—Messrs. Armstrong, Mitchell, & Co. have just put down the keels for four vessels of considerably more than the average dimensions, and a berth is being cleared for the laying down of a fifth vessel. They have ordered from the patentees (Messrs. Arthur Dixon & Co., Wallsend) a powerful frame bevelling machine, and it is intended that this shall be utilised in connection with a new frame furnace of improved design, the erection of which has lately been completed. Messrs. W. Richardson and Co., having effected the sale of an exceptionally large steamer, which was originally intended to form one of the now defunct Monarch Line, are altering the stern to what is commonly known as the "clipper" type, and are making other changes which seem to indicate that the vessel is meant for service on one of the great ocean routes, for the conveyance of passengers as well as ordinary cargo. Messrs. R. Stephenson & Co. have secured an order, from Messrs. Wilson, of Hull, for a steel steamer, to be over 400ft. in length. The firm have also orders for two composite lightships, and other vessels. The new boiler and engine works which this firm are erecting in connection with their shipbuilding works, are now so nearly completed that operations in the boiler department are expected to be commenced by the middle of March. Messrs. Hawthorn, Leslie, & Co. have some important orders to proceed with, but frame turning has been stopped for some days owing to the non-delivery of materials. The difficulty of procuring supplies of steel continues to be a source of great inconvenience to shipbuilders on the Tyne, as well as at other northern ports. Messrs. Palmer & Co. have now seven berths occupied. This constitutes the whole of their building accommodation at their Jarrow establishment with the exception of one berth, and it is expected that this will very shortly be filled by a keel. The Tyne Shipbuilding Company and Messrs. Edwards & Sons have each laid down keels for vessels lately, and it may be stated that the latter firm have a good deal of repair work in hand.

ENGINEERING.—The works belonging to Messrs. Hawthorn, Leslie, & Co., at Forth Banks, as well as those at St. Peter's, are extremely active, the marine orders in hand being sufficient to provide full occupation for the machinery in both establishments. Messrs. W. Richardson and Co. are making engines for a large vessel lately launched by Messrs. Hawthorn, Leslie, & Co., to the order of Messrs. Milburn, Newcastle. The North-Eastern Engineering Company, Wallsend, are about to utilise some steam hammers which have hitherto been inoperative, in manufacturing a portion of the heavy forgings required in their own establishment. Night work is still the rule at this and other marine works on the river. Those establishments that are devoted to other branches of engineering are, on the whole, doing well. Messrs. Clark, Chapman, Parsons, & Co. are receiving a good many orders for steam winches, steering gears, &c., and those departments of their works are again quite busy. Messrs. H. Watson & Sons, High Bridge, Newcastle, are having a well sustained demand for their various specialties, and their extensive resources are being put to a somewhat exceptional strain. Messrs. Donkin and Nichol, of the St. Andrew's Engine Works, are also very busy. Among other contracts in hand by this firm is one for the fitting up of electric bells and telegraphs in the three passenger steamers for the Hall Line, now being completed by Messrs. Palmer, and one for the fitting of similar appliances in the armour plated ship "Victoria," now receiving the finishing touches at Elswick.

BELFAST, 8TH FEBRUARY, 1888.

SHIPBUILDING AND ENGINEERING.—Trade still continues to be good, and large numbers of hands are now employed, especially in the shipbuilding yards. Machine makers, who have been suffering from the long continued depression in the linen trade, are now finding more work. Boiler makers have several orders on their books both for land and marine work. The various shipbuilders are preparing handsome models for the coming Glasgow Exhibition.

WOOLLEN TRADE.—The efforts which are being made by Irish woollen manufacturers to extend their trade are meeting with very encouraging success. The exports are very much increased, and the goods give much satisfaction. A special effort is now being made to increase the home trade, which is not nearly so large as it might be.

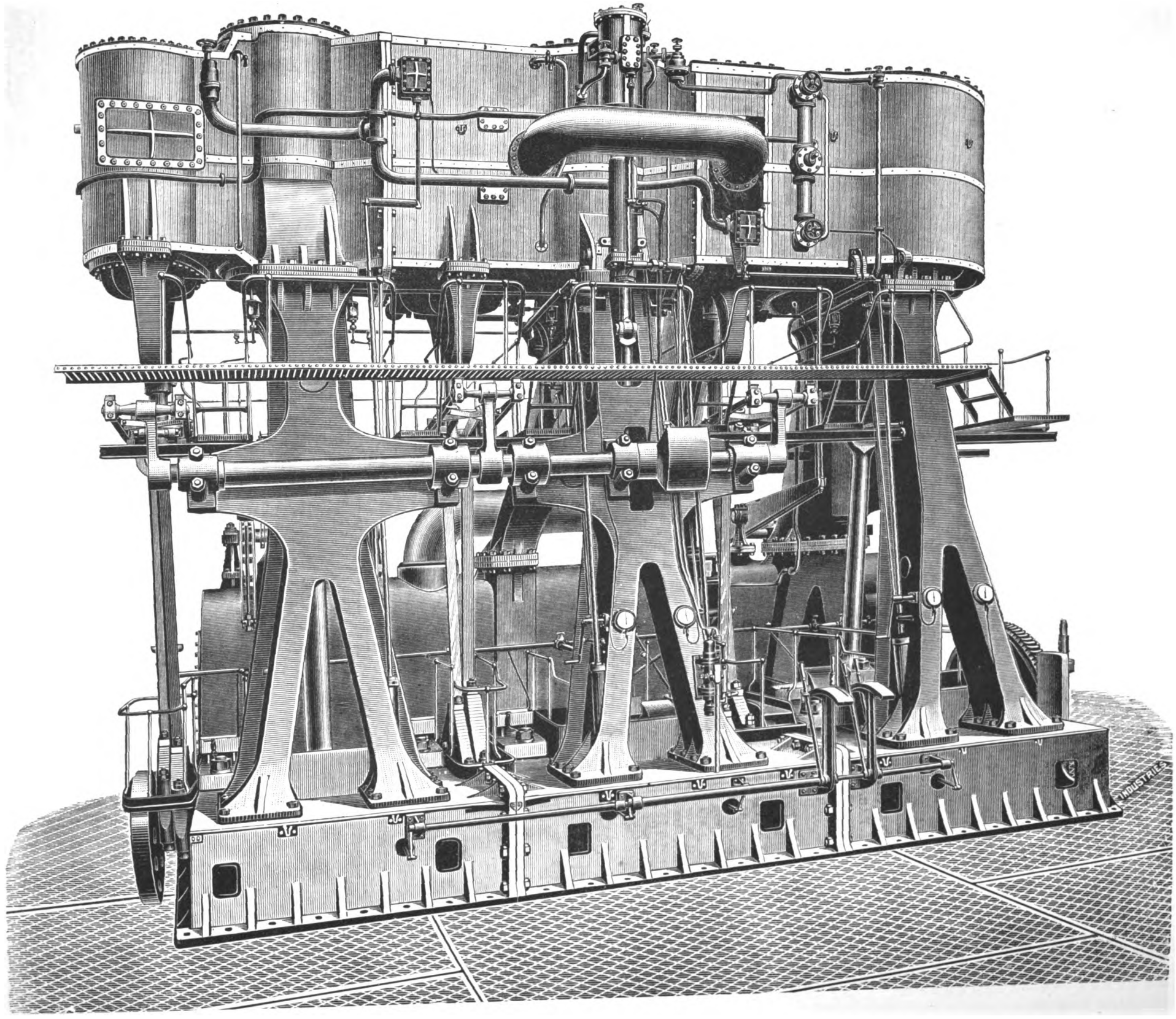
LINEN TRADE.—The late advance in prices still continues to be maintained; a steady trade is being transacted, while stocks are diminishing. The demand for yarns continues steady, with prices as before. Tows are in good demand, and prices are expected to rise. Cloths, brown goods, and finished linens are in improved demand, with prices in most instances hardening. Exports continue well up to the average. The supply of home grown flax is becoming very limited, and for good quality a high price has to be paid. Owing to an accident in the engine room, the large factory of the Braidwater Spinning Company, at Ballymena, has had to be closed, and over a thousand hands have been thrown out of employment for some weeks.

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TRIPLE EXPANSION ENGINES OF THE S.S. "CITY OF BERLIN."

CONSTRUCTED BY MESSRS. LAIRD BROTHERS, ENGINEERS AND SHIPBUILDERS, BIRKENHEAD.

(For description see page 137.)



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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
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Telegraphic address: "INDUS, MANCHESTER."
„ „ "INDUS, LONDON."
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Telephone number: 684, MANCHESTER.
„ „ 2785, LONDON.

Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 10TH FEBRUARY, 1888.

THE MANUFACTURE OF CHLORINE.

IN the review we recently published of the chemical progress of last year, we briefly drew attention to some of the more important patents and processes which are being worked with the view of utilising calcium chloride waste liquors, and for preparing bleaching solutions by other methods than that which is now almost universally used, and which was perfected by the late Mr. Weldon. M. Hermite's electrolytic method for the preparation of chlorinated bleaching compounds, and M. Brin's patented solution of hydrochloric acid containing dissolved oxygen, have not as yet been introduced for a sufficient time to compete with bleaching powder and the older processes of manufacture. A method for the preparation of chlorine from hydrochloric acid without any waste chloride has been long looked for by chemists, and Mr. Weldon, for some years before his death, was experimenting with magnesium chloride and its oxychloride with this idea in view, and a patent entitled, "Improvements in obtaining, partly in the free state and partly as vapour of hydrochloric acid, the chlorine of the chloride of magnesium, of aqueous solutions of chloride of magnesium, or of mixed solutions of chloride of magnesium and chloride of sodium," was taken out in his name in 1884. M. Pechiney has recently succeeded in developing the process, and overcoming the mechanical and engineering obstacles which presented themselves, and has so far perfected the method that at Salindres, where his experimental works are situated, from 720 to 760 kilo. of chlorine have been made per day for several months past, and plant is now in process of erection for producing some 6000 kilo. of free chlorine per day.

The competition between the two great processes for the manufacture of soda is frequently affected by the introduction of improvements in the utilisation of waste products, or by the opening up of new fields for the use of the materials manufactured. The great depreciation in the value of ammonia salts has not only benefited the agriculturist, but has also been advantageous to the ammonia soda maker, and if Mond is successful in obtaining ammonia and chlorine from ammonium chloride by means of nickel oxide, or other metallic oxides combined with non-volatile acids, the ammonia-soda maker will be able to be entirely independent of the other industry. For the older process, efforts have been directed towards the recovery of the sulphur from alkali waste without the use of hydrochloric acid, and this has recently been effected with such success by Miller and Opl that, if cheaply carried out, it will considerably benefit the Leblanc manufacturers. Solvay's improved continuous furnace for the production of chlorine and hydrochloric acid by the decomposition of calcium chloride by silica, and Lake's experiments on the same reaction will, we hope, be found satisfactory when worked on a commercial scale, and result in a recovery of hydrochloric acid, and therefore be an alternative to the sulphur recovery method just alluded to. The Weldon-Pechiney process for the manufacture of chlorine from chloride of magnesium appears to have now passed from the experimental stage, and the mechanical difficulties which were met with in the erection of the plant at Salindres having been overcome, a considerable decrease in the amount of soda made by the Leblanc process is expected. The old Weldon recovery process and the use of manganese will thus give place to the direct preparation of chlorine from the natural chloride of magnesium of Stassfurt. At present, the raw material employed is hydrochloric acid, and the process is meant to be worked in common with the Leblanc soda method as a substitute for the present methods for the manufacture of chlorine and bleaching compounds. The first step consists in the formation of a solution of magnesium chloride, obtained by dissolving magnesia in the hydrochloric acid, which is then evaporated down until the solution has the strength corresponding to that expressed by the formula $MgCl_2 6(H_2O)$. An oxychloride of magnesium is then formed from this solution by the addition of the requisite quantity of magnesia in an apparatus of special construction. The mixture becomes very hard, forming pieces of varying size, which are subsequently broken, crushed, and then sifted. The dust is utilised either in the first operation, or is re-introduced into the apparatus when a fresh quantity of the oxychloride is being prepared. The broken lumps have next to be dried at a temperature below 300° before they are ready for the final decomposition. This drying is effected in a brick work tunnel through which a current of heated air passes, and the oxychloride in small trucks is drawn in the reverse direction. The decomposition is effected in a furnace which can be rapidly heated by a movable regenerative burner, and through which a current of air is drawn by means of an aspirator consisting of two cylindrical gasometers plunging alternately in a solution of chloride of calcium in which the chlorine gas is not soluble. Between the furnace and the aspirator, a tower for condensing the hydrochloric acid and a glass tube refrigerator are placed. The chlorine, after passing through the aspirators, is driven into milk of lime, which is slowly converted into chlorate and chloride of lime, from which potassium chlorate can be prepared in the ordinary way. About 40 per cent. of free chlorine is produced, and about 48 per cent. of chlorine as hydrochloric acid is condensed and utilised in the first operation. The amount of free chlorine, therefore, which is obtained is 78 per cent. of the chlorine used. Professor Dewar has calculated from these figures the relative price of 1 ton of chlorine prepared in England by this way, as compared with that produced by the old Weldon process, in which he shows that there is a saving of £5. 12s. per ton effected by the new method. At Stassfurt, where chloride of magnesium as a natural product has practically no value, a ton of chlorine should be produced at a cost of £5, or £2. 9s. cheaper than in England, or about £8 cheaper than chlorine prepared by the old Weldon process. If the ammonium chloride from the ammonia soda process is converted into magnesium chloride by means of magnesia, or the calcium chloride be decomposed by carbonic acid in presence of magnesia, the process can be worked in conjunction with the ammonia soda manufacture. The chief expense of the new process appears to be for the fuel consumed, but if the experiments which are now being carried out prove successful, a considerable diminution in the expenditure will be effected. The quantity of chlorine produced in the last operation depends on the temperature of the furnaces, and by a slight modification of the present

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plant M. Boulouvard, the engineer at the works in France, hopes to be able to obtain hotter furnaces, and thus render the decomposition more complete.

Mr. Muspratt, in his presidential address to the Society of Chemical Industry at Liverpool, in 1886, pointed out that if magnesium chloride be substituted for salt as a source of chlorine, the natural seat for the preparation of chlorine compounds will be Stassfurt, and Professor Dewar, the president for this year, is of the same opinion. If Stassfurt magnesium chloride is used on any large scale for this purpose, considerable quantities of magnesia will accumulate, which may be readily converted into a useful and cheap cement. We hear that M. Hermite's process for electrolytic bleaching is now being tried on a large scale at Belfast, and in this process either calcium or magnesium chloride can be used for preparing the bleaching compounds. There will not be an accumulation of magnesia if this method be generally employed, unless the bleachers and dyers using the process consider it to their advantage to save their waste liquors. Considerable quantities of magnesium chloride could be, therefore, utilised by either or both of these new processes for the manufacture of chlorine, and with a demand for this salt at Stassfurt, it may then be worth while to recover the bromine which is at present lost by the present method of running the mother-liquor of the Stassfurt salts into the river. We must not forget that there have been recently several other methods proposed for bleaching on a large scale, and hydrogen peroxide appears to be capable of a much extended use. It may be that M. Brin's oxygenated hydrochloric acid will be found to be a cheaper bleaching compound than bleaching powder itself, and that the alkali manufacturers will then be content with the preparation of hydrochloric acid alone. Extended trials of these and other new processes in the same direction can alone decide which can be economially worked on a commercial scale; but we are inclined to believe in the future success of the Weldon-Pechiney process. The plant employed by M. Pechiney is complicated and expensive, but the engineering difficulties have been satisfactorily overcome, and although it may be unwise to predict, yet it would seem that we are on the eve of a new era in the manufacture of bleaching compounds from chlorine, and considerable alterations and modifications in the alkali trade may be consequently expected.

OUR BIG GUNS.

The bursting of a 10-inch gun while under proof at Woolwich again directs public attention to a subject which, though of vital national importance, has not yet received adequate consideration. Whether we regard it from the point of view of our national defences, or merely as a matter affecting our industrial supremacy, it appears a question of the first magnitude. From the former standpoint, it presents itself thus: Are our big guns efficient weapons, to be relied upon under all conditions? From the latter, we see it in this form: Are our manufacturers capable of building guns equal to those constructed by our rivals? In each direction lies a wide field for inquiry. Into neither of these, however, do we purpose at present to enter. But the occurrence at Woolwich cannot be allowed to pass without an expression of misgiving and apprehension, and a demand for a full and searching inquiry. We have been apt to look with pride and satisfaction on the marvellous achievements of the makers of our modern artillery. And truly we find in them just occasion for self congratulation. A big gun of the latest design is a remarkable illustration of the progress of science. It embodies the results of discoveries in several domains of knowledge. Chemistry has shown us the way to other and more suitable forms of iron than those known to our immediate predecessors. A better acquaintance with the structure of matter has enabled us to obtain greater resistance from the materials at our disposal. The development of engineering skill has led to the improvement and the multiplication of the mechanical means necessary for dealing effectively with those materials, particularly when in heavy masses. And a more accurate knowledge of the nature and the behaviour of explosive agents has brought within our reach forms of gunpowder capable of generating its tremendous forces according to a pre-arranged design. Thus a big gun is a triumph of modern science, to which the iron manufacturer, the engineer, and the powder maker have each contributed a large share. But our just admiration for the outcome of the combined efforts of these several parties is modified by a lurking suspicion, aroused and maintained by the frequent repetition of such accidents as that which occurred on 27th January at Woolwich, that there is somewhere in all this something amiss. The suspicion gathers consistence on reflection, and we are tempted to ask: has not the maker of heavy guns, in his desire to produce weapons more and more powerful, overstepped the limits of his knowledge and means, and built up his ponderous and imposing structures without due regard to the various conditions to which they are subject? Doubtless a chorus of voices will answer, "No." But we have to deal with the stubborn fact that of late guns have burst with alarming frequency. For this there must be a sufficient cause; and where are we to seek the cause if not in the inherent weakness of the gun? The elaborate reports of the commissions appointed to investigate these accidents served, by obscuring the point at issue, and by flattering our self love, to appease for a time the spirit of discontent which had been aroused. But frequent repetition of the same accident has thrown discredit upon these reports, and given rise to more disquieting misgivings. It will be hard to gloss over in the same way the utter destruction of the 10-inch gun at Woolwich the other day. We may safely assume that the gun was tested at Elswick, where it was built, before it was given over to the purchasers. Its breakdown can therefore hardly be due to a defect in the manufacture. This view is confirmed by the fact that it stood several rounds at Woolwich, and finally burst in a manner which points to a more serious fault. In his struggle with the manufacturer of armour plates, the artillerist has been compelled to increase again and again his charges of powder, till now he uses quantities that would have been regarded as fabulous a quarter of a century ago. If the truth be that he has gone too far in this direction, having in his haste outrun the gun maker and the powder manufacturer, it is well that he should be forcibly reminded of his error by the voice of public opinion making itself fully heard by the ruling powers. We shall await with interest the result of the official inquiry which must be made into the causes of the recent accident. Meanwhile the distrust which tends to paralyse the courage of our gunners will go on increasing. The matter is of extreme gravity, and it must not be allowed to rest where it now is, or to be languidly investigated with a view to its being quietly shelved later on.

THE PROTECTION OF TRADE.

The address which Lord Brassey recently delivered before the London Chamber of Commerce has deservedly attracted much attention, not only on account of the importance of the subject which he treated, but also because of the unique and thorough manner in which he had studied it. As a member of both Houses of Parliament, and as a Lord of the Admiralty, he had investigated all the ordinary sources of information; but not content with that he had undertaken a voyage of 36,000 miles, in order that he might personally inspect the positions of our coaling stations, our ports of commerce, and our Colonial defences, all of which are absolutely necessary for the carrying on of our immense trade. The London Chamber of Commerce has done good service in directing the attention of the public and of the Government to matters of national importance; but of all these, the latest —that of the defences of the Empire and the protection of trade—really includes all that have preceded it, for if our trade be destroyed all discussion about details is of no avail. From the remarks of the President of the Chamber of Commerce, it was evident that efforts had been exerted to arrange that the meeting should have been held in the Mansion House, under the presidency of the Chief Magistrate of the City of London, but the civic mind had not grasped the importance of the subject; at any rate these efforts had been unsuccessful. This, however, was compensated to a certain extent by the company of merchants and of distinguished naval and military officers who attended the meeting at the Cannon-street Hotel to hear what Lord Brassey had to say.

Before entering on the consideration of Lord Brassey's proposals, and with no wish to minimise the importance of these, it may be as well to remark that when persons or nations devote themselves too much to the study of self defence in case of attack, they are very apt to drift into a state of mind which magnifies trifles, and leads to scares over every little difficulty which arises, and gradually increase their defences till they become an intolerable burden. To exemplify this, we have merely to turn to the Continent, where we find nations armed to the teeth, and the Bourses of Europe agitated over every trifling incident, simply because these nations have carried their preparations for self defence to an extreme. Lord Brassey's proposals are by no means of an alarmist nature, and need inflict no great burden on the British taxpayer; but before even these are carried out, we ought to insist on the great spending departments of the army and navy being thoroughly re-organised, or an increase of their work will only intensify their present muddle.

Lord Brassey commenced by saying that all questions relating to national defences should be taken by common consent out of the domain of political controversy, and that the steps deemed necessary to the security of the Empire and its commerce once considered and determined, ministers on both sides should be equally bound to obey the mandate of the nation. We consider it altogether out of place to discuss party questions in this journal; but we cannot allow such a remark to be made without questioning its wisdom, or the possibility of ever carrying out the idea involved in it; it would just be about as easy to manage the internal affairs of the country without reference to party as it would its defence from external aggression. It is only by full and free discussion both in and out of Parliament, that the voice of the country, as distinguished from that of the Government officials, can be made known, as the opinions of the heads of departments are the most untrustworthy guides possible in such matters. Lord Brassey insisted that the proper defence of our coaling stations is strictly a measure of economy, that fortifications wherever practicable are the cheapest and most effective defence, and that the most costly and least effective is the detention in port of our cruisers, which should be employed in holding the ocean highways and in blockading the ships of the enemy. Not only are fortifications an economy, in that they reduce largely the numbers required to hold a position, they are an economy in regard to the description of force which is necessary; for example, the strong works by which our naval arsenals at home are now defended have not involved the addition of a single soldier to the regular army, as for the manning of these defences we must rely chiefly on the volunteers. These views are likely to be agreed to by all if they are not pushed to extremes, but no one will suppose that it is possible to render all our ports impregnable, we must confine our attention to the most important, and trust to our fleet for the defence of the others. Lord Brassey of course recognises this, and in his lecture he passed by Gibraltar, Malta, and Aden without any references to their defences, because we have the assurance solemnly given, on the responsibility of the Government to the Royal Commission, and renewed to the Conference of the Colonial Representatives, that the defences of these great Imperial fortresses will be maintained on a level with modern requirements. We must confess, however, that after personal inspection of the works at these three places, we have doubts whether they do meet such requirements. Passing from Aden to India, Lord Brassey considered the requirements of the chief ports in that vast country, and from there he went to Singapore, which he describes as a noble centre of trade, created as if by the enchanter's wand, under the British flag—the accepted emblem for all uncivilised and half civilised races, of justice, order, security, and unrestricted freedom of commerce. From Singapore he proceeded by St. George's Sound to Australia, and he bears witness to the high state of efficiency of the Colonial Naval Reserves. Turning homeward from Australia by the northern coast of the great Continent, he touched at Thursday Island, Port Darwin, and Mauritius. From thence he passed to Cape Colony and various other stations in Africa. Our space will only allow us to give his summary of the requirements which he considers necessary to complete the great scheme of defence which is now in course of execution. They are as follow: (1) At Aden, dredging operations; (2) at Bombay, additional monitors and the organisation of crews for the harbour defence flotilla; (3) at King George's Sound, Thursday Island, and Port Darwin, armaments of sufficient power to deny the harbour and the coal supply to hostile cruisers; (4) at the Cape, additional heavy breech loading guns, and a light military railway some six miles in length; (5) at Colombo, Singapore, Mauritius, St. Helena, and Sierra Leone, a local artillery militia; (6) at Ascension, if retained as a naval establishment, some armament is necessary. We agree with Lord Brassey that this enumeration will scarcely alarm the most jealous guardian of the public purse, as a moderate expenditure, fairly apportioned and judiciously applied, would fill up the gaps in our armour to which he has directed attention. He pointed out, moreover, that the above proposals should be supplemented by taking advantage of the assistance of our mercantile marine for the protection of our commerce, and he congratulated the present Government for the statesmanlike decision which they have taken to give subsidies for the retention of certain selected ships for the service of the navy in case of war. He recommended that in all contracts for the ocean mail services conditions should be imposed which would secure that the ships to be employed, or at least a certain number of them, should be adapted by their high speed and

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internal arrangements for conversion into cruisers, and that the officers and men should belong to the Royal Reserve.

In the discussion which followed, the views expressed by Lord Brassey were warmly supported. The Duke of Cambridge, while urging the necessity of being fully prepared, had no wish to be considered an alarmist, and urged steady systematic preparation; but he warned Lord Brassey that his demands, although moderate, would run up a much higher bill than he seemed to anticipate, and that difficulties would likely be raised by the Chancellor of the Exchequer. Admiral Sir J. Commerell on this point remarked that a Chancellor of the Exchequer should feel much prouder when he retired, or was turned out, by being able to say: "Owing to my efforts I have left the army and navy in a proper state of efficiency," than of saving a penny in the income tax. Lord Charles Beresford was of opinion that such matters should be settled on the advice of the experts belonging to the army and navy, subject, of course, to the control of Parliament. Mr. John Glover's remark that the time had now come when it should be laid down that private property at sea should be exempt from capture, is not likely to lead to much. It would certainly be a highly advantageous arrangement for Britain, but the other Powers are not likely to agree to a proposal which would take away their best chance of inflicting injury on this country in case they should ever find themselves at war with us. In the absence of any probability of such an arrangement we ought to calmly set about carrying out the suggestions which Lord Brassey has made.

Letters to the Editor.

A RECENT TRIP FROM LONDON TO NORTH CHINA.

To the Editor of "Industries."

Sir,—The following particulars of a trip to North China, which I made at the end of last year, will, I hope, prove of interest to your readers, and explain to some extent the progress which is being made in the Far East.

I left London on the 29th September last in the s.s. "Glenshiel," a fine new steamer of 3300 tons, and about 1800 i.h.p., built and engined by the London and Glasgow Engineering and Shipbuilding Company, and had every reason to be satisfied with the vessel selected for such a long voyage. Our first stoppage was at Port Said, and we saw in the distance a large dredger in course of erection, but I had no time to visit the works of the Suez Canal Company. During our passage through the Canal, I did not observe any material difference in its general aspect since I was there in 1877. We saw one large steamer pass at midnight, by aid of the electric light. This lighting arrangement I understand consists of a small dynamo driven by a vertical engine, and supplied by the Canal Company at a charge of £10. The effect as the steamer approaches is really grand, as the powerful light at the bow sheds a glorious halo over land and water, and makes everything around shine like molten silver.

After leaving Suez we pass the lights at Zafarawa, Ras Gharib, and Ashrafir, on the Egyptian coast. From Ras Gharib to Shadwan requires careful navigation, owing to the many rocks and shoals, especially in the lower part of the Gulf of Suez. From the Strait of Jubal, in a direct course down the Red Sea about 110 miles, we passed two small islands called the "Brothers," on one of which a light has been erected. About 100 miles farther on is a sunken coral shoal called the "Dœdalus," on which the P. & O. Company erected a light many years before the Suez Canal was opened. From this shoal to the Island of Perim, a distance of about 850 miles, there are no lights whatever, the course down mid-channel, as far as a group of islands off Musawa, being fairly clear. From here we had an intricate channel and no lights, with several islands in the direct course, on which lights might be placed with great advantage, such as "Jebel Teir," "Zebayir Islands," and on "Abu Ail" rock, the northernmost of the Hamish group. About midway between the "Zebayir" and "Abu Ail" rocks two steamers have recently been lost, having struck on hitherto unknown sunken rocks or reefs, the positions of which have not yet been ascertained. This now necessitates a deviation from the usual course, and the most careful navigation at night or in thick weather, owing to the want of lights. From "Abu Ail" in a direct line to Perim, the shoals off Mocha, on the Arabian coast, extend almost to the track taken by the steamers, and a light is much required here. From Mocha to the Island of Perim the course is pretty clear, and Perim is furnished with a good light, and also a Lloyd's signalling station. The Perim Coaling Company have erected a small engineering works and foundry, with appliances for executing repairs to a moderate extent to passing steamers, which must often prove a great boon, as there is no other available place for this purpose nearer than Bombay or Suez. At our next port of call, viz., Penang, we only remained from 6 p.m. till 1 a.m. next morning, and I had no opportunity of inspecting the tramway recently laid down there.

At Singapore I observed many improvements since my last visit ten years ago. A tramway has been laid down in the town and suburbs for seven or eight miles. It is worked by steam power, and carries both goods and passengers; but owing, I believe, to the introduction of jinrikishas (man power carriages) from Japan, numbers of which ply for hire in every street, at low fares, the tramway is not a success financially, and on one portion of the line passing Whampoa's Gardens, I found the working had been discontinued for want of sufficient traffic. The Tanjong Pagar and Metropolitan Dock Company's establishments were both fully employed on repairs to steamers, &c. Engineering work was also being carried out by several other firms. The Straits Ice Company turn out about five tons of splendid clear block ice per day, at a cost of about £4. 10s. per ton, their two works being under the management of Mr. Robert Park, who conducted us over them, and explained the different processes of the two plants of English and German machinery. Considerable alterations and improvements have been carried out in Singapore on the roads and bridges, under the superintendence of the municipal engineer, and I noticed several handsome little bridges erected at various points over creeks and ditches. I much regret that time would not allow me to inspect the progress of the new defences for this most important coaling station.

On arriving at Hong Kong we were moored to a jetty at Kowloon, on the opposite side of the bay from the town of Victoria. Since I was here in 1877, immense progress has been made. At that time where we were moored was a barren shore. Since then, large well built and handsome warehouses or go-downs have been built. Quays and jetties have been constructed, with well laid out lines of rails of about 2ft. gauge, with trucks to correspond, which are simply and strongly made, with steel wheels and axles. By this arrangement goods can be landed and warehoused in the speediest and most economical manner, with much less wear and tear than formerly. The workshops at Kowloon of the Hong Kong and Whampou Dock Company have been entirely re-arranged, and tools of the largest and most modern type laid down, capable of turning out any class of marine and general engineering work. The new dock, which, when finished, will take in our largest ironclads, is also making steady progress.

When *en route* to Japan in 1876, I had the pleasure to meet, in Chicago, Mr. A. Findlay Smith, of Hong Kong, and during our journey between there and Yokohama he spoke of a tramway which he thought could be made to the Peak on the mountain behind the city of Victoria, and on meeting him again after the lapse of eleven years, I was both surprised and delighted to find his former crude ideas not only matured, but worked out; and I believe the Hong Kong High Level Tramway will be in operation before this is in print. As probably few of your readers have been in Hong Kong, one of the most beautiful places in the Far East, it may not be out of place to state that owing to the hills rising abruptly behind the city, it has been hitherto cramped in its building extensions. The Government have made a series of splendid roads on the sides of the mountain leading to the Peak, and planted this once barren rock with many thousands of fir and other trees, under the superintendence of Mr. Ford, a gentleman highly skilled in arboriculture. This has enabled the wealthier residents to build houses on these terraces above the city, where they can enjoy the pure bracing air and lovely scenery. The completion of the high level tramway will not only enhance the value of the Government land, but render the whole mountain side available for building purposes, and make it a grand sanitarium within the reach of nearly all classes of the community. The tramway has been laid down from St. John's Place, Garden Road, to Victoria Gap, a length of 4690ft. The height of the upper above the lower terminus is 1207ft. The easiest gradient is 1 in 25, and the steepest 1 in 2. On the lower part of the line two steel rails of 35lb. per yard are laid, of 5ft. gauge, and forming a single line; and on the upper half three rails are laid, forming a double line. Half way is a cross siding with four rails about 130ft. long in the clear, having switches at the lower end. Steel sleepers, weighing 24lb. per yard, are bedded in lime concrete 6in. thick. The bridges, eleven in number, are constructed of wrought iron girders. The carriages are mounted on bogies, and carry about forty passengers, and when loaded weigh between five and six tons. The motive power consists of two pairs of compound horizontal engines with multitubular boilers, each 40 n.h.p., and erected at the upper terminus. Motion is communicated to the carriages by means of a flexible plough steel cable, $3\frac{5}{8}$in. in circumference, passing over grooved winding drums, and tested to a breaking strain of 54 tons. At each end of the cable the carriages are attached, so that while one train ascends the corresponding train descends, passing each other half way. The cable will haul up at one time one hundred and twenty passengers, equal to a maximum working load of $7\frac{1}{2}$ tons tensile strain. Cable guide pulleys are placed along the line at distances varying from three to eight yards. Each carriage is fitted with two steel clip brakes, arranged to grasp the centre brake rail, and to act at all times, unless held out of action by the brakesman; also with a pair of steel clip brakes to work on the 35lb. rails. The centre brake rail is of steel, weighing 66lb. per yard, and is laid between the ordinary rails. It is jointed and fixed to the sleepers with steel bolts and clamps. Starting from the lower terminus, the line proceeds for about 400ft. in a south-west direction, when a slight curve, of 500ft. radius, alters the course to south-south-west, which is continued until an altitude of about 900ft. is reached, where a curve of 300ft. radius changes the direction to west, after which it is almost straight to the upper terminus. The speed will be about six miles per hour, and reduced to four miles at the points and crossings. There will be several stations, and a single journey, without stoppages, will be made in ten minutes. The brakesman can at any time electrically signal the engine driver at the top to start or stop the train, and telephonic communication exists between the termini. The inhabitants of Hong Kong are much indebted to Mr. A. F. Smith and his co-directors for the energy and perseverance with which this unique undertaking has been carried out, and I earnestly hope that it will more than realise the expectations of all concerned, both practically and financially. Mr. J. F. Boulton, Assoc.M.Inst.C.E., is the engineer in charge, and Mr. James Anderson the manager.

Another improvement of great importance to Hong Kong is, I understand, being promoted by Mr. Chater. It is the bold one of extending the bund or quay seaward a distance of 250ft. This reclamation scheme would provide new sites for a splendid range of buildings on a fresh frontage to the bay, and a commodious bund, combining all the latest improvements for loading and discharging vessels. It would also provide for a splendid new street on the site of the present bund. I hope it will in due time be carried out, so as to meet the yearly increasing trade of Hong Kong.

On approaching Shanghai we had a good view of the commodious new dock, recently opened by Messrs. Boyd & Co., engineers; but as I left the "Glenshiel" and sailed again in a few hours for Tientsin I had no opportunity of inspecting this or the new water works, but hope to do so next spring. Leaving Shanghai by the "Kowshing," a fine steamer specially built for the Chinese coasting trade by the Barrow Shipbuilding Company, with great breadth of beam, moderate draught, and most commodious accommodation for first class passengers, and a large number of second class Chinese passengers, we arrived in three days outside the bar at Taku, the entrance to the river Peiho, and after a few hours' detention entered the Peiho, obtaining a good view of the forts guarding the entrance. On the south bank we passed the Imperial Naval Dockyard, and on the north side, further on, we saw a large number of men constructing the earth works for the new railway from the Kaiping Coal Mines and Taku to Tientsin. Since then several steamers have arrived with locomotives and other plant; the work will therefore go on uninterruptedly during the winter.

On nearing Tientsin, a distance of about 57 miles by the river from Taku, we saw a large balloon, partly inflated, in the grounds of the Military College, on the north side of the river, and on the south or Tientsin side, an immense building in progress of construction, which, we understand, when finished, will be a new Military and Naval Anglo-Chinese College, under the charge of European professors. At Tientsin were numerous piles of merchandise all along the bund, and crowds of coolies loading and unloading steamers and other craft, forming altogether a busy scene, far beyond my anticipations.

Yours, &c.

Allan C. Wylie.

Tientsin, North China, 10th December, 1887.

THE BOILER REGISTRY AND INSPECTION BILL.

To the Editor of "Industries."

Sir,—The letter from your correspondent "Boiler" was of special interest to me, as he opens up a subject which I was afraid would be overlooked by steam users generally until some fine morning they found from their morning paper that the Boiler Registry and Inspection Bill, with all its vexatious interference, had become the law of the land. I consider, sir, that no more unfortunate or inopportune time could possibly have been selected than the present for the introduction of a Bill of this nature. When trade is still languishing, and nothing but complaints are heard on every side, when some markets are closing, when foreign competition is so keen and vigorous that in some branches it is already pushing us from our stools, then Board of Trade officialdom endeavours to saddle the already failing horse with another burden, and to hamper its action by restrictive rules and regulations. Will the manufacturers and steam users of the United Kingdom sleep idly on, and allow another great blow at their interests to be struck, without even a protest? If they once allow the foot of a Board of Trade inspector of steam boilers within their premises, they will then have ample cause to regret their present supineness, and when writhing under the losses of time and money which will result, vainly wish they had not allowed the golden moments to pass when resistance would have been effectual. If the Bill to which I refer is allowed to pass, the steam users of this country will be saddled with a most oppressive enactment, involving great trouble, loss of time, and expense not only to be incurred in paying the staff necessitated by the Act, but also the expenses of carrying out the Act, the whole of which by the provisions of the Bill are arranged to fall upon them. In addition to this there will be enormous expense involved in altering their steam power to the absurd whims of the Board of Trade engineers, involving the removal of all Green's, Lowcock's, Twibill's, and other cast iron economisers, as foreshadowed by Messrs. Traill and Woodthorpe in their famous report No. 242, and the removal of all boilers with a factor of safety of less than 5, which would include about seven-eighths of all the boilers in use.

Assuming the total number of boilers in the kingdom to be 150,000, the carrying out of that rule alone would result in the replacement of upwards of 133,300 boilers, averaging an expense in so doing of £300 per boiler, the total cost of which would be £39,990,000. Of the value of the Board of Trade factor of 5, let the following facts speak: In the year 1869 a firm not far from this city laid down and set to work a boiler of the Lancashire type, 28ft. in length and 7ft. diam., single riveted, punched holes, plates $\frac{1}{4}\frac{3}{2}$in. thick, of ordinary Staffordshire make, and have continued to work it during the whole of the nearly nineteen years at 67lb. per square inch; that is to say, with a factor of 2·6, or about half the Board of Trade requirement. Taking the cost of replacing existing economisers at £6,000,000, as estimated by "Boiler," in his letter, a grand total of £45,990,000 is reached. Taking this amount as the capital sum required to be spent to bring steam users up to the Board of Trade requirements, and the cost of working the Act at, say, £500,000 per annum, I think it may fairly be admitted that the present time is not the one suited for such an experiment.

Sufficient grounds for the passing of such a Bill as the Boiler Registry and Inspection Act do not appear to exist. Can any good and sufficient reasons be brought forward to justify the infliction of such a tremendous imposition of penalty and loss upon the steam users of this country? The facts appear to show conclusively that, on the contrary, no further legislation is at present required, and nothing beyond a wise use of the means now in hand is necessary.

Sir Thomas Gray, assistant secretary to the Board of Trade, in his fifth annual report upon the working of the Boiler Explosions Act, 1882, gives the total number of explosions for the year 1886-87 as 37, and the deaths caused thereby as 24. These figures include the explosion of ammonia stills, kiers, steam pipes, drying cylinders, kitchen boilers (excluded from the provisions of the new Boiler Registry and Inspection Bill), &c.; in fact, every accident that could be included having the faintest resemblance to an explosion, from the improper giving way of a fusible plug, to the most serious explosion, involving great loss of life, the disposition of the Board of Trade inspectors being to multiply examples, and thereby to exalt their office. A striking instance of this disposition may be quoted from Report No. 242, in which Mr. Thomas W. Traill, the Engineer Surveyor-in-Chief says: "*Although the number of economiser explosions reported appears to be not very great, perhaps if all the failures of tubes were reported under the Boiler Explosions Act, as they should be, there would be more failures to record.*" If I had not the official report before me as I write, I should think this was merely the expression of a disappointed rival economiser

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maker, and not that of a judicial officer receiving a Government salary. However, perhaps he has an "exquisite reason" for it. Still, it will be observed, even with this disposition to exaggerate, it has not been possible to gather together more than 37 explosions, real and so-called, with a death roll of 24. During the previous four years of 1882-1886, that is to say, since the passing of the Boiler Explosions Act, 1882, 133 explosions, causing 90 deaths, took place, or an annual average of 33·2 explosions and 22·5 deaths.

From figures published by one of the boiler insurance companies, it has been clearly shown that taking the experience of the previous twelve to sixteen years into comparison, this represents a decline in the number of explosions of no less than 42·2 per cent., and in that of the number of deaths of 67·6 per cent. If the action of the Boiler Explosions Act, 1882, has been sufficient to produce such very satisfactory results in so short a time, simply from the dread of a preliminary inquiry, and without once putting in force its penal clauses, what would be the effect if, in the case of a proved instance of carelessness or of recklessness, a formal inquiry were held, and all the costs and penalties laid upon the culprit? In addition to this penalty, the Board of Trade are empowered by the present Act of 1882 to publish the circumstances as they think fit, and the unenviable notoriety thereby accruing would be, in my opinion, an ample deterrent. It is clear also that the decision of the Board of Trade would greatly affect the decision of any case under the Employers' Liability Act which might be pending arising from the explosion and its results. Nothing more requires to be done beyond simply setting the powers already held by the Executive in action, and it certainly would be most undesirable to erect and set to work enormous and cumbrous machinery of such an expensive character to do the work before we have tried the tools we already possess. Let the Act of 1882 have a fair trial, say of another four years, and let all its provisions be carefully and judiciously enforced; we shall then see that there is no need for further legislation on the subject. Explosions will have fallen to the few which even a Board of Trade inspector would admit were entirely accidental, and which could not by the exercise of any engineering skill be prevented.

When these views are generally known, I feel sure that their force will be seen, felt, and acted upon. The Oldham Chamber of Commerce, I notice from a local journal, has already passed the following resolution: "That this Association is strongly opposed to the Boiler Registry and Inspection Bill, 1887 (introduced into the House of Lords by the President of the Board of Trade last session), which it considers unnecessary, as shown by the rapid diminution of accidents which have taken place during the past few years, and as only likely to further embarrass trades already sufficiently harassed by Parliamentary enactments; and would call attention to the Boiler Explosions Act, 1882, the powers under which already conferred upon the Board of Trade, IF PUT IN FORCE, are amply sufficient to act as a safeguard against accidents, and as a deterrent to carelessness on the part of owners of boilers."

This example is to be commended to the notice of other Chambers of Commerce, and I certainly hope that a strong and irresistible force of opinion will be formed, so that the promoters of the Boiler Registry and Inspection Bill may be held in check, and prevented from adding this additional bar to trade and industrial progress.

Yours, &c.,

ECONOMISER.

Manchester, 6th February, 1888.

THE INVESTMENT OF CAPITAL IN SPAIN.

To the Editor of "Industries."

SIR,—I see from your London letter of the 26th January that a company has been registered under the title of the Andalusia Iron, Coal, and Steel Works Company, with a capital of £1,200,000. This seems to be a very large sum to employ in coal raising and metallurgical pursuits in Andalusia; but still the thing is feasible if it is intended to manufacture railway material and to build ships, as well as to export ore and pig, and furnish a coal supply to Gibraltar with the company's own steamers. But if the business is not developed to that extent, the home market is too small for the employment of such a large capital. I suppose that the coal fields which it is proposed to develop are in the Belmez and Espiel district; but their situation would not allow of their ever becoming the centre of a metallurgical industry on a large scale, owing to the scarcity of water. Again, if the iron mines which it is proposed to develop are the Pedroso or Fuente del Areo mines, the ores cannot be smelted on the spot, as there is not sufficient water even for the boilers, a small works in the district having been unable to obtain water during three months of the year for a 40 h.p. condensing engine.

In forming a large establishment in Andalusia on the lines of Creusot, Cockerill, or Krupp, it would be necessary to secure a site in the neighbourhood of the Guadalquiver, the question of a good supply of water being of the utmost importance. This would, however, cause a great part of the advantage of cheap ores and coal to be lost, since both would have to be transported a considerable distance. There would therefore be some difficulty in establishing an export trade, and for the inland market a works turning out 100,000 tons of pig iron per annum appears rather too large, even if the establishment goes in for making rails, locomotives, waggons, shipbuilding, and other branches of large engineering.

Your MADRID CORRESPONDENT.

Madrid, 2nd February, 1888.

TRANSMISSION OF POWER.

To the Editor of "Industries."

SIR,—Much has already appeared in your journal about the electric transmission of power. As *Industries* is very largely read, not only by electrical engineers, but by all classes who have anything to do with power transmission, I venture to add another letter. First, as to efficiency. The efficiency of transmission depends on a great many factors, such as cost of machinery, speed, power transmitted, &c. For instance, a large power, such as 500 h.p., can be transmitted a mile with a gross efficiency of 85 per cent. without any difficulty. If the dynamos and motors have to go at slow speeds, of course the efficiency is lower. For small powers, such as 50 h.p., with reasonable dynamo speeds, 75 to 80 per cent. is obtainable over a mile or so. Engineers do not seem to realise that electrical transmission is not a sort of guess work. A plant can be calculated within 1 per cent. or so without any difficulty, and the exact efficiency and waste is always known beforehand. In "Erg's" very able letter he points out that English makers try to make their machines too light. There may be some truth in this in some cases, but none of the large manufacturers countenance these practices. Many of the extraordinary slow speed machines, or light machines, are made to please customers with theories of their own on such subjects. If an engineer asks for a light dynamo or motor, or one to run at a slow speed, one naturally expostulates at first; but finding that of no avail, makes it rather than let the order pass. Engineers also often seem to think motors are in some way a special kind of machine that is not yet fully understood by dynamo makers generally. In fact the old fallacy that a good dynamo is a bad motor is not yet quite rooted out. With regard to Mr. Preece's letter, I am sorry to disagree with such an authority, but cannot see any inaccuracy in the calculations of the efficiency of the Oerlikon transmission. The only fault is the crude method of measurement of the powers supplied and received. It is rather barbarous to use brakes or transmission dynamometers for testing, when the electrical methods are capable of such perfect accuracy with infinitely less trouble. Perhaps, however, many engineers would not be satisfied with anything but brake tests, to which they are more accustomed. Electrical transmission has another advantage which must not be overlooked. A motor is always capable of giving an enormous output for a short time when required. For instance, a motor made for say 10 h.p. will give 30 or 40 h.p. for a short time if required. This property is especially important in locomotive work. Another advantage an electric motor has is its constancy of speed. When required a motor can be made to run with a varying load at even more nearly constant speed than the engine that drives the generator.

Yours, &c.,

JAMES SWINBURNE.

2nd February, 1888.

ON Saturday, the 4th inst., the Corporation of Stettin decided to purchase three ice breaking steamers, and a sum of £20,000 has been set aside for this purpose.

GREAT NORTHERN TELEGRAPH COMPANY.—Traffic returns: Receipts in January, 1888, £21,400; corresponding month, 1887, £20,400; corresponding month, 1886, £19,880.

EXHIBITION OF METEOROLOGICAL INSTRUMENTS.—The Royal Meteorological Society intend to hold an exhibition of apparatus connected with atmospheric electricity, including lightning conductors, photographs of lightning, and objects damaged by lightning, at the Institution of Civil Engineers, from 20th March to 23rd March. The exhibition committee is anxious to obtain as large a collection as possible of such apparatus, and will also exhibit any new meteorological instruments or apparatus invented or first constructed since last March.

SOCIETY OF CHEMICAL INDUSTRY.—At the February meeting of the Manchester Section Mr. Rowland Williams, F.I.C., F.C.S., read a paper on the "Adulteration of Tallow with Cotton Seed Oil," in which he said that during the past year he had examined a large number of samples specially for this adulterant, and had found it to be present in one or two cases. Owing to the comparatively low price of cotton seed oil there is plenty of scope for profitable adulteration by dishonest merchants. The author stated that it was possible to add as much as 40 per cent. of cotton seed oil to tallow without the mixture differing appreciably in general appearance from ordinary tallow. In fact, the only means of detecting the fraud is by chemical analysis. A series of mixtures of tallow and cotton seed oil, containing from 5 to 40 per cent. of the latter, was prepared in Mr. Williams' laboratory. The melting points and saponification equivalents of these were nearly the same as those of pure tallow. The author found, however, by determining the iodine absorptions of the various mixtures, that it is easy to detect 5 per cent. of cotton seed oil, which is the smallest proportion likely to be introduced into tallow. Each percentage of iodine absorbed in excess of that required by genuine tallow indicates adulteration with about 1½ per cent. of cotton seed oil. Mr. Williams therefore recommends, in addition to the usual tests, the application of Hübl's reagent in the analysis of tallow, as being the most certain means of detecting adulteration.

THE COAL FIELDS OF SOUTH AFRICA.—In a paper entitled "Contributions to the Physical Geology of Cape Colony," read by Professor A. H. Green at the meeting of the Geological Society, on January 25th, reference was made to the coal fields of South Africa. The coal seams occur in the Moltene beds, which overlie the well known Karoo beds, and are overlain by the Red beds and Cave sandstone. Their formation Professor Green considered as raising questions of much interest, as, unlike most coal seams, he believed them to have been subaqueous in origin. This opinion he based mainly on the absence of the underclay that forms so well known a feature in our English coal seams. The author maintained that the structure of the coal further confirmed this conclusion; the coal consists of excessively thin layers of bituminous matter separated by mud films; on examining the ash left by the combustion of the coal before the blow pipe, it is found to consist of minute lenticular grains of sand or silicious matter. Professor Green suggested that as the sand slowly sank through the waters of the lake in which the coal was deposited, it became coated with the decayed vegetable matter with which the water was charged. The coal field yields two principal varieties of coal, one free burning and the other slow burning; but even the best quality contains 25 per cent. of ash. The coal bearing strata have a very irregular dip, and hence one must accept with great caution the sanguine expectations of speculators. In conclusion, Professor Green said that he did not think it likely that the coal field would ever prove of great commercial importance.

SHIPBUILDING NOTES.

Messrs. Workman, Clark, & Co., Limited, Belfast, launched on the 28th January, a handsome steel screw steamer named "Macgregor," for Messrs. Colvils, Lowden, & Co., Glasgow. She is the sixth vessel built by them for this firm. She has been specially designed for the American fruit trade, to carry bananas from Belize to New York, and is expected to be one of the fastest boats on that station. The dimensions are: Length, 215ft.; breadth, 32ft.; depth to floors, 21ft. 3in. She is of the awning deck type, and has a cellular double bottom both fore and aft. There is accommodation for thirty passengers in a bridge house amidships. She will be classed at Lloyds' 100 A1 Awning Deck. After the launch she was towed to Glasgow to have her engines and boilers put in by Messrs. Muir & Houston.

On Monday last the new screw steamer "Nicholas" went to sea for her trial trip. The vessel is 212ft. by 30ft., and 14ft. draught, and has been built by Messrs. Wood, Skinner, and Co., Bill Quay, Newcastle, for the Russian Company of Land and Sea Conveyance of St. Petersburg and Odessa. She is a sister ship to the "Platon," recently built by the same builders for the same company. The engines have been constructed by the North-Eastern Marine Engineering Company, Wallsend, and they are the fourth set built by them for the same owners. They are on the three crank triple expansion type, with cylinders 17in., 28in., and 46in., by 30in. stroke, and include all the most modern improvements. During the trial the engines ran at 102 revolutions without difficulty, and great satisfaction was expressed with the machinery and the speed obtained, viz., 10¼ knots, being half a knot in excess of the guaranteed speed.

There was launched recently from the shipbuilding yard of Messrs. R. &. W. Hawthorn, Leslie, & Co., Limited, Hebburn, Newcastle, the first of two steel twin screw steamers, now being built by them for the mail and passenger service of the Chinese Government. The dimensions of the vessels are: Length, 260ft.; breadth, 34ft.; depth, 19ft. The vessel is made to the highest class at Lloyd's, with deck house for the accommodation of passengers from the after end of forecastle to the stern. Over this house is an awning deck extending the full width of the ship, and of the same length as the house. Forward of the engine and boiler space, in the large deck house before mentioned, is a handsome saloon for first class European passengers, together with the necessary state rooms, lavatory arrangements, &c. This saloon will be handsomely fitted in carved oak framing and ash panels. The vessel throughout will be lighted by the electric light, including mast head, side lights, cargo lamps, &c. This is being supplied by the Woodside Electric Light Company, of Glasgow. The vessel has steam windlass and steam winches by Messrs. Clarke, Chapman, Parsons, & Co., Gateshead, and also steam steering gear. The vessel will be driven by two sets of triple expansion engines, having all the latest improvements, including Marshall's valve gear. There will be two multitubular double ended boilers, which will be supplied with forced draught, and worked at a pressure of 160lb.

Messrs. Armstrong, Mitchell, & Co. launched from their Low Walker yard, near Newcastle, on the 3rd inst., a large vessel named the "Paula," which is intended for the oil carrying trade, and is now being fitted with engines by the Wallsend Slipway Engineering Company.

On Wednesday last the new steel steamer "Cabo San Antonio" made a very satisfactory full speed and progressive trial trip, after the vessel's return from Stockton-on-Tees, where the engines and boilers have been fitted by Messrs. Blair & Co., Limited. This vessel has been built by Messrs. J. L. Thompson & Sons, North Sands, Sunderland, to the order of Messrs. Ybarra & Co., Seville.

Reviews.

A PRACTICAL TREATISE ON BRIDGE CONSTRUCTION. By T. Claxton Fidler, M.Inst.C.E. London: CHARLES GRIFFEN & Co. 1887.

This book is a model of what an engineering treatise ought to be, and fulfils all the requirements which we have often pointed out ought to be met by text books intended for men engaged in practical work, as well as of great use to the more advanced students in colleges. Its author, who is well known, not only for the theoretical knowledge he possesses of bridge building, but also for his practical experience in actual construction, has made an excellent blend of theory and practice, not so much of the former to repel all except the mathematicians, and just sufficient of the latter to meet the requirements of intelligent engineers, who would of course supplement that part of it by the results of their own observations and experience. Moreover, the whole work is written in a fresh and vigorous style, and presents a considerable amount of useful information, which will be of interest to numbers of general readers; for, as the author explains, his object has been not only to describe the modern practice of bridge construction, but also to set forth in the simplest language the mechanical principles and experimental facts on which it is based. The necessity for such a work as that by Mr. Fidler has arisen from

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the many important changes which the art of bridge construction has undergone within the past few years. Engineers have been called upon to construct bridges of unprecedented magnitude, whose design and execution have presented a number of new problems, or have invested old ones with an interest which they did not before possess. And further, as our author points out, new problems of interest have arisen in connection with the introduction of steel, the adoption of new forms of construction, and the employment of new methods of research; while the constant accumulation of experimental facts has in the meantime added largely to our stock of practical knowledge in regard to such subjects as the strength of materials and the effects of wind pressure. In order to make the book useful not only to engineers and draughtsmen who may be engaged in the work of bridge calculations and bridge construction, but also to students, the author has devoted the earlier parts of the work to a simple demonstration of those mechanical principles which must of necessity form the beginning of any study of the subject, and which are more fully developed and applied in the later portions of the book. He has employed to a considerable extent a geometrical method of investigation, not as a mere translation from the language of algebra, but as a parallel and independent method which is capable in itself of affording positive demonstrations, and of yielding direct solutions for most of the problems that arise in bridge construction. He has, however, kept his geometry within moderate bounds. When an enthusiastic specialist takes up a subject he generally runs it to death, and his work is of little use to the practical engineer. Within the past few years geometrical methods have been much developed; but many of them are little more than curiosities and examples of misplaced ingenuity, and we are glad to observe that Mr. Fidler has restrained himself in this matter. The earlier parts of the work contain a detailed application of the combined geometrical and algebraical methods to the determination of those bending stresses which take effect in all bridges, and to the classification of bridges. The subject of the strength of materials, and its application to the design and construction of tension members and compression members, the strength of columns and struts, and a comparison of the results of those with those of the most recent experiments, is then taken up, and the facts, rules, and principles involved are collated and applied to the practical work of designing bridges of various types of construction; and in every case the calculations are so arranged and tabulated that the sectional areas of the various members can be readily determined by the older methods, or by either of the newer methods for fixing the working stress. The latter part of the work is taken up with the more practical aspects of the subject, and the methods of designing various types of parallel and bowstring girders, bow and chain bridges, arched ribs, suspension bridges, and cantilever bridges, each of which is treated in a highly satisfactory manner, and well worthy of the attention both of the engineer and the student. The concluding chapter of the work is devoted to the question of wind pressure, a subject whose importance has only recently been realised, and which a short time ago was discussed in the correspondence columns of this journal. Throughout the work there is a considerable amount of useful advice on miscellaneous subjects. For instance, on the subject of theory and practice, the author says: "In the practice of iron bridge construction, and still more in its future development, theory must always be regarded as an indispensable guide, if only for the reason that there is always a point beyond which experiment will not carry us. At the present moment the trustworthiness of theory is so fully recognised that no one will think of determining the proportions and details of an iron bridge without reference to theoretical calculations, or by the mere exercise of that indefinable quality which is known as the 'judgment' of practical men. The time has, therefore, gone by when it is necessary to protest against that unreasoning objection to theory which can only have arisen from a mistaken notion as to the real meaning of the word. In fact theory, in its broadest and truest sense, is universally employed in all mechanical designs and operations; and the so-called 'practical' man who will have nothing to do with it is unconsciously in the position of the bourgeois in Molière's comedy, who would not believe that he had been all his lifetime speaking and writing *in prose*." Then again, speaking of bridge construction, the author says: "Economy in bridge construction is something very different from mere saving of cost, and has nothing in common with that sort of economy which consists in reducing expenditure at a corresponding sacrifice of efficiency, or strength, or fitness. On the contrary, it insures the highest possible efficiency by making the best use of the given material, and without it the safe construction of very huge bridges would be impossible." On the whole, we have very much pleasure in commending Mr. Fidler's book, not only for its theory and account of practice, but also for the sound common sense opinions with which it abounds.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

At yesterday's meeting of this Society the paper read was on "Alternate Current Transformers, with special reference to the best proportion between Iron and Copper," by Mr. Gisbert Kapp. Reduced to its simplest form, a transformer consists of a magnetic circuit interlacing with an electric circuit, very much like two links in an ordinary chain, as represented in Fig. 1. In this

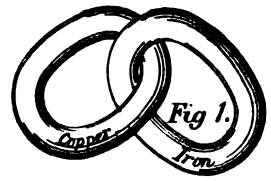


Fig 1.

case the co-efficient of mutual induction between the two circuits is a maximum, and is equal to the square root of the product of the two co-efficients of self induction. In all modern transformers the condition for maximum mutual induction is fulfilled, the iron core exhibiting no external magnetism, and the different types of transformers now in the market are only distinguished by the particular manner in which the circuits are arranged, with a view to obtain the following objects: reduction of the length of the two circuits, reduction of the weight of materials employed, ventilation, facility of manufacture and repair, efficiency of insulation, and reduction of cost of manufacture. The author divided modern transformers

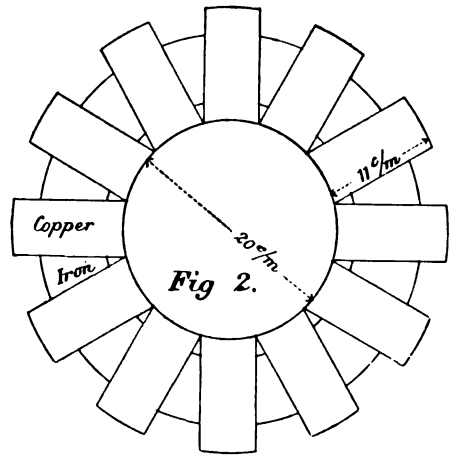


Fig 2.

into two classes—"core transformers," where the iron core is more or less enveloped by the copper coils; and "shell transformers," where the copper coils are more or less enveloped by an iron shell. As familiar examples of these two classes he cited the ordinary Gramme ring and the Zipernowski type of transformer, and part of the paper was devoted to a comparison between the merits of these types. To obtain a basis of comparison he assumed two transformers to be made, of circular ring shape, and of the same over all dimensions (Figs. 2 and 3). The

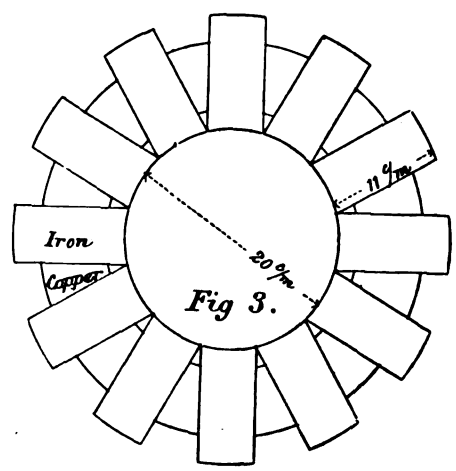


Fig 3.

internal diameter of the ring is 20cm., the cross sectional diameter 11cm., and the external diameter therefore 42cm. The circular cross section is made up by the iron core and the copper coils in the Gramme ring (Fig. 2), and by the copper coils and the iron shell in the Zipernowski ring (Fig. 3). An insulating space of 2½mm. between the core and the primary and between the primary and secondary circuit has been assumed in all cases, so that the available space for copper and iron in each type amounts to 10cm. The author then investigated how much of this space should be filled with iron and how much with copper, in order to obtain a maximum output with a given rate of heating, and maximum output under the condition that the electromotive force between the secondary terminals should not vary by more than 2 per cent. between full load and open circuit, if the e.m.f. on the primary terminals is kept constant. The theoretical part of this investigation was based on his graphic method of dealing with induction coils, which was published in *Industries*, Vol. II., page 360; but he has amplified the method then given by including the phenomenon of hysteresis or molecular friction in iron which causes heat. It is evident that the more heat is developed in the iron core itself, the smaller is the margin left for the heating of the copper coils, so that the output of a transformer becomes reduced as the amount of heat developed in the core increases. In calculating the output for the two types of transformers above described, an induction of 8500 lines per square centimetre and a period of one-eightieth of a second were assumed, under which conditions, according to Professor Ewing, the heat generated by viscous hysteresis amounts to 5000 ergs per cycle, or about 30 per cent. more than would be the case if the iron were carried slowly through a complete cycle of magnetisation (static hysteresis). The effect of hysteresis will be clear on a comparison of the two diagrams (Figs. 4 and 5), the former showing the original method, where hysteresis was neglected, and the latter the method under which it is taken into account. The circle represents the effective exciting power, which is assumed to coincide with the magnetisation, so that the projection on the vertical of the radius O P as it revolves clockwise round O represents the effective exciting power in ampère turns, and to a different scale; also the flow of force at any instant. The line representing the current in the secondary lags behind O P by a quarter cycle, and can be calculated according to a well known formula, from the maximum induction, number of turns, and resistancy of this circuit. This gives also the exciting power of the secondary circuit. Let O J_2 in Fig. 4 represent its maximum; then by erecting a vertical

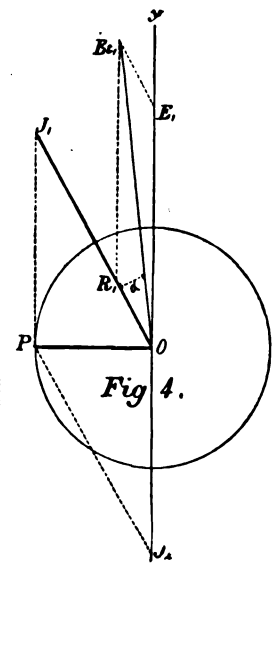


Fig 4.

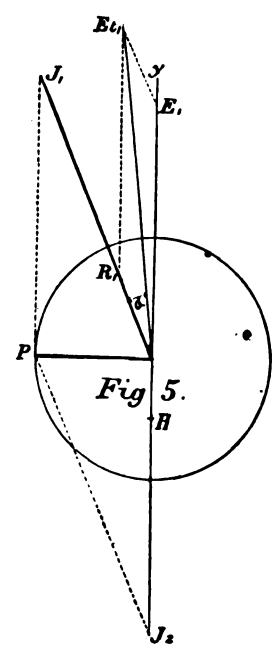


Fig 5.

on O P in P, and making P J_1 equal to O J_2, we find the line O J_1, which represents in position and magnitude the maximum exciting power due to the primary coil alone. This gives also the primary current, and the loss of e.m.f. due to the resistance of the primary coil can now be calculated. Let O R_1 represent this, and O E_1 on the vertical the counter e.m.f. of the primary, which is calculated from the total induction and number of turns. Then the parallelogram O R_1 E_{t1} E_1 gives the point E_{t1} and the line O E_{t1}, which represents in position and magnitude the maximum e.m.f. impressed on the terminals of the primary coil; whilst α is the angle of lag of current behind impressed e.m.f. The work absorbed in the primary coil is represented by the product of mean primary current, mean primary potential, and the cosine of the angle of lag; but in modern transformers the lag for full load is so small that the work absorbed is very nearly represented by the product of current and potential. In order to include the phenomenon of hysteresis, the author assumes that the rate of dissipation of energy by hysteresis follows the same law as the rate of dissipation of energy by eddy currents. When the induction passes through zero, the rate at which heat is generated would then be a maximum, which would gradually diminish to zero as the induction approaches its positive or negative limit.

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On this assumption he imagines an iron core, perfectly devoid of hysteresis and eddy currents, substituted either by imperfectly sub-dividing the iron core, or by wrapping round it a closed conductor of such resistance as to generate the same heat which in ordinary iron would be generated by hysteresis. The current in the third coil

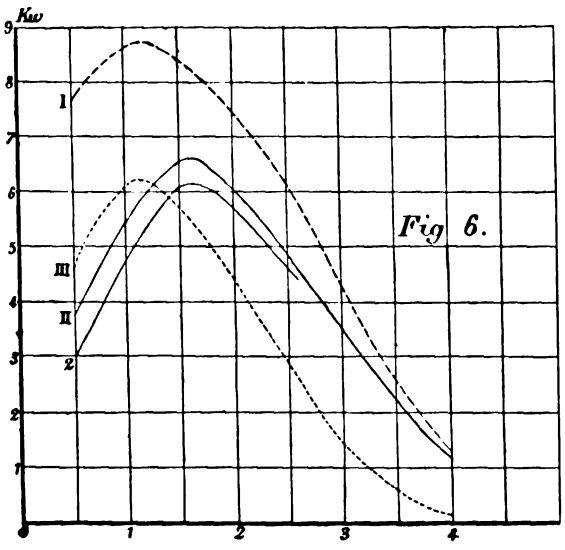


Fig 6.

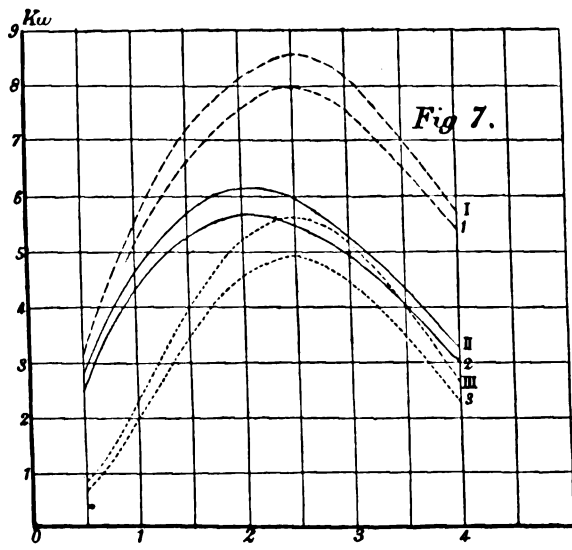


Fig 7.

would coincide with that in the secondary coil, and its exciting power would be added to it. This exciting power can now be represented by a length on the vertical in Fig. 5. Let O H represent the maximum value of this fictitious exciting power, and H J_2 the real exciting power due to the secondary coil, then O J_2 is the exciting power which must be overbalanced by the primary circuit, and the point J_1 in Fig. 5 will consequently be pushed higher up than it was in Fig. 4, the net result of the alteration being an

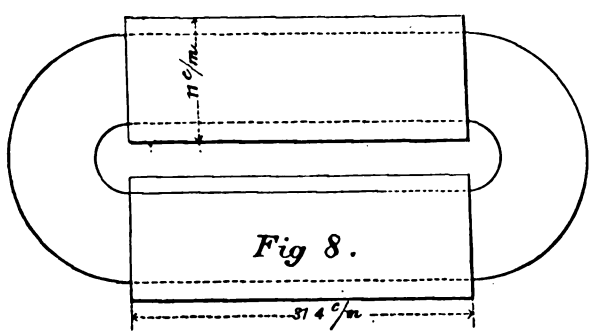


Fig 8.

increase in the amount of energy which must be supplied to the primary coil. By using this method for determining the output of the Gramme and Zipernowski rings, the author finds a series of results which are represented in the curves Figs. 6 and 7 respectively. The primary potential was assumed at 2000 volts, and the secondary at 100 volts. The total amount of heat which may safely be generated in each transformer was assumed to be 260 watts. In Fig. 6 the thickness of copper winding in centimetres is plotted on the horizontal, and the output in kilo.-watts on the vertical; whilst in Fig. 7 the thickness of the iron shell is plotted on the horizontal, and the output on the vertical. The curves I show the output which could be obtained if hysteresis did not exist, the curves II give the output allowing for hysteresis, and the curves III show the output as regulated by the condition that the pressure should not vary more than 2 per cent. The curves marked 1 2 3 give the output under similar conditions for a transformer made as indicated in Fig. 8. A glance at the curves shows that, both as limited by heat and as limited by self regulation, the ordinary Gramme ring is better than the Zipernowski ring. This result, however, refers only to the circular ring type, and if we so alter the shape as to reduce the length of the electric circuit, even if that of the magnetic circuit is thereby slightly increased, the shell transformer becomes actually the better type. The characteristics of the two types are given as follow: Core transformers consisting of one iron core and two sets of coils, and shell transformers consisting of two cores and one set of coils. Various transformers were exhibited on the table and described. The author also described two safety appliances by which the danger of leakage from the high tension to the low tension circuit is avoided. One of these is Mr. Kent's dividing sheet, consisting of a thin metal plate placed between the primary and secondary coil and connected to earth. Upon the insulation of the primary failing the leak is thus carried to earth before it can reach the secondary. The other appliance is the invention of Captain Cardew, and is based upon the electrostatic attraction between a platinum foil and a disc placed above it, which are respectively connected to earth and to a point on the secondary circuit. Upon the potential of the secondary circuit attaining any dangerous amount, the foil is attracted, and the contact causes a fuse wire to melt, which releases a short circuiting contact on the primary, thus causing the fuse of the latter to melt. Referring to the application of transformers, the author distinguished between the English, American, and Continental practice. In all countries the transformers are worked in parallel; but whereas here each subscriber has a separate small transformer on his premises, in America the transformers are fixed out of doors on the same poles which carry the primary and secondary mains, and in some continental installations there is a complete network of secondary mains laid underground in the same manner as if the supply were on the direct system, and this network is fed at certain points by large transformers which are not within the reach of the subscribers.

Mr. Kapp's paper was followed by one by Mr. J. Kenneth D. Mackenzie, dealing with the general subject of the distribution of electricity by transformers. We shall give an abstract of this paper in our next issue.

THE SEEL GLOW LAMP.

A new glow lamp, which has been invented by Herr Seel, is now being largely introduced in Berlin electric light installations and elsewhere in Germany, under the name of the "Berlin Glow Lamp." It is made either with a single or double filament, and of a power of 8, 10, 15, 20, and 30 standard candles, but recently larger lamps, giving a light of from 200 to 300 standard candles, have also been manufactured. The voltage varies from 35 for the two smallest lamps to 50, 65, 90, and 100 volts for the larger sizes. The inventor claims that in small lamps the energy required per candle is about 3 watts, but in the 200-candle size only 2 watts. The pear-shaped globe, as usual in several modern lamps, has no point in the centre, so that the light is freely emitted in all directions. The lamp is provided with a metal socket, into which it is cemented by plaster of Paris, but the end face of the socket is protected by a disc of serpentine, through which the lamp wires pass. In this way the plaster of Paris is prevented from absorbing moisture. A special fitting is used in connection with this lamp. The socket is fastened by a bayonet joint into a somewhat larger socket which is free to revolve on a plate, on the face of which are spring terminals of the branch wires, which are brought through the tube of the bracket. Two little studs, which are screwed into the serpentine plate, and are connected with the lamp terminals, form the contact with these springs when the holder is turned into a certain position. When the holder is turned 90° on its vertical axis this contact is interrupted, so that the light is switched on and off by turning the whole lamp with its holder on its axis. In order to avoid touching the lamp itself when switching on or off, the outer socket is provided with a slot, into which engages a pin on an arm, the prolongation of which is shaped into a handle of about the size used with an ordinary gas tap. By turning this handle the rotary movement in one or the other direction is imparted to the outer socket, and to make sure that even in careless hands the quarter turn should be fully completed, so that the contacts shall be either completely made or completely broken, the spindle of the tap is provided with a disc having flats, against which presses a spring.

The filament is prepared from a vegetable or animal fibre, the exact nature of which the inventor keeps secret. In cross section the filament is triangular, and consists of three layers, which are prepared in the following way: After the raw material is cut up into strips of suitable length, it is saturated with a solution of Senegal gum, a silicate, and caustic soda. Under this treatment it becomes plastic, and is pressed through hot rollers having triangular grooves, the object of the process being to completely fill the pores with the deposits from the solution, and to make the whole filament of equal homogeneity. After carbonising the centre of the filament consists of carbon, upon which is deposited a layer of silicate, protecting the carbon from contact with the air, and at the same time insuring great toughness. The third layer consists of carbon, which is deposited after baking, and by means of which the resistance of the filament is adjusted. In other glow lamps, as usually manufactured, this deposit is provided in what is technically termed the flashing pan, that is to say, the filament is put into the glass globe, the latter is filled with some hydrocarbon gas, and a current is passed through the lamp, heating the carbon filament unequally. In those places where the resistance is highest the filament becomes hottest, and there the carbon is most readily deposited. In this way uniformity of resistance throughout the length of the filament is obtained, and the total resistance of the lamp adjusted. Herr Seel, however, proceeds in a totally different way. He flashes his carbons, if such a term may be applied to the new process, before they are put into the glass globes, and instead of using hydrocarbon gas, he uses solid paraffin for the purpose. A number of baked filaments are attached by small clamps to the under side of a disc forming the cover of a vessel, which is filled to the top with molten paraffin. The vessel is left to cool until the paraffin solidifies, and then a current is sent through the filaments embedded in solid paraffin. Under the heat of the current the paraffin immediately surrounding each filament becomes first liquefied, and ultimately transformed into paraffin vapour, from which the carbon is thrown down on to the filament in those places where the temperature is highest. By this method of flashing air is excluded from contact with the carbon without having to previously seal up the filaments in the glass bulb of the lamps themselves. After the desired resistance has been reached the current is interrupted, and the rest of the paraffin is melted again by the application of external heat. The cover with the filament attached can then be taken up, and the filaments are ready for mounting. The lamp terminals consist as usual of two platinum wires, which are fused into the bottom of the glass globe. The connection between these wires and the filament is made in the following way: The ends of the wires are shaped into small cups, into which fit the ends of the filament, and the whole is then laid into a mould from which the air can be exhausted. When that is done a viscous paste of graphite and albumen is allowed to enter at the two junctions, filling up all the interstices and forming a kind of cement. After a further application of heat this cement sets hard, and the filament with its terminal wires is ready to be placed in the glass globe, when the manufacture proceeds in the same way as with other glow lamps.

PROSPECTS OF ELECTRICITY AS APPLIED TO ENGINEERING.*

In the present paper the author purposes confining his remarks to those branches of electric engineering which involve the employment of considerable power, and are in some way connected with the use of dynamo machines. The principal of these may be treated under the four following heads: (I.) Electric Transmission and Distribution of Power; (II.) Electric Locomotion; (III.) Electric Lighting; (IV.) Electric Metallurgy.

I. Electric Transmission and Distribution of Power.

In the near future this branch of electric engineering will probably occupy more attention and call forth more outlay of capital than either of the three others mentioned above; already, indeed, it is commanding a great deal of attention. Owing to its simplicity, the ease with which an electric motor can be applied to any purpose requiring power, and its high efficiency, it is certainly an approach to an ideally perfect system of transmission. No greater contrast can be imagined than the difference between the position of electricity in this country and in America. On the other side of the Atlantic, although the science of electricity is much behind, the practice is far ahead of our own. European science has supplied an agent, the value of which has been recognised by American engineers; and now in the United States the applications of electric motors are already rivalling, and will soon excel in importance, the application of electricity for lighting purposes. It is to be remembered, however, that there, owing to the high price of coal, the use of steam power is a more serious consideration than here; they have also in many places abundance of water power, which can be utilised by electric transmission. Notwithstanding these differences, there is in our own country an almost unlimited field for the employment of this mode of transmitting power cheaply to a distance, and of distributing power generated at a central station to a number of users in the neighbourhood. Were it not for the cost of the dynamos and motors, electricity

* Paper read before the Institution of Mechanical Engineers, on the 3rd inst., by Mr. Wm. Geipel, of Edinburgh.

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would supersede to a great extent the use of belts and shafting. In large works, where high speeds are required and the demand for power is variable, the efficiency of belts and shafting is very low indeed. As much as 25 per cent. of the power may be absorbed by the shafting when the full number of machines are in use; and in such a case, with half the machines in use, the loss of power rises to nearly 50 per cent., while in the extreme case of driving a single machine even 99 per cent. may be lost. With electricity, on the other hand, no power is being used in keeping the transmitting medium in motion, the conductor being stationary; the loss takes place only whilst power is actually being used by the motors, each of which drives its own machine. In fact, the percentage of power lost in the transmitting medium becomes smaller as the amount of power transmitted is reduced, which is exactly the converse of what happens with belting and shafting. For the sake of illustration and comparison, let it be assumed that a loss of 25 per cent. of power would take place in the electric conductor when the full load is on, although in reality the loss would never be above 10 per cent., and need not be more than 5 per cent. Then with half load the loss would be 12½ per cent., and so on; and with one machine possibly one-tenth of 1 per cent. might represent the loss in the conductor. When it is remembered in how many cases the average load in a factory is less than half the maximum, it is evident that this point is one demanding the greatest consideration. In New York, where a large number of motors are supplied with current from the electric light mains, it has been found by experience that on an average less than one-third of the whole number of motors are in use at any one time. The depreciation of the electric conductors is comparatively small; but whether the saving of renewing belts and of lubricating shafting would not be counterbalanced by the wear and tear of motors, is a question to be settled by individual experience. The advantage, however, of getting rid of shafting, thereby obviating the necessity for additional stability in the building, and doing away with constant lubrication, and the further advantages of saving the space and light absorbed by belts, and of the ease with which the conductor can be shifted to suit any desired alterations in position of machines, are also very important matters. The distribution of power by electricity from a central station to small users will, in the author's opinion, form in many towns a larger business than the lighting. Both can be done from the same mains and generators, just as is the case with gas; it is merely a question of economy and convenience as to whether gas or electricity should be used. The encouragement of small industries has long demanded some cheap means of obtaining power in small quantities, say from ½ h.p. to 25 h.p. The gas engine has not altogether met the requirements of small establishments, although needing but little attendance; for the first cost of even a small engine is high, and the amount of gas consumed is large. Moreover, the speed is generally irregular, owing to the intermittent impulse, which is more especially noticeable with light loads; and a considerable amount of wear and tear takes place in the valves and working parts. An electric motor can be started and stopped at will with the greatest ease; it requires the smallest amount of attention, occupies the minimum of space, and can be placed in almost any position. An ordinary shunt wound motor will run at an almost constant speed, with a maximum variation of only 5 per cent. from running light to fully loaded; this fact was first pointed out in an interesting paper in the *Philosophical Magazine* for January, 1886, by Mr. Mordey, who has done much valuable work in the perfecting of the modern dynamo machine. This exceedingly close regulation was obtained by using a simple shunt motor of suitable construction, and without any accessories such as the many forms of governing devices to which so much attention had previously been devoted. The result shows that such a motor possesses a practically perfect power of self control, not only over its rate of speed with varying load, but, what is of equal importance, over the energy absorbed by it; for it helps itself, as it were, to only such an amount of energy as will enable it to deal with the work imposed on it. Another advantage in the use of shunt motors is that they act as generators when themselves driven by any extraneous power, without any complication of switch gear, such as is required with a series motor. This fact was first pointed out by Sir William Siemens in a paper read before the Society of Telegraph Engineers, 3rd June, 1880. In such a system, where railways, lifts, &c., are being worked by motors, the current generated by descending trains or loads might suffice at times to supply the rest of the motors with sufficient current for their work, without absorbing any current from the dynamo; at any rate it would reduce the amount of current required to be supplied by the dynamo. The first cost is also small compared with that of a gas engine. A one h.p. motor will cost £20, against £100 for a gas engine. The cost of running a gas engine is about one penny per horse power per hour for gas alone; the same power generated by a dynamo driven by an efficient steam engine costs only about one farthing, current being supplied from street mains just as gas is. As small steam engines are being superseded by gas engines wherever the outlay for the latter can be afforded, the competition in regard to small power lies between gas and electricity, and steam may be left out of the question. There is of course a limit above which steam becomes the cheapest; and probably 10 h.p. may be taken as about that limit in this country. In Boston, in the United States, where some hundreds of motors are supplied with electricity from central stations, they range from ½ h.p. to 15 h.p., and are working lifts, printing establishments, small machine shops, and watch making, tailoring, boot making, and similar industries. Their working seems to be highly appreciated; and the author understands the users would be willing to pay even 25 per cent. more for them, in consequence of their convenience and regularity in working. In Geneva, within a radius of a mile and a quarter there are no fewer than 175 motors at work, varying from ½ h.p. to 70 h.p., supplying power to small workshops and for other purposes, the electric power being obtained from dynamos and turbines which are driven by water power derived from the Rhone. The installation is paying its way, and is about to be largely increased. At the Falls of Niagara plant is being put down to distribute power obtained from the falls to neighbouring towns, including Buffalo, which is twenty miles distant; the amount of power is stated at 15,000 h.p., of which 10,000 h.p. is contracted for at £3 per h.p. per annum for power and lighting purposes in Buffalo.

As an interesting example may be mentioned a 6 h.p. motor recently erected by the Brush Company of Cleveland, Ohio, in a printing establishment, where it was connected with the regular arc light circuit. It takes the place of a 10 h.p. steam engine, which had sometimes come to a standstill under its load. It drives about 70ft. to 80ft. of shafting, three cylinder presses, four platen presses, one large paper cutter, and one heavy lift; and by a 4in. belt carried up through three floors it also drives three ruling machines and four paper cutters. It does its work splendidly, and its motion is steady and regular. It has proved to the proprietor's satisfaction that printing offices could well afford to employ electricity instead of steam, even in cases where the first cost might be more. In many other towns in America, where the electric light mains are within reach, the number of motors already in use is very great; within two years 5000 motors have been supplied by one firm alone, and the author understands that the Brush Company are turning out as many motors as dynamos. In some places in this country, and more especially in Lancashire, it is customary for power to be supplied from a large steam engine to neighbouring buildings, which are let out as separate workshops. In such instances, however, the power supplied is more frequently above than below 10 h.p., and probably it would not pay to introduce an electric motor. Still it should not be forgotten that in renting these workshops considerable inconvenience may be incurred as regards the locality of the premises for the manufacture; moreover, the rent is often disproportionately high. Many schemes have been propounded for distributing power in manufacturing districts by means of steam, compressed air, and water pressure, each of which is in use to a somewhat limited extent; and as all of them have been known long enough, it may seemingly be inferred from their limited employment that there is not much to recommend their extended use commercially. With steam, the condensation in the pipes causes loss of pressure, and results in wet steam being supplied to the engines. Compressed air cannot efficiently be worked expansively, and is attended with loss of heat in the compressor. Water pressure commonly involves using the maximum power, whatever the work required. Besides these prominent faults of the three several methods, what is of the greatest importance and common to all three is that the generating plant has to be used almost exclusively for supplying the power, and cannot be utilised for other purposes in addition; whereas with a central electric station the engines and dynamos serve to generate current for lighting purposes also at night.

Collieries.—In collieries electricity will be largely adopted in the near future. For underground hauling, pumping, ventilating, and drilling, it can readily be applied with an efficiency double that of the compressed air. With a well arranged installation 75 per cent. of the brake power of the engine will be utilised on the shaft of the motor. For hauling and pumping, wire ropes or rods are the greatest competitors of electricity, which obviates the following disadvantages in connection with them: Chance of breakdown through strain; wear and tear; mishap to guides through falls of roof or dirt; trouble and expense of oiling the guides; and room required at pit mouth or at bottom for engine, pulleys or levers, or other gear. As the tendency in mines in this country is towards a reduction of working hours, the question of mechanical haulage becomes most important, because horses must be fed whether at work or idle, and the cost of haulage by horses therefore increases as the working hours become reduced. For ventilating and drilling, compressed air is perhaps most largely used; and one of the great points in its favour is that the exhaust is available for supplying fresh air to the miners, and for driving out the foul gas after the firing of shots. But the cost of the compressed air machinery is heavy, as is also that of the pipes for conducting the compressed air from the compressor to the place where it is used. The cost of electric plant is somewhat less, and the efficiency is very much greater; while by using old haulage ropes as conductors the cost of this item is rendered very small. At Trafalgar Collieries, in the Forest of Dean, there is an interesting instance of pumping on a small scale. A Gramme machine driven at bank supplies current to a motor in the mine 800 yards distant from it. A current of 15 ampères at 100 volts, equal to 1500 watts or 2 h.p., is found sufficient to work the pump, which is double acting, 5in. diam. and 8in. stroke, and runs up to 70 revolutions or 35 gallons per minute, lifting about 90ft. The entire installation cost £250; it has been working about four years, and has given so much satisfaction that additional plant has lately been put in at a distance of 1650 yards from the pit shaft for lifting 120 gallons per minute 300ft. high, the distance between the pump and generator being 2200 yards. A double throw pump with 9in. plunger and 10in. stroke is driven at 25 revolutions per minute by spur gearing reducing 6 to 1, the small pinion being driven by a belt from the motor. Current is conveyed to the motor by a conductor composed of nineteen wires No. 16 S.W.G. (0·065in.) thick, giving 0·065 sq. in. total sectional area, insulated and carried on earthenware insulators; an old 4in. wire rope serves for the return circuit. The efficiency obtained throughout is only 35 per cent.; but as much as 6·49 h.p. or 22 per cent. is lost in the engine alone, which is an old one. The cost of engine and electric plant and pump complete was £774, without pipes. The weekly cost of maintenance is given as follows by Mr. Brain, the colliery manager:—

	£	s.	d.
Engineers, half time	1	8	0
Men underground, full time	2	9	0
Small coal consumed, say 36 tons at 1s.	1	16	0
Oil, waste, and sundries	0	7	0
Interest and depreciation, say 15 per cent.	1	17	0
Total per week	£7	17	0

Total per annum, £408, showing a yearly saving of £470 on the water power that was superseded. The cost of the water raised is 0·02 penny per h.p. per hour, and 1·8 pence per 1000 gallons. At the same collieries a 6ft. fan is also being worked by an electromotor at 1800 yards distance from the generator. Another interesting example of pumping is afforded by the recent introduction of electricity for this purpose into St. John's Colliery, Normanton, where 39 gallons per minute are raised 530ft., equivalent to 6·3 h.p. of work done. An old girder beam engine is utilised to drive the dynamo, and indicates 14·2 h.p. with full load. The efficiency throughout is therefore 44·4 per cent. The power lost in the different stages is as follows:—

	h.p.		per cent.
Engine and dynamo running light	1·7	=	12·0
Conductors	0·88	=	6·2
Motor and first shaft	2·8	=	19·7
Driving pump empty	2·0	=	14·1
Other losses	0·52	=	3·6
Total loss	7·9	=	55·6
Useful work	6·3	=	44·4
	14·2	=	100·0

It will be seen that only a small part of the loss takes place in the electrical plant, the greater part occurring in the pump, engine, and gear. The pump is driven by toothed wheels, which are worked from the motor by a cotton belt, in order to obviate transmitting the vibrations of the pump back to the motor. This plant is being extended to pump in addition 120 gallons per minute against a head of 900ft. At Thallern Colliery, on the Danube, where electricity has replaced steam for pumping, it has been found after several months' work that a considerable saving in coal is effected; also that the temperature of the pit is reduced some 14°F., steam having previously rendered the atmosphere of the mine unbearable. In the mines of Blanzy, in France, a ventilating fan is driven from a generator at bank. The fan is 150 yards in, 2½ft. diam. by 11¾in. broad, and runs at 730 revolutions per minute. The temperature at the face has been reduced 15 degrees, from 95°F. to 80°F., since its introduction.

Shipyards.—In shipyards and similar works electricity has already proved itself a suitable and economical means of transmitting power for riveting, drilling, &c. The electromagnetic tools described in Mr. Rowan's paper at last year's summer meeting* are being successfully employed in yards at Dumbarton. This system possesses the additional advantage that the tool can be firmly held to its work by magnetic attraction alone, without the use of bolts, so that no holes need be left for hand riveting, as is required with other machine riveters.

PROSPECTS OF ELECTRICITY AS APPLIED TO ENGINEERING.

TABLE II.—*Cost per Horse Power Transmitted per Hour.*

Total power transmitted. h.p.	System of transmission.	Power Generated by a Steam Engine. Distance of transmission in yards. 110	1100	11,000	22,000	Power Generated by a Fall of Water. Distance of transmission in yards. 110	1100	11,000	22,000
		d.	d.	d.	d.	d.	d.	d.	d.
5	Electric	2·25	2·41	3·29	5·20	0·35	0·37	0·52	0·84
	Hydraulic	2·50	3·15	10·50	19·00	0·29	0·48	2·48	4·79
	Pneumatic	2·70	3·30	9·53	16·70	0·40	0·58	2·40	4·45
	Wire rope	1·13	1·88	10·40	22·70	0·11	0·30	2·50	4·86
100	Electric	1·79	1·91	2·63	4·08	0·20	0·23	0·32	0·50
	Hydraulic	1·62	1·78	4·15	6·84	0·16	0·19	0·72	1·14
	Pneumatic	2·00	2·09	3·10	4·50	0·22	0·24	0·48	0·33
	Wire rope	1·07	1·22	8·83	9·73	0·08	0·11	0·48	1·19

TABLE III.—*Trials of Tramway Motors at Antwerp Exhibition*, 1885.

Description of motor	Electric.	Rowan.	Wilkinson.	Krauss.	Compressed air.
Train miles run, total	2,359	2,617	2,473	2,458	2,259
Consumption of fuel: total lbs.	14,786	14,498	22,000	22,726	90,420
Consumption of fuel: per train mile, lbs.	6·16	5·42	8·82	9·10	39·48

TABLE I.

First Cost of Plant per Horse Power Transmitted.

Total power transmitted. h.p.	System of transmission.	Distance of transmission in yards. 110	1100	11,000	22,000
		£	£	£	£
5	Electric	75	81	142	210
	Hydraulic	41	97	610	1280
	Pneumatic	73	210	1090	2060
	Wire rope	6·5	61	760	1220
100	Electric	32	35·	59	87
	Hydraulic	14	28	164	310
	Pneumatic	26	34	109	192
	Wire rope	1·1	8·4	81	162

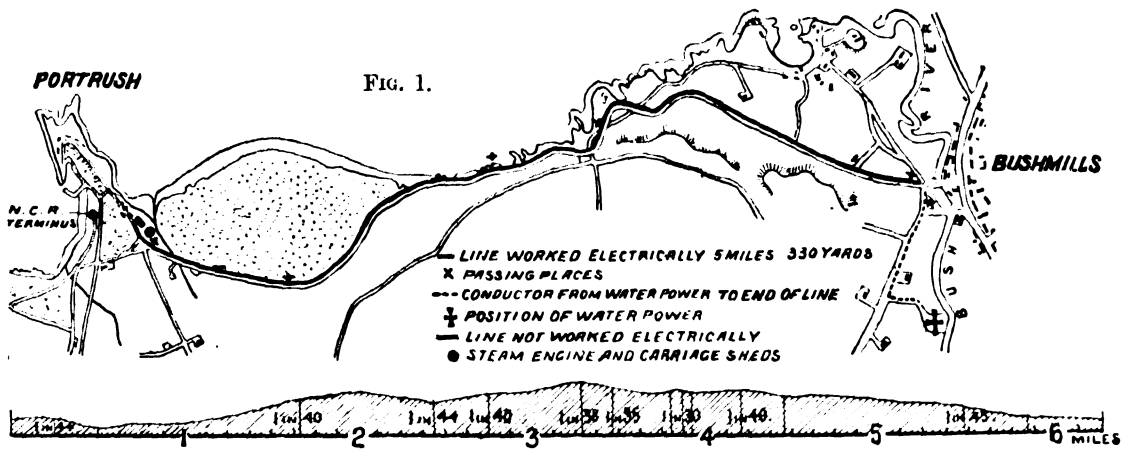
Transmission to Great Distances.—The transmission of power to great distances is not of such vast importance here as in the

*Industries, Vol. III., page 150.

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PROSPECTS OF ELECTRICITY AS APPLIED TO ENGINEERING.

FIG. 1.



Colonies, although even in the small sluggish rivers of this country there are large amounts of power running to waste. In many places where works have been erected for utilising water power, it has been at the sacrifice of convenience of situation, or of a ready and cheap means of receiving and dispatching goods; whereas by means of electricity the same water power might have been transmitted to a locality more suitable for the works. For short distances it does not pay to transmit water power by electricity, owing, as previously mentioned, to the cost of dynamos; in such cases transmission by shafting or wire ropes is cheaper. But for long distances shafting is out of the question, wire ropes become more expensive, and electricity is cheapest. In Table I. is shown the first cost of plant per horse power transmitted through different distances by electricity, water, air, and wire rope. There is, of course, a limit beyond which it would not pay to transmit power, because with the distance the capital outlay increases, until the interest thereon outweighs the cost of the coal which would be consumed by a steam engine on the spot. Wire rope is perhaps cheaper for distances of less than one mile, although the disadvantages of having to lubricate pulleys and to provide substantial supports would in many cases compensate for the higher cost of electricity. The limit of distance to which it is economical to transmit water power increases with the amount of power transmitted. From Table II., showing the cost of one horse power per hour,* it appears that, when the power is generated by a fall of water, 5 h.p. can be transmitted 11,000 yards at the rate of 0·52 penny per horse power per hour by electricity, while at the same rate also 100 h.p. can be transmitted 22,000 yards, that is, double the distance. The transmission of steam power over long distances is seen from the same table to be not economical; small powers, say up to 10 h.p., may be transmitted as far as three miles; but larger powers not so far, because for larger power a local engine becomes more economical. As an interesting instance of the transmission of power by electricity over long distances, that at the Phœnix Gold Mines in New Zealand† may be referred to. The current is generated by two No. 8 Brush machines, each capable of giving 20,000 watts or 26 h.p.; they are driven by Pelton water wheels, with a head of 180ft. The current is conveyed to the motor about three miles distant, and back again, by a No. 8 B.W.G. copper wire (0·165in. thick) nearly six miles long, supported on telegraph poles. The power lost in the line is only 3 h.p. A Victoria motor is used, running at about 350 revolutions per minute; and the power is transmitted to the machinery by a belt. Deprez succeeded in demonstrating practically that 52 h.p. could be transmitted over a distance of 35 miles, viz., from Creil to Paris, through a copper cable equal in section to a wire of less than 0·2in. diam. But his machines were not efficient, the power required to drive the dynamo being 116 h.p., of which 44 per cent. was lost in the dynamo and motor, and 11 per cent. in the 70 miles of the outward and return wire. There is no reason, however, why much more efficient results should not have been obtained; as much as 18 per cent. of the total power was absorbed for maintaining the magnetism of the field of the dynamo, whereas in a well designed machine less than 5 per cent. should suffice. Mr. C. E. H. Brown, of Oerlikon, has succeeded in transmitting by electricity 50 h.p. from water power at Kriegstetten over a distance of 5 miles to Solothurn in Switzerland, with a commercial return of over 70 per cent.‡ Two series dynamos and two series motors are arranged on the three-wire system. Each of the three wires is ¼in. diam., consisting of bare copper suspended on poles about 40 yards apart, with fluid insulators for insuring good insulation. For a span of 130 yards across the river Aare, silicium bronze wire is used, which has the same conductivity as copper, and a tensile strength of 30 tons per square inch. The current used is 15 ampères, and the potential difference at the terminals of each dynamo is 1250 volts. The resistance of the line is 10 ohms, and the loss in it is a little over 3 h.p., or 6 per cent. of the total power. The loss in dynamos and motors is 24 per cent., being much less than in Deprez' machines, where it was 44 per cent. At Hatfield, on the Marquis of Salisbury's estate, the river Lea is utilised to generate electricity, which is transmitted to the house and over the estate for a variety of purposes. Two turbines are used, one to drive a 40 h.p. Siemens alternating current dynamo for lighting the house, and the other to drive a 16 h.p. Brush machine for arc lighting at night, and in the day for working the motors at the house and on the farm. Those at the house drive pumping and ice making machinery, and a 24in. Blackman air propeller fixed in the roof for ventilating; on the farm the motors are used for elevating hay and corn sheaves to the tops of the stacks, for threshing, for cutting rough grass with a chaff cutting machine for ensilage, in fields extending to a distance of two miles, for grinding corn, &c., to make fodder, and for other purposes. The motors have also been used for pile driving, for making coffer dams where necessary in the river, and also for dredging the river and clearing it of weeds. A Gramme motor capable of raising 2500 to 3000 gallons per hour, pumps the town sewage into a tank at a height of 30ft. for irrigation. The conductors are carried overhead on poles about the farm, and underground in wooden troughs to the house. In favourable districts the supply of power to farmers by means of electricity is a subject well worthy the consideration of capitalists. If water power is not to be obtained as the prime mover, then steam power must be used as is now the custom, but in a more economical form than in a portable or traction engine. The expense of taking these engines about the farm, both in coal and wages, must render them costly to the farmer in respect of the power actually used. An economical engine could be fixed for generating an electric current to be transmitted through overhead conductors carried on poles along the roadside.

* This is a modification of a table given in Mr. Kapp's work on "Electric Transmission of Energy." The original table is based on the investigations of Herr Beringer and on the cost of power as determined by Professor Grove.

† *Industries*, Vol. I., page 594. ‡ *Industries*, Vol. IV., page 18.

II. Electric Locomotion.

The practical methods of accomplishing electric locomotion seem to the author to be the four following: Firstly, the use of a third insulated rail or conductor to convey the current from the generator to the motor carried on the locomotive, contact being made by a wheel or a sliding spring or brush; while the two ordinary rails serve as a return circuit, the current being conducted from the motor to the rails through the frame, axle, and wheels of the locomotive. Secondly, the employment of an overhead conductor supported on poles or from the roof of an arch or tunnel, contact being made either by a carrier on wheels running along the conductor, or by rubbing. The return circuit may be either through a second overhead conductor, or through the ordinary rails as in the third-rail plan. Thirdly, the use of an underground insulated conductor, placed in a conduit between the rails, and conducting the current from the generator through a contact carriage to the motor, whence it is conveyed back through the frame, axles, wheels, and rails. Fourthly, the employment of storage batteries, placed preferably under the seats of the car, with the motor and gear underneath, or the whole placed on a separate locomotive. The plan of using the ordinary rails as positive and negative conductors, and insulating the wheels or axles of the cars, is attended with the objection that, owing to the rail supports having to carry heavy loads, there is difficulty in insulating the rails sufficiently to prevent excessive leakage to earth. Of these four methods the first two are the cheapest and most efficient, but are applicable only to railroads; while the two other plans, of an underground insulated conductor, and of storage cells on the car, are both applicable to street tramways.

Gearing.—Owing to the high speed at which electric motors require to run, and the limited space available for them to occupy, the mode of gearing the motor to the axle of the locomotive or car forms an important consideration, more especially in places where the motor is placed upon the car which carries passengers, when noise and vibration would be most objectionable. The following five methods of gearing are those more generally employed: (1) Worm wheel gearing; (2) pitch chain gearing; (3) leather belting; (4) rope, either endless or not; (5) toothed wheels. Worm gearing appears from Mr. Holroyd Smith's experience at Blackpool, where his electric tramway is worked with an underground conductor, to be the best for tram cars. Although, as a rule, it is not efficient, yet if well designed and properly lubricated it can be rendered more efficient, and probably is fairly suitable for this purpose. Some tests made by Mr. Reckenzaun show a maximum efficiency of 87 per cent. The author thinks that a combination of toothed wheels and friction gear, such as has been introduced by Mr. Raworth for driving dynamos in electric lighting with excellent results where space is a desideratum, would make a silent working and durable form of gear: the friction gear would serve to reduce the speed from a motor to a counter shaft; and from the latter the driving wheels of the car would be driven by toothed wheels. The form of gear employed of course depends greatly upon the nature of the traffic and of the rolling stock.

Third Insulated Rail.—As an example of an electric railway with a third insulated rail, that at Portrush, Ireland, is probably the most interesting, as being one of the first started in the world and also the longest; its total length is six miles. The accompanying diagram (Fig. 1) has been kindly lent by Messrs. Siemens, by whom the railway was planned. Power is generated by two 50 h.p. turbines, driving a dynamo which is capable of generating 100 ampères at 250 volts; the current is transmitted from the river Rush through a distance of 1600 yards to the railway, the resistance of the line being 1·9 ohm. Pitch chain gearing is used, and gives satisfaction. The working expenses amount to less than threepence per car mile.

Another instance, also in Ireland, is the Bessbrook and Newry tramway, which is three miles long and 3ft. gauge, and is actuated by water power. A turbine, which develops 62 h.p., drives two Edison-Hopkinson dynamos, each capable of giving out 25 h.p. at 250 volts. The third rail is of channel section steel, supported in wooden blocks, which apparently act admirably as insulators, the leakage being only ¼ ampère per mile, or 0·3 h.p. in all. A train consists generally of one passenger car constructed to carry thirty-eight persons, and three goods waggons, each carrying 2 tons freight. The maximum speed that can be attained is fifteen miles per hour. Here also chain gearing is employed. The cost per train mile is 3·3d. during the busy months, and 4·2d. in slack months; these figures, however, do not include anything for depreciation on the cost of construction of the railway, which was £2,500, nor for general supervision.

Overhead Conductors.—The electric railway at Moedling, near Vienna, is a good example of the employment of overhead conductors. The number of passengers carried during the year 1886 was 342,257, according to Mr. Reckenzaun, and the average cost 3·42 pence per car mile; the coal consumption per car mile was 13·4lb. of very inferior brown coal. The current is generated by six Siemens dynamos, driven by three portable engines of 12 n.h.p. each; the use of these engines may account for the somewhat high consumption of coal. The overhead conductors, which are carried on posts 18ft. high and 90ft. apart, consist of slotted tubes in lengths of 15ft. each, soldered together; a contact carriage slides within the tube, which is 1in. diam. inside. Spur gearing is used, but apparently is not satisfactory. The objections to it are the rapid wearing out of the high speed pinions, the great weight of the gear, and the noise and vibration caused.

The Frankfort Offenbach electric railway, which was opened for traffic on 10th April, 1884, is similar to that at Moedling, the current being brought to the moving cars by means of slotted iron tube conductors carried overhead. The length of the line is about 4½ miles; the gauge is 1m. (3ft. 3⅜in.). The sharpest curve has a radius of 98½ft.; the steepest incline is 1 in 30, and only 18 per cent. of the line is level. The average speed of the cars is 7½ miles per hour. Two cars coupled together start from each end of the line every twenty minutes. Each car has seats for eighteen passengers and standing room for twelve more, the gross weight being 4 tons. The motor is placed under the floor of the car, and the connection to the wheels is made by toothed gearing. The generating station is at Ober-rad, about the middle of the line, and contains one twin engine of 240 i.h.p. and one spare engine of 80 to 100 i.h.p.; in regular work one cylinder only of the twin engine is used, giving off 120 i.h.p. The current is generated by three Siemens dynamos, called 300-light; a fourth similar dynamo is in reserve. The working electromotive force is 350 volts. The current generated by the three dynamos is sufficient to keep eight cars running simultaneously. This plan has been most largely adopted in America, where there are probably not far short of one hundred electric railways at work and projected. It has certainly the recommendation of cheapness, for a higher voltage is permissible, and consequently a smaller conductor with less loss of power than in the case of the third rail; this is more especially important for long lines. As an instance of what is being done, a railway of eleven miles length is now in course of construction at Richmond, and forty cars are building to be worked upon it on the overhead system. Another instance is the railway at Scranton, Pennsylvania, which has been in successful operation about a year. It is 4½ miles long; five cars carrying motors from 15 to 20 h.p. are in use, and four cars with 25 h.p. motors are being constructed, each of which will be able to draw two others; the cars carry seventy-five passengers each. The current is generated by two 100 h.p. dynamos driven by two 180 h.p. engines, one set being spare; the potential adopted is 600 volts. The overhead conductors are of copper $\frac{1}{16}$in. diam.; the supporting poles are 100ft. apart, about 20ft. high, and about 6in. diam. at the thick end; the return circuit is through the ordinary rails. The plant is also used for lighting the town. The potential generally employed in America for the longer lines is from 500 to 600 volts; the latter is probably the limit to which it is safe to work. With this potential two ⅜in. copper conductors would serve to work twenty-five cars in parallel, the current per car averaging about 10 ampères. With a voltage as high as this the leakage on the third rail system would be excessive.

Underground Conductors.—Perhaps the most important example of this plan is Mr. Holroyd Smith's electric tramway at Blackpool, which has been in successful operation for some two years. The underground conduit is somewhat similar to that of a cable tramway such as is working at the present time in Edinburgh and on Highgate Hill, London; but instead of the carrier being used to grip a running cable, it is made to rub along a stationary conductor. The cost of working is stated to be less than 4d. per car mile; during one week in the season of 1886 there were 44,306 passengers carried at a cost of £45 for wages and fuel, which is less than one farthing per passenger.

Where an underground conductor is employed, the advantages of having no slit communicating with the surface of the street are so obvious, that an ingenious plan has been proposed by Mr. Frank Wynne for placing the conductor in a hermetically sealed conduit under the line. A small carrier, which acts as a contact maker between the conductors and short sections of rails laid in the road, travels along the conduit, being actuated by a tiny electromotor and by part of the same current which works the tram car above it. An absolute synchronism between the tram car and the carrier is obtained by a simple device. The short sections of rails are in circuit only whilst the car is over them.

A plan has been proposed by Messrs. Ayrton and Perry for making contact between the underground conductor and the section of rail underneath the car, by means of the weight of the car, which actuates an arrangement of levers that make the contact so long as the car is on that section. A plan has also been proposed by them for employing the attraction of a

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magnet fixed on the car and keepers fixed in boxes underneath the street. The contacts on the keepers are permanently connected with the underground conductor, and when lifted by the attraction of the magnet on the car they make connection with a section of rail, putting the motor in circuit.

Storage Batteries.—Storage batteries on the car have not as yet been much used, though many experiments have been made from time to time. The problem was first attempted by Mr. Reckenzaun, who has done much to perfect the plan. The difficulty is that, if the accumulators are made light, their depreciation is high; while if they are constructed with a thoroughly serviceable make of cell, their weight is very great. The first cost of the cells is also somewhat prohibitive, and their depreciation is high. A trial of this plan on a practical scale is now being made by Mr. Elieson on the North Metropolitan Tramway in London. The storage cells are placed on a separate locomotive car. The motor turns itself round on an upright pivot, by means of a bevel wheel on the armature shaft gearing with a circular rack fixed on the floor of the car; and the revolution of the motor is transmitted to the axle of the car through mitre gear. Trials are also being made in Brussels, in Philadelphia, and in other places; but there appear to be no very reliable data as to the cost of working. The plan has been unsuccessful in the past, owing to the use of inefficient motors and gear, which require of course an increased size of battery in proportion to their inefficiency; the imperfection of the secondary batteries employed, as pointed out, has also prohibited success. With motors, speed reducing gear, and secondary batteries all improved, the experiments now being made bid fair to demonstrate the successful working of tramways by electricity in crowded thoroughfares.

Ordinary Rails as Conductors.—The short electric railway of Mr. Volk, at Brighton, on this system is interesting as being one of the earliest in use in this country. The expenses amount to 2d. per car mile, being made up as follows:—

Gas for engine	1·11	penny.
Wages	0·70	„
Oil and waste	0·07	„
Repair	0·12	„
Total per car mile	2·00	pence.

The total car miles per annum are stated to be 47,000, and the depreciation at 10 per cent. on the £3,000 cost of construction is therefore equal to 1½d. per car mile, thus bringing up the total cost to 3½d. per car mile. Several similar railways are now working or contemplated in seaside towns.

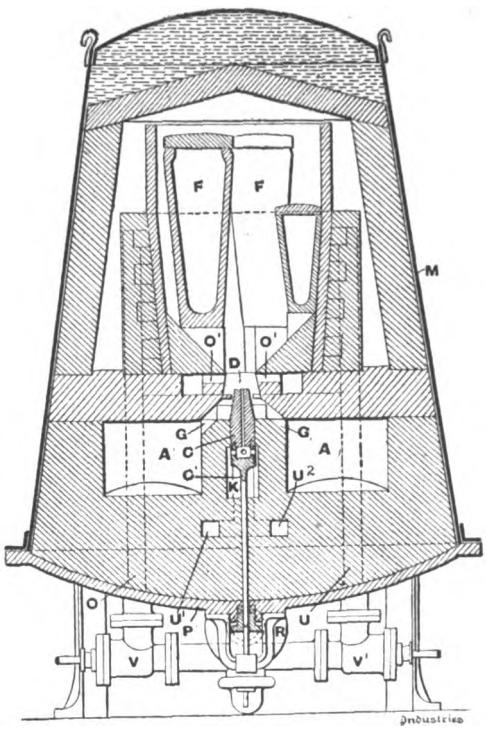
Cost of Working.—From these instances it will be seen that, taking into consideration the fact that the machines here employed are not so efficient as those now being made, an electric tramway may be worked for about 3d. per car mile; and as the cost of horses is from 7d. to 9d. per car mile, the importance of electric propulsion for tram cars and short railways is very evident. At the Antwerp Exhibition, in 1885, when electric locomotion was beginning to receive consideration in its commercial aspect, a series of trials extending over four months on five different kinds of tramway motors resulted in the first place being assigned to the electric car, in competition with the four following plans: The Krauss and the Wilkinson locomotives separated from the car, the Rowan engine and car combined, and the Beaumont compressed air car. The results of these trials are given in Table III.

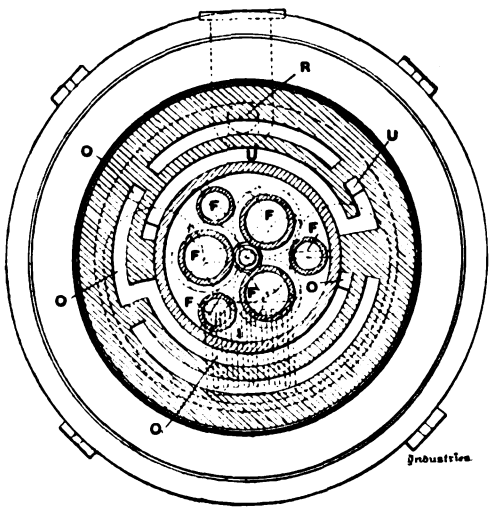
Notwithstanding that the use of electricity for heavy railway traffic has been predicted, the author thinks that so long as the electricity is generated by dynamos driven by steam engines, steam locomotives will not be discarded in favour of electricity for long distances. But for light railways and suburban lines, underground or overhead, where the use of a steam engine is a nuisance, there can be little doubt that electricity must be largely adopted in the immediate future, as the number of such railways already constructed and in course of planning is now between one and two hundred.

(To be continued.)

OTTO'S CRUCIBLE FURNACE.

We are indebted to our contemporary the *Chemiker Zeitung* for the accompanying illustrations representing a crucible furnace made on the Otto system. The furnace is made of the best fire bricks, and surrounded with an iron shell M bolted to a base plate P. From the generator A the gases are conducted through G into the burner D. The air is supplied to D from four nozzles O_1 connected to the upper air channel O. A perforated cone C is fixed in an air chamber K connected to O, and may be moved up or down, for regulating the draught in D, by means of a rod passing through a stuffing box, and carrying a screw and hand wheel. The gases are ignited at D, and the flame circulates round the crucibles F. A pipe R conducts the compressed gases to the boiler, which supplies the engines driving the air compressors. From the fire box of the boiler the gases are taken to a hot air engine, thereby making extensive use of the energy stored up in the products of combustion. The furnace is started in the following manner: The shell M is removed by means of a crane, and a fire is made in the ordinary way on a temporary grate I. At the same time a fire is made on a temporary grate in the boiler, so as to be able to start the engines. Now the shell M is replaced and bolted down on the base plate P, the engine and air compressor are started, and the valves V and V_1 opened. The pipe connecting the fire box of the boiler with the hot air engine is closed by a valve, until a considerable pressure has been attained. The compressed air enters the air-passages U and O. From U the air passes in semi-circles five times round the shaft of the furnace, and comes considerably heated through the nozzles $U_1 U_2$ into the generator A. The air entering O passes in a similar manner into a circular channel O, as shown in plan. From here it is conducted through the nozzles O_1 and through the perforation in C into D, where it is mixed with the gases passing through G and coming from the generator A, and the mixture is ignited. The flame may be observed through a lens made of mica, and the draught





is easily regulated by means of the cone C. As the parts of the furnace which are exposed to the flame are made of five large fire bricks only, which are able to resist very great heat without softening, the furnace may be taken to pieces and injured parts exchanged in a very short time. The furnace is especially adapted for the cheap production of aluminium bronze and aluminium iron on the system adapted by Cowles for the Electric Smelting Company.

Notes.

CHINESE BRASS AND COPPER WARE.

Large quantities of yellow metal sheathing are now employed by the Chinese in the manufacture of pots, pans, gongs, cymbals, &c., which were formerly cast. The United States Consul at Hong-Kong gives some interesting particulars regarding the native manufacture of hubble-bubble pipes, which is an important industry, some establishments employing over one hundred hands. The workman sits on a low stool in front of a narrow bench about 3ft. long. The metal is cut from the sheets into proper form with shears. The workman then hammers it into shape upon a block of wood with a convex faced hammer. The metal is annealed from time to time by heating in a charcoal furnace and cooling by immersion in water, in order to render it softer and tougher. The different parts are wired together and brazed. After having been filed smooth, the vessel is polished with fine sand and finished with a finely powdered silicious ash, obtained by burning rice husks. Gongs and cymbals are also made from this sheathing by hammering. Pots and pans, after being hammered, have a rounded and thickened edge given them by folding the edge over a wire and then soldering it.

NATURAL GAS AS FUEL.

Experiments for the utilisation of gas in mines are being made at Hebburn-on-Tyne. About six months ago a "blower," which gave forth about 200 cub. ft. of gas per minute, was discovered in one of the mines. A sample was analysed, and found to be suitable for burning purposes, although deficient in illuminating power. The owners of the mine thereupon decided to experimentally use the gas as fuel in the furnaces of the boilers, and are laying down a special set of pipes for transmitting the gas to bank. At the present time the blowers are tapped and diverted into the airways, through which bad air and gas are carried to the surface. The confinement of the gas to pipes will undoubtedly tend to additional safety in the working of the mine, while its consumption in the furnaces of the boilers may promote economy.

ARTIFICIAL SILK.

An artificial textile material resembling silk has recently been described by M. de Chardonnet to the Academy of Sciences in Paris. It is obtained from nitro-cellulose, which is dissolved in a mixture of alcohol and ether, and then treated with a reducing agent, either ferrous or stannous chloride giving the best results. A small quantity of a solution of tannic acid, dissolved in alcohol, is next added to the solution, and the mixture is filtered in a closed vessel to prevent loss by evaporation. This liquid is then placed in a large reservoir, from which a tube with a fine conical nozzle projects. This tube communicates with a vessel filled with dilute nitric acid, and the liquid as it flows into this acid hardens into a fine filament, which is drawn across a space through which a current of dry air is passing, where the thread is finally dried. The filament obtained in this manner is of a grey or black colour; but it can be made in any desired colour by previously dissolving some soluble colouring matter in the ethereal solution. The thread is transparent, cylindrical, pliable, and has a silky appearance. It is not acted upon by dilute acids and alkalies, and is insoluble in alcohol, ether, and hot or cold water. It dissolves, however, in a mixture of alcohol and ether, and in acetic ether. It does not explode when heated, but burns quietly. It bears a considerable weight without breaking (20-30 kilo. per square millimetre). Organzine, and a material resembling weft silk, can easily be manufactured by multiplying the number of nozzles through which the prepared liquid issues. The several filaments consolidate together in the dilute acid, and any desired thickness or strength can thus be readily obtained by altering the number of threads produced. M. de Chardonnet deposited with the French Academy a note describing his invention about four years ago; but it was opened at his demand at their meeting a few weeks ago, in order that he might establish his claim to priority.

BRITISH AND GERMAN BUILT VESSELS IN THE CHINESE NAVY.

A writer in a journal published in China describes four vessels which were recently added to the Chinese Navy, two having been built at Elswick and two at Stettin, and makes a comparison between them. He says the displacement of the German boats is 3100 tons, as against 2300 tons of the English; still they only carry two 21cm. and two 6in. guns, against Armstrong's three 21cm. and two 6in. guns, besides an auxiliary armament of vastly superior importance, while in speed there is also an enormous difference. The German ships only attain a speed of 15 knots, while the English have reached nearly 19 knots. In the matter of protection the latter are also superior. The German armour is laid on in three strakes only 30in. deep, and consequently liable to be easily broken across by a moderately heavy projectile. The upper strake is 8in. thick, the two lower 6in. only. The English armoured deck is 8in. thick, without taking into account the special properties of sloping armour for deflecting shots. The workmanship in general, and particularly the blacksmiths' and shipwrights' work in the German vessels, is very rough indeed. A large number of fittings provided in the Armstrong boats do not exist in the others, and in some instances these omissions constitute extremely grave defects. Among others the writer specifies the means of closing the doors in the water tight compartments in case of accident, the German vessels not being provided with gear above water for opening or closing them; the steering gear where there is an absence of relieving tackle; and the absence of davits for the principal boats, which have to be hoisted out and in by means of large steam derricks. Finally, the decks throughout the crew spaces in the German ships are of ordinary pine, in the Armstrong ships they are of teak.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

10176A. Hahn, E. J. — Carburetters for gas motors. (This application having been originally included in No. 10176, dated 20th July, 1887, takes, under Patents Rule 23, that date.)

27th January, 1888.

1236. Robinson, T. N. — Feed motion for wood planing machines.
1239. Biggin, H. — Chairs for railways.
1240. Holt, T. — Couplings for railway waggons.
1244. Sowden, M. — Looms.
1247. Sewell, S. J. — Type writers.
1250. Immisch, M. — Water wheel for driving electric generators.
1256. Jackson, J. P. — Soda water machinery.
1260. Halliday, T. — Propelling boats.
1262. Cutlan, J. E. — Machines for lasting boots.
1266. Monteith, J. — Starting tramway cars.
1279. Silverman, L. — Ordnance.
1282. Lyle, J. — Automatic retort grate.

28th January, 1888.

1293. Rowe, J. A. — Hydrostatic motors.
1296. Thomson & Biles — Rolling chambers for ships.
1299. Crabtree & Crabtree. — Looms.
1300. Holroyd, J., & others — Yarn machinery.
1306. Tennant & Sharpe — Appliances for getting coal.
1312. Holt & Carter — Mules.
1317. Pearson & Bennion — Self feeding eyeletting machines.
1324. Donkin, B. — Fluid pressure engines.
1329. Gentry, O. H. — Steam boilers.
1331. Thompson, H. — Vertical boilers.
1332. Donkin, G. M. — Excavators.
1333. Gauhe, O. W. — Chain elevators.
1335. Royce, W. — Pumps.
1336. Imray, O. — Starting tramway cars (*Weilbach*).
1340. Willcox, B. — Joining the ends of bands (*Uhlenhuth*).
1341. Evans, J. B. — Wire fencing standards.
1343. Skerrett, H. — Semaphore signals for railways (*Spicer & Schrender*).
1347. Lake, H. H. — Manufacture of screw nuts (*Ibbotson*).

30th January, 1888.

1351. Baraclough, W. H. — Shaping sheet steel.
1355. Howarth, R. — Heating of feed water.
1362. Spencer, J. — Manufacture of gloves.
1375. Archer & Faulder — Hoists or lifts.
1377. Britten, W. E. — Manufacture of boots.
1379. Thompson, W. P. — Braking the motion of machines (*Deimel*).
1381. Blessing, O. — Gas engines.
1382. Peach, C. — Grinding cutlery (*Johnston*).
1385. Chance, G. F. — Kilns for annealing sheets of glass.
1390. Imray, O. — Distribution of oil over rough water (*Stebbins*).
1391. Wyke, W. H. — Rotary engines.
1392. Newlands & Alliott — Apparatus for filtering saccharine liquids.
1397. Immisch, M. — Propellers.

31st January, 1888.

1400. Kitson & Holmes — Pulverising salt.
1402. Paterson, J. — Testing the fairness of crank shafts.
1403. Mansfield, J. W. — Manufacture of boots.
1407. Peltzer-Teacher and Rilke — Stop motion on doubling frames.
1408. Brown & Burnley — Shuttles.
1411. Cunningham, W. — Winding yarn.
1415. Richards, G. — Double acting steam engines.
1419. Thompson, W. P. — Refrigerating apparatus (*Craft*).
1420. Thompson, W. P. — Sewing machines (*Ehrlich and Bendix*).
1421. Boult, A. J. — Magazines for fire arms (*Hindley*).
1426. Madan, C. S. — Steam jet pumps.
1430. Gellert, K. L. — Scalper and flour dresser.
1431. McDowell, C. G. — Wheels for vehicles.
1432. Platt & Richardson — Carding engines.
1434. Velluet, A. — Apparatus for making wine.
1436. Brewer, G. — Driving gear for velocipedes, boats, and other machines (*Stevens*).
1437. Thomas, J. — Sewing machines.
1440. Kirk & Brook — Jacquard harness looms.
1446. Vojácek, L. — Centrifugal pumps.
1447. Anthon, H. T. — Apparatus for moulding pulleys.
1448. Stead & Roberts — Screw propeller.
1449. Gilles, D. — Furnace for annealing plate glass.
1450. Smith, C. H. — Wool scouring machine.
1452. Crocker, S. H. — Raisin stoning machine.
1459. Wells, C., & others — Machinery for making envelopes.
1460. Jefferson, W. — Davits for lowering ships' boats.
1465. Haddan, R. — Axle boxes (*Batlle*).
1467. Marshall, C. A. — Seamless tubes.
1473. Death, E. — Steam hosiery presses.
1474. Saxby, J., & others — Interlocking apparatus for railway point and signal levers.

1st February, 1888.

1481. Rudge, J. — Machinery for barbing fish hooks.
1486. Barlow, H. B. — Stop motions for drawing frames (*Mahoney & Leigh*).
1487. Dorman, W. H. — Forming screw threads.
1489. Yuill, W. — Ironing and polishing machines.
1490. Williams, G. J. — Manufacture of grooved brackets
1494. Palmer, H. — Mules.
1498. Moore, J. — Propulsion of steam vessels.
1501. Morrin, T. F. — Steam generators.
1502. Burbery, J. S. — Boats and vessels.
1506. Montgomerie, J. — Refrigerators.
1512. McLaren, J. — Steam generators (*Despeissis*).
1515. Eissner, C. A. — Machines for cutting clay.
1517. Tooth, H. — Manufacture of pottery.
1530. Woodcock & Gwyn — Multiple drills.
1531. Abel, C. D. — Sewing machines (*Rudolph*).

2nd February, 1888.

1534. Smith, W. — Dividing double piled fabrics.
1545. Ayres, P. P. — Safety apparatus for tram engines.
1547. Ashworth & Ashworth — Carding engines.
1550. Guy, J. P. — Machine for hollow earthenware.
1551. Payne, F. — Feeding paper to printing machines.
1553. Robertson & Orchar — Finishing woven fabrics.
1555. Brown, A. F. G. — Rotary engines.
1565. Butler, S. — Shipping coal.
1572. Stephenson, G. — Machines for compressing hay.
1574. Brand & Hill — Steam boiler furnaces.
1575. Thompson, W. P. — Lifting apparatus (*Pohl*).
1579. Chadwick, P. — Hansom gigs.
1580. Berridge, I. L. — Punching machines.
1582. Martin & Blackshaw — Sizing machines.
1584. Nordenfelt, T. — Quick firing guns.
1585. Hickman & Shelton — Propulsion of canal boats.
1588. Wilson, G. — Gas engines (*McNett*).
1589. Newton, H E. — Apparatus for evaporating and cooling (*Theisen*).
1590. Nicholson, W. G. — Lessening resistance to vessels moving through water.
1592. Imray, O. — Sheet metal (*Mannesmann*).
1595. Davy, C. — Plate rolling mills.

ELECTRICITY.

27th January, 1888.

1243. Lucas & Vaughton — Electric lamp.
1254. Spink & Gauzentes — Incandescent lamps.

30th January, 1888.

1364. Martin, F. J. — Electric lighting for railway carriages.
1383. Borel & Paccaud — Electromotor.
1386. Fowler, G. — Telegraph insulators.

31st January, 1888.

1406. Turton & Turton — Electric time signals.

1st February, 1888.

1525. Solignac, L. E. — Distribution of electricity.

2nd February, 1888.

1536. Battye, J. — Telephone and telegraph.
1557. Jacob, F. — Duplex telegraphy.

CHEMISTRY.

27th January, 1888.

1270. Donald, W. — Nictric acid.

28th January, 1888.

1346. Willcox, B. — Azo dyes (*Bayer & Co.*).

30th January, 1888.

1371. Hargreaves, J., and others — Treatment of alkali waste.
1393. Hanson, J. — Sulphurous acid.

31st January, 1888.

1463. Rademann, O. — Carbolic acid.
1469. Newton, A. V. — Explosive compounds (*Nobel*).
1470. Newton, A. V. — Safety fuses (*Nobel*).
1471. Newton, A. V. — Explosives (*Nobel*).
1472. Imray, J. — Colouring matters (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis*).

1st February, 1888.

1495. Chance & Chance — Sulphides of sodium and potassium.
1528–9. Abel, C. D. — Brewing processes (*Kiderlen, Van Leenhoff, Wernicke, Wilhelmi, & Köhlmann*).

2nd February, 1888.

1546. Wilson, J. — Sulphide of zinc.
1558. Squire, W. S. — Manufacture of yeast.
1560–1. Hake, C. N. — Chlorate of potash.
1569. Barnard, E. N. — Chlorinating ores.
1571. Newburn, J. C. — Black colour from toluidine (*La Société Jeannolle et Cie*).
1591. Abel, C. D. — Explosive compounds (*Schöneweg*).
1593. Leigh, H. H. — Colouring matters (*Williams*).

MISCELLANEOUS.

27th January, 1888.

1233. Longworth, J. — Supplying moisture to the atmosphere in weaving sheds.
1237. Jenkinson & Greaves — Hammers.
1245. Alliott & Paton — Steam disinfecting apparatus.
1246. Vering, H. — Pitch chains.
1248. Burt, H. J., & others — Metallic shell spinnings.
1251. Dronsfield, S. — Prevention of "snarls" and "lashed ends."
1252. Wood, T. — Pipe facing tool.
1253. Royston, J. — Disinfecting gas producer.
1255. Kaye, J. — Bolting doors.
1259. Royle, J. J. — Heating by steam.
1264. Shackleton, J. — Heating railway cars.
1267. Buckley, E. — Equalising the feed in scutchers.
1268. Howcroft, W. J. — Metal buckets.
1271. Tandy, H. R. — Velocipedes.
1273. Morisseau, A. — Boring and drilling tools.
1274. Settle, T. — Relieving gas retorts from pressure.
1280. Garrod, G., & others — Curtains for preventing the spread of conflagrations.
1281. Clark, A. M. — Harness (*Dax*).
1283. Lyle, J. — Improved clip or binder.
1284. Pückert, H. — Lamps (*Schwarz*).
1285. Hall & Phillips — Velocipedes.
1286. Townsend & Gould — Needles.
1287. Fletcher, R. G., and others — Velocipedes.
1288. Stevens, C. — Fire escapes.
1289. Jones, J. H. — Bottle stoppers.
1291. Stanbury, C. H. — Dark chambers for photographic purposes.

28th January, 1888.

1292. Wilson & Chittenden — Slip hook.
1294. Cliffe, J. — Asphalt composition.
1295. Harrison, R. R. — Devices for opening fan lights.
1297. Pemberton, W. — Moistening and drying warps.
1298. Parr, J. — Bicycles and tricycles.
1301. Rogers & Felmingham — Apparatus for keeping railway carriage doors closed.
1302. Campbell, S. — Fire escape.
1303. Riley, J., & others — Figured fabrics.
1304. Roberts, T. — Automatic stop block.
1307. Seage, E., & others — Fasteners for printers' tapes.
1310. Hosken, W. A. H. — Coupling for railway trucks.
1313. Redfern, W. — Valves or taps (*Howard*).
1314. Carter & Boughton — Taps for measuring spirituous liquids.
1315. Brotherhood, C. — Generating gas.
1316. Nightscales & Illingworth — Retainer bolt.
1318. Horwood, H. — Velocipedes.
1319. Wright, H. W. — Reservoirs of oil stoves.
1320. Bowen, E. — Lamp stoves.
1325. Brangwin, F. — Emptying carboys.
1326. Roberts, W. C. — Sanitary disinfecting apparatus.
1327. Bamlet, W. H. — Stopper for bottles.
1328. Dearlove & Davies — Velocipedes.
1337. Nicholls, R. — Purification of sink water.
1344. Everitt, P. — Alarm apparatus.
1349. Shaw & Sydenham — Recording the revolution of wheels.

30th January, 1888.

1352. Morgan, W. — Ironing and velouring felt hats.
1353. Wilson, J. A. — Recharging stale beer.
1354. Shingler, E. I. — Frame pulleys.
1357. Winter, T. — Immersion rollers.
1358. Washington, W. — Cardboard boxes.
1359. Thornton, J. E. — Photographic cameras.
1360. Cook, H. W. — Needles.
1366. Thomas & Thomas — Foul gas pressure indicators.
1368. Wynne, F. — Making infusions of tea.
1370. Parsons & Whitworth — Finger plates.
1373. Dittrich, J. — Chimney cowls.
1374. Mushing, E. — Velocipedes.
1376. Singer & Lea — Velocipedes.
1378. Smith & O'Donnell — Railway signalling apparatus.
1380. Moss, J. — Miners' lamps.
1388. Lübbe, L. von — Bicycle and tricycle wheel.
1389. Erfurth, O. — Support for scaffolding.
1394–5. Heaton, C. J. — Ornamental work for walls.
1398. Waquier, M. — Mincing machines.

31st January, 1888.

1399. Watkins, J. S. — Military cycles.
1401. Lloyd, A. — Pocket compasses.
1405. Leadbeater & Leadbeater — Guards or screens for machinery.
1410. Cowan, D. — Gas cooking stoves.
1412. Fraser, D. — Sights for guns.
1417. Bennett, J. F. — Brakes.
1418. Kreissig, C. H., & others — Increasing the light from burners.
1423. Smith, T. — Glass and mount cutters.
1424. Taylor, H. — Bobbins for ring spinning machines.
1428. Allison, H. J. — Nuts (*Stout & Underwood*).
1435. Carter & Aynsley — Spring to open and close doors.
1439. Martin, J. S. — Cycles.
1441. Grünbaum, H. O. A. E. — Coupling harness, railway carriages, and other objects.
1443. Boothroyd & Renouf — Velocipedes.
1444. Pert & Weston — Coating cisterns.
1445. Duffy & Fawcett — Purification of water.
1451. Hillman, W. — War cycles.
1454. Johnson, J. Y. — Tool for cutting screws (*O'Hagan*)
1456. Downes, W. J. — Spring clip pen.
1457. Gilbert, B. F. — Mop holders.
1461. Boyle, R. K. — Applying metals to metals.
1464. Rohart & Rohart — Scouring cloth.
1468. Barham, G. — Scale.
1475. Batchelor & Latch — Wire ropes.
1477. Cluse, W. — Gas burner.
1478. Tylor, J. J. — Liquid meters.
1479. Macgregor, A. — Apparatus for registering payments.

1st February, 1888.

1480. Duffy & Duffy — Window fasteners.
1484. Holmes & Sugden — Draught excluders.

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1485. Baker, F. R..... Oil lamp burners.
1488. Perrins, W. C..... Fire escape.
1493. Philburn, A. ..... Stoppering bottles.
1496. Truscott, J..... Safety bolt.
1499. Gibson, S. D..... Wheels.
1500. Pearson, J. ..... Safety lamps.
1507. Adams, R. ..... Springs for doors.
1508. Bowman, R. D..... Lamps.
1510. Krügener, R. ..... Photographic cameras.
1511. Vincenzo de Luca, G... Stoppers for bottles.
1513. Davidson, S. C..... Boxes in which to pack tea.
1514. Haverson, W. W. ..... Lamps.
1519. Avery, W. B..... Scale beams.
1520. Latch & Batchelor.... Wire ropes.
1523. Ward, J. R. ..... Cooking stove.
1527. Bridge, F..... Stoppers for bottles.

2nd February, 1888.

1532. Andrews, H..... Cartridges.
1537. Bury, J..... Draught excluders.
1538. Cox & Oakley..... Fastening for bands.
1539. Guye, A..... Keyless watches.
1540. Hill & Hill..... Ball cocks.
1541. Brode, L. A..... Fastening metal capsules on bottles.
1542. West, T..... Hay collectors.
1548. Macdonald, J. D..... Ambulance apparatus.
1549. Guy, J. P..... Refractory material for furnaces.
1563–4. Field, E., & others.... Lock nuts.
1577. Crosfield, A. H..... Lubricants for use in wire drawing.
1581. Rucker, M. D..... Velocipedes.
1583. Dallmeyer, T. R. ..... Photographic lenses.
1594. Gestetner, D..... Obtaining copies of type writing (*Klaber*).

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

4th February, 1888.

1105. Peterson, E. W. I. ..... Breech loading guns.
1120. Williams, G. J. ..... Ornamental metallic tubes.
1181. Conacher, A. ..... Refrigerating machines.
1274. Schulhof, J..... Breech mechanism for fire arms.
1281. Smallman, J. W..... Small arms.
1453. Stevens, T. G..... Controlling ships' rudders.
1764. Richardson, F. W..... Water jet propulsion for steam ships.
1770. Murrie, J. ..... Regulating the temperature of fluids in steam generators.
2003. Kelsey, J. R. ..... Shaping machines in the manufacture of hats.
3046. Gray, T..... Apparatus for registering and recording earthquakes, earth tremors, and changes of level of the earth's surface (*Milne*).
3093. Williamson, J. T. ..... Gun mountings.
3210. Fraser, R..... Feed heating.
3213. Harris, S. C. ..... Excavators.
3318. Newall, J. W..... Adjustable bearings for shafting.
3665. Pickles & Whitehead. Combing machines.
4085. Pegg & Edmonds..... Machines for brushing articles of hosiery.
4182. Lake, H. H. ..... Railway carriages or vehicles (*Smith*).
4337. Nuttall, W..... Mules.
4500. Bamford, S. B..... Mowing and reaping machines.
4638. Heselwood, J..... Washing machines.
4661. Worsdell, T. W..... Compound engines.
4692. Howard, R. L., & others Hot air engines.
4743. Parker, T. ..... Boiler feed regulators (*Dumas*).
4745. Dalby & Hunt..... Knitting machines.
4765. Shepherd, J. W. ..... Lifeboat.
4788. Purser, G. J. ..... Type writers.
4820. Perkins & Perkins ... Machinery for rolling roads.
4868. Thomas, H. M..... Ice making machinery.
4880. Eadie, P., & others ..... Ring doubling machines.
4910. Roberts, H. T..... Machines for polishing leather.
4923. Sturgeon, T. ..... Gas engines.
4936. Gardner, J. S..... Washing sand.
4958. Heslop, J..... Feed water measurer.
4961. Lawson, A. T. .... Spinning yarns.
4962. Botwood, W. ..... Broughams.
4968. Booth, E..... Loom shuttle tongues.
4984. Eves & Hanna..... Apparatus for carrying bobbins.
4992. Margetson & Hek..... Dog carts.
5012. Redfern, G. F. ..... Artificial fuel (*Robert*).
5077–8. Anderson, A. ..... Sewing machines (*Greene*).
5113. Stewart & Walker..... Washing woven fabrics.
5164. Butterfield, F..... Cutting or shaping stone.
5168. Weir, J..... Force pumps.
5205. Lake, H. H..... Fabrics composed of silk (*La Société Gillet et Fils*).
5626. Schulz, R..... Hoisting machines.
5668. Sipman, C..... Winding and doubling mechanism.
5676. Platt, J..... Furnaces.
6238. Abel, C. D..... Cylinder and piston motor engines (*Grabner & Ruperti*).
6597. Low, R..... Breech and muzzle loading gun.
6631. Sunter, L. E..... Manufacture of screws.
6759. Rockliffe & Key ..... Connecting gear for ships' boats.
8277. Jukes, W. ..... Manufacture of steel.
8645. Gallowitsch & Seel... Polishing of metallic rollers.
11327. Sumner, W. ..... Spindles.
12747. Boult, A. J. ..... Welding and tempering metals (*Ries*).
13846. Lake, H. H. ..... Machine for attaching buttons (*Mervin & Bennett*).
14088. Aldrich, F. E..... Looms (*Field*).
14158. Lake, H. H. ..... Knitting machines (*Esty and Busiel*).
14909. Sipman, C..... Winding or doubling yarns.
14922. Taylor, J..... Controlling the supply of steam to machines for yarn sizing.
15241. Cochrane, W. F..... Roller mills.
16714. Thorbiörnsen, T. ..... Discovering leaks in ships.
17533. Lake, H. H. ..... Sewing machines (*Metcalf*).
17579. Justice, P. M. ..... Meters for liquids (*Thomson*).
17763. Leak, E..... Supporting pottery in kilns.
17857. Haddan, R..... Machines for cutting clay (*Burr and Stipes*).
17934. Drummond, F. A ..... Water gauge for steam boilers.
17939. Hawkins, R. B..... Rotary brushing machines.
18006. Jantzen & Lutz..... Cocoa grinding apparatus.
18016. Chwalla, G..... Fancy pile fabrics.
16. Willcox, B..... Coupling for propeller shafts (*La Société des Usines Franco-Russes*).
18. Craven, W..... Retiring bearings for travelling cranes.
26. Willcox, B..... Lasting boots (*Chase*).
30. Bay, A. V..... Dampers for steam boilers.
31. Grollimund, M..... Grain separating mills.
57. Allison, H. J. ..... Sewing machines (*Pippey*).
98. Lake, H. H. ..... Rails, sleepers, chairs, and other parts of railways (*White*).
107. Kapteyn, A. P..... Automatic brake.

ELECTRICITY.

4th February, 1888.

3658. Dick & Kennedy ..... Current transformers.
3767. Lea, J. ..... Arc lamp.
4070. Sankey & Willans..... Dynamos.
4781. Electrical Power Storage Company and Butler ..... Electric batteries.
4809. Tortora, E..... Insulating electrical conductors.
17837. Justice, P. M. ..... Generating electricity from heat (*Acheson*).
17888. Smith, G. A..... Electromagnetic marine governors.

CHEMISTRY.

4th February, 1888.

3704. Hargreaves, J., & others Treatment of cupreous pyrites.
4389. Snelus, G. J..... Treatment of furnace slag.
8666. Chance & Chance ..... Treating alkali waste.
16495. Lake, W. R. ..... Extracting metals from ores (*Vogelmann*).
17693. Berkeley, H. B. ..... Fixing photographic pictures.

MISCELLANEOUS.

4th February, 1888.

1297. McMinn, F. A. ..... Inflammable gas.
1304. Golding, W..... Velocipedes.
2262. Thornk & Burr ..... Lamps.
2412. Hoole, H. E..... Register grates.
2817. Moore, H. J..... Self locking bolts.
3375. Rowe, J..... Extinguishing oil lamps.
4122. Thornycroft, J. I..... Controlling pressure.
4305. Pinchbeck, J. ..... Polishing table knives.
4627. Silverlock, W. B. ..... Applying bronze or other powder to the surface of paper.
4684. Wood, W. C..... Stoppering bottles.
4826. Simon, G. Y..... Capsuling of bottles.
4865. Godbolt, C. ..... Tilting casks.
4894. Lloyd & Wilde ..... Metallic boxes.
4908. Nicholas, A..... Call bells.
4911. Vigers, E..... Removal of sewage.
4926. Hall, W. C. ..... Apparatus for reproducing drawings.
4928. Ellis, G..... Horse shoe.
5384. Beck, J..... Steam cooking apparatus.
6628. McLaren, H..... Reducing valves.
8781. Burgess, H. J..... Gas burners.
10705. Woodland, W..... Stop cock.
10926. Molyneux, P..... Lining tanks used for the storage of petroleum.
13057. Sleat, J. F..... Lamp.
13126. Feller, T..... Ball valve.
13933. Wotherspoon, J..... Connecting branch pipes to main pipes.
14429. Darby & Blakeslee..... Impregnating chamois skin with rouge.
15680. Waddington, H. H..... Vulcanisation of waterproofed fabrics.
16858. Smith, J..... Disinfecting sewers.
17066. Ehrlich & Storck..... Printing decorations on ceramic articles.
17503. Cook, G..... Spirit levels.
17575. Gisborne, J. S..... Indicating the direction of revolution of shafts.
17647. Imray, O. ..... Drive chains (*Jeffrey*).
17810. Manton & Newton..... Sights for fire arms.
17816. Hawley, C. P. ..... Securing ferrules.
17852. Thompson, W. P..... Ventilation (*Oehlmann*).
17965. Redmond, F..... Machines for cleaning windows.
18012. Woodruff, O. D..... Meat cutters.
18017. Lake, H. H. ..... Call bells (*Russell*).
35. Sewall, J. H..... Heating railroad cars.
94. Haddan, H. J. ..... Lock fastenings (*Kristóffy, Németh, & Zacsek*).
96. Platenka, F..... Syphons for aerated liquids.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 28th October, 1887, inclusive.)

Year 1883.

5015. Jensen, P..... Pumps (*François & another*).
5016. MacCallum, J..... Packing of goods.
5017. Smiley, G. W. ..... Extinguishing lamps, &c. (*Smiley, and another*).
5024. Allison, H. J. ..... Printing telegraphs, &c. (*Field*).
5026. Cunningham, W..... Twisting yarns, &c.
5028. Pitt, S. ..... Shoddy pickers (*Dodge*).
5032. Williamson, W. B..... Fastenings for trunks, &c.
5033. Cleaver, E. L..... Recovering tin from tin scrap.
5037. Lindsay, F. ..... Construction of silos.
5041. Lake, W. R. ..... Sewing button holes (*Banks and another*).
5042. Lake, W. R. ..... Electrical igniting apparatus (*De Kabath*).
5051. Maughan, B. W., & ano. Propellers.
5052. Allison, H. J. ..... Supplying air to lamps (*Haseltine*).
5053. Pohl, O. E..... Preserving perishable liquids.
5054. Johnson, J. Y..... Traction rope tramways, &c. (*Bonzano*).
5060. Haddan, H. J. ..... Automatic car couplers (*Gifford*).
5062. Macaulay-Cruikshank, G..... Perspectographs (*Ritter*).
5072. Roe, E..... Insulators.
5076. Haddan, H. J. ..... Two wheeled road vehicles (*Clinch*).
5079. Glaser, F. C..... Motor engine with steam generator (*Heinrici*).
5082. Dunston, R. E., & others Dynamo-electric machines.
5084. Roberts, S..... Couplings and unions.
5085. Bullock, C. A..... Gas motor engines.
5088. Berman, J. S. ..... Distribution of electricity.
5099. Whittaker, T..... Treating residual matters from refuse.
5103. Taylor, T., & another.. Electric gas lighters.
5109–10. Williams, J. S. ..... Generation, &c., of electricity.

Year 1882.

5030. Bonneville, H. A..... Manufacturing anhydrous alumina (*Gardair & another*).
5055. Varley, F. H. ..... Generating & storing electricity.
5103. Hughes, G. H. C..... Velocipedes.
5104. Bauer, M., & others..... Electrical insulation.
5121. Pickles, J. H. ..... Winding linen, &c.
5134. Landreth, C., & ano.... Regulating air in cupolas, &c.

Year 1881.

4678. Leoni, S. ..... Heating water by gas, &c.
4687. Pitt, S. ..... Asbestos material (*Johns*).

Year 1880.

4310. Lake, W. R. ..... A magnetic apparatus (*Howes and others.*)
4312. Parkinson, J. ..... Temples for looms.
4326. Groth, L. A. ..... Horseshoes (*Luchaire*).
4334. Johnson, S. H..... Production of saccharine substances.
4348. Baxter, F. ..... Excluding air from casks.
4353. Johnson, J. H..... Working of combined iron and steel (*Haldeman*).
4362. Wallace, J..... Potato diggers.
4368. Lake, H. H. ..... Holding cartridges, &c. (*Parkhurst*).
4394. Ambler, W. ..... Spool tubes.
4404. Browning, G., & ano.... Sewing machines.
4406. Craven, F., and ano. ... Spinning fibrous substances.
4412. Boult, A. J. ..... Breech loading fire arms (*Houghton*).

Year 1879.

4367. Hastie, J..... Hydraulic motive power and pumping apparatus.

Year 1878.

4199. Perrett, E. ..... Arrangement of wheels of tram cars, &c.
4207. Chambers, J. ..... Core bars.
4265. Singer, G ..... Bicycles, &c.
4297. Hunt, B. ..... Agglomerating coal and other substances (*Couffinhal*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Gas Engines.—*H. Williams, Stockport.*—This invention relates more particularly to the type of engine known as the "Stockport" gas engine, and consists chiefly of introducing one portion of the charge of the explosive mixture of gas and air into the power cylinder at its extreme inward end, and simultaneously introducing the other part of the charge from a point in the cylinder near the head of the piston when at the extremity of its outward stroke. The object of this arrangement is to obtain a homogeneous combustible charge prior to ignition. The charge is to be ignited while compressed within the combustion chamber of the cylinder, at a point near the head of the piston when at the end of its inward stroke. The charge drawn into the charging cylinder by the outstroke of the piston is, on the instroke, compressed into a reservoir, whence different portions enter the power cylinder through separate openings. At the moment when the charge thus enters the power cylinder, the exhaust port of the cylinder is opened, and the inrushing charge expels through it the products of the previous explosion. The

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charge is thus rendered homogeneous, and is ready for combustion after the piston in its return stroke has compressed it into the combustion chamber. The inventor makes three claims for the method and construction.—No. 16144. November 24th, 1887. 8*d*.

SPINNING MACHINERY.—*J. Butler & T. Howarth, Bolton.*—This invention involves the use of revolving under clearers in drawing frames and other machinery employed in spinning fibrous materials, for the purpose of removing the fluff which is gathered during the passage of the sliver. Suitable rollers are mounted in vibrating frames and are disposed below the ordinary rollers; while the frames are attached to double levers secured to the main supports of the machine. The outer ends of the levers are fitted with sliding weights in order to adjust the pressure of the under clearers against the ordinary drawing rollers. The vibrating frames are provided with a metallic roller disposed immediately below the feed roller, and with others of wood under the third and fourth drawing rollers. These clearing rollers are enclosed in an endless band of cloth, which revolves by the action of the feed roller and the pressure of the lever and frame. The cloth operates on the under side of the ordinary drawing or other rollers, clearing them of their imperfections. The inventors make two claims: For the combination of the endless band with the vibrating frames and levers; and for the general construction of the improved under clearers.—No. 6955. May 12th, 1887. 8*d*.

MULES.—*B. A. Dobson, Bolton.*—The improvements are for the purpose of effecting the changes in long lever mules in a more expeditious manner. The diagrams show the method and mechanism adopted by the inventor. Fig. 1 represents a side view, and Fig. 2 a plan of part of a self acting mule to which the invention is applied. A is the quadrant band shaft, and B is the head stock. On the shaft A is mounted a small pinion A^1 gearing with a spur wheel C, which has a scroll attached to it. A lever E is pivoted at E^1 to the head stock B; a bowl E^2 on this lever engages the scroll, and the lever E thus receives an upward and downward movement. At the end of E is a slot, into which enters a stud F^1 fixed on a slide F. This

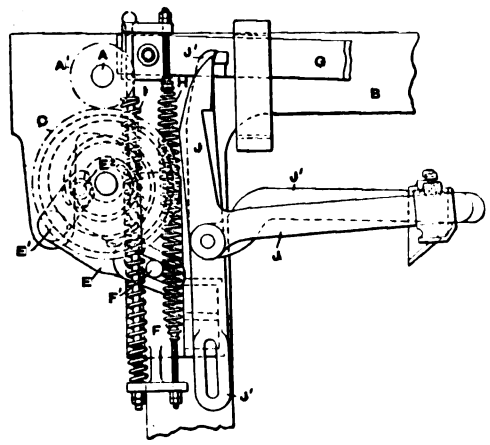


FIG. 1.

slide is free to move in a slideway fixed to the framing, and is connected by two springs H and I to the ordinary long lever G. In the outward run of the mule carriage the spring I is compressed by the revolution of A actuating the scroll, lever E, and slide F. When the catch on the latch lever J is withdrawn at the moment of making the first change, the spring I exerts its force to move the long lever G. During the inward run the quadrant shaft is reversed, and the scroll and lever draw the slide F down, and extend the spring H; so that when the carriage arrives at the end of the inward run, there is sufficient power left in H to make the third and last change when the catch on the latch lever J^1 is withdrawn. At the back end of the long lever is a stud or bowl working in a lever pivoted near

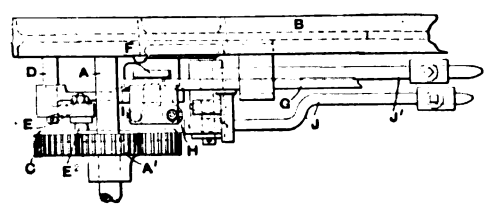
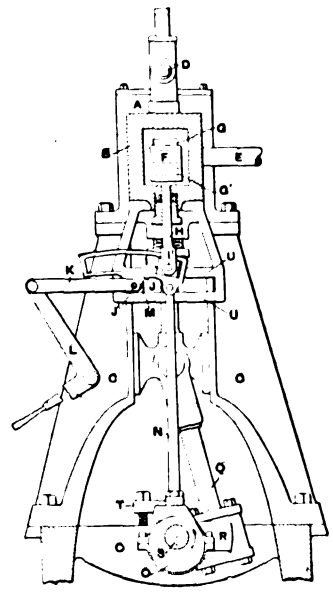


FIG. 2.

one side of the head stock. This lever is made in two parts connected together by a closed spiral spring, and one extremity of the lever has a fork which enters a groove in a catch box on the back shaft. When the first change of the long lever is made the catch box will be drawn out of gear, and the revolution of the back shaft will thus be stopped. On the second change the slot in the pivoted lever will be in a direct line with the line of motion of the stud on the long lever, and thus no further movement will be imparted to the catch box. When the third change takes place the catch box will be instantly moved back into gear and the back shaft again turned. Should the carriage be impeded in its outward course the spring will yield sufficiently to allow the catch box to slip out of gear. The inventor makes six claims for these combinations.—No. 2577. February 19th, 1887. 8*d*.

STUFFING BOXES.—*S. Griffin, Bath.*—The construction of stuffing boxes and of the metallic packing is arranged in such a manner as to reduce the friction as much as possible. A box or sleeve is arranged to contain the packing rings, and is of a diameter somewhat larger than that of the piston rod. At the bottom of the box there is a shoulder whose size is determined by a second sleeve fitting the piston rod in the usual way. A certain number of packing rings are parted at one point by a thin slot, so that when the piston rod is passed through the rings they can open and accommodate themselves to its diameter. Their tendency is to continually close on the rod and prevent the steam from escaping, and the rings are necessarily arranged so that the slots do not register with one another. In order to prevent the escape of steam between the outer edge of the rings and the inner surface of the stuffing box, the inventor introduces between each group of two or more rings a second series of rings which are bored of the same diameter as the piston rod. These rings are split, so that their tendency is to press upon the inner surface of the stuffing box, and thus the steam is prevented from escaping. The rings are held in their places by a suitable gland. The inventor makes four claims for the combination of the two sets of packing rings, and for the apparatus for adjusting them and holding them in their places.—No. 3350. March 4th, 1887. 8*d*.

VALVE GEAR.—*D. Williams, Cardiff, and W. E. Raymond, Yarmouth, Nova Scotia.*—The reversing of a steam engine is effected, according to this invention, by the employment of one eccentric only. By referring to the accompanying figure, this arrangement will be seen fitted to a vertical steam engine. The cylinder is indicated by A and the valve chest by B. The valve F controls the action of the supply ports G and G^1, and the steam and exhaust pipes are represented at D and E. At the



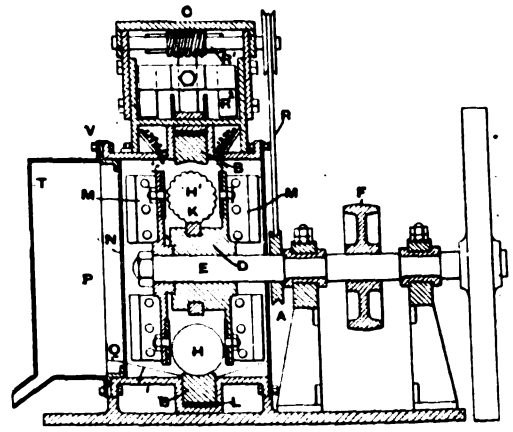
lower end of the valve spindle H is a jaw, in which is a block I loosely fitting on a pin I^1. Upon the upper and lower faces of the block I bears the radius link J, towards one end of which is connected the eccentric rod N. The eccentric O is set at right angles with the crank R. The radius link J is pivoted at J^1 to blocks M, which are free to slide in grooves U. A pair of drag links K are connected to the pivot pin J^1, and are operated by the hand lever L; and the blocks M are thus moved in the grooves U. In the figure the position of parts is such that the shaft S is being driven in the direction of the arrow, and the eccentric rod N and the valve spindle H ascend together as the radius link J oscillates on its pivot J^1. In order to reverse the engine the radius link is moved by means of the hand lever until the blocks M are at the opposite ends of the guides U. In this position the eccentric rod moves up and the valve spindle descends, while the shaft S revolves in the reverse direction. The inventors make three claims for the combination of parts represented in the drawings by the letters I J M U K with the other parts of the engine. No. 15915. November 19th, 1887. 6*d*.

STEAM ENGINES.—*A. J. Boult, London.* (*J. T. Case, Bristol, Connecticut, U.S.A.*)—The case of the engine is in the form of a flat thin box having a removable cap on one side. The upper end has a flange, by which it is secured overhead in a pendant position, and to serve as one of the hangers for the main line of shafting. Through the case a hollow axle extends transversely, and is divided into two longitudinal chambers, each having a port upon their upper and lower sides, opening radially. The steam pipe is connected to one chamber and the exhaust to the other. A piston surrounds this hollow axle, and is provided with a port at each end. Surrounding the piston and fitted to it is a steam box, and the piston is fitted to the sides of the steam box with ordinary packing rings. The open sides of the steam box are covered by the broad sides of the principal frame. The surface of the frame over which the steam box travels may be elevated a little over the rest. This steam box forms the cylinder of the engine, but it reciprocates instead of the piston. The steam box is connected to a crank pin on a disc mounted on a shaft by a connecting rod, which is screwed into one end of the steam box. The lower end of this rod is provided with a round stem and a shoulder. The crank pin is held between two half boxes secured to a frame having a threaded neck, through which the stem of the connecting rod passes. Within the lower part of the frame a pipe is secured which may act also as a standard. This pipe has a branch pipe at one side which is connected with a chamber provided with a central outlet pipe extending in the chamber to the level of the first motion shaft. This chamber is filled with water, which flows through the pipes and rises in the case, where its surface is covered with lubricating oil. Live steam admitted through the supply pipe passes through one port of the piston, and drives the steam box in one direction, while the exhaust steam escapes through the other port of the piston into the chamber of the hollow axle. As the crank reaches the limit of its stroke, both steam ports are closed by the solid metal between each pair of ports of the hollow axle. The further motion of the crank again opens the opposite port of the piston. The inventor makes ten claims.—No. 11915. September 2nd, 1887. 8*d*.

METAL ROOFS.—*S. Taylor, Birmingham.*—In constructing a metal covered roof the inventor uses stepped roofing sheets of zinc or galvanised iron. The steps are arranged equi-distantly and parallel with the eaves of the roof. Along each bearing edge of the roofing sheet a convex beading is made, and between the beading and the extreme edge of the sheet is a gutter, which is formed by bending upwards the extreme edge of the sheet at an obtuse angle. The combined beading and gutter is made at each bearing edge of the roofing sheets. The beading acts as a barrier to the passage of water, which the gutter conveys away. The beaded edges of adjacent sheets are not in contact, but are arranged at a short distance apart on the rafter. The opposed edges of the separated sheets are fixed to the rafter by means of a cap or fixing strip having steps in it corresponding to those in the sheets. The fixing cap between its locking edges is arched for the sake of rigidity, and in the middle of its arched part holes are made for the passage of fixing screws. The bearing edges of the sheets are thus secured firmly on the rafters, and the sheets are capable of expanding and contracting. The inventor makes five claims.—No. 4818. March 31st, 1887. 11*d*.

CARDING ENGINES.—*E. W. Wrigley & R. Patterson, Oldham.*—The object of this invention is to construct an improved indicator applicable to the flexible bends which support the ends of carding engines, so as to enable the card surface of the flats to be set with accuracy concentrically with the main cylinder. The indicator consists of a vertical finger which moves upon a pivot at one end. A short arm projects from the lower part of the finger near its pivot at right angles to the finger. This arm carries a short horizontal slot, in which works a pin in connection with the flexible bend. The flexible bends are usually mounted on three equidistant brackets. The index plate of the indicator is fixed to the central bracket, and the pin is attached to the flexible bend and works through a vertical slot in the central bracket. In the case of the two sliding brackets, the pin is fixed to the brackets, and the index plate is carried by an outer bracket secured to the framing in front of the sliding bracket. In the indicators made by the inventors each mark on the index plate represents one four-hundred-and-fiftieth part of an inch in the adjustment of the flexible bend, and thus great accuracy is attained. The inventors claim the combination of a fixed dial plate with a movable pointer actuated directly by the movement of the sliding bracket or of the flexible bend.—No. 3011. February 26th, 1887. 8*d*.

PULVERISING MACHINERY.—*J. W. Pope, London, and R. Pope, Bristol.*—The annexed figure represents a longitudinal sectional elevation of the improved machine. The outer case A is mounted on a frame, and the rotary beater D is fixed to the shaft E, which is driven by a belt passing round the pulley F. This rotary beater is cupped or chambered at its outer edges, so as to receive a number of balls H^1. These balls rest perfectly free in the chambers, and upon the rapid rotation of the beater they fly out centrifugally and revolve against the path or ring B in the casing, and thus pulverise the material which descends through the machine. In order to lessen the jar of the balls the inventors provide springs K in the base of the chambers; and behind the ring B a similar cushion L is placed. The withdrawal of the pulverised material is effected by means of a series of vanes M mounted upon the outer side of the beater. These



vanes direct the draught through a coarse mesh N and a fine gauze screen P; the coarser material which cannot pass through the second screen is returned to the machine through the outlet which is represented at Q. The machine is fitted with a hopper and a feeding apparatus which is driven by a strap R. A worm wheel R^1 is thus caused to rotate, and by these means a series of arms R^2 feeds the material in a uniform manner through holes in the bottom of the hopper. The sides of the chambers in the beater are preferably lined with hard steel plates, which may be rotated and removed in order to present fresh surfaces to wear. The part T is made removable, in order to provide access to the interior of the machine. The inventors make three claims: (1) For the combination of ring B with the rotary beater chambered to receive balls; (2) for fitting these chambers with elastic buffers; and (3) for the combination of the machine with the automatic feed, as described.—No. 1879. February 7th, 1887. 8*d*.

MANUFACTURE OF CAST STEEL.—*F. H. Lloyd, Wednesbury, and H. White, Newport, Monmouthshire.*—The inventors take highly carbonised pig iron and melt it in a cupola. A fixed converter with a silicious lining is in close proximity with the cupola, and the molten metal is allowed to flow into it. Air is blown into the converter as usual, and decarbonises the metal entirely. The metal is then run into an open hearth furnace, where it is mixed with molten metal containing the fixed amount of alloy required. The inventors make four claims for the method and apparatus designed.—No. 3670. March 10th, 1887. 6*d*.

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CARDBOARD CUTTER.—*T. Furnival, E. Tudor, C. Preston, and W. Byway, Manchester.*—This improvement relates to machines for cutting out the corners in cardboard sheets used in the making of boxes. The rectangular knives which have hitherto supplied the cutting power have frequently exhibited a tendency to cross and overlap during their action. By this invention the blades are provided with projections or prolongations at their ends, so that in no position which they assume will they be altogether out of contact with each other. The possibility of their ever crossing during their up and down motion will thus be effectually precluded. The inventors make three claims for this improvement.—No. 15756. November 17th, 1887. 6*d.*

TUBULAR BOILER.—*O. Lilienthal, Berlin.*—The boiler is preferably mounted in an inclined position, and the steam generator consists of a series of bent pipes arranged in parallel planes within the outside shell. A series of walls enclose the pipes in order to form a furnace chamber and flues. The water enters the system of tubes at one end, and passes through them to the exit of steam or heated water. The flames and heated products of combustion thus come into intimate contact with the water circulating in the tubes, and the heat thereby imparted to the water causes it to rise in the tubes and sets up a continuous supply of feed water. The inventor makes two claims.—No. 16555. December 1st, 1887. 6*d.*

MACHINE FOR MAKING DOWEL PINS.—*C. F. Stewart, Norwalk, Ohio, U.S.A.*—In the manufacture of dowel pins the wood is cut into suitable lengths which are fed into the machine, where a reciprocating plunger forces the timber against the splitting knife. Hitherto a gauge has usually been rigidly attached to the bed, and the splitting knife was arranged obliquely to the line of the gauge in order to give sufficient clearance for the blank in case the wood did not split straight. If that event occurred, it was probable that the block would be turned to one side and enter the finishing die obliquely. This was the cause of many blanks being spoiled. The inventor proposes to remedy this defect by setting the splitting knife parallel with the axial line of the finishing die, and by providing a yielding guide block rabbeted along the inner lower corner to engage the blank on the rear and top sides. Springs are arranged to press the guide block downwards and forwards, by means of which the blank is always firmly held against the knife and against the bed, and made to enter straight into the finishing die. The inventor makes six claims for this improvement and for the details of its construction and arrangement of parts.—No. 13705. October 10th, 1887. 8*d.*

CASTING METALS.—*F. R. Schweiger & C. F. Mühlmann, Chemnitz, Saxony.*—The drawback connected with the casting of metals and alloys in moulds of cast iron is the difficulty experienced in expelling the gases from the molten metal in order to form a homogeneous casting without bubbles and flaws. In the usual chill and sand moulds the expanding gases drive the metal towards the walls, which yield to the pressure. The object which the inventors have in view is to provide between the molten metal and the walls of the chill a layer or coating of material which will expand on being heated. This expansion of the coating of the walls of the chill will prevent the metal being forced to the sides, and the imprisoned gases will have to escape at the free surface of the molten metal. The bubbles will thus be absent, and the number of flaws in the casting will be considerably diminished. The composition of the material which the inventors use for this purpose consists of American lard and soapstone. The chill is slightly warmed, and its interior is first coated with a layer of old American lard, the excess of which is wiped off with waste. Powdered soapstone is afterwards sprinkled over and well worked in with a soft brush. The inventors claim a chill having its inner surface coated with a layer of material adapted to expand by the introduction of molten metal for the purpose set forth.—No. 3409. March 5th, 1887. 6*d.*

OPENING AND CLEANING COTTON.—*J. Greenhalgh, R. Greenhalgh, and J. Greenhalgh, Oldham.*—This invention relates to the class of machinery known as "Willows." The roller hitherto used for periodically projecting the material through the door at the top of the machine is dispensed with; the delivery door is mounted on a pivot at its lower edge, and is provided near its hinge with an eccentric roller for automatically widening and narrowing the passage between the hinge and cylinder; suitable guide plates are placed at the ends of the cylinder, and the flake or grid is opened and closed by the usual mechanism. When open the delivery door forms a shoot to guide the material delivered on to the lattice. In order to prevent the cotton from spreading to the sides of the cylinder, flanges are provided which have corrugations on their inner side, for the purpose of directing the cotton towards the centre of the machine. The inventors make three claims: (1) For opening and closing the passage by means of the eccentric roller; (2) for the combination with the door and roller of a sweeper or cleaner; (3) for the corrugated flanges for the purpose specified.—No. 3306. March 4th, 1887.

ELECTRICITY.

INCANDESCENT ELECTRIC LAMPS.—*A. Heintz, London.*—This invention relates to the method of manufacture of incandescent lamps of low resistance, and its object is to overcome the difficulty of introducing the straight carbon rod into the neck of the bulb. The inventor takes a glass tube whose ends may be denominated by A and B. Both ends are first drawn into taper form, then the end A is closed and a bulb is blown in the tube. The end A is opened and the end B closed, and a second bulb is blown at the A end of the tube. The end A is then opened and expanded to the form of a broad cylinder. In this state the carbon is introduced after it has been attached to the leading wires. The leading wires are held together by a stem of glass, which is subsequently attached to the neck of the bulb. The next operation is to close the opening through which the carbon has been introduced by means of a heated glass rod as is usual in glass blowing. A small glass tube is welded to the A end, which serves to exhaust the air from the lamp. The tube is afterwards sealed. The inventor makes two claims: (1) For forming the large opening opposite the neck of the lamp for the introduction of the leading wires, and (2) for the improved lamp constructed as described.—No. 16728. December 5th, 1887. 6*d.*

REGULATING DYNAMOS.—*R. P. Sellon, W. M. Mordey, and Major-General C. E. Webber, London.*—The means which the inventors make use of for the purpose of obtaining the self regulation of the electromotive force of a dynamo are illustrated in two cases in the accompanying diagrams. In Fig. 1. A^1 A and F are respectively the armature, collector, and field magnets of an alternate current generator. A commutator C is placed on the shaft, and M M^1 are main conductors connected with the collector A. The resistance R is placed on the main circuit. T T are lamps or other translating devices; and D and I are respectively the initial and correcting coils of the field magnets. The collector A is composed of two rings G connected with the terminals of the conductor on A^1. The two brushes H serve to make contact with these two rings, and the two brushes K rest on the two contact pieces of the commutator. Across some portion of the main conductor M M^1 the inventors take a shunt, the current in which is commutated at C and conducted to the initial exciting circuit I, or to a separate coil on the field F. The shunted portion of the current so obtained is for the purpose of obtaining constant potential. As this derived current is proportional to the main current, the machines may be so

FIG 1.

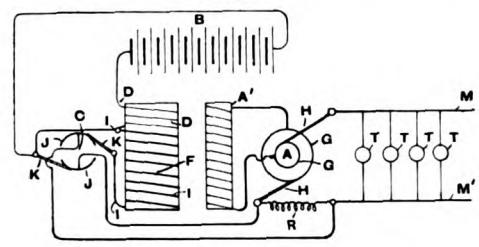
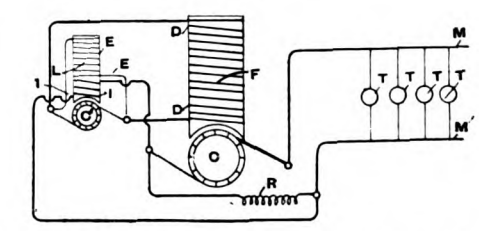


FIG. 2.



made as to maintain a constant or rising and falling difference of potential as required. For constant current working this shunted and commutated current is made to have a demagnetising effect. When a separate exciter is employed for the fields of either continuous or alternating current machines, this invention is applied in the following way: The current shunted and commutated is passed through the field coils, or through a separate coil of the fields of the exciter. The initial excitation of the main dynamo may be obtained from the separate exciter, and the correcting excitation may be produced simply by augmentation of the field current of the exciter. Fig. 2 illustrates the application of this principle to a continuous current machine. C is the commutator, and F the field magnets of the main dynamo. The fields F are excited by a current generated by a separate dynamo, of which C^1 is the commutator and L the field magnet. This exciter is in the form of a shunt machine, E being its shunt circuit. Its brushes are connected directly to the terminals D of the exciting coil of F. In addition to the shunt coil E the field is provided with a coil I, which is connected directly to the terminals of the resistance R. The coil I thus forms a portion of the main circuit, and a very small expenditure of energy is required to control the field L by the current flowing through the mains M M^1. The main current is regulated by an augmentation or diminution of the exciting current in the coil D. In constant electromotive force systems the current in I is made to strengthen the magnetisation of L; and in the case of working with constant current, the coil I weakens the effect produced by the coil E. The principle of this invention may be applied to many dynamos, and several modifications are introduced in the applications. The inventors make eleven claims.—No. 16661. December 18th, 1886. 8d.

CHEMISTRY.

HYDRATES OF BARIUM AND STRONTIUM.—*H. L. Pattinson, Felling-on-Tyne, Durham.*—In his specification of Patent No. 16989 of 1884, the inventor describes a method of manufacturing the hydrates of barium and strontium, in the course of which a liquor containing the hydrate and tersulphide was obtained. This liquor was crystallised so as to obtain the hydrate; and the crystals of the hydrate were washed with water to remove the tersulphide. In accordance with the present invention, the sulphur is removed by washing the crystals with cold water by either of the two following processes, which form the subject of this invention. In the first way a series of tanks are employed which are arranged so that the bottom of the first communicates with the top of the second, and so on, in the same way as the black ash tanks are arranged in the Leblanc soda process. The liquor from one tank, which has been almost exhausted from its sulphides, goes to the next, which has a considerable quantity of sulphide in it; the solvent powers of the water for sulphides are thus fully utilised, while with the cold water the minimum quantity of hydrate is dissolved. According to the second method, the inventor makes use of a series of cylindrical tanks, which are kept agitated mechanically. The cylinders are filled from the bottom, and are provided with a filtering arrangement at the top, through which the water passes out, leaving the solid matter behind. The water is subjected to a slight pressure when put in, and is thus made to circulate. The crystals obtained in this manner are dried by heat. The remaining liquor consists of tersulphide together with a small proportion of the hydrate. This remnant of hydrate is saved by concentrating the liquor by heat, and then cooling it down so as to separate the hydrate crystals. The inventor makes five claims for the processes and methods here described.—No. 3144. March 1st, 1887. 6*d.*

DYEING WITH ANILINE BLACK.—*F. Towlson & E. Weldon, New Basford, Nottingham.*—The object of this invention is to remedy the defects of aniline black dye—that is, its perishable colour and its lack of fastness. The material to be dyed is, according to this invention, subjected to the action of a bath composed of bichromate of potash, aniline oil, hydrochloric acid, and water. After this treatment the material is wrung out, and placed in a drying chamber and aged at a low temperature for twelve hours until it assumes a brownish black colour. On its removal from this chamber it is steamed at a low pressure for about half an hour, and then soaped and dried. In the printing process a rather different bath is used, and starch is added to the previous ingredients. The inventors make two claims for the constitution of the bath, and for the general process.—No. 3389. March 5th, 1887. 6*d.*

MISCELLANEOUS.

PACKING FOR STUFFING BOXES.—*S. Lamont & C. Lamont, Glasgow.*—The inventors employ triangular shaped packing composed of compressed canvas, with an india-rubber core placed alternately with triangular metal rings. Instead of canvas, asbestos may be used. A metal neck ring of less diameter than the stuffing box serves to keep the triangular rings in position, and also to tighten the packing when worn. The packing may be used without the metallic rings, by reversing the packing at every alternate turn. The inventors claim: (1) The triangular form of packing; (2) the adjustable neck ring; (3) the economy derived from the use of this packing, only one-half of the packing being in contact with the piston rod, every alternate turn being neutral.—No. 99. January 7th, 1887. 6*d.*

SHOE SOLE SEWING MACHINES.—*J. Albrecht, Cannstadt, Wirtemberg.*—This invention relates to the class of machines which produce double lock stitches, and its object is to sew the soles on to the shoe with two pitched threads by means of a hook needle and a shuttle. The details of the improvements are shown in Figs. 1, 2, 3, 4. The shuttle S rotates in a ring R, and is operated by a disc C and driver C^1. It has its point on its side, so that the position of the shaft A^2 is made to incline with respect to the needle bar N. The press ring H surrounding the ring R has its fulcrum in the pin H^1, and is closely guided by the cheeks H^2 and screw H^6. Two cams E^2 E^3 are inserted in the disc C and push alternately against the cheeks, thus pressing the ring downward at one time, and at another time to the left, while the spring H^5 tends to pull the ring in the contrary directions. The screw H^6 is arranged for the regulation of the length of the stitches, for when it is screwed forward the ring will not travel such a great distance. The bed plate is movable in its bearing

FIG 1.

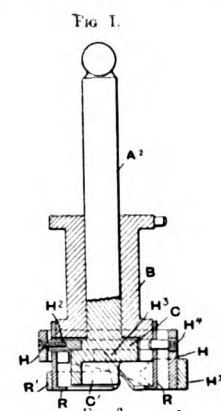


FIG. 2.

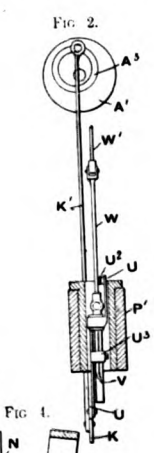


FIG 3

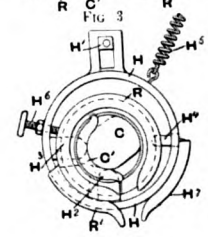
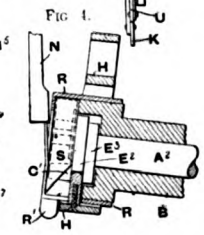


FIG 4.



P^1 (Fig. 2), which projects from the frame of the machine. The bed plate is bent so that the length of the boot shall be kept in the proper position, and that the threads shall go through the sole vertically. The thread lever K receives its reciprocating motion by the rod K^1 from the eccentric disc A^3, and carries at its front end a lever U which has a projection U^4 and a roll U^2. The rod W^1 is provided at its upper end with a small crank having an eyelet through which the thread passes on its way from the bobbin. The square rod V is somewhat twisted at its lower end, so that it may be turned by the lever as it passes up and down. This movement causes the rods W and W^1 to turn, and thus the thread is laid upon the hook of the needle. Before the thread has been drawn tight the cam E^2 has pushed against the cheek H^2, and has pressed the foot H^7 against the sole leather. The foot H^7 will be raised again by a spring attached to B. The cam E^2 presses on H^2 and moves the leather along. The cheek H^2 will then enter the indented part of E^2, and the spring H^3 draws up the presser and the latter rests on the leather. But when H^3 has sunk into the indentation of the cam E^2, the presser ring H will be drawn to the right in Fig. 3 by the spring, and the presser and shuttle will regulate themselves according to the thickness of the leather. As soon as the presser has gone back the needle will make a new stitch. The inventor makes four claims.—No. 13352. October 3rd, 1887. 8*d.*

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HEATING RAILWAY CARRIAGES.—*J. Langfield & R. L. Martland, Tyldesley, Lancashire.*—The heat of the fire box or smoke box of the locomotive is utilised for the heating of the railway carriages with hot air. A tube with a trumpet-shaped mouth projects in front of the engine, and during the motion of the train the air is forced down the tube. The tube leads through a chamber of cast iron, which is placed inside the fire box or smoke box of the locomotive, and the air thus heated circulates with the draught through a system of tubes, which convey it to the carriages. Under the floor of the carriages are arranged perforated pipes, which supply the hot air to the carriages, and suitable cocks are provided in the pipes for the regulation of the quantity of air admitted. The inventors claim the application of the draught caused by the motion of the train for the heating of the carriages, the air being first heated in a chamber provided in the fire box or smoke box of the locomotive.—No. 3183. March 2nd, 1887. 8*d.*

GAS GOVERNORS.—*G. Bray, Leeds.*—The object of this invention is to provide a suitable cover for the valve and flexible loaded diaphragm, which are used for governing the pressure of the issuing gas. The cover is necessarily removable in order to alter the load on the diaphragm, and to apply oil to preserve its pliability. The cover made by the inventor is hinged at one side to the case, and a lock and hasp are provided on the case for securely closing it down. This cover is thus only removable by the owner of the key. The claim is for providing a gas governor with a cover over its diaphragm, which cover is hinged to the body of the governor and secured by a hasp, as described.—No. 16716. December 5th, 1887. 6*d.*

AUTOMATICALLY EXTINGUISHING LAMPS.—*J. Y. Johnson, London. (A. Berry, Warden, Quebec.)*—The object of this invention is to provide means of automatically extinguishing the lamps in a railway collision. Compressed air is supplied to a tank under each coach from an air brake cylinder or elsewhere, and mechanism attached to the tank is arranged in such a way that a blast of air shall be admitted to the lamp to extinguish the flame in case the vehicle is telescoped or assumes an inclined position. The apparatus is shown in plan and sectional elevation in Figs. 1 & 2 herewith appended. A represents the floor of the carriage, and C is the tank which is supplied with compressed air through the tube E. The valve E¹ prevents the escape of this air. The outlet pipe is provided with a valve G, which is mounted on a spindle. This spindle is attached to the centre of the frame H, which consists of four arms. The rail rods I extend

FIG. 1.

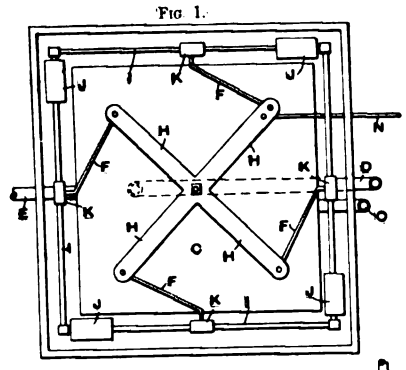
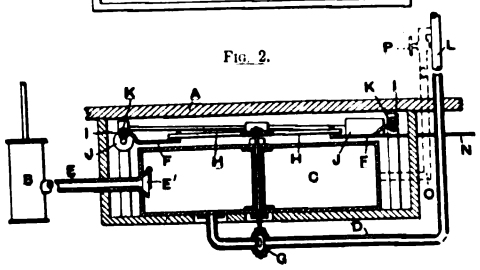


FIG. 2.

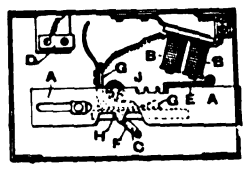


all round and outside the tank, and are carried on brackets. The weights J slide on each rail, and one or other will gravitate in the direction in which the car tips. A sleeve K also slides on each rod, and is connected by a bar F with one of the cruciform arms H. When the weight gravitates and strikes against the sleeve K, the spindle on the frame H rotates and opens the valve G. The air is thus liberated, and its discharge causes the lamps to be extinguished. The rails I are preferably slightly inclined downwards towards the normal position of the weight in order to keep the weight from accidental contact with the sleeves. The arms H have to be re-set by hand in their former position after each operation of the air and weights. N is a rod having one end attached to one of the cruciform arms H, and extending to the end of the car. In case of collision or telescoping this rod is thrust back, and thus operates the valve G in the same manner as the weights. A branch pipe O connects the tank with the distributing pipes L, and is provided with a cock P, so that by turning P the lights may be simultaneously extinguished at any time. The inventor makes six claims for these combinations, as described and illustrated.—No. 15438. November 11th, 1887. 8*d.*

INDICATING THE DIRECTION OF ROTATION OF SHAFTS.—*J. C. Ricketson, Milwaukee, U.S.A.*—This invention provides an improved method of ascertaining from a distance the direction of rotation of engine shafts. The different positions of the eccentric rods during direct or reverse rotation supply the means of operating the mechanism designed. Two electric or pneumatic push buttons are mounted on the frame of the engine, and the eccentric rods engage one of them during each revolution in one direction, and during rotation in the opposite direction the eccentric rods, being in a different position, engage the other push button. These automatic signals are communicated by an electric wire, or by a pneumatic tube, to the locality where the information is required, and one or other indicators are there actuated by one or other of the push buttons according to the direction of rotation. The inventor makes one claim.—No. 16742. December 6th, 1887. 8*d.*

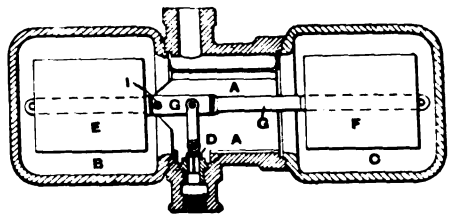
GERMAN PATENT ABSTRACTS.

ELECTRIC LOCK.—*G. Straka, Gradiska.*—This invention relates to a lock with a tumbler moved by electricity. By turning the key C the key bit H presses the lever G on the contact D, thereby establishing an electric circuit in the electromagnet B



which attracts the tumbler E. The bolt A can now be moved by means of the key bit F. By doing so G is removed from the contact D by the spring J, the electric circuit is broken, and E falls into one of the notches in A, thereby locking A again.—No. 41811. June 15th, 1887.

STEAM PIPES.—*J. Kroog, Halle.*—This invention relates to the automatic removal of condensed water from steam pipes. The apparatus consists of a valve casing A and two caps B and C, which may be easily removed for cleaning. In this casing the



lever G is fixed with the fulcrum at I. G carries two solid pieces of metal E and F of equal volume but different weight, which are fixed on G in such a manner that the distances from the fulcrum I are inversely proportional to their respective specific gravities. As the water in the casing rises and partly immerses E and F, those two bodies get lighter by the weight of water displaced by them, and as E and F are of equal volume, as pointed out before, they lose an equal amount of weight; but F, acting on a longer lever than E, overbalances E, thereby opening the valve D and allowing the water to flow out.—No. 41847. May 18th, 1887.

UNITED STATES PATENT ABSTRACTS.

LIGHTNING ROD.—*S. R. Lawshe, Chicago.*—This rod is made in sections, and each coupling is formed of two parts, one of which has a threaded end or tenon, and the other part has a threaded cavity to receive the tenon. The length of each section is made up of one centre steel wire and two or more outside steel wires, and of a sheathing of copper arranged in such a way as to separate the steel wires from each other. The outside wires fit into collars at the end of each section, and the middle wires touch each other through the threaded tenons.—No. 375756, dated 3rd January, 1888.

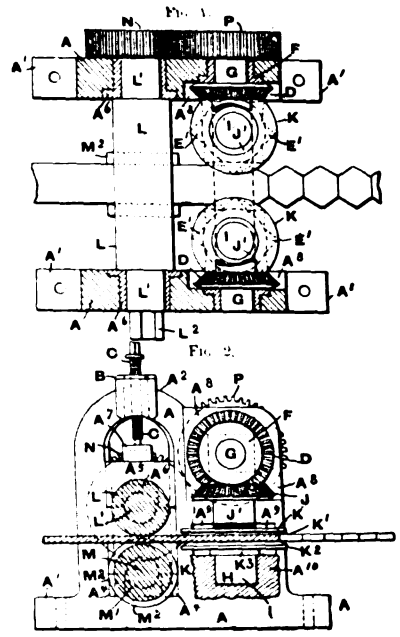
PRESERVATION OF MILK.—*O. Von Roden, New York.*—The method consists of charging the milk with carbonic acid. The milk is first heated in order to expel all the air from it, and is afterwards heated in the presence of carbonic acid to a degree sufficient to destroy all germs of fermentation. After the milk has been subsequently cooled it is charged more perfectly with carbonic acid gas. A special apparatus has been designed for the carrying out of this process. The inventor makes four claims.—No. 376495, dated 17th January, 1888.

DIRECT ACTING STEAM ENGINE.—*G. W. Stewart, New York.*—The driving shaft passes vertically through the centre of the cylinder and valve chest, and has attached to it a double crank whose connecting pin slides in a slot in a metal piece, which forms the middle part of the double ended piston. The crank also has fixed to it a circularly revolving valve, which regulates the admission and exhaust of the steam. The lubrication of the moving parts is effected by placing the oil in a hollow tube, which extends the length of the vertical driving shaft, and the oil thus is admitted to the inner wall of the cylinder, and to the shaft bearings. Three claims are made.—No. 376271, dated 10th January, 1888.

TREATING LOW STEEL.—*H. A. Harvey, Orange, New Jersey.*—This invention is designed for the purpose of imparting to the metal the qualities of refined crucible steel, that is, an increased tensile strength and a greater capacity for welding. The method consists of embedding the ingots of low steel in a body of granulated wood charcoal, and depositing the whole in a crucible made preferably of plumbago. The crucible is covered so as to prevent combustion, and the furnace to whose heat the crucible is subjected is raised to a temperature exceeding that of molten cast iron. The process lasts for such a time that on removal the objects of metal exhibit clean, unblistered surfaces. The inventor makes two claims.—No. 376194, dated 10th January, 1888.

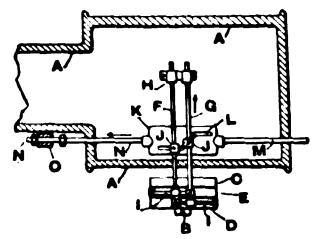
PULVERISING MACHINE.—*A. D. Searls, sen., A. D. Searls, jun., and D. C. Searls, Troy, Illinois.*—The outer case of the machine is of cylindrical form, and is mounted on a bed with the axis of the cylinder placed horizontally. A rotatable drum is disposed within, and concentrically with the outer case. On the inner peripheral surface of the drum are projections, and the radial arms of the drum are provided with lateral beaters. On the same axis is arranged a smaller cylindrical body which carries short beating arms, and the mechanism is so arranged that while the drum is rotated in one direction the short beating arms are driven in the opposite direction. This combination of beaters is designed to effect a rapid granulation of the materials. One claim is made.—No. 376112, dated 10th January, 1888.

MACHINE FOR MAKING NUTS.—*H. Harris, Reading, Pennsylvania.*—The machine is adapted for forming the nut blanks out of a continuous bar of metal. The diagrams show the essential features of the invention. Fig. 1 represents a plan of the apparatus, and Fig. 2 a sectional elevation. The frames and standards A are attached to the main frame of the machine, and carry bearings which support the rollers L M. The pinion gearing P N serves to communicate rotary motion to the shaft G, on which are fitted two bevel wheels D. These bevels gear with similar bevels J on the shafts L, which are journalled on bearings in the bed of A. On the shaft I are fixed the discs K K², and between them is the forming disc E, which has a corrugated periphery, as shown. The rollers L M are journalled



in bearings in the upright standards A, and are made adjustable by the ring M², which may be taken on or off the roller M, and by the mechanism shown at A⁷ and C. This adjustment is necessary for different thicknesses of bars of metal which are used in the process. The operation consists of introducing the bars between the rollers L M, which act as a feed, and passing them between the discs K K². The forming peripheries of E, which are placed between K K², and act in unison with each other, compress the bars into the proper form for octagonal or hexagonal nuts. The bar thus proceeds from the machine in the form shown in the diagram. The inventor makes five claims for this combination of horizontal rolls and vertical shafts carrying the forming discs.—No. 375746, dated 3rd January, 1888.

AUTOMATIC BELT SHIFTING DEVICE.—*E. R. Hyde, Springfield, Massachusetts.*—The essential features of this mechanism will be seen by reference to the accompanying diagram. The pulleys C D E are mounted on the shaft B, C and D being fast and E being loose. The belt shippers I are connected to the two shipping rods F and G, which slide in the bearings H. The guide rods M and N are fixed to the ends of the plate K and receive a longitudinal reciprocating motion from the bar O,



which is connected with one of the moving pieces. The plate K has a cam slot in it, as is shown at L in the diagram, and the pins J, mounted on the rods F G, work in the slot. The longitudinal reciprocating motion of the rods M N cause the pins J to move at right angles in the slot, and this motion is transmitted to the belt shippers I. The inventor makes one claim.—No. 375752, dated 3rd January, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE "WADDINGTON" ELECTRICAL SUBMARINE VESSEL.

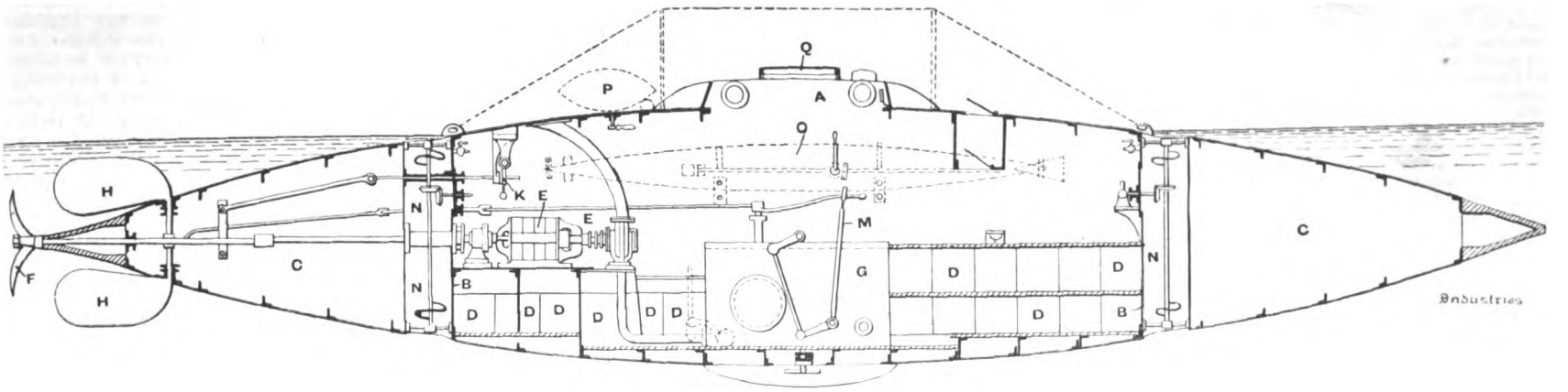


FIG. 1.—SECTIONAL ELEVATION.

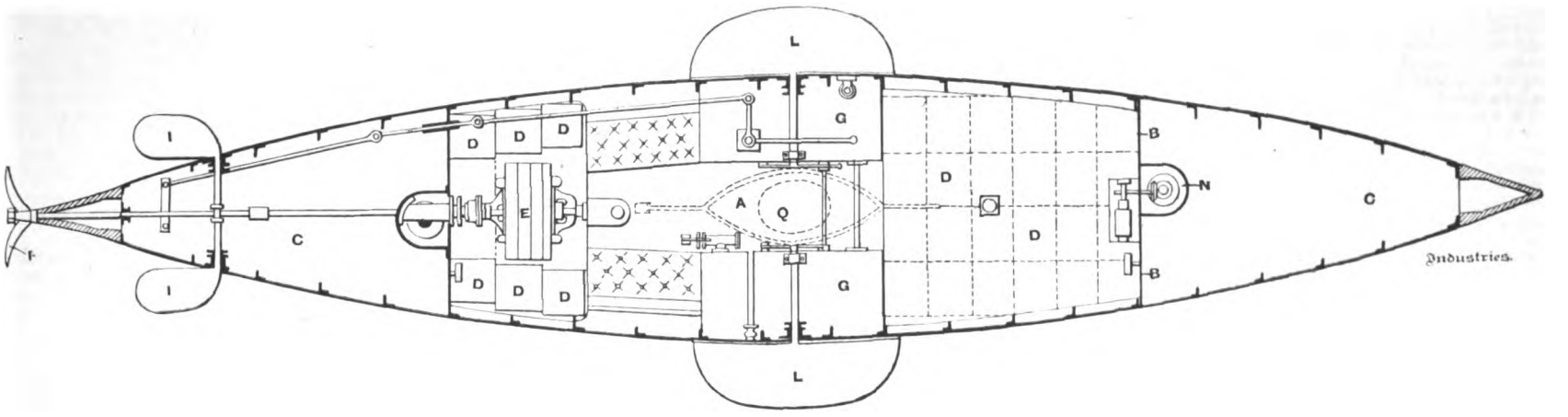


FIG. 2.—SECTIONAL PLAN.

THE "WADDINGTON" ELECTRICAL SUBMARINE VESSEL.

OUR illustrations represent a new electrical submarine vessel, designed by Mr. J. F. Waddington, of the firm of Messrs. J. F. Waddington & Co., shipbuilders and engineers, Seacombe, near Liverpool, which has recently undergone trials before representatives of the British and Foreign Governments; Count Candiani, of the Italian navy, and other gentlemen, accompanying the inventor in the vessel, below water, on various occasions. The length of this vessel is 37ft. over all, and her diameter amidships is 6ft., tapering in a curve to a point at each end. On the top of the vessel is the conning tower A, provided with ports at the sides and a water tight scuttle Q on top for entering the interior. The vessel is divided by the bulkheads B B into three compartments, of which the two end ones C C are used for storing the supply of compressed air, while the centre one is occupied by the driving, pumping, and steering apparatus. The electricity used for working the motor is stored in forty-five large accumulator cells D, which have a capacity of 660 ampère hours each, and are connected in series to an electromotor E, which drives the propeller F direct at about 750 revolutions per minute. The motor when working at full speed uses a current of about 66 ampères and 90 volts, developing 7·96 electrical horse power, which would drive the vessel for ten hours at a rate of eight miles an hour, thereby enabling the vessel to go eighty miles at full speed without replenishing the accumulators, while at half speed she would travel 110, and at slow speed 150 miles. The great advantages the inventor claims in using electricity are that when once charged the vessel is ready to start at a moment's notice; that when stopped, the motive power is not subject to waste, as in the case of steam power; and that no heat or poisonous gases are given off to pollute the air in the vessel, which is an important feature in submarine vessels; also that a small sized class of these vessels can be carried on a man-of-war's davits, ready for instant use, the same as any ordinary launch. All the levers for manœuvring the boat are arranged amidships, within easy reach of the steersman, so that he can control the movements of the vessel whilst looking out of the conning tower. A second man accompanies the steersman, to assist in case of emergency, so that the crew of the boat consists of two men only. On either side of the vessel large water ballast tanks G are provided, by filling which the buoyancy of the vessel may be reduced by several hundredweights when preparing to dive. At the after end are arranged two vertical rudders H H and two horizontal ones I I, the latter ones being used for keeping the vessel on an "even keel" when moving under water. It was found necessary to make the rudders I I act automatically, as a man might lose his presence of mind when most required. The inventor at first provided a pendulum suspended from the top of the vessel and connected to the rudders I I; but it did not answer readily enough to the action of the vessel, and he now adopts an electromotor K working into worm gearing, and arranged in such a manner that the slightest cant up or down causes the rudders to be put over to meet it, and then stop in the same manner as a steam steering gear. At each side of the vessel balanced side planes L L are provided, which may be inclined at different angles by the lever M. Close to the bulkheads at each end of the compartments C C a vertical tube, open at each end, extends right through the vessel so as to leave a clear course for the water from the vertical propellers N N, which are worked by separate motors, and may be used separately or together, as the occasion may require. At the bottom of the vessel a heavy weight is attached in such a manner that it can be released from the inside in case of an emergency, such as a sudden leak, &c. The mode of working the vessel is as follows: The water tanks G G are filled, so that only the conning tower is above water, representing only several hundredweights of buoyancy, the motor started, and a speed of say four to five miles an hour attained. Then the side planes are inclined by means of the lever M, and the vessel thereby submerged. By regulating the angle of the side planes and the speed, any reasonable depth may be maintained. If it be desirable to submerge the vessel without forward motion, only the vertical propellers are used, and any reasonable depth may be maintained by regulating their speed. These vertical propellers may also be used for regulating the depth when the vessel is moving onwards, but the side planes are considered preferable in that case. The fresh air is drawn from the two end compartments C C, and the bad air escapes through a valve as soon as the pressure inside becomes greater than that outside. But the compressed air need only be used when staying below a lengthened period, as the centre compartment contains air sufficient for two men for six hours without drawing upon the supply of compressed air. The vessel carries two locomotive torpedoes O, one on each side, secured by grips, which can be opened from the inside of the vessel. By releasing these grips the propelling motor of the torpedo is started, and it shoots ahead of the submarine vessel. A mine torpedo P is also provided for attacking any vessel at anchor with the torpedo nettings down, and which can be fired from a distance by an electric wire paid out from the submarine vessel. The dotted lines indicate portable guard rails and stanchions, which are put in place when the boat is above water—a very necessary precaution in a seaway. Mr. Waddington is still engaged in further perfecting his invention, which can be worked by compressed air as well as by electricity, and hopes at no distant date to rival the present high speed surface torpedo boats.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the ordinary meeting on Tuesday, the 7th of February, the President, Mr. Bruce, being in the chair, the paper read was on "The Alexandra Dock, Hull," by Mr. A. C. Hurtzig, M.Inst.C.E. The Alexandra Dock was commenced on the 15th of January, 1881, and was completed and opened for traffic on the 16th of July, 1885, and during this period the works were for five months practically stopped. The dock was essentially a foreshore dock, some four-fifths of the site being below the high water mark of the Humber, and a considerable portion below the low water mark, the range of tides at springs being 22½ft. The works included a dock of 46½ acres, with two miles of dock walls from 52ft. to 62ft. in height, two large graving docks, a lock 550ft. long by 85ft. wide, a river embankment 40ft. high and 6000ft. long, the dredging of an artificial channel through the Hebbles shoal, erecting pumping machinery, the construction of sheds, and various minor works. Pending the completion of the main river embankment, the north dock wall and the graving docks were carried on under the protection of temporary reclamation banks of clay, which at the more exposed places were protected by a pitched stone face. The lock, and all the works to the westward, were included within a second reclamation, consisting of a coffer dam, a portion of the main embankment, and two transverse earth embankments. These latter were constructed with much difficulty across a foreshore consisting of mud, sometimes 27ft. in thickness, and frequently the banks made no progress for days together, owing to their sinking into the mud, and to the loss by tidal wash. The coffer dam was segmental in form, 255½ft. in radius and 461ft. long, constructed of two rows of piles 6ft. apart with clay puddle between. The piles were 50ft. to 60ft. long, and were driven about 33ft. into the ground, the toes reaching down to about 54ft. below high water mark. The dam was commenced in July, 1881, and completed in June, 1882, and contained 67,702 cub. ft. of timber. The excavations reached a total of 3,350,000 cub. yards, and in the removal of this quantity five steam navvies and two hydraulic navvies were employed, as well as hydraulic cranes and jiggers, thirty-one locomotives, and 975 waggons and trucks.

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The southern portion of the dock site was covered with warp or river mud, which was stiff and sticky inshore, but softer further out; this, though drying on the surface when reclaimed, remained quite soft below for a long time. The mud varied in thickness, the greatest depth being 27ft.; and below it beds of warp, sand, gravel, clay, and peat were met with, in no definite order. The roads over this thick bed of soft mud had to be laid with two and sometimes three thicknesses of close timber and sleepers, and the passage of a locomotive over these was accompanied by a distinct undulation. A good deal of excavating was done at night by aid of electric light. The dock wall was designed to be founded 12ft. below the bottom of the dock, at which depth it was anticipated that hard clay would be found, and at the first place excavated, near the middle of the north wall, boulder clay was reached 4ft. above the required level. Proceeding eastwards, the favourable level of the clay was maintained; but westwards there was much variation, and in the last 300ft. of the western portion of the north wall the clay, after running 5ft. to 6ft. below the desired level, dipped suddenly, almost vertically; on further excavating the sand, water began to boil up all over the bottom, and the trench sides commenced to sink. A boring was put down in the trench, and it was found that an excavation 12ft. deep would have to be made to reach the clay, and to do this would have risked the collapse of the trench. Accordingly it was decided here, and for the future elsewhere, to enclose the foundations between sheet piling, tongued and grooved, and to found the walls at the designed level, unless clay could be certainly reached about 1ft. deeper. Large chalk was thrown into the enclosed space until a firm bearing was obtained, and then the concrete was deposited. The portion of the north wall on this site was finished and backed up for nearly three years before the water was let into the dock, and it showed no sign of settlement or displacement. The foundations of the lock were designed to be laid 48½ft. below high water spring tides. The side walls were built in deep trenches. In the eastern trench the clay was reached at a very suitable level; but in the western one it was 51ft. below high water spring tides. One or two slight "blows" occurred, but these were promptly dealt with in each case by placing an iron pipe in the hole, surrounding it and filling the hole with chalk rubble to the surface level of the clay, and covering with layers of Portland cement concrete in bags, upon which the foundation of the wall was laid. As the masonry was built up to near the level of the stand pipe, the water was led away from the blow holes in a horizontal pipe to a sump in the invert, thus keeping the vent open till the last moment. A far more serious "blow" occurred at the north end of this trench, and gave much trouble. The excavation over the first length at the north end was almost completed, when, without warning of any kind, the bottom of the trench suddenly began to heave, and soon water burst up in two or three places and rapidly filled up the trench, mastering the pumps. Though additional pumping power was provided, the impossibility of pumping out the water to the required level soon became apparent, not only on account of the great volume of water to be dealt with, but because of the very large amount of extremely fine silt brought up with it from below the bed of clay. This clay was thus gradually undermined, so that the sides of the timbered trench settled, and large holes appeared in the adjacent ground, forming fresh exits for the water from below, whilst the material was brought up into the trench through the main blow hole. These holes were staunched by tipping in clay puddle mixed with stable litter, straw, and bags loosely filled with Portland cement concrete. Soundings showed that the bottom of the trench was covered with a layer of silt 5½ft. thick, while a rod could be put more than 40ft. down the blow hole. The total collapse of the trench was threatened, and strong lacings were inserted, while the centre piles and struttings were partially suspended by long beams thrown across the trench. Accordingly, the pumping was reduced to the amount necessary to get in a pile foundation for the side walls at the highest possible level. The holes were filled up with chalk, and the whole area was also covered with it in order to intercept, as much as possible, the silt brought up by the water. Bearing piles were then driven between the network of temporary timbering, connected at the top by whole timber caps, on which a double thickness of elm planking was laid, forming the foundation of the inner gate recess wall and the heel post stone. The timber platform was placed as high as the level of the under side of the heel post stone, to reduce the pumping to a minimum, and thereby obviate further ill effects of the "blow." Though the difficulty was thus overcome for the time being, further trouble was anticipated at the inner gate platform, and it was proposed to excavate the foundations in small areas enclosed by half timber grooved and tongued sheeting; but after driving a short length of sheet piles, 25½ft. long, and two or three gauge piles in a longitudinal direction, some "blows" occurred at the surface, which was a little above the dock bottom, and considerable volumes of water came up. In a short time several large holes were formed, and some of the sheeting sank down and disappeared. Cast iron pipes were driven as deep as possible into the two principal springs, and in one of these the water subsequently rose 14ft. above the bottom of the dock, and remained at this level, indicating the upward pressure at this point. Clay puddle was tipped into the large holes and well trodden in, one hole alone absorbing several hundred cubic yards of puddle. The extensive area of the disturbance was manifested by the cracking and settling of the east and west dock walls at certain points, and the whole of the work at the northern end of the lock seemed in jeopardy. The continued flow of water highly charged with silt was likely to lead to further injury, whilst 14ft. of excavation remained to be accomplished for the foundations under the sill as designed. To reach the origin of the disturbance it was clearly necessary to carry the sheeting lower down; and accordingly pitch pine piles, not less than 14in. square and 50ft. long, grooved and tongued, were driven so as to enclose the principal blow holes and disturbed places, and effectually cut off the flow of water into the foundations, and the excavations were made and the foundations completed without the slightest appearance of water. The lock as finished was 550ft. long by 85ft. wide, and it had three pairs of gates, being subdivided by the middle pair into locks 325ft. and 225ft. respectively. The walls were designed to be built with rock ashlar on the face, and rubble chalk backing from the bottom of the dock up to 14ft. below the coping, and to be faced with fine ashlar above this level. A large amount was so built, but a strike of the masons whilst the work was in progress led to the substitution of 7 to 1 Portland cement concrete, faced with 5 to 1 in place of the lower ashlar and chalk. The masonry was set in lias lime hydraulic mortar, made from limestone brought from Lyme Regis and burnt upon the works. The graving docks, one 550ft. by 65ft., and the other 500ft. by 60ft., were constructed of masonry throughout. They were emptied by two centrifugal pumps of 4ft. suction. The pumps also performed a second and important duty—they were used to maintain the water level in the wet dock, and supply, as far as possible, the loss from penning. This was done by pumping from a fresh water stream, and the process was intended to obviate the necessity of dredging from the dock. The pumps could raise 14,500,000 cub. ft. of water from the stream in twenty-four hours, thus greatly benefiting the drainage of the surrounding low lying country, as well as reducing the cost of maintenance of the dock. Opposite the entrance lock, the navigable channel of the Humber, 35ft. to 40ft. deep at low water spring tides, was some 960ft. distant from the outer sill, the intervening space being the "Hebbles Shoal," consisting of hard clay and boulders. Through this shoal an artificial channel was dredged, 35 acres in extent, and the depth had been increased from between 3ft. to 6ft. down to from 12ft. to 14ft. at low water spring tides. A timber wharfing lined the sides of the trumpet entrance to the lock, and was returned for a length of 300ft. up and down the river along the Conservancy line. It was constructed in bays 10ft. apart, generally braced transversely and longitudinally, and covered with 5in. decking. The dock was well equipped with cranes, &c., and was laid out on the north side for the accommodation of the coal trade; but at present a portion only of the extensive space available was so utilised. The system of coaling was the same as that so successfully adopted at some ports in South Wales. The dock was designed and carried out by Mr. James Abernethy, Past-President Inst. C.E.

THE SCOTTISH HERRING FISHERY.

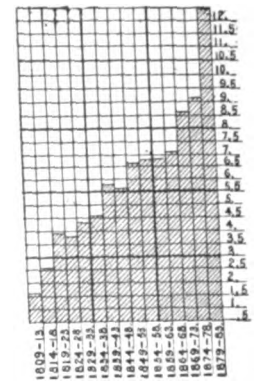
I.

The continued prosperity of the fisheries around the Scottish seaboard is to a large extent due to the fostering care of the Fishery Board for Scotland, which was constituted by Act of Parliament in 1808. By far the most important of these, from a financial point of view, is the herring fishery, which now reaches an annual value of £1,500,000, being considerably larger than the annual rental of the seven northern counties of Scotland. Long before the Board was instituted, the fisheries were prosecuted with some degree of success, but the fishing companies which were started failed to realise expectations. The Dutch continued to fish not only on their own shores, but reaped a rich harvest on the Scottish seaboard. Jealous of their rivals, the resident Scottish fishermen began to bestir themselves to take advantage of the bountiful supply within their reach, and the Legislature seconded their efforts by helping them to find the necessary fishing tackle. Certain bounties were given by the Board of Manufactures under an Act passed in 1727; but matters were put on a proper footing in 1808, when the "British White Herring Fishery Board" was constituted. The benefits conferred on the fishing community by this Act were so marked, that at a subsequent date an Act following on the same lines was passed for Ireland; but from various causes the Irish Board did not so thoroughly work out its provisions as was done in Scotland. Among other powers vested in the Board, official brands were made on all barrels of fish which came up to a particular standard of quality and cure. These brands indicated the nature of the contents, and allowed the barrels to pass from the curing yard all over the Continent direct to the consumer, without being opened. From the carefully compiled statistics of the Board we learn that in the sea fisheries of Scotland a capital of £1,795,000 is invested in boats, nets, and other gear, while partial or permanent employment is given to about 50,000 men and boys, in addition to coopers, fish curers, and others who are largely dependent on the fisheries for employment, such as boat builders, sail and net makers.

Herrings frequent the Scottish seaboard throughout the whole year, though the greatest numbers are found during the autumn months. The winter fishing also has been of late years vigorously prosecuted; no fewer than 40,000 crans having been caught off Anstruther during 1885, while 22,184 crans were captured at Wick during the months of January, February, and March, 1886, the latter quantity, when prices were low, representing a value of £11,092. It is, however, on the summer season that the fishermen chiefly depend; this is begun on the West Coast about the middle of May, and prosecuted over the whole of the Minch till July, after which the boats move round the coast to the shores of Caithness, between which and North Sunderland the industry is vigorously carried on until September.

Although there have been considerable fluctuations from year to year, the record is one of continued progress. Beginning with a cure of 89,500 barrels in 1809, the quantity rose pretty steadily till 1884, when it reached 1,697,000 barrels. At 20s. each this represents £1,697,000, and it should be noted this is for cured fish alone—immense quantities are sent off daily to be used fresh, or as kippers. The cure of 1884, which has not since been surpassed, was larger than the total of the first ten years embraced in the Board's returns. Loud complaints were made during the years 1876 and 1877 that the herring fishery was in an unsatisfactory state, and a Commission was appointed to inquire "whether any legislative regulations would tend to promote the welfare of the fishermen engaged in the herring fishery, and to increase the supply of herrings for the benefit of the public." The best answer to the alarmists is given by the above statistics; and the Commission was no doubt right in reporting that "nothing that man has yet done, and nothing that man is likely to do, has diminished, or is likely to diminish, the general stock of herrings in the sea." The progressive character of the herring fishery is perhaps best shown by the following diagram, which gives the average cure of each five years from 1809 to 1883, and in which the figures on the right represent millions of barrels:—

Average cure of herrings in Scotland during periods of five years from 1809 to 1883.



Beginning with an average cure of 104,457 barrels for the five years 1809 to 1813, the progress has been gradual as the means of capture increased, with the exception of the five years 1844 to 1848, when there was a slight decrease, till we come to the years 1879 to 1883, when the cure averaged 1,195,787 barrels, or more than elevenfold that of the first five years. We are therefore warranted in concluding that the Scottish herring industry has attained an importance which could scarcely have been expected in the initial stages of its growth, when boats were few and bounties were given. An article of diet has thus been brought within the reach of the poor, for large quantities of herrings find their way in a fresh state daily to London and other English markets, especially in the manufacturing towns of England. From some of the Scottish fishing ports there have frequently been sent off as much as 900 tons weekly to English towns during the height of the summer fishing. During the year 1885, 139,875 crans of fresh or lightly salted herrings were sold, representing a sum of £122,034; while during 1886, 129,136 crans were disposed of, the value of which is estimated at £83,417, prices being lower in the latter year than in 1885. Before the year 1833 the bulk of the cured herrings were sent to the West Indies or Ireland, but since 1847 the demand from the latter has very greatly decreased. In 1884, when the exportation had reached its highest limit, viz., 1,185,220 barrels, Ireland and places out of Europe only took 2 per cent., the remainder all going to the Continent. Only about one-third of the total cure is reserved for home consumption. It is therefore to the Continent of Europe that the fishermen must look for their markets. Here they have powerful rivals, and in some cases almost prohibitory duties to contend against. Of late years some of the fish curers have suffered heavily in the disposal of their stock, and perhaps it may yet be necessary for the fishermen in particular districts to combine and become their own curers. This they could accomplish if the scheme were fairly taken up and judiciously worked. At present the fishermen contract with the curers for a certain number of crans per season, at a fixed price per cran, with a bounty in addition. But both the fish curers and the fishermen are beginning to see that this system cannot continue, and it has been suggested that the fish as caught should be sold at the market price of the day. There is an obvious disadvantage in this, for, when there is a large fishing, the men would be entirely at the mercy of the fish curers, who might refuse to take such a quantity of fish as might be beyond their resources. A valuable fishing might thus be entirely lost, the fish either being thrown back into the sea or used as manure; and until some radical change is made in the relations of the fishermen and fish curer the present somewhat unsatisfactory state of matters must prevail. The fishing industry has attracted to it a set of hardy men who are ever ready to prosecute their arduous calling in storm and calm along a coast line which has been described as the most dangerous in Europe, and they have been able out of their savings to invest a large capital in the purchase of boats and fishing gear.

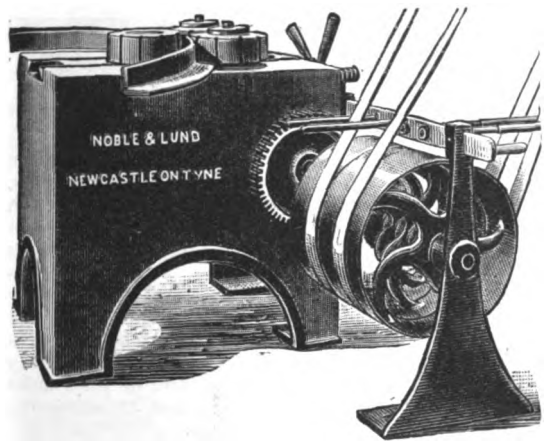
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As is well known, the herring fishery is prosecuted at night. The boats leave the harbours or fishing creeks before sunset, and make for the fishing grounds, which vary from three to 100 miles from land, the large boats now used enabling the distant fishings to be reached in good time. The most experienced fisher, when he reaches the ground, is unable to tell whether the fishing will be successful or not. One boat may have 100 crans or more, while the nearest boat may come in empty. Taking the fishing of 1886, some boats had only 50 crans for the season, while others had from 80 to 600. Fluctuations in the catch of individual boats, and in particular districts, it will readily be understood, are to be looked for. The state of the weather, the temperature of the sea, and many other circumstances come into play in the herring as in other industries. When caught and landed, the fish are without loss of time sent to the curing yards, where they are operated upon by "gutters." The gutters work with great rapidity—a gang of three women, for instance, can gut and pack during the six or seven weeks of the season 660 barrels, which means the passing through their hands of about 600,000 fish. After being properly cured in accordance with the requirements of the Board, should the fish curer desire it, on payment of a fee of 4d. the official "brand" is given to the barrels, which is simply a certificate burned on the barrels that certain conditions as to quality and cure have been complied with. There has been much controversy regarding the value of the brand, and its effect on the fishing industry. By many the operation of branding is considered an interference with trade, and it was urged that if the affixing of the brand required to be paid for it would cease to be operative. This, however, has proved to be fallacious, for, from 1859, when the fee of 4d. per barrel was imposed, instead of falling off, the brand has been in greater request than when no charge was made. The trade find it to their advantage to adopt the brand, which has yearly been used to an increasing extent. A higher price is always obtained for branded herrings than for unbranded on the Continent, as a guarantee is given for the contents of the barrels, and reliance does not require to be placed on the name which the curer may have in the market. The brand, as already stated, allows the barrels to pass unopened over the Continent, the merchants knowing well that the quality is vouched by officials who have no interest in branding herrings of inferior or doubtful quality.

(To be continued.)

IMPROVED BENDING MACHINE.

The accompanying illustration represents a bending machine constructed by Messrs. Noble & Lund, engineers and tool makers, Newcastle-on-Tyne, which is intended for bending iron or steel bars of various sections, such as angle irons, T irons, flat bars, &c., into a complete circle or part of a circle of any required diameter. The bar is passed between three rollers turned to the section of the bar operated upon, and mounted on strong spindles, which



run in bearings attached to the main frame, thereby insuring great rigidity. Each spindle is driven by a worm wheel and worm fixed inside the main framing, an arrangement which makes the machine accessible from all sides, and materially assists in preventing accidents. The worms are actuated from a shaft carrying three pulleys, as shown in the illustration. The middle pulley is keyed on to the shaft, while the other two are loose pulleys, one of which carries a crossed and the other an open belt, in the manner commonly used in planing machines. By this arrangement the machine may be instantly started, reversed, or stopped. In order to bend bars to any required diameter, one of the rollers is made adjustable by means of a screw and star handle. The machine is very compact and easily managed, and we understand that it will bend angle irons up to 3½in. by 3½in.

A NEW PNEUMATIC STONE DRESSING TOOL.

Last week we had an opportunity of inspecting a new stone dressing tool used at the works of Messrs. Farmer and Brindley, 67, Westminster Bridge Road, London, the invention of Mr. J. S. McCoy and others. The tool is a kind of rock drill in miniature, but the valve movement and internal arrangements are different. The tool consists of a gun metal cylinder in which works a loose cast iron piston. One end of the cylinder is prolonged into a nozzle through which projects a stem, into which may be inserted various forms of chisels or bits. This stem is pressed inwards by a spiral spring and receives on its inner ends the blow from the piston, which is shot backwards and forwards by air under a pressure of 40lb. per square inch. The main feature of this invention is the manner in which the air is distributed. The distributing valve is placed within the piston and with its axis at right angles to that of the piston. In the cylinder there are suitable ports by which air is admitted to one or the other end of the valve chamber, so that upon arriving at the end of its stroke the valve is shot over from one side to the other, so as to admit air through the main port to the end of the cylinder against which the piston has just arrived. We are told that in the smallest sizes the piston makes 15,000 strokes per minute, the number being ascertained by comparison with a tuning fork. There is no lubrication required for the piston, as the slight leakage which takes place between the piston and the inner surface of the cylinder practically keeps the piston floating in a thin film of air. The power required for the average size of tools which are used in stone dressing and sculpture works is about 1 h.p. per tool. In using the tool the workman supports it in his right arm and holds the front nozzle by his left hand, so as to guide the chisel or bit over the surface to be dressed. The stroke of the chisel is exceedingly short, ⅛in. or less, and as the strokes follow each other with great rapidity, the dressing of the surface is far more even than if the work were done by hand. On the back of the cylinder there is a nozzle communicating by means of an india-rubber pipe with a main supply pipe, the air being compressed by an ordinary Westinghouse reciprocating air pump. The exhaust air from the tool escapes by a hole near the back nozzle, and the tool can be stopped either by shutting off the cock on the main supply pipe or by pressing the thumb over the exhaust hole. On the occasion of our visit, the tool was shown at work on stones of various hardness, and also on wood, though we doubt that a field exists for the application of this percussive machine for working wood which can so easily be treated by rapidly revolving cutters. In all cases the work appeared to be done with great rapidity, and the dressed surface was beautifully smooth and even. The inventors also use this tool in America for caulking steam boilers and for coal getting.

EXHIBITION IN MUNICH.

An exhibition of motors and accessories for use in handicrafts is being organised in Munich by the Allgemeine Gewerbeverein of that town. It is under the patronage of Prince Luitpold of Bavaria, the Bavarian State Government, the Municipality of Munich, and the Polytechnic Society of the same town. The Exhibition will open on the 1st August, and close on the 15th October next. An international art exhibition, and a German national art exhibition will also be held this year in Munich. Thus a favourable opportunity will be given for German machine manufacturers to bring before the public their improved implements, machines, accessories, and tools. A petition has been addressed to all the German railway administrations requesting that all exhibits which remain unsold at the close of the Exhibition, should be returned to their owners without any charge being made for their carriage by the railway companies, and it is expected that this request will be granted. The construction of the exhibition buildings will be commenced on the 1st April, whilst their demolition must be completed by the 1st December. The buildings consist of two large halls in addition to various annexes. We extract the following particulars from the official programme which has been issued. The Exhibition will be supervised by the managing directors, and the site for the erection of the buildings, which is on the Isarthorplatz, has been placed at the disposal of the management by the town council of Munich. Exhibits are classed under two headings, viz.: prime movers, and machine tools and other mechanical appliances. Awards for merit will be given in the form of medals, the adjudication of which will be determined by a jury, whose formation will shortly be announced. Applications for space are to be addressed to the managing directors in Munich not later than the 1st March, and those arriving later will not be considered. A committee appointed by the management will decide as to the admission or otherwise of exhibits, and also as regards the amount of ground space to be allowed. Considering the objects of the Exhibition, heavy machinery will be entirely excluded or only accepted in the form of models. Motors exceeding 3 h.p. will as a general rule not be admitted. Persons desiring to exhibit will be informed within fourteen days after the time fixed for sending in applications as to whether their exhibits will be accepted or refused. The management consider it desirable that the performances of motors should be practically demonstrated, and trials for this purpose will be made, unless the exhibitor in his application states that he will not submit his exhibit for trial. With the exception of those articles which are manufactured in the Exhibition, and of small specialties, no exhibit will be permitted to be removed from the building without the special consent of the directors. At the same time that exhibitors receive notice that their applications for space have been granted, they will be informed how much ground space is allotted to them, the rent for which has to be paid within fourteen days after the allotment. If the payment is not duly made, or if the space granted is not occupied by the 15th July, the management reserves the right of disposing of the space as they think proper, and the exhibitor has no claim upon them. No money paid as rent will be refunded. The rent is 15s. per square metre of floor space and 10s. per square metre of wall space. Exhibits must be delivered at the Exhibition and installed at the cost of the exhibitor. The exhibits will be received before the 1st July, and the erection of working machinery must be completed by the 25th July. Special provision has been made for the transport of goods from the railway station to the exhibition buildings. Before any exhibit can be copied or photographed, the consent of the owner and directors must be obtained. The management are not responsible for any losses which may be experienced by exhibitors; but they will bear the cost of fire insurance. Exhibitors must remove their goods within eight days after the closing of the Exhibition.

RAILWAY CARRIAGE AND WAGGON WORKS.

By M. Powis Bale, M.Inst.M.E., Assoc.M.Inst.C.E.

I.

To secure in these days of excessive competition an adequate return on capital invested in wood converting works, it is necessary that such works should be very carefully arranged and managed. In arranging a saw mill, the great points to be aimed at are economy and efficiency of production. Economy in working is chiefly secured by reducing manual labour to the lowest limit by the introduction of mechanical appliances, and by having the building and its arrangements well suited to the work to be performed. In planning a railway carriage and waggon works, advantage should always be taken of the site with reference to the land or water carriage of the timber, as much money is often spent in unnecessarily hauling the timber about. The works should be so arranged that as the timber leaves the rail or water it should pass directly to the heavy machines, such as the cross-cutting machine, timber frames, or rack benches for breaking down. Its further manipulation is thus at once made easier. To illustrate this point a rough plan of a mill, designed by the author, and adapted for manufacturing railway carriages and waggons, is given (see Fig. 1). It represents a building eighty yards long by twenty yards wide. The boilers and engines, represented by 1 and 2, are arranged in a house entirely separated from the main building, and a line of rails for bringing fuel should be laid to run at the side of the boilers. The mill is divided into four sections by the rails running between them. The two sections nearest to the motive power comprise the heavy sawing machines for breaking down the logs, and sawing rough timber. These consist of cross-cut, circular, mill, and band saws. The third section includes planing, moulding, trying up, surfacing, and other machines for still further dressing and preparing the wood after it has been sawn to dimensions. The fourth section contains mortising, tenoning, scraping, sand papering, and other machines for finishing the various articles prepared in the previous sections. A sub-section may be attached to this for sawing, adzing, and boring sleepers, making treenails, compressing keys, and preparing other wood work connected with the permanent way of a railway.

It will be seen from this brief sketch that the mill is so arranged that the heavy timber enters at one end, and is gradually manipulated through the various machines till it reaches the opposite end of the building in the shape of sets of wood work for railway carriages or trucks; and mills for manufacturing any kind of wood work should be designed on this system of gradual progression. When it is once thoroughly established, and each machine has to look to another for work, a regular and economical method of manufacture is thus secured.

Sheds for storing sawn timber are not shown in the

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RAILWAY CARRIAGE AND WAGGON WORKS.

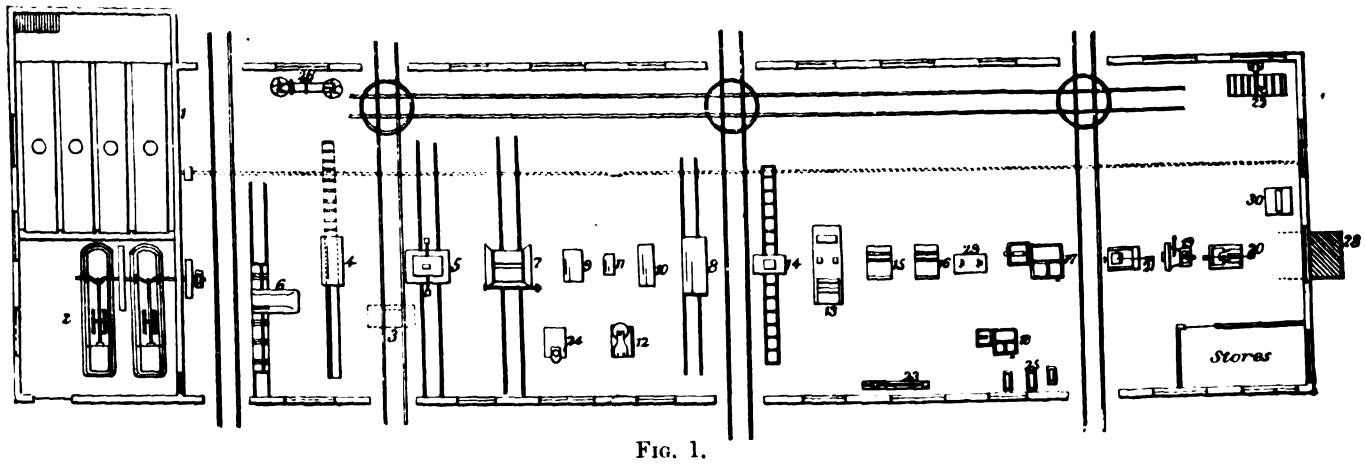


FIG. 1.

plan; but the author strongly recommends their use in preference to outdoor storing, as the wood is thus saved from unnecessary deterioration due to the action of rain, frost, or sun. In designing these sheds, care should be taken that the air is allowed to circulate freely through them. A magazine for the reception of shavings and sawdust should be attached to the mill near the boiler and engine house, which should be made as nearly fire proof as possible, and fitted with iron doors to separate them from the mill. The chimney stack base is best made of stone, laid in cement, and the engine and boiler room floors should also be cemented. All saw mill floors, whether ground or otherwise, should be of ample strength and well laid, and either a tunnel or cellar should be provided to receive the sawdust, &c., from the machines. Tramways, for bringing the wood to and from the various machines, should be laid, and an overhead traveller should traverse at least that part of the mill where the log sawing is done. Where an overhead traveller cannot be erected, Wellington travellers, running on rails and passing over each machine, are useful, as with them several logs may be lifted at the same time. Wellington travellers of about 20ft. span will usually be found sufficiently wide, and they should be fitted with both lifting and traversing gear. For fixing or turning over logs on the rack bench or saw frame, where an overhead traveller is not in use, an extremely serviceable apparatus is a travelling crab, which is usually made to run on rails attached to a beam or roof principal; the winding drum is worked by a rope, which actuates suitable worm gearing, and timber clips are attached to the end of the winding chain. Sufficient space should be left between all the machines for hand trucks to pass between them. It is important that the mill should be amply lighted both for day and night use. The electric light will, in large establishments, be found of considerable value. Should a railway run directly into the mill, it will in many cases be found advantageous in unloading the timber to have the mill floor raised a few feet above the level of the rails.

Care must be taken that the motive power is amply sufficient to drive the various machines at their full speed, as irregularity in driving through having insufficient power is detrimental to the quality of the work and output of the machines. The selection of the machinery for any particular class of manufacture is a matter of the highest importance, and, unless judiciously undertaken, the investor may find himself saddled with a lot of costly machines ill adapted to his wants. Owing to the high rate of speed it is necessary to work at, and the various strains it is subject to, first class workmanship and material is in wood working machinery more necessary than in many other kinds of machinery. In the following the author will give a few notes on what he considers the features to be desired in the construction of the various machines used in a wood works for the manufacture of railway carriages and waggons, taking the plan (Fig. 1) as a basis. No. 1 on the plan represents two pairs of Lancashire boilers, fitted with Galloway cross tubes, 35 h.p. each. The selection and proper working of a boiler must be held to be of even greater moment than the selection of the engine, and it is of the highest importance that a boiler best suited to each individual trade or manufacture should be chosen. In selecting a boiler, the chief points to be considered are what kind of water and fuel will be used; in fact, the water should in all cases be tested, and if found to contain a large percentage of sulphate of lime, or iron, or acid sulphates, no one would dream in such a case of employing a locomotive or complicated form of boiler difficult to clean, no matter what advantages may be claimed for it. In wood converting establishments, where usually large quantities of wood waste has to be burnt, Cornish or Lancashire boilers arranged with ample grate area will be found very convenient. On the plan duplicate sets of boilers are shown, an arrangement advisable in large establishments, so that in case of breakdown the whole works need not be laid idle. Each set of boilers can be used say for a month at a time, so that opportunities are given to clean or repair the boilers not in use. It will be found the best plan, unless the water is very bad, to keep the idle boilers quite full of water. Feed water heaters should be fitted, and steam pipes so arranged, that waste or other steam can be conveyed to the timber bending department, where the roofs of carriages are prepared. Steam pipes should also be laid for heating the works. Instead of slide dampers worked by hand, automatic steam worked dampers are much to be preferred, as these are entirely independent of the boiler attendant, and can be arranged to act at any desired pressure of steam, and so effect a considerable saving. Electric or other communication from the various machines to the engine room should be installed, so that the engine can be instantly stopped in case of accident.

The construction and arrangement of the main driving shafting is a factor of no little importance in economical working, but is one that as a rule does not receive the attention it deserves. Wherever the site will allow of it, the shafting should be fixed below the mill floor, as thereby the belts are out of the way, lubrication is easily seen to, and there is much less damage to the building from vibration. The shafting is best mounted in substantial standards set on brick or stone piers (Fig. 2), and so arranged that the pull of the belts is as far as possible in both directions. Steel shafting is to be preferred to iron, as it is lighter for a given amount of work, and less liable to spring. As shafting driving sawing and wood working machinery is subjected to very severe duty, and consequently to considerable and sudden strains, it is important that it should be well supported, and have a fair margin of safety. In saw mills the speed, number of pulleys, and belt tension are all considerably in excess of what is usually found in manufactories, and the shafting has to bear intermittent loads, as in the starting of heavy planing machines or rack circular saw benches. It will be found advantageous where the shafting is long to make the first length, which receives the power from the prime mover, of somewhat larger diameter than the remainder, and to place the bearings closer together. A bearing should be placed on either side of the main pulley. As regards the increase in the diameter of the first driving shaft over the following lengths, no arbitrary rule can be given; but the writer has found that if it is made about one-seventh larger than the rest, it will be amply sufficient to receive all the power transmitted. In calculating the diameter of shafting necessary to transmit a given power, it is well to err slightly on the side of strength; but care must be taken that this is not carried to excess, or considerable power may be lost daily in friction. Roughly speaking, every ton of shafting takes about 1 h.p. to move it. In erecting, the main driving shaft should be set from the driving wheel of the engine, and not from the walls of the building, as is sometimes done. Cross shafts, vertical shafts, and toothed gearing should be avoided as much as possible, as all these appliances are especially unsuited for driving high speed wood working machinery. One line of horizontal shafting should not be set vertically above another, as the driving power of the belt under these circumstances is diminished. The lengths of shafting should be arranged so that, as far as possible, the couplings should come close to the bearings. The proper distance between the bearings depends on the material of which the shaft is made, the nature of the work, the load the shaft has to carry, and the manner in which the power is taken off. A formula often used for iron shafting is as follows: $S = 4{\cdot}5\ \sqrt[3]{D^2}$ where D= diameter of shaft in inches, and S=distance of supports apart in feet; when power is taken off by pulleys between the supports, or $S = 5\ \sqrt[3]{D^2}$ when no power is taken off between the supports. In the case of saw mill shafting, the bearings, speaking generally, should be placed say 15 or 20 per cent. nearer each other than is usually done in ordinary factories. Pulleys, couplings, and toothed gearing, if used, should be placed as near the bearings as possible. All bearings should be made adjustable for wear and be arranged to pivot, as they are thus enabled to automatically adjust themselves to the exact line of the shaft in case it should be sprung or otherwise thrown out of alignment. The author, in his recent practice, has found it advantageous to considerably increase the length of bearings; the working pressure being thus distributed over a larger surface, the life of the brasses is much increased, and the amount of lubrication required is lessened. For use on saw mill shafting a bearing of three diameters in length can be recommended. All driving pulleys should combine strength with lightness, be turned true inside and out, and be perfectly in balance. As regards couplings, half lap joints with a taper of about 1in. to the foot are to be preferred to butt ends, and muff couplings to frictional or compression couplings, as

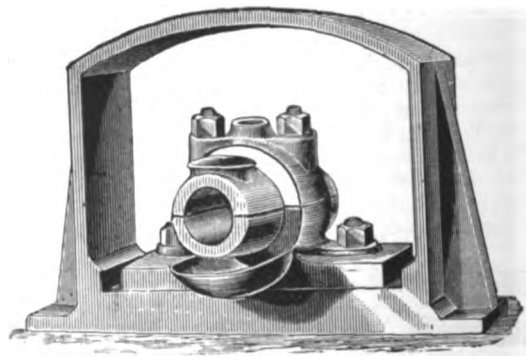


FIG. 2.

they are less liable to disarrangement. The illustration (Fig. 3) represents an improved form of muff coupling. It is made in halves, with recesses for the bolts which clamp the coupling round the shaft. This plan has the advantage of simplicity, and from the fewness of its parts it is less liable to disarrangement than some of the compression couplings in use. With the object of doing away with a number of intermediate shafts, the main shaft driving wood working machinery should be run at a tolerably high speed; 250 revolutions per minute may be accepted as a standard, and if a second or third shaft is used for driving the lighter machines, these may be speeded at 300 revolutions per minute.

In placing the various machines care must be taken that they are fixed at a dead level and on adequate foundations. The question of foundations is a factor of considerable importance in the performance of wood working machinery; more particularly that working with a reciprocating motion—such as log frames and heavy steam mortising machines. The question of getting rid of the sawdust and shavings is of some importance. If the mill is built with a tunnel or cellar the *débris* can readily be removed to a magazine near the boiler house, either by a pneumatic apparatus, by travelling bands, or even by hand. In the pneumatic apparatus the fan should be capable of creating an exhaust considerably greater than is theoretically necessary, as owing to bend friction, and in some cases back pressure, a very consider able margin is required to insure effective working. The speed of the fan should be moderate. Bends or contrac-

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RAILWAY CARRIAGE AND WAGGON WORKS.

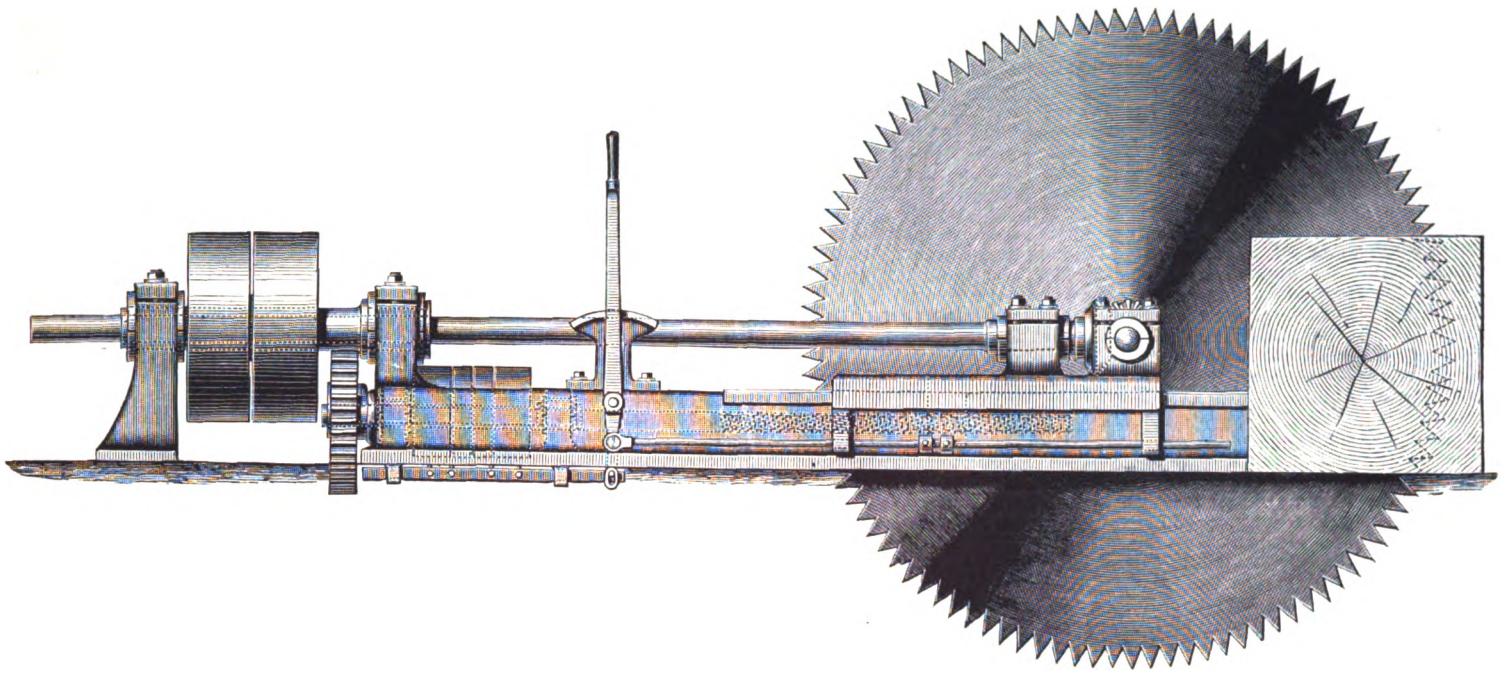


Fig. 4.

tions in the pipes should be avoided, and where necessary they should be made as gradual as possible. In joining up to the various machines care must be taken that they are tightly hooded, and in cases where cutter blocks are arranged to rise and fall they can be fitted on the telescope principle.

Returning now to the machinery shown in Fig. 1, the boilers shown at 1 are two pairs of Lancashire boilers fitted with Galloway cross tubes, 35 h.p. each; 2 is a pair of high pressure horizontal engines of 30 h.p. each; 3, circular saw cross-cutting machine (fixed below floor); 4, rack circular saw, arranged with two saws mounted one above the other, but in the same plane; 5, combined log, deal, and flitch frame, to take in logs up to 48in. diam.; 6, large band saw, with travelling table for breaking down logs, wheels 6ft. diam.; 7, horizontal single bladed saw frame, for cutting panels or crooked timber, able to take in logs 48in. diam. by 30ft. long; 8, circular saw bench arranged with roller and rope self acting feed, to carry saws up to 48in. diam.; 9, rising

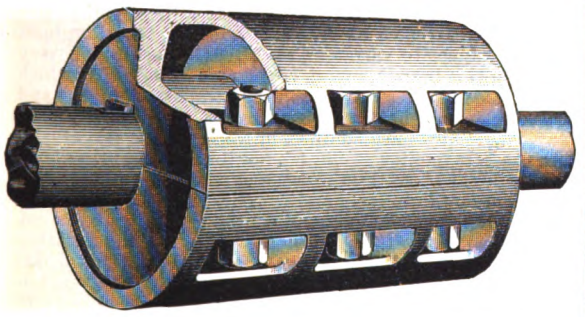


Fig. 3.

and falling spindle saw bench, to carry saws up to 36in. diam.; 10, cross-cutting circular saw bench, to carry saws up to 42in. diam.; 11, combined ripping and cross-cutting circular saw bench, to carry two saws up to 24in. diam.; 12, band saw, to cut up to 22in. deep, and having 42in. wheels; 13, four-cutter centre roller feed planing, jointing, tongueing, grooving, and moulding machine, to work wood up to 16in. wide by 6in. thick; 14, trying up and planing machine, to work up to 24in. wide by 18in. deep by 20ft. long; 15, panel planing machine, to work up to 24in. wide by 6in. thick; 16, large double tenoning and cross-cutting machine; 18, small tenoning machine; 19, slot mortising and boring machine; 20, multiple boring machine; 21, large combined steam mortising and boring machine; 22, sand papering machine; 23, large wood lathe; 24, saw sharpeners; 25, grindstones, &c.; 26, a band saw sharpening machine; 27, main shafting; 28, tunnel for shavings, running the whole length of mill; 29, double spindle irregular moulding, shaping, and recessing machine; 30, drum sand papering machine.

Additional plant for sawing sleepers and manufacturing wood work for permanent way can be fixed in a separate building or annexe. The number of machines will depend on the quantity of work required; but the plant should comprise at any rate the following: (1) Engine and boiler; (2) endless chain feed saw bench for sawing sleepers; (3) sleeper adzing and boring machine; (4) key shaping and compressing machine; (5) circular saw bench to carry saws up to 30in. diam.; (6) axe, hammer handle, and spoke dressing machine; (7) treenail turning machine; (8) horizontal slot mortising machine for fencing. When heavy timber is brought into the works, it first of all passes either to No. 3, the circular cross-cutting machine, No. 4, the rack circular saw bench, No. 5, the log and flitch frame, No. 6, band sawing machine for cutting logs, or No. 7, horizontal single bladed frame for cutting panels. If the log is of too great a length for readily converting, it is placed in any desired position on the floor over No. 3, the circular cross-cutting machine. This being set in motion, the saw rises above the floor line, and cross-cuts the log as it lies, thus at once rendering it more portable for further manipulation. To do rapid and effective work with this machine, it is important that the saw is run at the proper speed, and the teeth are kept very true and sharp. The duty of this saw—which severs or cuts the fibres of the wood crosswise—is much more severe than in an ordinary ripping saw, which cuts with the grain, the work of this latter being more of a dividing or splitting action. With woods up to a moderate degree of hardness, a speed of 10,000ft. per minute at the periphery of the saw will be found suitable. With hard woods this will require reducing. The teeth usually employed for cross-cutting purposes are known as dog, fleam, and lancet teeth. The dog tooth is illustrated in Fig. 4; it is placed perfectly upright, and the points and spaces should be the same angle, viz., 60°. This illustration represents a cross-cut circular sawing machine from the designs of Messrs. John McDowall & Sons, of Johnstone, near Glasgow. It is adapted for cross-cutting logs and trees, and consists of a strong cast iron bed, upon which is mounted a sliding carriage carrying the saw spindle. The carriage is traversed by a screw feed, actuated by toothed gearing and a set of pulleys, which receive motion from the main shaft. Motion is given to the saw spindle by means of a longitudinal shaft and pair of mitre wheels. This shaft is also driven from the main mill shaft. Another form of cross-cutting machine occasionally used consists of a straight saw, to which a horizontal reciprocating motion is given by means of a steam cylinder and piston. If it is required to cut the log into scantling, soles, buffer beams, &c., it is at once passed to the rack and other circular saw benches. Before pursuing its course further, it may be as well now to briefly consider the points of construction to be desired in the various machines, commencing with No. 4, and including the various circular saw benches. In these machines, in all cases, the main frame should be made on the "box" system, and cast in one piece. This system without doubt more readily absorbs the strains and vibrations of working than is the case when the frame is put together in sections. The face and edges of the bench should be planed. The bearings should be of ample length—at least three diameters—as the pressure and strains put upon them in working are very considerable. In all saws above 30in. diam., three bearings should be provided, one of these being placed outside the driving pulleys, to withstand the pull of the belt. In large benches, it will be found convenient to let the bearings in from the top of the bench, and fit in false plates, in preference to bolting them to the under surface of the frame. The bearings should be bored out in their places, and be made adjustable for wear. The saw spindle should be of steel, and free from seams and hard places, and fitted with a lock nut to take up end wear. The saw collars and steady pin should be very carefully made, and the latter be an easy fit, or it may throw the saw slightly out of truth. The hole in which the pin is fitted should be countersunk. The fence should be very accurately planed, arranged to bevel, and fitted with strips and fine adjustment screw, for accurately gauging the thickness of the cut. Important factors in satisfactorily working circular saw benches are the diameter and width of the pulleys employed. Many of these are undoubtedly made of too small a diameter, and too narrow on the face for the power they have to transmit, the result being over-strained and slipping belts, with rapid deterioration of bearings. The table of rack circular saw benches should be fitted with adjustable head blocks, simultaneously worked by a lever, and by means of a graduated scale any desired thickness of cut may be readily taken. By this arrangement of head blocks the timber is kept steadier, whilst under the action of the saw, than is the case with the ordinary plain table. The ordinary forms of saw benches do not require any particular notice till we come to No. 11, a combined ripping and cross-cutting circular saw bench. This machine is arranged with two saws—one for ripping and one for cross-cutting—mounted in a revolving frame. This frame is moved by means of worm gearing, worked by a hand wheel, and either saw is raised above or depressed below the table as required, the saw below the table being thrown out of motion. The fence should be arranged to bevel to an angle of 45°, and sliding plates for cross-cutting, mitreing, &c., fitted into the top of the table. This bench will be found extremely useful where there are frequent changes in the work, such as in interior carriage work, joinery, &c. It need hardly be said that the quantity and quality of work, and the power required to produce it, depend largely on the selection of the saws, and working them in what may be termed a scientific manner. For ripping purposes circular saws should have a speed of 9000ft. per minute at the periphery, and for cross-cutting about 10,000ft. It is very important also that the teeth of the saws be of the correct shape for the nature of the wood, and be equal in pitch, space, bevel, gullet, length, and set. There is an immense variety of saw teeth in use, but within the scope of these articles it is impossible to go into the question fully.

(To be continued.)

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 14TH FEBRUARY, 1888.

THE IRON MARKET.—In its general situation, the iron trade has undergone further improvement. The failure of the negotiations over the renewal of the treaty with Italy has operated to depress the market; but, on the other hand, the more peaceful aspect of political affairs has acted as a stimulant. Consumers have made up their minds that prices must rise to a higher level, and they accordingly buy freely. Hence arises the activity which now characterises the business in iron, and which seems likely to continue, for besides a general revival of trade to maintain the demand, there is the prospect of an immediate resumption of building operations to quicken the trade in joists. The Paris market is animated and buoyant. The merchants are firm in their demands, their rates for bars being £5. 16s., and for joists £5. 8s. per ton. Old rails sell readily at £3. 4s. The practice, extensively indulged in by some manufacturers, of dealing directly with the consumer, gives occasion to many bitter complaints on the part of the merchants. Common plates have advanced 4s. a ton, making the present rates £7. 8s. Reports from the provinces indicate a steady improvement all round. In the Loire district, better prices are now obtained for finished iron. In the Haute-Marne, wire and wire nails are in strong demand. Chains have advanced from 1s. to 2s. a ton. Foundries are everywhere busy, and in some places are asking 4s. a ton more for castings.

THE ASSOCIATION OF FRENCH INDUSTRY.—The annual meeting of the Association of French Industry was held here last week, under the presidency of Senator Noblot. The meeting was largely attended, and some important resolutions were unanimously passed, among which the following will excite interest abroad: (1) That the State shall publish a list of all contracts made abroad, with the reasons which led to their being entered into. (2) That with a view to advance the export trade, a more judicious choice of men be for the future made to fill the post of consul. (3) That the system of temporary admission of raw and half wrought materials be regulated by law; and (4) that the railway tariffs be revised with a view to the abolition of preferential rates. The last is aimed at the import trade in English coal, which benefits by these rates.

THE SUGAR BOUNTIES QUESTION.—From trustworthy information just received, I judge that the anticipations indulged in on your side of the Channel, concerning the success of the project which forms the object of the mission of Baron Henry de Worms, are ill founded. In so far as the adhesion of France is concerned, the scheme is to be regarded as having failed. The Government dare not risk its popularity by running counter to the strong feeling against the measure which is manifesting itself among the manufacturers and the agriculturists. Letters from Berlin lead me to believe that a similar feeling exists in Germany.

AGRICULTURAL EXHIBITION IN PARIS.—The annual agricultural exhibition was held here at the beginning of the month, under the management of M. Menault. The number of exhibits was large notwithstanding the unfavourable season for a show of this character. There was a large display of agricultural machinery and a fair show of apparatus used in distilleries and dairies. The French colonies were well represented, a large number of exhibits having been sent from Algeria. Rice, tobacco, and corn from Cochin-China, Tonkin, and Annam, and sugar and rum from Réunion, Sénégal, and Guadaloupe were also exhibited. The attendance of visitors was good.

THE ELECTRICAL LABORATORY.—The inauguration of this establishment, regarding which some particulars were given in *Industries*, Vol. IV., page 91, took place on Friday last.

NEW SYSTEM OF RAILWAY CHARGES.—An agitation has been set on foot to obtain a reduction of the railway charges for commercial travellers. It is supported by some of the most influential representatives of French industry, and has been taken up by M. Dutrèsme, the Minister of Commerce, who proposes to meet the requirements of the class affected by a system of travelling cheque books, to be used in the following manner. The system is to be made applicable to all the lines in the country, and cheque books will be issued representing a certain sum per kilometre, which sum diminishes as the distance increases. A traveller buys, for example, a book of 25,000 kilometres journey. Desiring to travel from Paris, say to Lyons, he tears out one of the cheque forms and fills in the names of the stations of departure and arrival with the number of kilometres between them. He delivers this cheque to the ticket clerk, who then issues to him a ticket at the reduced rate indicated on the cheque. The tickets being paid for beforehand by purchasing the cheque book, no money passes in this transaction.

BERLIN, 13TH FEBRUARY, 1888.

THE COAL MARKET.—The firm tendency which the coal market assumed at the beginning of the year, continues to be maintained. The union of the owners of collieries producing gas coal has been prolonged to the end of the year, and at the next general assembly the question of an increase in prices will be settled. Meanwhile there is an increase in the price of coke, and every prospect of a steady trade.

THE IRON MARKET.—In the Upper Silesian district the demand for forge pig is so brisk that some furnaces are completely sold out, and have great difficulty in keeping pace with their orders. This fact is the more remarkable as nearly the whole of the production of crude iron is consumed at home. A year ago the owners of the Silesian blast furnaces had so poor an opinion of the buying capacity of the home market, that they considered the prospective decrease in their export trade an irreparable loss. The decrease was principally due to the new import tariff imposed by Russia, and has amounted during 1887 to something like 75,000 tons. Now, however, they see that their anticipations are not realised, and although the export trade has been practically abolished, the home consumption has more than made up for this loss. The increase in the demand for pig iron is partly due to the greater requirements of steel works both for the Thomas and Bessemer processes; but the principal reason is the larger demand for rolled iron. The consumption of foundry pig has not materially altered since the end of last year. The Silesian foundries making enamelled and plain ware are now erecting a common sales bureau in Gleiwitz, the organisation being on the same lines as that of the Silesian rolling mills. Tenders were recently issued by the Breslau railway management for the supply of railway tyres, and the successful firms were the following: Messrs. Borsig, 2092 waggon tyres of ingot steel, at 210s. per ton; the Laurahütte, 346 tender tyres at the same price; the Oberbilker Steel Works, 714 locomotive steel tyres of crucible steel at 225s. per ton; and the Bochum Union, sixty locomotive wheel tyres of specially selected crucible steel at 385s. per ton.

GERMAN SUGAR ABROAD.—The export sugar trade is steadily progressing, and promises soon to recover the position reached in 1884. The total exports in 1887 amounted to 12,389,238cwt., an increase of 9 per cent. on those of 1886; or an increase of 17 per cent. on those of 1885. The quantity exported in 1884exceeded 12,750,000cwt. Great Britain was last year a much larger purchaser of German sugar than in 1886. As far as can be judged at the present moment the beet harvest of 1888 promises well, and the area under beet cultivation is this year considerably greater than it was in 1887. The ruling price for contracts between the sugar factories and the farmers is now about 10s. per ton for the next harvest, and 9s. will probably be the minimum even if the harvest should prove very abundant.

TEXTILES.—Reports to hand from various centres of the weaving industry describe the position of trade as fairly satisfactory. The prices obtainable in the export trade, both in woollen and in cotton goods, are yet very low, but as the goods are mostly of inferior quality no great improvement in prices can be expected. On the other hand, however, there is a distinct improvement of prices in the home market, where the better qualities of piece goods are in strong demand, indicating the greater purchasing power of the population, which is the result of the general improvement in trade. Good orders are to hand for the spring season, especially in flannels and shirtings. The export of cloth to Italy is, however, decreasing, on account of competition from England.

THE BOILER EXPLOSION AT THE FRIEDENSHÜTTE.—As already mentioned in one of my previous letters, the Verein Deutscher Eisenhüttenleute are taking an energetic action against the attempt of boiler insurance companies to bring about an alteration in the law with regard to steam boilers fired by blast furnace gases. A few days ago the Society held a general meeting, and during the discussion on the causes of the boiler explosion it was conclusively shown by the engineer who was in charge of the works at the time, and who made a careful investigation of the boilers immediately after the explosion, that the latter was simply due to the mechanical weakness of the boilers. The plates were manufactured in 1872, that is to say, at a period when no proper and reliable tests were made before using the material. The theory that the accident was due to an explosion of blast furnace gases underneath the boilers was unanimously rejected by the Society.

VIENNA, 13TH FEBRUARY, 1888.

THE IRON MARKET.—The long expected rise in the iron market has at last taken place, and in sympathy with the better condition of trade in Germany, the prices of finished iron are advancing in Austria. The first to advance were sheets, which since the beginning of the month rose 8s. per ton. The crude iron market, however, is still depressed. Engineering shops are on the whole well employed, and as regards boiler makers and manufacturers of machine tools, work is abundant. The influence of speculation in the metal market is beginning to subside. There has been a slight rise in the price of copper, whilst tin remains firm. The prices for zinc and lead have not changed, and there is every prospect of a steady trade, provided there are no political complications to interfere with it.

TEXTILES.—Owing to the continued and strong demand for woollen piece goods of all kinds, the Moravian cloth mills are running full time, and have plenty of orders in hand for forward delivery. In yarns the markets are exceptionally firm, and unbleached cotton piece goods are accordingly advancing. As only small quantities of bleached cotton goods are imported, the quotations are also high. The market for raw silk is equally firm.

ELECTRIC LIGHTING.—The motive power required for the Jubilee Exhibition was at first estimated at 450 h.p., afterwards at 600 h.p., and now it is reckoned that it will reach 1000 h.p. The lighting of the fountains, which it is proposed to effect in the same manner as at the exhibitions in London and Manchester, has not been included in this estimate. The number of applications from persons wishing to exhibit is considerably higher than was anticipated. The Town Council of Stockerau are at present divided in opinion as to the advisability of using gas or the electric light. Sixteen councillors are in favour of the adoption of gas, and twelve advocate the employment of electricity. It has been decided to adopt gas for lighting purposes; but the necessary money for the carrying out of the project has not been granted, since the consent of more than sixteen councillors must be obtained before the money can be spent. The partisans of electricity still hope to prevail on the majority, so that the electric light may be eventually installed. In some spinning mills in the Erzgebirge the electric light has been installed. On winter mornings artificial light has to be used till 10 a.m., and in the afternoon from about 3-30 p.m. The glow lamp installation in the Court Theatre is progressing but slowly, and is not expected to be finished before the autumn. The Houses of Parliament are also to receive an electric light installation; the lighting will, however, be restricted to the legislative chambers and lobbies, the private rooms remaining lit by gas as heretofore.

STORAGE BATTERIES.—A series of experiments is now in progress at the Electro-technical Institute of this town for determining the comparative merits of the accumulators devised by Julien, Reckenzaun, and Scheneck-Farbaki. The last named cells are manufactured in Baumgarten, a suburb of Vienna, under royalty of the Electrical Power Storage Company. The local representatives of this company are Kremenesky, Mayer, & Co. In the Court Theatre scene painting is now done by electric light in order to insure the artistic effect of the colours. The current is supplied by Scheneck-Farbaki accumulators, which up to the present have proved very satisfactory.

BRUSSELS, 14TH FEBRUARY, 1888.

THE COAL MARKET.—Owing to the cold weather, large orders for household coal are being given, and as a number of blast furnaces in Belgium and Luxembourg have been blown in, coal for industrial purposes continues firm. The canals being closed by ice, it is now necessary to send coal by rail, and the old complaint as to scarcity of waggons has in consequence been revived. The competition of Belgian coal in the Mulhouse market has caused German colliery owners to demand a reduction in their railway rates, but the Belgian railways have met this move by a corresponding reduction. There is a good demand for small coking coal, coke, and briquettes.

THE METAL MARKET.—There is a still a good demand for iron, especially for girders and sheets. M. Eiffel has ordered 4000 tons of girders and sheets for Panama from La Providence works of Haumont, and it is stated that further orders for 3000 and 5000 tons offered to Belgian works have been declined, owing to the stipulated time of delivery being too short. The following orders were obtained at the adjudication of the last State railway contracts: Rolin, six third class carriages at £4,795; Verhaegen, twelve carriages of different classes at £4,781; Malines, six third class carriages at £4,795; Dyle Bacalan, twelve carriages of different classes at £4,785, and twelve composite carriages at £7,344; and La Métallurgique, twelve composite carriages at £7,164. Business is very active in this branch, owing to the number of orders which have been recently given out, and carriage builders and those who supply the material are consequently well employed. Ordinary qualities of forge pig are sold at 36s., and the best quality at 43s. 3d. per ton. These prices have been brought about by the large demand of rolling mills, and by orders from Italy and America, which have greatly reduced the stocks of pig, and caused the prices to be out of harmony with those of finished iron. This situation will, however, be altered by the increased supply of 300 tons daily, which is due to the Couillet, the Sclessin, the De Hourpes, and the D'Aloy furnaces having been just put into blast. There are throughout Belgium fifty blast furnaces, of which twenty-nine are at present at work. Of the latter, eighteen make forge pig, four foundry pig, and seven pig for conversion into steel. The daily production of forge pig is 1510 tons. At the general meeting of the Association of Bolt Makers it has been decided, in consequence of the improved condition of industry, to raise the prices of bolts.

ELECTRIC LIGHTING.—The Société Phœnix (Edison) have installed the electric light in the Ghent theatre. In addition to the arc lamps for special stage effects, there are 200 glow lamps of 10 c.p. and 140 of 20 c.p. All the lamps are of 63 volts, those of 10 c.p. requiring ½ ampère and those of 20 c.p. 1 ampère. They are all in parallel. The glow lights on the stage can be regulated, by the insertion of resistances, from dull red to a bright light in ten steps. A novelty is the employment of arc lamps instead of magnesium or lime light. When only used for a short time hand fed arc lamps are employed, but when required for a longer time the lamps are self feeding. An Edison dynamo of 70 volts and 300 ampères, running at 700 revolutions per minute, is employed. It is driven by a 45 h.p. Hertay engine working at 78 revolutions per minute. The lighting of the Molière Theatre, in this town, by the Thomson-Houston Company, has proved a great success, and the installation, which was put up under the charge of M. Admirally, the engineer of the company, is of such a

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simple and economical character, as to compare favourably in cost with gas. The central electrolier in the auditorium is composed of an arc lamp of 1000 c.p., and a number of incandescent lamps of 65 c.p., which produces a very peculiar effect. Electric lighting has been introduced in the town of Mende, the generating station being placed in the cellars of the town hall.

Public Tenders.—The present manner in which State payments for contracts are made in Belgium is faulty, because settlement of accounts is often delayed for unreasonable periods. Contractors contend that if payments were always made at stated times, and if they had not to give long credit, the number of tenders would increase, and contract prices would be more moderate. M. A. Legrand, a manufacturer at Mons, has just addressed a petition to the members of the Chamber of Representatives, with a view to bring about certain reforms in the law regarding State payments, which would increase the resources of the budget. His proposal is to the effect that accounts against the State should be paid thirty days from the end of the month of delivery, with a deduction of 2 per cent. as a cash discount, and the sum thus saved by the Treasury is estimated at £80,000 per annum. This measure, if adopted, would enable small manufacturers to participate in State contracts, from which they are at present excluded in consequence of the long credit required.

DÜSSELDORF, 13th February, 1888.

The Iron Market.—The iron market is still vigorous, and consumers manifest a greater desire to buy. Political influences have had a marked effect upon business. The uncertainty which existed a fortnight ago retarded the course of affairs; but, since Prince Bismarck's speech cleared the horizon, the tone of the market has improved, and the current of business flows more freely. The strengthening of the army by the addition of 700,000 men has had a stimulating effect, for the measure will occasion the spending of not less than half a million sterling in some branches of the iron trade within the next two years. This circumstance has, for the moment, diverted men's minds from the evil effect of the current high rates on the export trade, and further advances are expected again. Manufacturers of finished iron and steel, most of whom have sufficient work in hand to keep them occupied till the end of May, are reluctant to enter into fresh contracts at present prices. In view of increasing business, they are seeking to buy pig iron for delivery in June. Hence the pig iron market has grown more active. The demand is strong for all sorts. Spiegel of 10 to 12 per cent. manganese is being freely bought at 59s.; and forge is in strong request at 53s. The blast furnace owners have now sold practically the whole of their make in the first half of the current year. Bessemer and basic steel pig are in brisk demand, but the latter is most sought after. The price is now 45s. to 45s. 6d.; Bessemer fetches about 53s. 6d. The situation is good for finished iron and steel. There is considerable activity in bars on home account, but the demand is not so strong as it was a few weeks ago. It is expected that the price will shortly be again advanced. The plate syndicate has decided on a rise of 5s. a ton in boiler and common plates, in which a very active business is being done. Sheets are less inquired after, but the demand for this class of iron is never very strong at this season of the year. Wire remains dull. The new syndicate has fixed the price of wire nails at £8. 5s. a ton.

The Wire Nail Industry.—The German wire nail industry, now brought into prominence by the syndicate, is of considerable magnitude. The works are numerous, and range in capacity from 150 tons to 14,000 tons a year. The total production exceeds that of all the rest of the world together. Assured of the home market by the protective duties imposed on foreign goods, German manufacturers have been able, thanks to cheap production, to give a good account of themselves abroad. The quantity exported in 1887 amounted to 41,303 tons, against 39,673 tons in 1886, 38,762 tons in 1885, and 38,619 tons in 1884.

The Export Trade of 1887.—German manufacturers continue to make headway against the keen competition which is encountered in most of the foreign markets, and the Customs returns for 1887 afford much encouragement. From these it appears that our foreign trade has expanded in the most desirable directions, and that the degree of expansion is in many cases large. The exports show, relatively to 1886, an increase for coal, iron, textile goods (notably cotton fabrics), glass and glass ware, paper and pulp goods, chemicals, and sugar. Machines of all kinds also show a large increase; even in sewing machines, concerning the trade in which there were so many complaints throughout the year, we see an augmentation from 6899 tons to 7347 tons. There is a slight falling off observable in the case of locomotives and portable engines.

LILLE, 14th February, 1888.

Textile Manufactures.—The general situation of the linen trade steadily improves. Last week was a period of considerable activity, woven goods having been largely bought, and stocks are now being rapidly reduced. The imports of linen cloth into the Lille district, in the month of January, amounted to 4055 kilo., and the exports to 4762 kilo.; against 7263 kilo. and 7479 kilo. respectively, in the same month of 1886. The cotton goods trade, which for a long time past has been in a depressed state, is reviving. There is a steadily growing demand for woven goods. The woollen trade is also recovering from the extraordinary fluctuations of last year. After a rise of 0·5fr. per kilo., prices are now firm at about 1fr. above the lowest rate of 1886, and 1fr. below the average of the last ten years. Thus the present situation is to be regarded as strong. Some thousands of bales of wool were bought at the London auctions last week for Roubaix-Tourcoing and Reims, chiefly the latter district, at prices from 5 to 10 per cent. above those of the last preceding sales. There is a fair inquiry for combed wool at 5fr. to 5·25fr. per kilo. for South American, and 5·75fr. to 6fr. for Australian. Cloth is steady, but the market is not animated.

Flax and Yarn Markets.—Business continues active in home grown flax, and prices remain in favour of sellers. Larger dealings have taken place in Russian flax, but prices exhibit a tendency to weakness on account of a lower rate of exchange. In yarns business has fallen off somewhat, weavers having bought much for forward delivery. Prices remain unaltered. The market is still active for jute yarns. The statistics of trade for the month of January show the quantities of raw or half manufactured textile goods imported into the Lille district, and exported therefrom, to be as follows, the quantities in brackets being those of last year: Imports of raw and scutched flax, 6,297,704 (4,609,037) kilo.; of tows, 563,361 (505,687) kilo.; of linen yarns, 109,247 (104,643) kilo.; exports of raw and scutched flax, 605,678 (251,447) kilo.; of tows, 623,443 (898,541) kilo.; of linen yarns, 149,980 (100,481) kilo.; of tow yarns, 69,554 (23,205) kilo.; and jute yarns, 7757 (3734) kilo.

The Iron Market.—Activity now forms a conspicuous feature of the iron market of this locality. Perfect unanimity prevails among the manufacturers, and the firmness of the prices of finished iron and steel resulting therefrom serves as a stimulant to consumers, who hasten to buy in anticipation of a further advance. The orders received exceed for the moment the capacity of the works, so that for some months to come there is a certainty of full employment for all. The more peaceable aspect of political affairs has had a very favourable effect upon the iron markets.

The Harmel Wool Cleaning Machine.—The Civil Tribunal of Lille has delivered final judgment in this important patent case (see *Industries*, Vol. III., page 681), and have declared, contrary to the reports of the experts, in favour of the holders of the patents, Jonathan Holden and M. Harmel. The infringers, Isaac Holden & Sons, are condemned to pay costs and damages; to give up the seventy-two machines seized at their works; and to publish the decision of the Court in five different newspapers, to be selected by the prosecutors. Thus the rights of Offermann & Harmel in this valuable machine are upheld, and there is no longer a prospect of its becoming public property before the expiration of the time the patents have yet to run.

AMSTERDAM, 14th February, 1888.

German Basalt in Holland.—The owners of German basalt quarries in the Rhine provinces are complaining of the policy of the Dutch Government, who seem determined to exclude German basalt as much as possible. Formerly this stone was much used in constructing quay walls and other works; but latterly the Dutch authorities are giving preference to the indigenous stones, and exclude German basalt from all tenders for public works on Government account. This line of action appears to be the direct consequence of the agitation got up some time ago amongst the owners of quarries and brickfields in Holland, who petitioned the States-General against the intrusion of foreign stone, where "Dutch stone would do equally well." The wisdom of the new policy of our Government officials seems doubtful. In the first place, it is well known that basalt cannot in all cases be advantageously discarded, least of all where durability is the primary condition. Besides, many basalt quarries in the Linz district and elsewhere along the Rhine belong to Dutchmen. Moreover, the Germans are now beginning to threaten retaliation, and they propose to levy an import duty on Dutch tiles, which at present, with the exception of glazed tiles, are allowed to enter duty free.

The Paris Exhibition.—At a numerously attended meeting, held in Amsterdam, it was resolved to form a society to assist intending Dutch exhibitors in every practicable way, and to advertise the advantages of this Exhibition among our manufacturers generally, so as to induce them to participate. Of course, money will be required to do this, and it is therefore proposed to start a guarantee fund. It was announced by the chairman at the last gathering that the French Government will reserve a space of 950 sq. m. for Dutch exhibits.

MADRID, 13th February, 1888.

Electric Lighting at Pamplena.—The municipality of this town invites tenders for supplying electric light for the public thoroughfares, and offers to place at the disposal of the contractor two turbines of 120 h.p. each for driving the dynamos. The turbines are situated at a distance of about half a mile from the town.

A Concession for Water Power.—A concession has been given to Señor Faura, an enterprising contractor for public works, to utilise a fall of water of the river Manzanares, at a distance of sixteen miles from Madrid. The head of water will be 90m. deep, and the quantity sufficient in any season of the year for 1000 h.p., whilst during nine months it can furnish 3000 h.p. The time allowed to carry out the works is nine years, so that the concessionaire will have plenty of time to finance his scheme.

NEW YORK, 4th February, 1888.

The Iron Market.—During the last week there has been a decided improvement in the outlook for iron, but prices remain about the same. Quotations now are 87s. 6d. to 89s. 6d. per ton for No. 1 foundry, 79s. for No. 2, and 71s. to 73s. for grey forge. The demand for bar iron is large and likely to be maintained, as a great deal of work is being contracted for in which bars will be required. Some of the long delayed orders for steel rails have now been placed, including nearly 50,000 tons for the Pennsylvania Railroad Company, and 20,000 tons for the Chicago, Burlington, and Quincy Road. The fact of these companies having placed their orders, the Pennsylvania at 131s. per ton, and the Chicago, Burlington, and Quincy at 133s., will at once bring in a number of smaller orders which have been held back under the idea that they might perhaps be placed at lower figures. The chances appear to be in favour of better prices from now until summer.

The Metal Markets.—The copper market has been active. The statement that the Tamarack Company had sold its entire output for three years at 13c. per lb. plus one-half the advance over that figure, caused considerable activity and increase of price. Sales to about 1,000,000lb. took place at 15·90c. to 15·95c. per lb. for spot, and 16·05c. to 16·10c. for delivery at end of month. The tin market has been steady but dull, prices being from 34c. to 34·10c. per lb. for March, and 33·25c. to 33·30c. for April. In lead there has been speculative buying, amounting to about 1000 tons, at prices ranging from 4·90c. to 5c. per lb. The spelter trade remains about as before, prices being from 5¼c. to 5⅜c. per lb. for Western, with very little available at the lower figures. The tendency is slightly upwards.

The Coal Market.—The condition of affairs among the Reading coal miners is unchanged. Most of the anthracite coal now in the market comes from the Wyoming region. Since the beginning of the year about 100,000 tons more have been mined than during the same period last year.

Railways.—The committee of general passenger agents of the trunk lines have arranged a system of through checks for baggage from New York to San Francisco. These checks will be given for baggage not exceeding the 150lb. allowed free on each first class ticket, but baggage above this weight will have to be re-checked at Missouri River Points as before. In the course of a paper read before the New York Railroad Club, by Mr. George Westinghouse, on continuous brakes on freight cars, it was stated that the adoption of air brakes on all the goods trucks in this country was merely a question of time.

PHILADELPHIA, 4th February, 1888.

Car Building.—Business generally in the car building line is good, and there is every indication that an exceptionally large number of cars will be built in this country this year. It is estimated that there will be required during 1888 not less than 200,000 cars. As about 400,000 tons of bar iron, and about 600,000 tons of cast iron will be required for these, the demand for manufactured iron for this purpose alone will be very great.

Cast Steel Guns.—Steel makers have been much interested in the casting of a steel gun for the Government at the Pittsburg Steel Casting Works. The casting on being taken from the pit was found to be perfect, as far as a superficial examination could determine. In casting it, 8¼ tons of special Bessemer steel were used, and when finished the piece will weigh 5½ tons. It will be 22ft. long, 6in. bore, and the outside diameter will vary from 23in. to 10in. The satisfactory castings that have already been made by the firm, the high tensile strength and ductility obtained, make it very likely that, if no defects are found in the casting on finishing it, it will stand the tests which it has to undergo before being accepted by the Government.

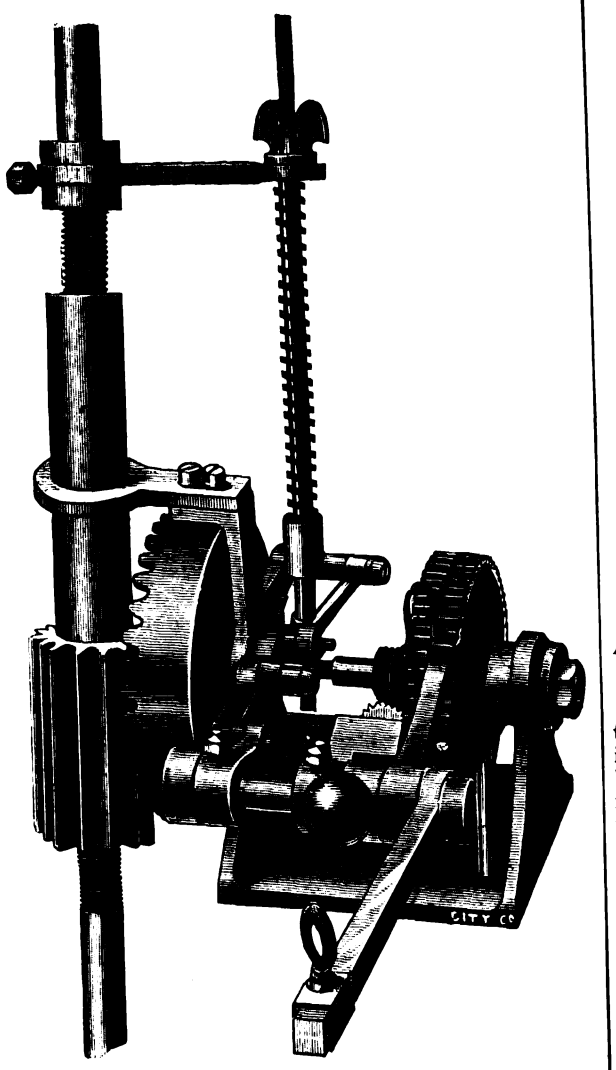
Armour Plates.—Some large armour plates have been rolled by the Spang Steel and Iron Company, for the two cruisers and a gunboat now being built by the Government. They are 7ft. wide and 10ft. long, having been rolled from a 2000lb. ingot. The same company are making the steel plates for a merchant vessel for the Oregon Improvement Company, under the inspection of the Bureau Veritas.

Beet Sugar in California.—The future of the beet sugar industry in California seems to be a promising one. A letter from San Francisco gives some facts with respect to the successful working of the factory at Alvarado, from which I learn that the company, although labouring under the disadvantage of a small plant, has conducted its operations at a profit for some years past. The land surrounding the factory will produce 3000lb. of refined sugar to the acre, and for the six seasons that the factory has been in operation, their average annual production has been 2,400,000lb. of sugar. The average cost of the refined sugar has been 5½c. per lb.; but by the introduction of improved machinery, which is now contemplated, it is expected that the cost will be reduced to 4c. per lb. The success of this factory has attracted the attention of sugar manufacturers, and several schemes are on foot to increase the number of factories. Among others, Mr. Spreckles proposes to establish factories for crude sugar in various parts of the State, the intention being to ship the crude product to San Francisco, and have all the refining done in one large refinery in that city.

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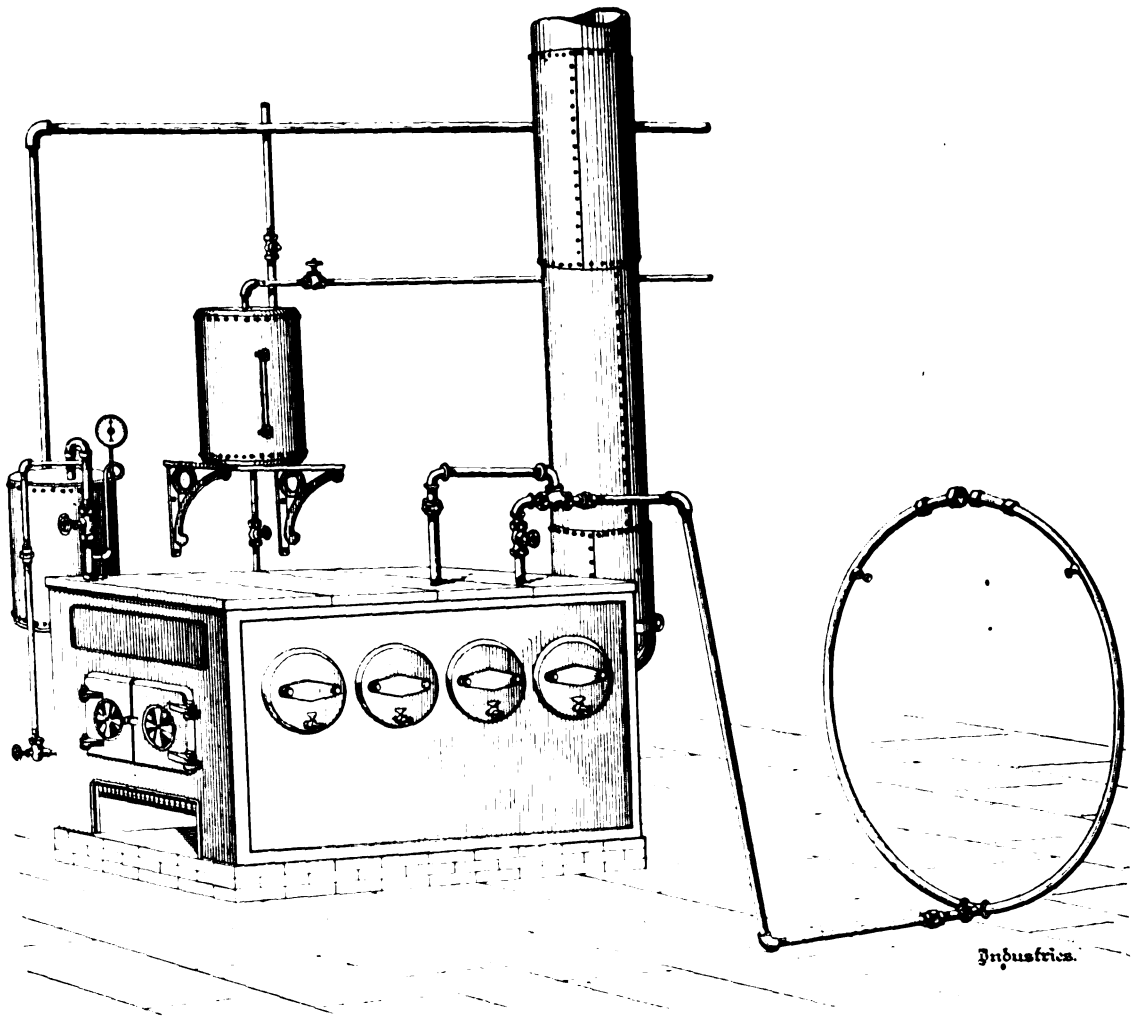
AN IMPROVED SPEED REGULATOR.

There is oftentimes a want felt by steam users and engineers for some automatic mechanism to supplement the action of the ordinary steam engine governor. As is well known, the ordinary ball governor adjusts the supply of steam to the engine through its plane of motion being raised or lowered owing to the variation of speed. It therefore follows that for any given plane of motion there is a corresponding speed, and that the desired steadiness of running of the engine may be sometimes only imperfectly obtained by the ordinary governor. With the view of remedying or nullifying this imperfect action of the main governor, several supplemental mechanisms have been adopted, which have more or less successfully overcome the difficulty of keeping the engine at a constant speed under varying conditions of load and initial pressure. The above engraving illustrates a simple mechanism of that kind, which is the invention of Mr. Wilby, and



made by Mr. James Lumb, engineer, Elland. In this arrangement the admission-valve rods of a Corliss engine, for example, would be lengthened or shortened automatically to suit the speed requirements by means of a specially arranged ratchet motion. The novelty claimed for the invention consists in the method of working the pawls in and out of gear at the required time. A rocking frame is worked by a cord or wire from some reciprocating part of the engine, and the pawls are moved in and out of gear by means of a bracket and rod connected with the governor. The regulator is fixed in a suitable position to gear with the long pinion, clearly shown in the illustration, and which is fixed to the right and left hand regulating screw shown on the left. We understand that this regulator is very sensitive, and that even a movement of $\frac{1}{16}$th of an inch in the main governor will cause it to have a compensative influence on the speed. Another advantage possessed by this regulator, and to which the inventor attaches considerable importance, is that it ceases to act altogether when the steam pressure falls below that necessary to keep the engine at its normal speed with the stop or throttle valve full open. It, however, automatically comes into action again when the pressure rises sufficiently high to give the ordinary speed. Taken altogether, this regulator seems very effective, and as it can be applied to various kinds of cut-off arrangements, and made at a reasonable cost, it is likely to come into extended use.

TYRE HEATING APPARATUS.

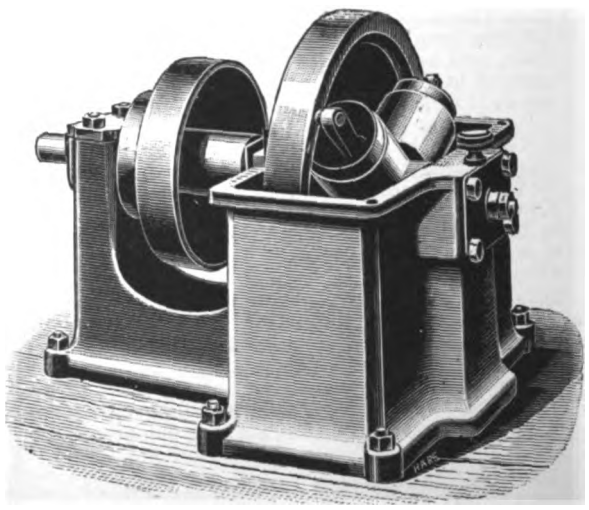


APPARATUS FOR HEATING, SETTING, AND REMOVING TYRES.

We are indebted for the accompanying illustration to our American contemporary *The Iron Age*. The illustration represents an apparatus recently introduced by Messrs. Pedrick & Ayer, of Philadelphia, Pa., and intended for putting on new tyres or taking off old ones without removing the wheels from the engines. We understand that with this apparatus the work is done in one-tenth of the time usually occupied, and that the paint on the wheel centres is not injured. In case of loose tyres the connecting rods need not be taken off; but in removing old tyres and putting on new ones they will, of course, be generally removed. Our illustration shows the apparatus in its stationary form; but arrangements have been made to fix the same on a truck for moving it from place to place. The engine operated upon is raised by jacks, so that the wheels will clear the rails by about 2½in., to allow the burner hoop to be placed round the tyre. This hoop is not one continuous ring of pipe, but has a little space left between the two ends, so as to allow the connecting rods to pass through. The ends are plugged up, and small studs are placed at intervals for keeping the hoop the right distance from the tyre. The apparatus consists of a furnace or generator fitted with four cast iron retorts, three of them being used for making the gas, whilst the fourth heats the air used with the gas. Besides this furnace there is provided a reservoir for holding common kerosene oil, a gauge for registering the air pressure, a needle-pointed valve for regulating the flow of oil, and an injector for mixing gas and air for burning in the hoop. The working of the apparatus is carried out in the following way: The oil reservoir is filled and the oil cock shut, so that no oil can enter the retorts, and a fire is made inside the furnace with any desired fuel. In about half an hour the retorts will be hot enough for producing gas. The hoop is then placed round the tyre and connected to the injector. Then the air pump is started, and when the pressure gauge shows a pressure of say 15lb. per square inch, the needle-pointed valve is opened and oil allowed to enter the retorts, until a rich smoke escapes from the burner holes of the hoop. Then the air cock is opened to allow air to mix with the gas, and a proper mixture of gas and air being made a torch is applied. An intensely hot blue flame will then strike the tyre and heat it up very quickly. The needle-pointed valve is fitted with a fine threaded screw, so as to allow a perfect regulation of the oil supply. The gas being used up as quickly as it is made, danger of explosion and waste of gas is prevented. When the tyre has attained the required temperature the oil supply is cut off, and the flame and generator stopped. A 4½ft. and 5ft. burner hoop are supplied with each apparatus. We understand that with the regular standard of shrinkage tyres can be taken off or put on in from four to ten minutes. The plant shown in our illustration is at work in the West Philadelphia shops of the Pennsylvania Railroad Company.

RIGG'S DOMESTIC WATER MOTOR.

It will be remembered that at the Birmingham meeting of the British Association in 1886, Mr. Arthur Rigg, of 42, Old Broad-street, E.C., showed a wooden model



of his new rotary hydraulic engine, and we illustrated the principle of this engine in our issue of the 10th September, 1886. At the Manchester meeting last year, Mr. Rigg again read a paper on the same subject, giving details of hydraulic engines which had been constructed in the interval, and were then satisfactorily running. A small domestic water motor was also exhibited. This machine we now illustrate. It is intended for use on town mains carrying water at a pressure of 60lb. per square inch, when it

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will develop a power equivalent to that of two men. It weighs about 100lb., and occupies a space of 1 cub. ft. The speed can be varied from one hundred to three hundred revolutions per minute. The general construction of this machine is similar to that of the larger hydraulic engine, but the stroke is not variable. There are three cylinders radiating from and revolving independently of each other on a central stud, and water is admitted to and exhausted from each cylinder through an opening in a face at the inner end, the face sliding over the valve seat, which is at right angles to the centre of rotation. In this valve seat are the openings communicating with the inlet and exhaust pipes. The three pistons are connected to corresponding crank pins set equi-distantly on the rim of the fly wheel, the centre of rotation of which is parallel to that of the cylinders, but shifted by a distance equal to half the stroke. As the wheel revolves each piston makes thus a complete out and in stroke in each revolution. Since the stroke is fixed the quantity of water consumed per revolution is a constant, and this engine may therefore also serve the purposes of a water meter at the same time as it supplies power. The pistons and cylinders are of gun metal, so that the water is not discoloured upon issuing from the motor, and can, after its power has been given up, be used for ordinary domestic purposes.

THE WORLD'S STEAMERS.

The number of steamers existing in the world last year was estimated at 9969, of an aggregate burthen of 10,531,843 tons, and this was made up as follows: Iron steamers, 8198, of an aggregate burthen of 8,911,406 tons; steel steamers, 770, of an aggregate burthen of 1,206,962 tons; and wooden steamers, 822, of an aggregate burthen of 380,655 tons. Of the steamers afloat in 1885, 5792 were owned by the United Kingdom and its Colonies, the aggregate burthen being 6,695,871 tons. The other countries of the world owned last year the following steamers: Germany, 579; France, 509; Spain, 401; the United States, 400; Norway, 287; Russia, 212; Denmark, 200; Italy, 173; Holland, 152; Brazil, 141; Japan, 105; Greece and Turkey, 82 each; Belgium, 68; Chili and the Argentine Republic, 43 each; China and Portugal, 27 each; Hawai, 21; Mexico, 15; and miscellaneous, 50.

Lloyd's Register of Shipping.—The *Nautical Magazine* for February contains an article on this subject, in which it alludes to a statement we made to the effect that there is a movement on the Clyde for the re-construction of that body. Besides dealing with the undue predominance of the Thames and Mersey representatives on the committee, our contemporary discusses Mr. Duncan's proposal to include the load displacements as a factor in the basis of scantlings. One difficulty which presents itself to this course is, that no reliance could be placed on the statement of the shipbuilder, and that an official surveyor would not have the opportunity or the means of making an independent measurement with accuracy. The other objection which the *Nautical Magazine* suggests is, that the policy of the shipbuilder would be to have a minimum displacement, and possibly it might be found that the declared load line would be less than that allowed at Lloyd's, while in loading at a foreign port there would be no scruple about exceeding the supposed load line. In preference to Mr. Duncan's proposal our contemporary suggests that it would be simpler to alter one of the existing factors of the basis of scantlings, by substituting the actual mean girth of the hull for the girth of the midship section.

Professor Ryan, of the University College, Bristol, delivered an address at the distribution of prizes at the Science and Art Schools, Newport, Monmouthshire, on the 13th inst. He referred in complimentary terms to the disinterested action of the men who created that school fourteen years ago, and who were energetic and far-seeing enough to solve the problem of technical education for their town at a time when the British Government were thinking about appointing a Royal Commission, which he characterised as the unfailing resource of procrastination. Their pupils were now spread far and wide, producing an effect on engineering industry, not only in England, but in her remote Colonies. They had, he might say, turned out a generation of engineers, while the Government had not got beyond a prospective Bill. Professor Ryan went on to show how science and art enhanced the value of raw material. Science has more than answered the extravagant hope of the alchemist, and surpassed the fabled power of Crœsus. Science and art can transmute ignoble metal into objects worth more than their weight in gold. If a Crœsus should touch the balance spring of a modern watch, it would lose two-thirds of its market value. Again, a single lens for a telescope may be worth more than £1,000 sterling. He urged them, therefore, not to seek after the gold of the earth, like the ancients, but to mine in the unexhausted and inexhaustible fields of science and art, and to rely on the potentiality of wealth and power that existed in their own brains and in the cunning of their own hands. He thought it high time that Monmouthshire and South Wales should prepare for the inevitable struggle that is close at hand. It was a frequent boast that they were the largest exporters in the world of finished iron and steel; but they were scarcely yet alive to the fact that the conditions of that trade were gradually changing—that the balance was going against them. Their supremacy depended on coal and the seaboard. These they still retained; but science had reduced the expenditure of coal to less than one ton per ton of steel produced in many cases, and, consequently, to much less than one ton per ton of ore treated. On this account it would be cheaper to take the coal to the ore than to carry ore to the coal. Up to the middle of the last century, iron works were situated in the neighbourhood of the ore, the fuel being furnished by adjacent works. By the beginning of this century, the industry had shifted to the coal fields, and there it must have remained so long as it took eight tons of coal to produce one ton of iron. The knowledge and ingenuity of Neilson and others had, however, effected vast economies, until now industrial inertia seemed to be the chief reason why the steel works still stick to the coal fields. Up to 1860, South Wales smelted much of the ore raised in the Barrow district, but increased facilities for getting coal from Durham and elsewhere enabled the ore to be profitably worked on the spot, and South Wales turned to the North of Spain for supplies. The Spaniards in their turn have now found it profitable to get our coal and make steel rails for themselves. In course of time the foreign manufacturers will be protected, and we shall be practically shut out of Spain and Italy. The tendency of science is to minimise natural advantages; it abridges space and time, and alters the effect of original distributions. Welshmen have, however, shown that they can take advantage of it, as they did when they substituted Bessemer plant and steel rail mills for the old iron ones. Engineering and metallurgical industries have reached such a pitch of perfection that they cannot any longer be improved by chance experiment. Inasmuch as the future was with the scientifically trained engineer and metallurgist, Professor Ryan was glad to see that the subject of technical education was engaging the attention of the University College authorities at Cardiff.

Notices of Meetings.

THIS WEEK.

The South Staffordshire Institute of Iron and Steel Works' Managers.—Saturday, 18th February. Ordinary meeting. Paper to be read on "Some Curiosities of Iron Manufacture," by Mr. A. E. Tucker, F.I.C., F.C.S.

NEXT WEEK.

Society of Arts.—Monday, 20th February, 8 p.m. Cantor lecture on "Yeast: its Morphology and Culture," by Mr. A. Gordon Salamon, F.I.C., F.C.S.—Wednesday, 22nd February, 8 p.m. Paper to be read on "The Technical Education Bill," by Mr. Swire Smith.

Society of Chemical Industry.—Monday, 20th February, 8 p.m. Papers to be read on "The Bromine Absorption of Mineral Oils," by Mr. James B. McArthur, and "Note on Camphor Oil and Oil of Sunflower," by Mr. C. T. Kingsett.

Royal Institution of British Architects.—Monday, 20th February. Ordinary meeting. Nomination of candidates. Paper and discussion.

Institution of Civil Engineers.—Tuesday, 21st February, 8 p.m. Ordinary meeting. Discussion upon the Paper by Mr. Pierce, jun., on "The Economic Use of the Plane Table in Topographical Surveying," and Papers to be read, time permitting, on "Manganese in its Application to Metallurgy," and "Some Novel Properties of Iron and Manganese," by Mr. R. A. Hadfield, Assoc.M.Inst.C.E.—Students' meeting. Friday, February 24th, 7-30 p.m. Paper to be read on "The Erection of the Superstructure of the Forth Bridge," by Mr. Arthur J. Knowles, B.A., Stud.Inst.C.E.

Liverpool Engineering Society.—Wednesday, 22nd February, 8 p.m. Ordinary meeting. Paper to be read on "Flood Gates and Weirs on the River Weaver," by Mr. J. A. Saner.

Society of Telegraph Engineers and Electricians.—Thursday, 23rd February, 8 p.m. Paper to be read on "The Present State of Fire Telegraphy," by R. von Fischer Treuenfeld.

Royal United Service Institution.—Friday, 24th February, 3 p.m. Paper to be read on "How to secure our coast line generally against sudden attack with the means of defence at present available, or with such means as might be made available at a few weeks' notice," by Colonel Sir Charles Nugent, K.C.B., late R.E.

PRICES CURRENT, 16th February.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3	31/2	Cash	
Scotch Warrants, m/n	39/2½	"	
Hematite Warrants, m/n	41/10½	"	
Stocks in Stores. Scotch	946,582—Inc. for week,	1566	Tons
Middlesbro'	343,220—Dec. "	4539	"
Hematite	212,031—Dec. "	1195	"

Exclusive of stocks in makers' yards.

Market still weak.

	No. 1.	No. 3.	
Coltness	49/6	42/6	f.o.b. Glasgow.
Gartsherrie	45/9	42/3	" "
Dalmellington	41/6	39/9	" Ardrossan
Eglinton	40/6	38/9	" "
Glengarnock	45/6	41/-	" "
*Derbyshire	—	38/-	f.o.t. Works.
*Lincolnshire	—	33/-	" "
*Lancashire	—	38/-	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.		Best.	
Middlesbro' Bars	£4 17 6		£5 7 6	f.o.t. wks
" Angles	4 15 0		5 5 0	"
" Plates	5 0 0		5 10 0	"
Staffordshire Bars	5 5 0		5 15 0	Manch'r.
" Angles	5 15 0		6 5 0	"
Crown Sheets	6 15 0		7 0 0	"
" Hoops	5 10 0		5 12 6	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 15 0	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	10	0	to	£19	15	0
Copper: British Cakes and Ingots	80	0	0	"			
" Chili Bars	77	10	0	"	78	0	0
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	0	0	"	15	10	0
" English Sheet	16	0	0	"	16	10	0
Tin: Straits	166	5	0	"	166	10	0
" Australian	167	5	0	"	167	10	0
" English Ingots	161	0	0	"	162	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Quotations for Chili bars have been stronger during the past week; sharp cash parcels at the time of writing closing at £78. Manufactured prices unaltered. There is, however, amongst buyers a better feeling springing up, as they become used to the new range of prices.

Tin is a trifle lower than in our last, but appears to be steadying.

Lead firm, with an upward tendency.

Spelter.—This metal is recovering slowly from the recent fall in prices, and seems likely to reach the figures lately ruling.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	28	0	0
" Ceylon	"	24	15	0
Cottonseed	"	20	10	0
Cod	"	19	0	0
Lard	"	42	10	0
Linseed	"	18	17	0
Palm, Lagos	"	22	0	0
Rapeseed: English	"	25	0	0
Seal: Pale	"	23	0	0
" Brown	"	17	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	6
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6½
" Spirit	"	0	0	7¾

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6½	—	0	1	6¾
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	12	5	0	—	12	10	0
" Liquor	lb.	0	0	3½	—		.....	
Bleaching Powder	ton	7	10	0	—	7	15	0
Bisulphide of Carbon	"	13	0	0	—		.....	
Borax	"	28	0	0	—		.....	
Benzole (90%)	gal.	0	3	9	—	0	3	10
" (50/90%)	"	0	2	9	—	0	2	10
Copper Sulphate	ton	22	0	0	—	22	10	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	23	0	0	—	24	0	0
" White Sugar	"	28	0	0	—	29	0	0
" Brown "	"	23	10	0	—	25	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	6⅛	—		.....	
" Prussiate (Yellow)	"	0	0	7⅞	—		.....	
" Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	7	0	0	—		.....	
" " " 60%	"	6	0	0	—		.....	
" " (Cream, 60%)	"	5	18	9	—		.....	
" Crystals	"	2	10	0	—	2	12	6
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	2	—	0	1	3
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

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HOME INDUSTRIES.

MANCHESTER, 16th February, 1888.

The Cotton Trade.—There is nothing new to report in connection with this trade. The buying of yarns is proceeding at an unsatisfactory rate. As far as possible buyers are keeping aloof, and are thus endeavouring to lower the prices; while spinners, being in many cases under contract, are indisposed to meet the competition. Manufacturers experience great difficulty in obtaining prices which are at all remunerative, and are being daily placed in a more unfavourable position. Profits are being made in both spinning and weaving; but the great increase of manufacturing power, together with the stationary condition of spinning mills, is tending at present to give the spinners better prices, and the manufacturers a materially diminished margin of profit. It is interesting to note the various plans pursued by limited companies with reference to depreciation. Thus two mills with 85,920 and 84,024 spindles respectively have set down for depreciation during the past three months £1,000 and £1,142. Again, two other mills, with 120,219 and 118,540 spindles, depreciate respectively for the same time £1,350 and £1,064. These differences are very marked, but may be accounted for by the difference in the age of the concerns and the state of the capital account. The gross profits per spindle of the four are respectively 8·25d., 8·05d., 8·06d., and 6·55d. In the latter two cases it is the more heavily depreciated mill which shows the best results. The gross profits per spindle range from 15·2d. to 4·58d. for the three months, a difference which is somewhat striking.

The Late Jubilee Exhibition.—A meeting of the Council of Guarantors was held yesterday at the Town Hall, when the Chairman of the Executive Committee submitted an abstract of accounts, prepared by Mr. A. A. Gillies, the secretary, and audited by Messrs. Broome, Murray, & Co. Appended to the abstract was an approximate balance sheet made up to the 21st January, which went to show that the estimated surplus on that date amounted to £43,239. 6s. 1d.

The Ship Canal.—The works in connection with this undertaking are being very rapidly carried out, and a large amount of plant is being put into operation. Speaking at the annual gathering of the Manchester Association of Engineers, Mr. Leader Williams, C.E., said that great progress was being made, mechanical appliances from all parts of the world being in operation which were equal to the labour of ten thousand men. The contractor has several vexatious actions pending against him for alleged damage to the roads in several localities, and the amounts claimed are very large in some cases.

A New Damping Apparatus.—Before subjecting cotton cloth or prints to the action of calender rolls, it is usual to damp it by means of a fine spray thrown upon it. Mr. James Parrott, of Salford, has introduced a new spray producer, consisting of a wooden roller into which are fixed a number of serrated steel plates. The teeth of the plates are long, so that when the roller is revolved at a high speed in a water trough, a very fine and continuous spray is thrown upon the under side of the cloth. The makers state that this contrivance is found to be much superior either to a brush or a spray producer such as ordinarily used, the water being more perfectly distributed, and with less liability of accident or damage.

LONDON, 16th February, 1888.

The Money Market.—A languid activity prevailed in the money market this week on account of the settlement, and the demand for accommodation in this connection was by no means great. With a few exceptions, the rates for loans remained at the same low level which has now prevailed for a considerable time. The Stock Exchange is beginning to recover from the depressing influences of the past fortnight. A tendency showed itself even before the close of the last account to transact business for the new one, and the result has been a distinctly firmer tone. Still the markets are not in a secure or normal condition, the recent scare having rendered them peculiarly sensitive. Home securities are distinctly better, but the American market is inclined to fall. This tendency was fully anticipated, but a marked recovery is looked for in American railways in the course of a few weeks. The shares of the Cape Copper Company have benefited by the move. A disposition is shown to invest in the Indian gold mines upon prospects which appear to be sound. People are discussing what is to be done with the £750,000 which is asked for as the capital of the European and American Machine Made Bottle Company. A considerable slice of the money must have disappeared in advertising, which has been indulged in to an extremely wide extent.

Companies.—Since our last report, the following new companies have been registered: Midas Goldfield Company, Limited (Victoria), with a capital of £180,000; Golden Queen, Limited, with a capital of £180,000, to carry on mining operations in the United States; the Syndicate of South African Prospectors, Limited, with a capital of £25,000; the Tetuan Gold Mines, Limited (South America), with a capital of £200,000; Australasian Gas Association, Limited, with a capital of £250,000; Gard and Co., Limited, with a capital of £10,000, to carry on business as manufacturers of self cleaning chemical plate cloths; Blue Spar and Gabriel's Gully Consolidated Gold Company, Limited (New Zealand), with a capital of £130,000; Ashton Brothers & Co., Limited, with a capital of £250,000, to acquire cotton spinning businesses at Hyde and Newton, Cheshire; Electric Traction Company, Limited, with a capital of £30,000; Eclipse Electric Lighting Syndicate, Limited, with a capital of £20,000; Fourness Regenerative Lamp Company, Limited, with a capital of £50,000; West Argentine Extensions, Limited, with a capital of £50,000, to work mines in the Argentine Republic; the Bratsberg Copper Company, Limited, with a capital of £120,000; the Marsh Light Company, Limited, with a capital of £5,000, to carry on business as gas engineers; Treveddoe Tin Mining Company, Limited, with a capital of £50,000; Oldham Mineral Water and Beer Bottling Company, Limited, with a capital of £3,000; Gamble's Window and Lock Alarm Company, Limited, with a capital of £25,000; and the African Prospecting Syndicate, Limited, with a capital of £6,005.

Board of Trade Returns.—The exports for January amount to £18,583,671, as compared with £17,808,735 in the same month of 1887, an increase of 4·3 per cent. Iron and steel show a marked improvement, the quantity being 5·5 per cent. and the value 16·5 per cent. higher than last year. The exports of copper have increased by over 12 per cent. in quantity, and a very much larger increase is of course shown in the value, viz., 70·5 per cent. Cotton piece goods have fallen off a little, owing to a smaller demand for the Indian market. The value of imports for the month amounts to £34,803,000, as compared with £31,047,422 in January, 1887, an increase of 12·1 per cent. The quantity of wool imported shows an increase of nearly 50 per cent.

Textiles.—The attendance at the first series of public sales of Colonial wool, which opened on the 31st ult., has been satisfactory. The market shows a considerable improvement, and the demand is good. Manilla hemp for present delivery is scarce, and prices have consequently risen. The Russian markets are somewhat firmer.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 5th February, amounted to £1,125,672 on 15,831½ miles, as compared with £1,112,707 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 122¾ miles, or 0·7 per cent., and in the receipts of 1·1 per cent.

Exhibitions.—The seventh annual Sportsman's Exhibition was opened last week at the Agricultural Hall, Islington. As usual, it comprised a large number of exhibits connected with aquatics, cycling, shooting, driving, and fishing; but there was little which was new. The most noticeable novelty was Hannay's patent window for hansom cabs, shown by the Forder Company, Limited, which consists of a single pane of glass, instead of the usual double frame, the lowering of which is so productive of discomfort and damage to hats. The new arrangement can be adjusted either by the driver or the occupant, and when being opened, slides against the roof of the cab; it can also be left partly open for ventilation. Messrs. Parkin & Webb exhibited a ramped wheel tyre, made of mild steel, in which oblique cuts are made on both sides of the tyre, so as to prevent skidding on tramways, the object being the same as in Fox's corrugated tyre, described in *Industries*, Vol. III., page 186. A new reservoir fire engine, the "Merton," was shown by Messrs. J. H. Heathman & Co. It is portable, and contains 36 gallons of water.

Technical Education.—In our issue of the 23rd December last we reported a conference on technical education, which was held at the Royal Victoria Hall. The discussion was adjourned at the time, and was resumed yesterday evening at the same hall, when Sir Douglas Galton occupied the chair. Last autumn two conferences were also held at the Finsbury Technical College, on the same subject. These were followed up by one last month in connection with the cabinet making trade, and last night by one for bricklayers, when a paper was read on "The Technical Education of Bricklayers and Brickcutters," by Mr. H. W. Richards. On Saturday there will be a conference of carpenters and joiners.

GLASGOW, 16th February, 1888.

The Copper Syndicate.—The Tharsis Sulphur and Copper Company have announced that they have entered into an arrangement with the Société des Metaux, Paris, for the sale of its output of copper for three years. The Cape Copper and the Rio Tinto companies having already come to an agreement with the syndicate, and the Mason and Barry Company being expected to follow suit, the syndicate may be regarded as having acquired the strength necessary to maintain its position as arbiter of the copper market.

Coal Trade.—Large contracts are reported to have been made by local firms during the past few days. Among these are mentioned 20,000 tons of coal for the Swedish State Railways, 15,000 tons having been placed with Messrs. James Nimmo & Co., and 5000 tons with Mr. Forrester, of Roughrigg Collieries, near Airdrie. Mr. Forrester has also a contract of 40,000 tons for the Danish State Railways.

Engineering.—Messrs. James Donald & Son, engineers, Johnstone, near Paisley, have received from Messrs. Archibald Orr, Ewing, & Co., of Levenbank Print Works, Alexandria, instructions to make machinery for the new process of rapid turkey-red dyeing which the latter firm are about to adopt.

New Railway.—An agreement is announced to have been entered into by the Caledonian and North British Railway Companies and the Kilsyth and Bonnybridge Railway for the joint working of this new local line. The line is expected to be open early in spring.

New College for Glasgow.—The text has been published of a Bill which has been introduced into Parliament by one of the members of the city (Mr. J. G. A. Baird). The object of the Bill is the establishment in the east end of the city of a college of the University of Glasgow. The governing board of the college is to be composed of persons chosen by various public bodies, and of a number of persons *ex officio* — *e. g.*, the Chancellor of the University, the Lord Provost of the City, and the Chairman of the Glasgow School Board. There is thus an important difference between the constitution of this body and that of the governing bodies of the chartered universities, there being none of the teaching staff upon the governing body of the college. Powers are taken to found professorships and lectureships in any subject or in any branch of learning the governors may direct. But the intention is understood to be in the meantime simply to consolidate the medical school as at present carried on in the Royal Infirmary, to make it the medical faculty of the college, and to proceed thereafter with the organisation of the faculties of arts, law, &c.

Fiscal Reform.—A meeting was held in Glasgow last week, to receive reports from a number of sub-committees appointed at previous meetings to inquire into the incidence of foreign tariffs upon various industries. Reports were given upon the "Iron and Steel Industries," by Mr. James Neilson, of the Summerlee Iron Works, and upon the "Scotch Fishing Industries," by Sir James Maitland, Bart. Both papers gave interesting statistics of the conditions of the industries concerned.

International Exhibition.—The buildings are so well forward that there is no doubt that they will be ready in time for the reception of exhibits. At a meeting of the Executive Council at the end of last week, it was announced that the offer of Messrs. A. & J. Stewart for steam piping, and that of Messrs. Ross & Duncan for electric light shafting, had been accepted; also that Messrs. Wordie & Co. had been appointed official carriers to the Exhibition. Arrangements have also been made for the exhibition of a working dairy.

(From our own Correspondents.)

LIVERPOOL, 15th February, 1888.

The Mersey Railway Company.—This great public work, which, since its opening, has been of such advantage to the inhabitants of Lancashire and Cheshire, is likely to prove financially disastrous to the original shareholders. The affairs are now in the hands of an official receiver, and as a preparatory statement to the official report ordered by the High Court of Justice, Mr. Samuel Lack Mason, one of the receivers and managers, has addressed to the directors an elaborate report of the finances of the company. Stating the facts briefly, the company has, up to the present time, spent £1,000,000 of ordinary capital, £500,000 of preference capital, and £576,600 of debenture stock, and is still saddled with a floating debt of £226,000. The works are not yet completed; the estimated cost of completing the Boldstreet Station is £183,775, and for constructing the Rock Ferry Line and Station £110,500. These amounts, added to the floating debt, make a total of £520,556, to provide which the financial proposals contained in the Bill deposited in Parliament have been formulated. Mr. Mason points out that there are two alternatives—either to employ the present resources of the company, which could only be adopted by issuing the stock at a ruinous discount, or to rely upon the proposed new powers, when first debenture stock could be issued with priority over all others, redeemable in five years, the latter course being more preferable.

Engineering and Shipbuilding.—Several important orders have been booked since the New Year, and many of the yards have now a more active appearance. Messrs. Laird Brothers, Birkenhead, are converting one of the London and North-Western Railway Company's passenger steamers on the Holyhead and Dublin route from a paddle steamer into a twin screw steamer, and expect to have it completed within four months. They are also constructing a war steamer for the Colonial Government, specially intended for navigating the rivers of the West Coast of Africa.

SHEFFIELD, 15th February, 1888.

The Condition of Local Trade.—The smallpox epidemic at Sheffield has undoubtedly injured local trade, but the injury is confined chiefly to shopkeepers and holders of licensed premises. The Corporation and other public bodies, acting in concert with Dr. Barry, the medical officer sent down by the Local Government Board, are doing everything in their power to check the epidemic, and there is a very sanguine hope that the town will soon be entirely freed from smallpox. It is suggested that for the benefit of business men visiting the town there should be some official notification of the districts in which the disease is most prevalent.

Iron and Steel.—So far as these industries are concerned, trade has not been so brisk for some years past. Orders are coming in freely for nearly all descriptions of heavy material, and at many of the large works there is great activity, though prices for the last day or two have been fluctuating a little. Hematite has ranged from 51s. 6d. to 52s. 6d. and 54s. 6d. per ton; forge and foundry have changed hands at from 51s. 6d. to 53s. 6d.; and Lincolnshire pigs

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have been quoted at rapidly changing prices from 34s. 6d. to 37s. 6d. per ton. At the Sheepbridge Iron Works, near Sheffield, where a good deal of Derbyshire pig is turned out, there is a decided improvement in trade, with a prospect of a busy time through the spring. For merchant bars as much as five guineas, and for sheets up to six guineas per ton have been realised. Steel rails, that have been sold at a much too cheap rate for years, are now realising more profitable prices, and for all classes of railway material—rails, tyres, axles, and springs—there is a good demand. Ship plates and heavy machinery are ordered more readily, and one or two of the best known engineering firms in Sheffield are doing excellently on home and foreign orders. Indeed, nearly all the heavy branches are in a more flourishing condition, and the bulk of work turned out is exceptionally large.

Mitis Castings.—These castings appear to have been extensively adopted by firms who formerly made use of malleable iron and brass castings, or manipulated iron and steel forgings. Mitis castings can be welded and hardened, and as they require no annealing they can be supplied in a few days. Messrs. Hansell & Co. and Messrs. Seebohm and Dieckstall, of Sheffield, were the pioneers in the manufacture of these castings in Great Britain, having obtained licenses from the Castings Improvement Syndicate, who previously granted licenses to several foreign firms in France, Germany, and Sweden. The Eureka Cast Steel Company have just closed a contract with the United States Mitis Company for the right to manufacture castings by the Mitis processes for certain districts, in conjunction with the Midvale Steel Company, who are also licensees. Up to the present time the Sheffield plant has been restricted to the production of small castings, but we understand that considerable extensions are in contemplation.

NORTH STAFFORDSHIRE, 15th February, 1888.

The Iron Trade.—Specifications are coming in but slowly, and most of the works are running short time. The small advance in price secured in January has fallen off, and the old unremunerative rates prevail. Deliveries of pig iron continue on contract, but consumers are for the most part fully bought for the current quarter. As some makers are getting anxious as to the future, and forcing iron on the market, it is likely that prices will further recede.

The Coal Trade.—The recent cold weather gave an impetus to the house coal collieries, which are now working full time, and are still unable to fully supply their customers' requirements. The demand for forge and manufacturing coal is fairly good, at a basis of about 7s. at the pit. The operation of the Mines Bill is a source of great worry to managers, and expense to colliery owners.

The Pottery Trade.—The condition of this industry has shown some signs of improvement since Christmas, and the outlook is now hopeful. Manufacturers, however, still complain bitterly of prices, which are low and unremunerative. The operation of the associations lately called into existence with a view to advance prices, is being watched with curious interest, and should it prove successful in checking the keen competition for orders which is now rife, a great boon will have been conferred on the district.

Engineering.—In every branch trade is dull and prices low. Local founders find it difficult to get orders and to make both ends meet. At Crewe the workmen are still on short time, and there seems little prospect of any change for the present.

BARROW-IN-FURNESS, 15th February, 1888.

Great Shipbuilding Scheme.—The scheme previously alluded to in these columns, by which a new company proposed to take over the business and works of the Barrow Shipbuilding Company, has been realised, with Lord Hartington as its chairman, Lord Brassey as its vice-chairman, and Mr. Nordenfelt as one of its directors. It is significant of the operations of the new company that it has acquired some of Mr. Nordenfelt's patents, particularly in ship construction, and it is proposed to build Nordenfelt torpedo boats and other classes of modern war ships, for which purpose all the features of a naval dockyard are to be established. The Barrow Steel Company are laying down new plant for the production on a large scale of Siemens-Martin steel in plates, angles, and other shipbuilding material. Barrow will thus be doubly benefited by this new development, and a large amount of work will be furnished for its docks and harbour. The district abounds in iron ore, from which Bessemer and Siemens-Martin steel of high quality is readily made.

Iron and Steel.—There is a quieter tone in the hematite pig iron trade this week, consequent on speculative operations, and business in hematite warrants has been done as low as 39s. per ton. Makers, however, do not recognise this figure as representing the position of the market, and are quoting 43s. per ton net f.o.b. for Bessemer iron in mixed numbers, with 42s. 3d. for forge and foundry iron No. 3, at which prices some well known brands have been sold. Steel rails are in fair request at the steady price of £4 per ton for heavy sections. A good business is doing in ships' plates, angles, &c., the former at £7. 2s., and the latter at £6. 7s. 6d. per ton net f.o.b. Engineers are busily employed, and orders are offering which are likely to be accepted and bring about renewed activity both in this and the boiler making industry. Iron ore is not so active as of late, and prices are down 6d. per ton, ordinary qualities being quoted at from 9s. to 12s. per ton net at mines. The shipping trade is well employed for the time of the year.

MIDDLESBROUGH, 15th February, 1888.

Pig Iron.—The pig iron market is quite a dissappointment this month. The fall in prices is most marked, and shows a decrease from 32s. in January to 31s. 6d. in February for No. 3 G.M.B., prompt delivery. This is not iron in makers' hands, however. They maintain their price on the basis of 32s. 6d. to 35s. per ton for prompt f.o.b. deliveries of No. 3. Forge iron even in merchants' hands maintains its price at 31s. per ton, as it is in good request on account of the improvement in the finished iron trade.

Shipments of Pig Iron.—The shipments of pig iron from the port of Middlesbrough up to the 13th inst. are about 6000 tons more than in the last month, and about 6300 tons more than in the corresponding month last year. The improvement is not restricted to any particular direction, but is general. The falling off of shipments to America amounts to between three and four thousand tons.

Iron and Steel.—In the finished iron trade the improvement is still maintained. The works have plenty of orders to keep them going for the next two months or more, so that there is not the anxiety to press for further orders. Prices are unchanged; common bars are from £5, plates from £5, ship angles £4. 15s. per ton on trucks at works. In finished steel there is not the same activity, and prices are hardly so strong. Rails, from £4, according to section; ship plates, £7; ship angles, £6. 10s. per ton in trucks at works, less the usual discount. The North-Eastern Steel Works are again fully employed, the difficulty with the men having been settled some time ago. The Eston Steel Works also are as busy as they can be. The public have been rather startled to hear that the general manager, Mr. Richards, has resigned and accepted the managership at Low Moor. This change has no connection with the Lloyd's inspector difficulty.

Shipbuilding.—The strike at the Cleveland Dockyard has been settled by a friendly arrangement between the masters and the men's representatives. There are favourable accounts from all the yards in the district.

Salt.—The boring at Seaton Carew, which was reported as unsuccessful so far as the salt bed was concerned, is said to have struck a brine spring saturated with 20 per cent. of salt, so that it is not so bad as was represented. They are still boring further down than the 1200ft., in hopes of striking a coal bed.

SUNDERLAND, 15th February, 1888.

Shipbuilding.—Local shipbuilders continue to obtain a fair share of the orders in the market. Messrs. J. L. Thompson & Sons, North Sands, have added another to their list, a steel screw steamer of about 2700 tons dead weight. Messrs. Wm. Pickersgill & Sons, Southwick, have booked an order for an awning deck screw steamer, 220ft. in length, for China river trading. Ship repairing continues to be very brisk, the salved steamers, "Pinnas" of Hamburg, and "Saltburn" of Sunderland, being the most recent important additions to this class of work.

Marine Engineering.—All the establishments are now actively employed. At Mr. John Dickinson's Palmer Hill Works there are eighteen sets of engines in hand, one of which is a quadruple expansion engine, 16in., 22½in., 38in., and 52in. cylinders, 30in. stroke, for the old steamer "James Drake." In this instance the old columns, shafting, &c., will remain, the principal addition being the four new cylinders. Messrs. William Doxford & Sons have five triple expansion engines in the course of construction for vessels which are being built in their shipbuilding yard. The extensive additions and alterations at Messrs. Allan & Co.'s (late Carr & Co.'s), Limited, works, continue to progress rapidly, and arrangements have been completed with the River Wear Commissioners and the Corporation for the erection of a deep water quay at the river front of the works.

The Coal and Shipping Trade.—The coal shipments during the last week reached 75,277 tons, of which 14,433 tons were exported and the remainder shipped coastwise. In the previous week, the shipment was 90,721 tons, 5073 tons in excess of the corresponding week of last pear. The general export trade also continues to be favourable, last week 2700 tons of patent fuel, 1160 tons of coke, 17,000 dozens of bottles, 122 tons of cement, and 50 tons of fire clay being shipped.

Rope Manufacturers.—The manufacturers of iron and steel ropes are now well employed, owing to the recent influx of shipbuilding contracts; but the competition is so severe that only a small margin is left for profit.

Chemical Works.—The Wear Patent Fuel Company, South Docks, are sharing in the improved state of trade, both in their fuel manufacture from the residues of tar distillation, as well as in the costly products of aniline, alizarine, &c. In all their departments night work is being carried on.

NEWCASTLE, 15th February, 1888.

Rope Works.—Within the past three or four weeks rope manufacturers have added considerably to the number of orders on their books, most of the new contracts secured having come from northern shipbuilding firms, and consisting mainly of wire rope for rigging, &c. The requirements of colliery owners have also helped to increase the amount of prospective work, and on the whole, the industry may be described as in an exceptionally healthy state.

Glass Works.—In the pressed glass trade business continues good; but the brisk season in the lamp chimney trade is drawing to a close, and the pressure of work is already sensibly lessened in establishments which make that branch their specialty. The Gateshead Stained Glass Company, who have already a good many forward orders booked, are now in negotiation for a contract of more than ordinary importance. There is still a large demand for "polished plate," and the works in which that commodity is produced are as busy as could be wished.

Carriage Works.—At the old established carriage and harness manufactory of Messrs. Atkinson & Philipson, Pilgrim-street, Newcastle, the state of business is, for the time of the year, exceptionally good. In the course of a few weeks, however, a large increase of work is anticipated, and the extensive resources of the firm will then, it is expected, be very fully utilised. That the demand for the productions of this firm is not confined to a limited area, is seen by the fact that they have recently shipped specially ordered carriages and harness to Bathurst (West Coast of Africa), Sierra Leone, Lucknow, and Bombay. They have other foreign orders now on hand, in addition to those that are being executed for customers in different parts of the United Kingdom.

Wire Works.—Wire working establishments are at this moment somewhat slack, excepting in the case of Messrs. W. Mountain & Sons, New Bridge-street, who, being principally manufacturers of window blinds and appliances used in paper manufactories, are experiencing a steady demand for their specialties. Messrs. Foggin & Co., High Bridge, cater chiefly for the requirements of collieries and brick making works, and the demand from these sources is just now greatly reduced. In a short time, however, the demand for articles required in gardening and agricultural pursuits will give a considerable stimulus to the industry.

Leather Works.—The state of business in the leather and india-rubber trades has undergone little change during the past few weeks, but the outlook for the latter branch especially is cheering. The well known firm of George Angus & Co., leather factors and manufacturers, has been registered as a limited company.

Ship and Engine Forgings.—These establishments on the Wear, which are specially adapted to ship and engine forgings, are exceptionally busy just now, and so great is the pressure of work that in some instances it has been found necessary to make extensions and put down new plant. The marked increase of business at those establishments is, of course, to be attributed to the improvement in the ship building and marine engine industries; and according to the present outlook in the latter trades a still greater accumulation of orders in the hands of forge proprietors is likely to take place ere long. The most recently constructed establishment of this description in the district, viz., the King's Forge, Pallion, is at present inoperative; but as it is offered for sale, it is not likely to remain long in this condition, and will no doubt soon be helping to supply the pressing requirements of engine builders and shipbuilders.

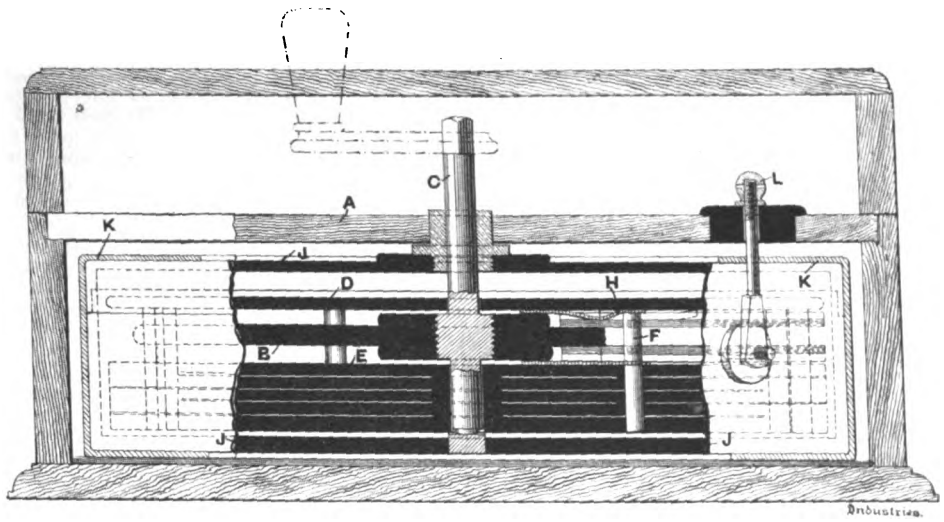
DUNDEE, 15th February, 1888.

Flax and Jute Trades.—The textile idustries of Dundee and district have not undergone any material change during the last fortnight. The linen branches have shown more activity than the jute trade. In flax the demand has been chiefly confined to spot goods at about previous prices. For shipment the tendency is in favour of buyers. Flax yarns are selling at comparatively low rates. Spinners are unwilling to give way in price, but they find it difficult to effect sales. Moderate business is reported in linen goods at late prices. Throughout Fife manufacturers are well employed, and forward orders are understood to be fairly plentiful. Telegrams from Calcutta report a dull market for jute, without change in rates. In jute yarns a moderate business is passing, and spinners are firm in their demands. Hessians meet with only a moderate inquiry, and there is not more business passing than suffices to take off present production Sacking continues in fair request, and the demand for tarpaulin and bagging is fairly active. The jute spinners and manufacturers have resolved to stop the spinning and weaving departments for a period of three months, commencing the first Saturday of March.

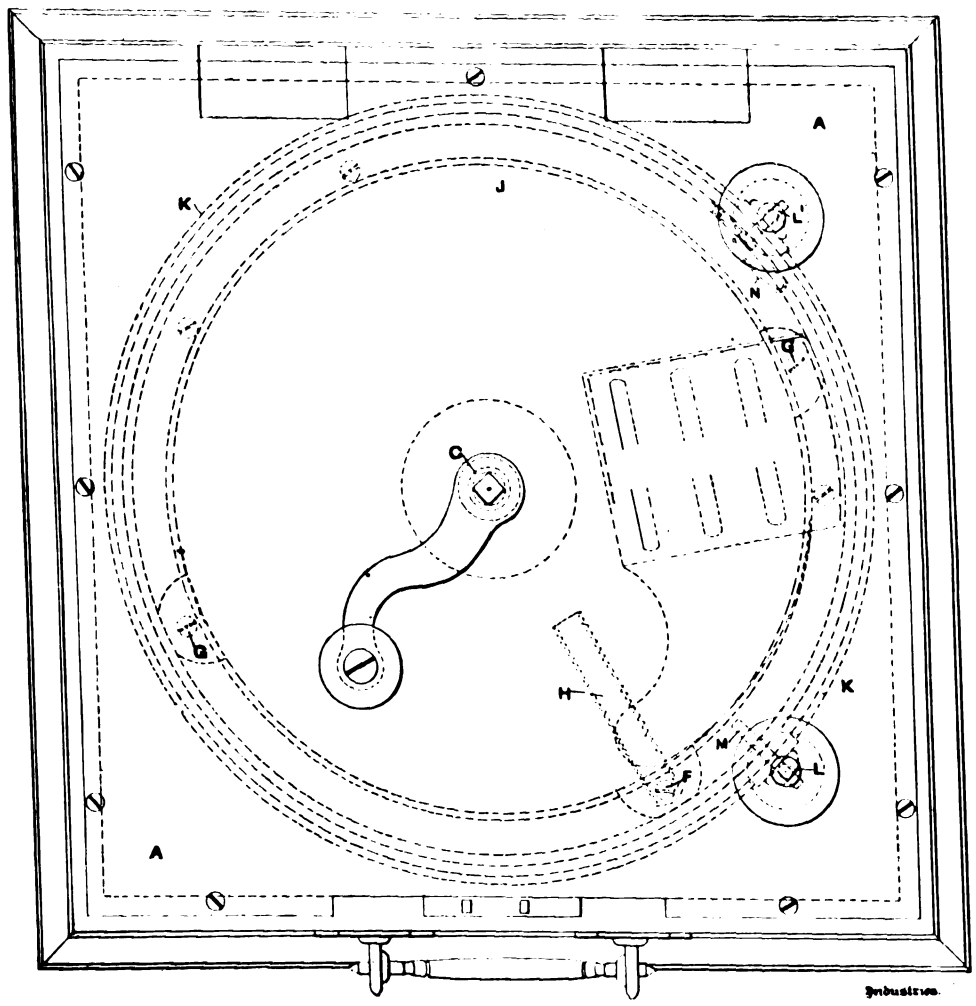
Erection of New Works.—A new carpet weaving factory was opened here last week. The machinery is driven from tunnel shafting, power being transmitted to the wing shafts by noiseless helical toothed bevel wheels, One advantage of this arrangement is that the light from the roof is not obscured by overhead gear. The driving moreover is very steady. The factory is heated by wrought iron steam pipes, which are led round the room on brackets attached to the supporting pillars. At night the factory will be entirely lighted by means of electricity. The installation consists of 423 lamps of 16 c.p., and there are also some lamps of 32 and 50 c.p. Narrow looms are lighted from one lamp, but the wider looms require two. The lamps used are of the Edison-Swan incandescent type. As a precaution against accident the factory is fitted up with gas lamps, which can be lit without interruption of the work.

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AN IMPROVED MINE EXPLODER.



SECTIONAL ELEVATION.



GENERAL PLAN.

AN IMPROVED MINE EXPLODER.

THE above illustrations represent in section and plan an improved form of mine exploder, manufactured by Messrs. David Moseley & Sons, of Manchester. The apparatus is enclosed in a square wooden box, and is further protected within the box by the cover A. It consists of the rotating vulcanite disc B, which is firmly fixed to the vertical spindle C, upon the upper end of which a square is formed for the handle to fit upon. Above the rotating disc is a fixed disc D, and below it a thick fixed disc E, within which is the condenser indicated by the thin white lines. The sheets of tin foil forming the condenser are placed in the disc before it is vulcanised, and the sheets are connected alternately to the posts F and G, F being connected to the collectors H. There are two rubbers, kept in contact with each of the surfaces of the rotating disc, and having the form indicated in dotted lines in the plan. These rubbers are of special construction, and are charged with an amalgam, the nature of which appears to have a controlling effect in securing a very high efficiency for the apparatus. The rotating and fixed discs are enclosed within a circular vulcanite box J, which is as nearly air tight as possible; but in order to secure the total exclusion of atmospheric moisture, a deep U shaped soft india-rubber ring K is slipped over the edge of the box. The terminals L L^1 are connected by metallic posts—L to the stop M, and L^1 to the flattened spring N. If the disc B is rotated, the thick disc J and the thin disc D are carried with it until their motion is arrested by the contact of the post G with the stop M. The motion of the disc is continued for about twenty-five revolutions, when the direction of rotation is reversed through about a quarter revolution. This brings the post F in contact with the terminal post M, and the post G in contact with the spring N, and consequently puts the condenser, which is now fully charged, into the external circuit. The apparatus produces a full thick spark through a 2in. air space, and is capable of simultaneously exploding 1000 submarine fuses in series. Its weight is precisely one-third (18lb.) that of the ordinary magneto exploder, and it occupies a somewhat smaller cubical space. The positions of the posts F and G are those occupied by them just after the commencement of charging and just before discharge.

THE PHYSICAL SOCIETY.

THE annual general meeting of this Society was held on the 11th inst., and after the reading of the report for the past session, and of obituary notices, by Dr. Gladstone, vice-president, the officers and council were elected for the coming session. Professor Reinold, F.R.S., was elected president, in the place of the late Professor Balfour Stewart, and Professor Perry takes Professor Reinold's place as one of the secretaries of the Society. The first paper read was by Mr. T. Pelham Dale, "On the Limit of Refraction in Relation to Temperature and Chemical Composition." The author showed, many years ago, that Cauchy's generally accepted formula expressing the relation between the wave length of a ray of light and its velocity of propagation in an isotropic medium does not give even approximately correct results, except within very narrow limits. In the present paper, the author obtains some formulæ which are found to agree more nearly with the results of experiment; but there is a fairly uniform deviation from theory in the relation between wave length and dispersion, and the uniformity is specially marked in the case of chemical compounds of similar molecular structure. Some anomalies are found to exist in the dispersion in flint glass and some kinds of sulphide of carbon, and still more markedly in the case of selenium. The author assigns, as the probable cause of the deviations from theory, the loss of energy arising from the transformation of light into heat when passing through the medium; and he is of opinion that, in the case of selenium, this is confirmed by its other peculiarities. After some remarks by Dr. Gladstone and others, Mr. Bosanquet read a note on the use of the term "resistance" in the description of physical phenomena. The note was suggested by an objection raised by Dr. Hopkinson to the use of the term "magnetic resistance," on the ground that the quantity so designated is not a constant for a given circuit. The author considers that any physical change may be considered as made up of a cause and an effect. If there is an opposition to the change which is greater, the greater the measure of the cause and the less the measure of the effect, he calls it resistance. Ohm's law is one of the most familiar examples, and in this case we have resistance=cause/effect. As another example, he considers the compression of a substance into a smaller volume. Here the pressure is the cause and the corresponding compression is the effect, and the resistance is a function of the effect, as is the case with magnetic resistance, which is a function of the magnetic induction. Objections have been raised against the term magnetic resistance on the ground that it is not of the same dimensions as its electrical analogue. But the objection would be equally applicable to the terms magnetic potential and magneto-motive-force, and, in fact, it is merely an objection to an analogy; that it is not an identity—which, of course, is not asserted. The author defines resistance at a point of a curve, giving its variation as the quotient of the small change in the cause by the corresponding small change in the effect, subject to the sum total of the conditions undergoing only a small change in the interval; in mathematical languages it is expressed by differential of cause / differential of effect. As an example, he gave Lamont's formula for a magnet, and defended his definition of magnetic resistance as the quotient of magneto-motive-force by magnetic induction, against M. Hospitalier's recent criticism that the denominator should be the total magnetic flux instead of the magnetic induction (or flux per unit of area), on the ground that his own definition, by making the magnetic resistance a linear quantity, greatly simplifies practical calculations. Professor S. P. Thompson mentioned that Rankine had used the term thermal resistance as the reciprocal of thermal conductivity, and he suggested that we might, by analogy, call it the quotient of thermo-motive-force by the thermal flux. He also instanced the characteristic curve of a series dynamo, where if ampères be taken as abscissæ and volts as ordinates, gives the resistance of the circuit as the tangent of the slope at the corresponding point of the curve. He thought it would be very useful to draw characteristic curves to express mechanical conditions. For example, instead of constant speed, we might draw a curve for constant driving moment; or, again, for a shunt wound motor, we might take speeds as abscissæ and the corresponding torque on the axle as ordinate, and we should have resistance to driving equal to torque/speed.

Professor Ayrton considered that the expression resistance=cause/effect should be confined to cases where this quotient was fairly constant, as was the case for magnetic resistance, except for very small magnetising force and near saturation.

Professor Foster mentioned that, in teaching mechanics, he found it useful to define inertia as the measure of resistance to change of velocity (inertia=force / acceleration), and moment of inertia as the measure of resistance to change of angular velocity.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 17TH FEBRUARY, 1888.

PROPOSED LEGISLATION FOR STEAM BOILERS.

THE correspondence which we have published in our columns during the last few weeks, and that which appears in our present issue, together with the action recently taken by the Oldham Chamber of Commerce, are sufficient to show that at least some of the steam using public are beginning to appreciate the importance of the proposed boiler legislation and its probable effect on our industrial progress. We need hardly state that any subject which materially affects the manufacturing interests of this country comes within our special province to discuss, and we therefore intend to devote some space to a consideration of the boiler legislation brought forward during last session, and which, together with a Bill just proposed by Mr. Provand, may be introduced during the present year. While we, of course, are not bound by any opinions expressed in our correspondence columns, we believe that our readers will agree with us in thinking that the facts put forward in opposition to the proposed legislation by our able correspondents "Economiser" and "Boiler," deserve careful consideration, not only from steam users generally, but from the Board of Trade officials, upon whom some rather severe comments are made. We presume, however, that these gentlemen will at the proper time and place be able to look after themselves, and give what they may consider sufficient reasons for the opinions they have officially expressed. We may therefore proceed by explaining that two measures dealing with the supervision and inspection of steam boilers were brought before Parliament last year. The first was the Bill backed by Mr. Burt, Mr. Crawford, Mr. Abraham, Mr. Fenwick, Mr. Pickard, and Mr. Dyke-Acland, and was entitled "The Steam Engines and Boilers Bill," and the second was the Bill introduced on behalf of the Board of Trade, by Lord Stanley of Preston, entitled "The Boiler Registry and Inspection Bill." The object of the first measure was to compel all boiler attendants to pass an examination before, and to receive a certificate from, the Board of Trade. The object of the second measure, briefly stated, was to compel all owners of boilers to register their boilers in a registry to be kept by the Board of Trade, and to have these boilers periodically inspected under the supervision of the Board of Trade. The view of the promoters of the first Bill was that many, if not most, of the boiler explosions which occur, are due to incapable attendance, and that of the promoters of the second was that the number of explosions might be minimised by rendering all stationary boilers liable to compulsory inspection, and thereby dispensing with inquiry as to the competency of attendants. The first Bill was a revival of a similar proposed measure introduced by Mr. Broadhurst a short time before, and rejected on the second reading. An opportunity was not found during last session for the discussion of the new Bill, and there now seems only a small probability of its being again brought forward. The second Bill was read a second time in the House of Lords on the 15th of last August, almost without debate, on the understanding that a Commission on the subject would be moved for early in the present session. It is supposed that this Commission will be largely composed of boiler experts, so that the result of their labours may be the production of a Bill as fitted for promoting public safety as such a measure can well be. Notwithstanding the other Bills proposed, it is likely, unless the recent Ministerial changes interfere, that the discussion on the question of boiler legislation will concentrate itself upon the Bill to be brought forward during the present session by the Board of Trade, and upon the labours of the Commission whose collective wisdom is to be invoked to construct the provisions of a suitable measure.

Some of those interested in the subject would appear to take it for granted that legislation should be carried out whether there is need for it or not, and seem to conceive that the best plan is by timely legislation to anticipate the probability of having to pass a Bill in a hurry in order to satisfy public clamour caused by some serious explosion. For this point of view there is something to be said; but it cannot be held as affording alone sufficient reason for legislation. Two main questions emerge at the outset in seriously considering the subject, viz., what do we really require? and is further legislation the best means of obtaining it? Granted that what we want is public safety, and that the only means of safeguarding the public from the explosion of steam boilers is to have such boilers properly constructed, properly managed, and satisfactorily inspected, it would still be necessary for additional legislation advocates to show that further additions to the statute book of the nature of the proposed Bill will secure these objects. In 1882, a measure was passed called the Boiler Explosions Act, which empowered the Board of Trade to do certain things in the event of an explosion to any boiler coming under that Act. For example, Section VI., sub-section 4, enables the Board of Trade to form a court of investigation which shall have "all the powers of a court of summary jurisdiction when acting as a court in the exercise of its ordinary jurisdiction;" and in sub-section 5 it is enacted that "the court making a formal investigation with respect to any boiler explosion shall make a full and clear report to the Board of Trade stating the causes of the explosion and all the circumstances attending the same, with the evidence, adding thereto any observations thereon, or on the evidence, or on any matters arising out of the investigation, which they think right to make, and the Board of Trade shall cause every such report to be made public *in such manner as it thinks fit.*" Again, in Section VII., we find that "the court may order the costs and expenses of a preliminary inquiry or formal investigation, or any part thereof, including therein the remuneration of persons holding such inquiry or investigation, *to be paid by any person summoned before it*, or by the Board of Trade." It is clear, therefore, from the portions of this statute which we have just quoted, and especially from the words which we have italicised, that the resources of the statute book, as regards steam boilers, are not yet exhausted, for some parts of the Act of 1882 have never yet been put into force.

Having regard to the reduction made in the number of serious boiler explosions since 1882—we use the word serious here advisedly, having in view the wide definition of "explosion" adopted by the Board of Trade—it would be perfectly reasonable to take a stand upon this Act, and specially upon the unused portions of it, and demand that the Board of Trade officials, instead of seeking enlarged powers, should exercise more efficiently the powers they already

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possess. The common answer to such an argument would be that during the currency of the Act a number of prosecutions have been undertaken against the owners of exploded boilers, while a conviction was only obtained in a solitary case, juries being most unwilling to convict unless a guilty knowledge of the condition of the boiler was absolutely brought home to the person charged. Thus it is held that the Boiler Explosions Act is in that direction practically inefficient, and that more stringent provisions are necessary to secure the public from the danger incurred by the presence of the many steam boilers in use in the manufacturing quarters of our large towns. Yet the failure to carry out the provisions of one Act of Parliament does not form a very substantial reason on which to demand another Act. Besides, past experience of the policy of the Board of Trade, no matter by what political party the Board may for the time be controlled, would lead steam users to expect a perpetual grasping for increased powers, rather than efficient use of the powers it may possess. We do not desire to take up a position unfriendly to the Board of Trade; but in considering this question the public will have a right to demand full information as to how the existing powers of the Board of Trade are exercised, before giving over to it the very extensive additional powers which are proposed in Lord Stanley's Bill. We have on former occasions discussed the extension of the functions of the State, which is at present so marked a feature of our legislation, and need not now do more than point out that the Boiler Registry and Inspection Bill is one of those measures whose intention is avowedly to strengthen and extend the control of the State, through the arm of one of its administrative departments. It therefore demands the most careful scrutiny, not only that the interests of individuals may not be unduly sacrificed, but also that the interests of the public—by no means to be confounded with the assumed interests of the State—may be adequately conserved.

The leading provisions of the Bill, as introduced into the House of Lords by Lord Stanley, are as follow: (1) Existing boilers must be registered. (2) All new boilers must be registered before they leave the makers' premises. (3) Every boiler thus registered must be inspected within twelve months of the passing of the Act. (4) A consultative committee will be appointed to act with the President of the Board of Trade. (5) Any inspecting company or society whose rules are approved by the Board of Trade may appoint inspectors. (6) The Board of Trade may appoint inspectors in any district where provision for inspection is not made by private companies. (7.) Every application for the inspection of a boiler must be made according to certain regulations, and is to be subject to a prescribed fee. After an inspection by the Board of Trade or private company a certificate is to be issued declaring that, subject to the statement as to pressure, the boiler is fit for work. Provision is made for appeal to the Board of Trade, and for the initiation of an inspection by the Board of Trade should it so determine. The Board reserves extensive powers. It may alter the mode of inspection, the proceedings of inspectors under the Act, the forms, fees, allowances, and, finally, any matter authorised by the Act to be prescribed. (8) All rules made under the Act must be submitted to Parliament within a certain period. (9) Boiler insurance societies must pay to the Board of Trade 5 per cent. of the fees received by them under the Act. (10) Offences against the Act are punishable by a fine of £20. (11) All boilers fall under the provisions of the Act, except those in ships classed at Lloyd's, those under the Merchant Shipping Act, those in Her Majesty's use, and all boilers belonging to railway companies, or for domestic use. Having explained the leading provisions, we intend to defer our further comments on this Bill for another occasion; but, in the meantime, we would strongly recommend steam boiler owners to study its various clauses, and decide for themselves how far the proposed legislation will affect their industrial interests, and to what extent it may be objectionable or unnecessary.

MR. GOSCHEN ON EDUCATION.

A Scotch Rectorial address is not a subject which would usually require notice in a technical journal; but the one recently delivered by the Chancellor of the Exchequer at Aberdeen bears so directly on some of the educational questions—general as well as technical—which are now being discussed, that we think it may be interesting to our readers to know some of the opinions of a man like Mr. Goschen, who in his day took a high place as a student, and who is now one of our leading economists and statesmen. Speaking of the prevailing opinion that it was the vastly superior knowledge of our rivals in trade, especially the Germans, that was the most dangerous competing force, and of the inference that we are therefore to bustle into a system of immediate and rapid cram, Mr. Goschen did not hesitate to say that he believed that such a method would be altogether useless. Greater knowledge is good, but there is a higher ideal—greater love of knowledge; and unless a system of education produces this it is largely useless. People may be frightened into working harder, but the results will be disappointing unless they are also made fonder of work. How little it is after all that schools and colleges, even of the highest order, can teach directly. Yet even the humblest of them can do something better. They can develop in their scholars a capacity and inspire an interest, which will cause them to go through life teaching themselves; and Mr. Goschen insisted that this, after all, is the final test of the value of an educational system, whatever its curriculum may be. Is it intelligent? Is it thorough? Above all, is it rousing? Does it excite intellectual interest in those who come under its influence? Does it develop in them the temper which always asks for a reason and struggles to arrive at a principle? He confessed that when he looked at the augmented list of subjects which now figure in our elementary education, he sometimes feared lest it should lull us into the belief that our object is gained if we can only pile up high enough the number of our studies. The question is, whether they are so taught as to expand the mind or merely to fill it? Are the teachers interested? Are they interesting? Do they stimulate as well as inform? He did not wish it to be supposed that he desired to say one word against the wider range and greater variety of modern studies. Variety promotes interest. But the mere multiplication of subjects is not what is essential. What is essential is the intellectual gymnastic which strengthens the mind to grapple with tough problems, and the intellectual interest which leads men to delight in that exercise. The live mind will provide itself with varied knowledge, as the well tilled soil will grow all sorts of crops. But on the half cultivated intelligence the stores of knowledge are lavished in vain, as the best seed is wasted on the unploughed and unharrowed field. To beget a right spirit in education in all its grades is a national work. No mere system can do it; nor does it rest with educationists alone. It is not programmes of study however ample, nor time tables however well constructed, nor examinations however searching, which will make an educated people. We want the steam to drive the machinery as much as the machinery itself. If a strenuous intellectual temper is to become more fashionable in all classes, if the idea of being tired by work is gradually to die out, if all callings are to be endowed with keener interest, it is to public opinion that we must look to effect the change.

The above questions and opinions should be carefully weighed by all who are responsible either for the arrangement or carrying out of education. Too often these are content with drawing out codes and syllabuses, collecting statistics, or preparing the students to meet their requirements, and they never ask whether education in the proper sense of the word is being imparted, or whether the intellectual interest which is essential to success is being generated. Mr. Goschen showed that this interest was as essential in industrial and commercial pursuits as it is in what are usually called the learned professions, and he illustrated this by reference to the controversy or discussion which is now being held regarding commercial education, and especially that part of it relating to the fact that foreigners are ousting Englishmen in our counting houses at home, and in the competition for new trade abroad. German clerks are invading every business house in London, and the reason is said to be their greater knowledge, their command of foreign languages, their acquaintance with all the technicalities of their business, and the excellence of their commercial schools. Conferences have been held to consider the cause of English failure, and remedies have been suggested in plenty to meet an admitted danger. Foreign languages are to be more and more introduced into our educational system. English clerks are to have a special business training; higher commercial schools are to be founded to produce an article capable of competing with the foreign importation. All this is good in its way, but Mr. Goschen pointed out that it may be all labour lost, unless when you have done all this, when you have taught the English clerk five languages, have instructed him in the technicalities of his business, you will not have done enough, unless you have succeeded in making him as fond of his work as his German competitor. There is danger in thinking that it is only knowledge that is lacking—that it is only in width of information that the foreigner is superior. He knows more, no doubt; but that is not the root of the matter. The root of the matter is, that he cares more about his work; that as a rule, he takes an interest in it apart from its results in money, which, for whatever reason, the Englishman has not hitherto learnt sufficiently to take, and this arises in great part from the difference in the methods of German and English educational institutions. The want of thoroughness which we have had to deplore in English middle class and popular education is due in a large measure to the fact that our upper class education had adapted itself to the wants of a section of society which had no need to work. In Germany an opposite social condition produced an exactly opposite result. The great body of students at German public schools and universities, even the most fashionable, are men who have to depend upon their own exertions alone for their future livelihood. The consequence is that hard work, wide knowledge, the thorough ploughing of the mind, are the great objects of the highest education. And the example, which is set on the highest educational plane, has made itself felt down to the lowest. It has made industry, knowledge, and reasoning power, interest and delight in every form of work, national ideals to a degree unparalleled elsewhere. It has carried the scientific spirit into every form of national enterprise, into trade, into industry, even into the operations of war.

Mr. Goschen pointed out very distinctly that changed times require changed methods, both of transacting business and of preparation for it. The merchants of a former generation, who built up the splendid fabric of British commerce, were undoubtedly more conspicuous for unerring instinct and audacity of enterprise than for any intellectual greatness. Their interest in their business was exclusively practical, but none the less they achieved great results, and perhaps persons of their turn of mind and practice do their work with all the more vigour and energy because they have no love for it in itself, and are glad to get rid of it as soon as possible. Their strength lies in their natural shrewdness. They are bored by nothing so much as by a principle. Thousands of people have made fortunes by methods such as these, but circumstances are very much changed from what they were even a few years ago. Our position in the race of civilised nations is no longer what it was. We had a great start in industry and commerce, and by virtue of that start we attained to a station of unprecedented and long unchallenged supremacy. That supremacy is no longer unchallenged. Others are pressing on our heels. We require greater efforts than formerly to hold our own. Mother wit, and boldness in seizing great opportunities—the chief factors in our previous success—are no longer sufficient, if others are to be more strenuous, more painstaking, more widely informed. It is the recognition of this fact which is at the bottom of the great stir in our educational world, of the ever increasing demands made on our elementary schools, of the cry for technical and commercial training, of the new spirit which is manifesting itself in our public schools and universities. If this new movement is wisely guided the pressure of competition, which we feel so bitterly to-day, may be fraught with greater blessings than the easy supremacy of the past. The perusal of Mr. Goschen's speech gave us considerable pleasure, as his opinions agree with those which we have always tried to enforce, and coming from a politician of his standing we trust they will influence education, and also any legislation bearing upon it.

COAL, IRON, AND COGNATE INDUSTRIES.

The Board of Trade Returns for January are, on the whole, satisfactory. In the aggregate there is an increase of £3,755,566 in imports, and of £774,936 in exports, as compared with the same month in 1887. We append our usual tabular statement:—

	Month of January. 1888. £		1887. £
Pig and puddled	112,041	.....	149,377
Bar, angle, &c.	132,683	.....	103,539
Railroad	490,489	.....	301,021
Steel, unwrought	108,210	.....	136,284
Coal	752,811	.....	746,338

So far as the iron trade is concerned, it will be noticed that although there is a falling off in our exports of pig iron and puddled bars, it is more than made up by an increase in those of railroad and finished iron. The proposed alteration in the American tariff has not had the effect, anticipated in some quarters, of increasing the imports of iron. There is a diminution of over 9500 tons, as compared with the corresponding month of last year,

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in our exports of pig iron to the United States, and of 7500 tons in those to Italy. To India and the Argentine Republic is mainly attributable the satisfactory increase in the consumption of railroad iron, our exports to the United States having fallen off materially. We have frequently pointed out the need for British iron masters to look to other fields than America for future demand. The "cornering" operation of the copper syndicate has largely increased the value of our exports of that metal, as compared with January, 1887. It is with much satisfaction we record the continued advance in our export coal trade. In spite of the great development of mining properties on the Continent, the volume of our trade increases, and France, Italy, and Germany continue to draw on our resources on a large scale. In 1887 we sent to those three countries over ten million tons of English coal. On the whole, then, there is no reason to be disappointed with the result of our export trade in the first month of the current year. It is with somewhat gloomy feelings, however, that we turn to a contemplation of the present position of industrial affairs at home, so far as the trades under review are concerned. The price of Scotch warrants is once more below 40s., and stocks in Connal's stores are increasing. In the North of England prices of both crude and finished iron are flat, and in that district, too, the requirements of consumers are below the capacity of production. In the Midlands a total collapse has taken place, and sellers are as much in the hands of their customers as before. It may turn out that this is but a temporary check on the progress of revival, the influence of which might in that case be beneficial; but, in face of the enormous stocks at different centres, and of the margin of productive power at present lying dormant, but which recent experience demonstrates will be brought into operation should improved prices obtain, it is difficult to adopt the optimist opinions promulgated in the general press.

Letters to the Editor.

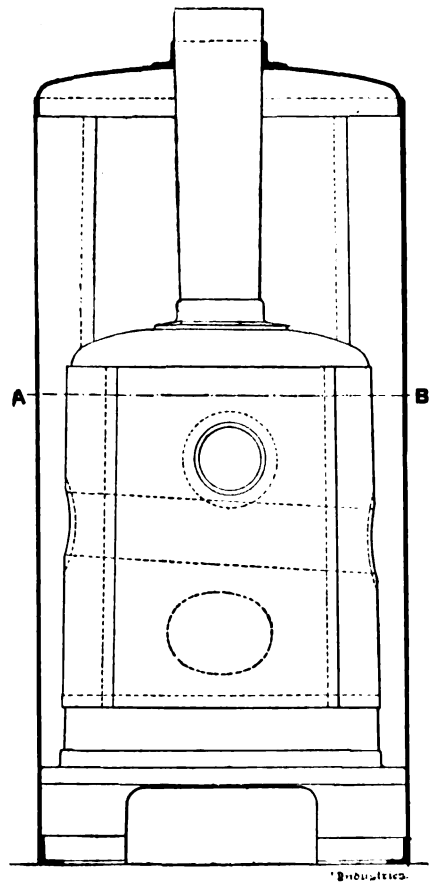
THE BOARD OF TRADE INSPECTORS AND GREEN'S ECONOMISERS.

TO THE EDITOR OF "INDUSTRIES."

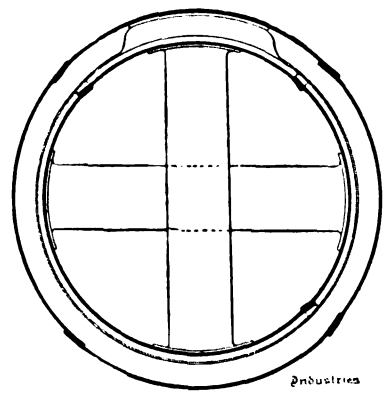
SIR,—That my letter which you kindly published in your issue of the 27th January, should have drawn forth the very suggestive and important letter from "Boiler," published in your issue of the 3rd inst., in relation to this subject, and also with regard to the Boiler Registry and Inspection Bill, is to me a subject of much pleasure; still the issues raised by the engineer-in-chief, Mr. Traill, and his assistant, Mr. Woodthorpe, in relation to the use of Green's economisers, are so important, both with relation to the questions of economy of fuel, and also of safety to life and limb, that I should like to have seen either some attempt at defence on their part, or, what would have been still better, an honest, straightforward, manly admission of error. That these gentlemen have written a report to the Board of Trade, which has been published with the weight of all its authority, and which will, consequently, have great influence and effect with the public, without sufficiently considering either the accuracy of their statement or the injurious consequences which might arise from them, will, I think, be admitted by all those whose opinion is of any value on the subject.

My reason for again referring to this report, is that probably ere long the whole steam-using public will be subject to the dictation of these Board of Trade inspectors. It therefore behoves everyone interested to carefully inquire what will be the result; and, in forming a fair estimate, we have no safer and better criterion than the work they have already done. It is therefore requisite that a sharp and searching scrutiny of each report should be made. It is much to be regretted that so much time is lost in presenting these reports to the public, as usually all interest in the particular explosion reported upon has been lost, and the event entirely forgotten long before the Board of Trade inspector's report is published. It becomes, therefore, of little interest, and the value of its deductions and assertions excites no attention.

For my purpose, let me explain here that Green's economiser is an arrangement of vertical pipes through which all the feed water used by a boiler is passed. It is placed in the external main flue of the boiler, which is enlarged for the purpose, and the heated gases, which have entirely left the boiler, and which are then on their way to the chimney, are passed through it. Every degree of heat, therefore, which may be taken up by the feed water while passing through a Green's economiser, is obtained from waste gases which would otherwise have passed directly up the chimney; consequently every degree of heat added to the feed water is produced without any cost of fuel, and reduces in exact ratio the weight of fuel consumed under the boiler. In the report under consideration, viz., No. 242, Mr. Woodthorpe says: "The temperature of the feed water after it had passed through the economiser was from 240°F. to 300°F., the average being about 280°F.," that is, a temperature corresponding to about 35lb. gauge pressure was imparted to the whole of the feed water passed into the boiler. Yet in the face of this, his own statement, he can go on to say that by discontinuing the use of this "so-called economiser," and "easily working all the boilers at once, the owners would effect a substantial saving." Should not consideration have been given to the well known fact that thousands of boilers, not only in Great Britain, but upon the Continent and also in America, are fitted with these economisers, and that they have been in daily use from twenty-five to thirty years, and further inquiry made before making such sweeping statements as are contained in this report? Had such inquiry been made, the overwhelming mass of evidence which could have been obtained, not only as to the economy effected by Green's economisers, but also as to their safety, would have been sufficient to convince, it is hoped, even Board of Trade inspectors.



SECTIONAL ELEVATION.



PLAN THROUGH A B.

I propose to refer to another case. On the 31st October, 1885, Mr. Peter Samson, a Board of Trade inspector, reported upon a preliminary inquiry (No. 145) which he made into the cause of a steam crane boiler explosion that took place at the West India Docks, London, on the 5th of the same month. The boiler was of the ordinary wrought iron vertical type, with cross tubes in the fire box, and a vertical up-take, as per above sketch. The cylindrical portion of the shell was $\frac{7}{16}$in. thick, 4ft. diam., and 7ft. 4in. high, exclusive of the part forming the ash pit. It was made of four plates arranged vertically, the seams lapped and double riveted with $\frac{3}{4}$in. rivets, 2in. pitch. The crown of shell was in one plate dished, flanged, and single riveted to shell. The fire box was slightly conical, about 4ft. high exclusive of the crown, 38$\frac{1}{4}$in. at the top and 40$\frac{3}{4}$ in. at the bottom, internal diameter. It had been originally made of four plates arranged vertically, lap jointed, and single riveted. The lower end had been in the first instance worked out to join the shell, but had been altered and fixed to a ring shaped thus, ⌐, of the same width as the water space. The side at the firing hole was worked outwards to the extent of 2$\frac{3}{4}$in., and joined to the shell, with a thin distance piece between, by single riveting. The crown was made in one plate, dished, flanged, and single riveted to the top of the fire box. There were two 8in. welded and flanged cross tubes in the fire box, placed at right angles to each other. The uptake was 12$\frac{1}{4}$in. at the top and 10$\frac{3}{4}$in. at the bottom in diameter, and secured to the crown of shell and top of fire box by angle iron rings. This boiler was made in 1872, and was about thirteen years old. The safety valve was loaded to 49lb. per square inch, and consequently usually worked at about that pressure; but, as Mr. Samson observes, "the safety valve was in a position favourable for fouling ropes, &c., when the crane was being swung." The evidence led Mr. Samson to the conclusion that the explosion was due to the collapse and "rupture of the fire box, apparently from over pressure, but how the over pressure arose there is no conclusive evidence to show." The inference, however, being that the "favourable position of the safety valve" fulfilled its expectations, and being fouled by some rope or ropes became inoperative, or at least so deranged, that a sufficient pressure to collapse the fire box was possible.

Mr. Samson, in reviewing the evidence given before him, further says: "As regards overheating, there is no sign of it, and it was stated by the inspector of the Manchester Steam Users' Association that the fire box was in good form when last examined by him thirteen days before the explosion occurred. The fire box plates are, however, thinned by corrosion on the fire side, and are only $\frac{1}{4}$in. thick in places, but the mean thickness is quite $\frac{5}{16}$in." .... After some further remarks, Mr. Samson again states that "the thickness of the fire box plates for the purpose of calculating the collapsing pressure may be taken at $\frac{5}{16}$in., and if that thickness be used in the formula

$$\frac{266{,}760 \times T^2}{(L+1) \times D} = P$$

where T = the thickness of the plate in inches;
L = the length of the fire box in feet;
D = the diameter of the fire box in inches;
P = the collapsing pressure in lbs.;

the collapsing pressure is found to be 106lb., or 2·16 times the normal pressure on the safety valve." This formula "is that given in the Board instructions to surveyors, with the constant multiplied by 4·94, which is the mean factor of safety possessed by two fire boxes with cross tubes, that were tested to destruction by cold water pressure."

It is to this formula, which we have Mr. P. Samson's authority for stating "is that given in the Board of Trade instructions to surveyors," that I venture to direct attention. It is generally assumed that there are about 150,000 boilers in the kingdom, and Lord Stanley, when moving the second reading of the Boiler Registry and Inspection Bill, in the House of Lords, on the 15th August, 1887, said that about 70,000 of these were under inspection and insurance. From the tables and statistics published by the various boiler insurance companies, it appears that somewhat over 15 per cent. of all the boilers under their inspection are of the vertical type, such as the boiler in question. It will therefore follow that about 25,000 boilers are subject to decision as regards the strength of their fire boxes by this formula. When we consider that by the ordinary rules which are adopted by boiler makers for this type of boiler, the collapsing pressure of the fire box would be more than four times that it is stated to be by the Board of Trade official calculation, some faint idea may be formed of the inconvenience, loss, and expense which will be thrown upon steam users by the enforcement of this one instruction alone to the Board of Trade surveyors. Every day large numbers of such boilers are being made and set to work, being almost universally in use by small steam users, and for such purposes as the case now before us, it is therefore a question of the highest interest and importance, for should the Board of Trade formula prove correct, the great majority of the boilers of this type are working in a dangerous manner, many at double and treble their safe working pressure.

By the Board of Trade formula it will be seen, taking the usual—that is, the most generally accepted—factor of safety, viz., four, that the boiler in question should not have been worked beyond $\frac{106}{4}$ = 26·5lb., whereas the safety valve was loaded to 49lb., and had been so for thirteen years, at which pressure the factor was then only 2·16. By the same formula, the collapsing pressure of this furnace when new would have been 141lb.; and consequently even then, with a safety valve loaded to 49lb., it had only a factor of safety of 2·89, instead of 4·94, with a safety valve load of 28·6lb., as demanded by the Board of Trade instructions. Does any competent engineer believe that a fire box only 4ft. high, 38$\frac{1}{4}$in. and 40$\frac{3}{4}$in. diam. respectively at the top and bottom, made of $\frac{5}{16}$in. plate, and stiffened by two 8in. welded and flanged tubes, placed at right angles to each other, would collapse at 141lb. pressure? Would any such engineer hesitate for one moment to subject a fire box of similar construction and dimensions to a test of that amount by hydraulic pressure? Would any fear of permanent injury to it in form, or even fear of producing leakage, deter him? If Messrs. Samson or the Board of Trade will have a similar boiler made, with a fire box exactly of the same construction, and test it, they will find that the fire box will not collapse at 141lb., according to their formula, and that 200lb. per square inch will fail to cause the slightest sign of weakness. I have no hesitation in saying that if a few of the boiler makers who are habitually turning out such boilers every day will give us the result of their daily experience, that we should find that hundreds of such fire boxes have regularly been tested to beyond their collapsing pressure by this Board of Trade rule. Having Report No. 242 before me, I am not surprised to find that this formula, given as a Board of Trade instruction to surveyors for the strength of fire boxes of vertical boilers, should be admittedly based on "the mean factor of safety possessed by *two fire boxes* with cross tubes, that were tested to destruction by cold water pressure." Upon this experience of two fire boxes Mr. Samson, or, rather, the Board of Trade, has presumed to base a formula, which will affect in this kingdom alone about 25,000 boilers. It is as purely empirical, misleading, and objectionable as Messrs. Traill and Woodthorpe's pronouncements in regard to Green's economisers, and apparently based on about the same amount of practical knowledge and experience.

The final observations of Mr. Thomas W. Traill, engineer-surveyor-in-chief, upon the report of the preliminary inquiry No. 145, are so truly ingenious and refreshing, that I cannot refrain from quoting them in conclusion. I trust they will be as amusing to your readers as they have been to me; they run thus: "The safety valve, considering the circumstances, was not constructed in a manner which can be considered satisfactory; the pressure at which the boiler was worked was too great for the thickness of plates in the fire box; consequently, with an unsuitable safety valve and a weak plate, we cannot be astonished at the explosion. *The strength of such fire boxes ought to be known by this time; and if the plates had been drilled they would have probably been found thin, as they turned out to be.*" The italics are mine.

Any words of mine would lamentably fail to do justice to the truly Dogberrian wisdom of the last "observations" of the surveyor-in-chief, and I will leave it to be judged upon its merits.

I shall be glad if any of your readers who may have evidence

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as to the test or collapsing pressure "of such fire boxes" will give it. It would be interesting as well as useful at this juncture, when Board of Trade engineering appears to be endeavouring to re-enact the part of the "lean swine."

Yours, &c.,

Manchester, 13th February, 1888. ECONOMISER.

THE BOILER REGISTRY AND INSPECTION BILL.

TO THE EDITOR OF "INDUSTRIES."

SIR,—The letter of your correspondent "Economiser," in your last issue, appears to me to be far too sweeping in its condemnation of the above Bill, which he can hardly have read, or he would not be so much astray in his statements. Inspections, under the proposed new Act, need not be made by the Board of Trade officials themselves, as the Act (clause 8, par. 2) reads: "Any society, company, or body of persons, whose rules for the survey of boilers are for the time being approved by the Board of Trade (in this Act referred to as an approved boiler inspection society) may from time to time appoint surveyors under this Act," &c. This practically leaves the inspection of steam boilers as it is at present, viz., in the hands of the various boiler inspection associations; but it also provides that *all* steam boilers shall be periodically inspected by some one. After an experience of some twenty-three years amongst boilers, this is a course I heartily approve, as it will do something towards preventing explosions, whilst the Acts in force now simply order an inquiry *after* a fatal accident has occurred. Your correspondent will probably not deny that thousands of boilers are in use that ought to have been on the scrap heap years ago, and that many accidents have been brought about through the parsimony or the criminal carelessness of the owners, combined, in some cases, with the gross ignorance or carelessness of the attendant. In addition to compulsory inspection, I have long advocated that all boiler attendants should possess a certificate of competency that they are capable of undertaking the work. This would prevent day labourers being made to do duty in this connection. A step in this direction has recently been taken by a Scottish boiler insurance company, and certificates of competency are also granted in America, Germany, and some of the Australian colonies. I do not wish it to be understood that I am advocating Board of Trade inspections, as it is more than probable that if the work were undertaken by independent insurance associations it would be much better done than if undertaken by a Government department, which would have no particular interest in the boiler, and would not be liable in any way if the boiler did explode. The proposed Bill as it at present stands is not by any means complete, and contains one or two extraordinary clauses, for instance clause 9, that certificates shall be granted to the boiler owner, "and the period stated therein as the period during which the boiler may be safely used shall not exceed twelve months or *any less period* specified in the declaration of fitness." I take it he would be a clever boiler inspector who would dare to say a boiler is fit to work six months, not to say twelve months. If it is not safe to work it for twelve months it cannot be safe to work it at all. In case boiler inspection were made compulsory, the great increase in business would probably provide sufficient funds to enable the various associations to make a thorough examination of every boiler in the kingdom once a year. In France and Germany Government boiler regulations are in force, which place the manufacturer as well as the boiler owner under restrictions as regards the construction and setting of the boiler in the first place, and afterwards as regards its periodical inspection and testing. I think a Bill enforcing compulsory inspection of steam boilers, and the granting of certificates to competent attendants, could be introduced without causing undue friction or interference with the rights of boiler owners, and by making use of the machinery of some of the present boiler insurance associations, this inspection could be carried out at a very moderate cost. Yours, &c.,

THE AUTHOR OF A "HAND BOOK FOR STEAM USERS."

London, 13th February, 1888.

ENGLISH AND AMERICAN PRACTICE IN ELECTRICAL ENGINEERING.

TO THE EDITOR OF "INDUSTRIES."

SIR,—May I be permitted to correct a statement in your last issue, in which I am reported to have said, in the discussion on Mr. Geipel's paper, "that both in science and practice the Americans led the way." As this will convey an impression contrary to my meaning, I send you copy of my notes, which, though I did not read from them, is, I believe, word for word what I said:—

"On page 1 the author says: 'On the other side of the Atlantic, although the science of electricity is much behind, the practice is far ahead of our own.' I wish to take exception to the word 'much.' Though I cannot admit that American scientists are superior to our own, seeing we have such men as Thompson, Preece, Hughes, Hopkinson, Kapp, and many others who are bad to beat, still, when we look fairly, it is going a little too far to say that our American cousins are *much* behind; we must remember Franklin and Edison, Houston, Thornton, Brush, and a host of others, who are not children in science. I wish also to emphasise, that in practice they are far ahead of us, and I think we may profitably ask, why? We are behind not merely because our laws and monopolies are against us, but from the conservatism which is our national characteristic. Perhaps our scientific attainments are a hindrance. We go looking at, and round and about, searching into, and turning inside out, and not finding perfection, do nothing; whilst they see a way, perhaps not the best way, they do it, it works, they are satisfied. The American takes what is, the Englishman waits for something better." Yours, &c.,

M. HOLROYD SMITH.

Halifax, 10th February, 1888.

STEAM HEATING COMPANY.—The Hussey Re-heater and Steam Plant Company, New York, has been incorporated, with a capital of £20,000; its object is to supply hot water, hot air, and steam for motive power.

CLYDE SHIPBUILDING FOR JANUARY, 1888.

LAUNCHING in January is usually light, and this year has been no exception to the rule. The heavy booking of orders during the autumn and early winter months seems to have exhausted the demand, and few orders have in consequence been added to the books of local firms during the month. The orders booked during the month have included two steamers of 5000 tons each, to be built by Messrs. Denny Brothers, Dumbarton, for the Transatlantic Company of Barcelona; a steamer of 3000 tons, to be built by Messrs. Stephen & Sons, Linthouse, for Messrs. Dunlop and Sons, Glasgow; two vessels of 4000 tons each, for the British India Steam Navigation Company, to be built by Messrs A. & J. Inglis. The new tonnage ordered during the month reaches upwards of 20,000 tons.

The following vessels were launched in January, making a total of twelve vessels and 13,056 tons: No. 199, steel screw steamer, 5000 tons and 5000 i.h.p., built on builders' account, by Messrs. A. & J. Inglis, Pointhouse; "Amber," steel, 1050 tons and 1450 i.h.p., for the Eastern Telegraph Company, by Messrs. Robert Napier & Sons, Govan; "chaloupes," Nos. 36, 37, and 38, each 40 tons and 65 h.p., for the Panama Canal Company, by Messrs. Lobnitz & Co.; "Flying Cormorant," steel twin screw tug, 260 tons, for the Clyde Shipping Company, built by Messrs. Robert Duncan & Co., Port Glasgow; "Lady Ailsa," steel, 1250 tons and 600 i.h.p., for Messrs. J. & A. Wyllie, Troon, built by Messrs. The Ailsa Shipbuilding Company, Troon; "Lady Weld," steel paddle steamer, 511 tons, built by Messrs. Scott & Co., Greenock, for the Netherlands India Steam Navigation Company; "Nefiche," hopper barge, 400 tons and 300 h.p., for the Suez Canal Company, built by Messrs. Lobnitz & Co., Renfrew; "Ocean," 2800 tons, for Messrs. Hermann, Stursburg, & Co., built by Messrs. Russell and Co., Greenock, engines by Messrs. Duncan Stewart & Co., Glasgow. Sailing vessel, "Sutlej," 1660 tons, for Messrs. Foley, Aikman, & Co., London, built by Messrs Russell & Co., Greenock. Lifeboat, 5 tons, built at Irvine.

	Steamers. No.	Steamers. Tonnage.	Sailing Vessels. No.	Sailing Vessels. Tonnage.
United Kingdom	4	7,560	2	1,665
United States	1	2,800	—	—
Holland	1	511	—	—
Egypt	1	400	—	—
Central America	3	120	—	—
January, 1888	10	11,391	2	1,665
January, 1887	10	12,935	1	2,500

	Tons.
Aggregate, January, 1888	13,056
" " 1887	15,435
" " 1886	9,140
" " 1885	10,760
" " 1884	6,340
" " 1883	17,339
" " 1882	23,695

Reviews.

A HAND BOOK FOR STEAM USERS. By M. Powis Bale. London: LONGMANS, GREEN, & Co. 1887.

Some years ago, the author published a chart of rules to be hung in engine rooms for the guidance of engine drivers. The work before us is an amplification of these rules, with chapters on steam engine and boiler management and steam boiler explosions added, in order to render them of service to steam users generally; and all the information is given in numbered paragraphs under appropriate headings. Chapter I., which contains rules for engine drivers and boiler attendants, requires no special comment; the directions are all clearly given, and of a thoroughly practical and common sense character. We note that the author recommends the use, wherever possible, of a damper worked by steam automatically, as it is certain in its action and independent of the boiler attendant. In Chapters II. and III., the management of steam engines and boilers is dealt with. With respect to the remedies for incrustation in steam boilers, the author gives various recipes, but is careful to state that he does not guarantee their success; to tannate of soda he appears, on the authority of Dr. Joseph Rogers, of Indiana, to give the preference, and explains its chemical action in purifying water of carbonates of lime and magnesia. Instructions are also given for testing feed water for lime or acid in cases where it is not practicable to get a proper analysis made, but the author recommends the latter course whenever possible.

Want of space prevents our noticing in detail the various matters treated in this book, but a few of the headings will give a fair idea of its scope and aim. Among those relating to boilers are: Water gauges and test cocks, covering steam boilers and pipes, water circulation in boiler, plugging leaky tubes, firing steam boilers, &c. Rules are given for the dimensions of boiler chimneys, and a short table of the proportions of the latter for boilers of various horse power, according both to the American system and the Armstrong rules. The work also contains a useful table for calculating the volume of the steam or water space in steam boilers. In connection with steam engines, there are paragraphs on: Pounding and knocking of engines, piston rod packings, sight feed lubricators, and hot crank pin bearings. Although the author enumerates the causes of knocking in engines, we notice that he does not attempt to give instructions how to ascertain where the knock is. This, as every practical engineer knows, is by no means always easy, and can in many cases only be done by the exhaustive method. In Chapter IV., the various causes of boiler explosions are enumerated and discussed in succession. The author's remarks should be carefully read by all owners of boilers and those in any way responsible for their management. He is in favour of a compulsory system of boiler inspection, and of granting certificates of competency to those having boilers under their charge. Altogether, we can recommend Mr. Bale's work to those for whom it is more immediately intended; and we also think that it might be studied with advantage by engineers and draughtsmen who have to design boilers, for, as experience proves, defective design is answerable for many of the ills to which steam generators are subject, and can only be avoided by careful attention to the various important practical details to which it is part of the author's purpose to draw attention. The fact that this little book has just seen a second edition is sufficient proof of its practical value.

THE BRASS FOUNDERS' MANUAL. By Walter Graham. Seventh Edition. London: CROSBY LOCKWOOD & Co.

This work forms one of Weale's Rudimentary Scientific and Educational Series, and the fact of its having arrived at its seventh edition shows that it has been found useful by those engaged in brass founding. After some brief instructions with regard to the general arrangement of a brass foundry, the apparatus and material for moulding are dealt with, and Mr. Graham here takes the opportunity of giving a few words of sensible advice to workmen on the subject of the benefit of labour saving machinery, though it is doubtful whether the enunciation of the principles of political economy will suffice to dispel the prejudices of the less educated among the working classes. Instructions are given on alloying, turning, filing, burnishing, soldering, and other processes connected with the trade. The book also contains a classified list of most substances used by brass founders, with a brief description of each. Besides the various useful tables contained in former editions, there have now been added a table of the new Imperial Standard Wire Gauge, prepared by the Iron and Steel Wire Manufacturers' Association, and a table giving the properties of materials, such as specific weight, melting point, contraction, strength, hardness, &c. Where necessary to explain the author's meaning, simple illustrations are supplied.

WRIGHT'S AUSTRALIAN, INDIA, CHINA, AND JAPAN COMMERCIAL DIRECTORY AND GAZETTEER. 1888-9. New York: GEORGE WRIGHT. London: WATKINS AND OSMUND, 6, Ludgate Hill.

This bulky volume is intended as a hand book of the trades, professions, commerce, and manufactures in the Australian Colonies, India, China, and Japan; and, in view of the rapid increase of our business relations with those countries, will prove useful and supply a long felt want. It contains several useful maps, made expressly for this work by Mr. Gaylord Watson, the well known map maker, of New York; and, for the convenience of traders, a list of the leading British and American exporters and manufacturers is appended. At present comparatively little is known by the majority of British traders of the vastness of our Australian dependencies, their commerce, progress, and growing civilisation; affording as they do a new field for our manufactures, and much valuable information is contained in the present volume which will tend to make these facts better known. Thirty years ago Australia and New Zealand were scarcely known to the commercial world; at the end of 1884 the imports amounted to upwards of £64,000,000 sterling, the exports, consisting chiefly of raw products, exceeding £51,500,000. It is claimed that this is the only directory which gives a full history of all the trades and professions in all the Colonies in a compendious shape, and the publisher states that the bulk of the information has been gathered on the spot, he personally having visited the several countries and the most important cities dealt with in the book.

Each country and colony is printed on different coloured paper, and has a separate index. The towns in each country are arranged alphabetically, and the name of each manufacturer, trader, or professional man is given under his town and calling. The following countries are included in the work: The Australian Colonies, Victoria, New South Wales, New Zealand, Queensland, South

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Australia, Tasmania, West Australia, Fiji, India, Burmah, The Straits Settlements, Java, Siam, The Philippine Islands, Ceylon, China, and Japan. Australia and New Zealand together cover an area of over 3,000,000 square miles, and have a population of nearly 3,500,000, which is growing by emigration at the rate of 65,600 per annum, the difference between the birth rate and death rate being 66,000 per annum. There are over 686,000 scholars in the State schools, and the public revenue is upwards of £24,000,000, the public debt exceeding £140,900,000. There are 8049 miles of railway open, and 2333 miles now in course of construction, and 66,439 miles of wire are in use for telegraphic purposes. The live stock in March, 1886, was estimated at 1,327,806 horses, 8,264,994 head of cattle, 84,222,262 sheep, and 1,129,851 pigs. These figures will give some idea of the growth of this particular portion of our Colonies. For many years after the discovery by Captain Cook in 1770, we used the country as a penal settlement, but this prevented free colonisation and the healthy development of the community; now we have grown wiser, and keep our convicts at home, extending our markets, and providing a new outlet for our manufactures and surplus population. Australia is rich in minerals—gold, copper, tin, iron, and other metals having been found—in addition to extensive coal deposits. These will insure for the country a great future in manufactures, though at present it chiefly relies on sheep, cattle, horses, grain, and sugar. For each country a large amount of useful information is given on the history and development of the country, its geology and physical features, its divisions into districts, and details of its population, together with statistics relating to the population and industries of such district. Particulars are also given of the government departments, the postal regulations, and the Customs duties, and under the heading of each town much important information is given. The maps are large, drawn to a good scale, and show the railways, mail and coach roads, as well as all the towns and cities. It is interesting to learn that Fiji, one of the latest territories annexed to the British Crown, comprises about 255 islands and islets, about one hundred of which are inhabited, the population consisting of about 2700 Europeans and 140,000 natives. The principal towns, Suva and Levuka, are fully described, and a classified list of their inhabitants is given. The British Empire in India, with its area of 1,486,319 square miles, and population exceeding 257,000,000, is treated separately, its chief towns being arranged alphabetically. The Chinese Empire, most of which is imperfectly known, as it is practically closed to foreigners, has an area of 1,535,000 square miles, and a population of about 405,000,000. All the treaty ports are fully described, and given in alphabetical order. Japan, a country probably as ancient as China, but which has shown a remarkable capacity for development and the adoption of Western ideas within recent years, has a population of about 37,000,000. The Government has shown a progressive spirit in recent times, and the advance of the country in arts and science has been great. Education has made rapid strides; gas, steam, electricity, railways, and machinery are all eagerly adopted by the Japanese. The first Japanese railway was opened in 1872; now there are several hundred miles of railway open, and about 5000 miles of telegraph lines. Much useful and interesting information is given respecting the country, and the principal towns are fully described in alphabetical order. The book is well printed, and conveniently arranged, and will form a useful reference volume for the merchant's office or counting house.

SAFETY LAMPS IN COLLIERIES.*

On a fine summer's day the sun expends an average of 1 h.p. on every 30 square feet of the earth's surface in this latitude, or 1450 h.p. per acre. This great gift of energy is neither utilised nor stored by man at present, though Nature presents us with some of it in waterfalls and flowing streams. The sun itself has been more generous. Ages upon ages ago it shone with resplendent glory on a grand luxuriant flora of a uniform but flowerless character in a climate warm and damp. England formed part of a tropical jungle or swamp, where grasses, mosses, ferns, and sedges, *coniferæ*, *araucariæ*, *equisetæ sagittariæ* grew and flourished, perished and fell *in situ*, to be covered up by following geological formations and compressed into those grand seams of coal that form now the principal source of England's greatness and wealth. If language be fossil poetry and words condensed history, then coal may be derived from *coelum* or κοίλος (*koilos*), and imply a Heaven's sent gift. The first authentic account of coal digging dates from the reign of Henry III., when Newcastle sent its first cargoes by sea to London, and thus gave the mineral the name of *sea coal*. Early records of the output of coal are wanting. In 1700, it was 2,614,000 tons: in 1800, is was 10,000,000 tons; in 1850, it reached 42,000,000 tons; in 1886, it reached 157,518,482 tons. A ton of coal occupies very nearly a cubic yard of space. Hence this quantity of coal, if placed in Hyde Park, would form a mountain as high as Snowdon, and if erected as a wall around the coast line of Great Britain it would be 6ft. wide and 30ft. high. It would form a girdle round the world 3ft. wide and 12ft. high. We extract from the earth twenty times more energy than the sun can possibly restore to it by the growth of forest, and we are gradually, but surely, tending towards the time when this store of power, heat, and light will be exhausted, when our busy hives of industry must seek other shores, and when England will perhaps become a summer resort for a wealthy Anglo-Saxon race occupying other quarters of the globe. Coal is not only, like knowledge, power, but, like the precious metals, it is wealth. The average price of coal at the pit's mouth in 1886 was 5s. per ton, and thus its total value was £40,000,000; but when we consider the average price paid for it, we must double, if not treble, this lump sum. The number of collieries open was about 3500, and since it costs £100,000 to open a colliery 2000ft. deep, when we think of the railways, the canals, the ships, the shops, the marts employed for its transit and its distribution, we can only conclude that the capital embarked in this industry must equal, if not exceed, the National Debt. The hewing and raising of coal is unquestionably a dangerous occupation. "The price of coal is pitmen's lives," said an old collier to George Stephenson. Five hundred and twenty thousand persons are employed in our collieries, and the output per person is 308 tons. Nine hundred and fifty-three persons met their deaths in 1886; but it is satisfactory to know that a miner's life is more than twice as safe now as it was thirty years ago. The number of persons employed per death was—in 1856, 242; in 1886, 545. The number of tons raised per life lost was—in 1856, 64,700; in 1886, 188,800. Most people, if asked what was the principal cause of this loss of nearly 1000 lives, would answer explosions of fire damp, but this would not be true. The principal cause of accident is falls of roof and sides. In 1886 there were from falls of roof and sides, 461 deaths; explosions, 129; trams and tubs, 81; and miscellaneous, 282. Thus falls of roof form 41 per cent. of the whole, and explosions 23 per cent. Explosions attract immense attention, from their publicity and their appalling suddenness and magnitude. It is dreadful to take up a morning paper and read of 268 fellow creatures engulfed, as at Abercarne in 1878, or 164 at Seaham in 1880; but the daily and steady loss of life by ones and by twos fails to get chronicled, and passes unheeded in the same way as the great majority of the 20,000 violent deaths that occur in these islands every year. All mines are required to have two shafts—one the intake or downcast, the other the return or upcast, and the workings are so interlaced with ways and roads, doors are inserted here and there to direct the current; anemometers are used to measure its rate of flow, that any ordinary inroad of gas is swiftly swept away. Fire damp, or pit gas, is marsh gas (CH_4). It oozes out gently from the exposed seam, or sometimes it bursts out through some fissure with great force, forming what are called "blowers." If it be mixed with air, in the proportion of from 5 to 9 per cent. of gas, it becomes highly explosive, and is the prime cause of those fearful disasters that have made coal mining so terrible. In gasless mines, candles always have been and still are used; but in early days, in foul places, men had frequently to work in the dark, or to be content with the feeble illumination of the phosphorescence of decaying fish. It is remarkable how the eye adapts itself to feeble light, and in the Cimmerian darkness of a coal mine even phosphorescence has a useful illuminating effect. In many places they used the steel mill; a disc of steel rotated rapidly against flint, giving light by the shower of sparks thrown down. It is most remarkable that no scientific thought was devoted to this subject until 1815. In 1813, Dr. Clanny, of Newcastle, had devised a very poor lamp, the air to support which was driven by bellows through water; but in 1815 Sir Humphrey Davy devoted his powerful mind and skilful hands to solve the question, and speedily invented in this very Institution his immortal safety lamp. It is a remarkable coincidence that in the same month another powerful but untutored mind, by strong observant powers and pure mechanical reasoning, had arrived at very nearly the same result; and even to this day the affectionate remembrance and name of the eminent Northumbrian brakesman, George Stephenson, is maintained by the use of the "Geordie," in his old home, the Killingworth Colliery. Davy's classical paper was read before the Royal Society, on November 11, 1815, and was entitled, "On the Fire Damp of Coal Mines; and on Methods of Lighting the Mine so as to Prevent Explosion." He showed that flame would not pass through small tubes and apertures, and how in comparatively still air, however charged with gas, a wire gauze surrounding the flame so reduced the temperature by radiation that explosion was impossible. Ingress of air and egress of products of combustion are resisted. He showed that a flame so protected gave immediate intimation of the presence of gas by burning dimly, and by becoming capped with a blue flame, or *aureole*, that though the wire gauze became red hot, it still radiated away the heat sufficiently to prevent its reaching the temperature point of explosion. He also pointed out, which has been strangely neglected, until enforced recently by the Royal Commissioners on Accidents in Mines, that it failed to act in a current of air, but that this effect of currents could be diminished by shielding or protecting the inlet of air. The main principle discovered by Davy is the basis of all safety lamps burning oil or spirit, but several departures in form have been proposed at different times. The "Geordie" is in reality a Davy lamp with a glass shield. The "Jack" lamp is a Davy in a tin can. The "Clanny" is a Davy lamp with the flame portion surrounded by a thick glass cylinder to increase the emission of light, and now with a bonnet or shield to protect it from currents of air. The "Mueseler," or Belgian type, is a "Clanny" with a central metallic cone acting as a funnel to increase the draught, and therefore the light. The "Marsaut," or the French type, is a bonneted or protected "Clanny," with two and three gauzes added to increase the security. The number of lamps is legion. A new intake here, a fresh egress there, a new direction to the currents of air feeding the flame, a change in the form or character of the wick, a lock, a different form of pricker, a shut-off or extinguisher (automatic or manual), is quite sufficient to justify a new patent and a new name. The Royal Commission experimented upon 250 different kinds of lamps. Since the commencement of the year a new Act has come into force rendering it unlawful to use the plain "Davy," "Stephenson," or "Clanny" lamp in mines where safety lamps are necessary. They must be shielded, and great numbers are being converted into bonneted "Marsauts" and "Mueselers." They are also being constructed to burn the best vegetable oil (rape or colza), to which one-third mineral oil is added, as recommended by the Royal Commission, to enhance the light giving power of the lamp. These converted lamps have baffled all attempts to explode them in currents of explosive gases of very high velocity, and under the most rigid tests. There are several objections to these oil lamps. They go out, or are put out when danger exists; they render that most important and essential duty, examination of the roof, difficult and insufficient. If they become extinguished by accident or design, much time is necessarily wasted in getting them re-lighted, an operation that must be done at or near the shaft, perhaps two miles away from the working face, and which therefore reduces the output of coal and the earnings of the collier. The light they give, even at the best, is very small—about one-third to half of a candle. There are several dangers present. The Royal Commission said: "The source of light within the lamp should be unable under any circumstance at all likely to occur in working coal to cause the ignition of an inflammable mixture of fire damp and air, even when this is passing at a high velocity." But glasses break by water, heat, falling coal, and accident. Joints get loose and bad even when protected by asbestos washers. They prove a constant temptation to the thoughtless and callous to get a light. The perfect light does not exist at present; but while these mechanical lamps are very excellent in their way, electricity seems likely to step in and supply their deficiencies and fill a decided want. An electric lamp can be made to give any desired amount of light; but anything between half a candle and a candle seems easily attainable, and such a light can be maintained steady and bright in explosive gases and in strong currents of air. They are simple in construction, easy of inspection; they are not likely to be extinguished in handling, like the Mueseler; but they do not act as detector of the presence of gas, and they might explode gas if their protecting glass shield were accidentally broken. It is remarkable that Davy himself in 1815 experimented with an arc lamp in a closed vessel of glass, but it was not until 1865 that a practical lamp was proposed for collieries. Dumas and Benoit used a small Geissler tube illuminated by sparks from an induction coil and excited by a primary battery; but it was heavy—it was a kind of knapsack to be carried on the back, and it met with no success. Mr. Swan has been more successful. The great success of the glow lamp, in the introduction of which he has played so prominent a part, and the perfection of the secondary battery, have enabled him to produce a lamp that compares in weight and size and light with the best mechanical lamp. Eight hundred of these lamps are in constant use in the National Colliery in the Rhondda Valley in South Wales, and one thousand six hundred more are on order for the Risca and Abercarne Collieries, belonging to Messrs. Watts, Ward, & Co. They are giving great satisfaction. A collier told me that the electric light was "as good as the moon." The lamp batteries are charged a great number at a time in blocks at the pit bank. Mr. Pitkin has also been very successful in making light portable lamps, and they have been practically used in Cannock Chase and at the Tyldesley Collieries in Lancashire. The "Sun" lamp is another very promising form, worked by secondary battery. It is light—3lb. 12oz.; it gives 1¼ candle, and this is maintained for ten hours. Secondary cells usually require about twelve hours charge to emit a ten hour discharge, but this cell will give a ten hour discharge with four hours charge. It is fitted with a safety appliance—a plan patented by Mr. Sennett in 1882—by which the lamp is automatically switched out the instant the outer protecting glass is broken or cracked, so that contact between the hot filament of the lamp and explosive gas is prevented. This safety appliance has been tested by Mr. Rhodes at the Aldwarcke Colliery in actual explosive mixtures. Many efforts have been made to introduce primary batteries for the same purpose, but up to the present moment I have seen only one—the Schanschieff—which in efficiency, lightness, and economy, comes up to the requirements of a safety lamp. A primary has this advantage over a secondary battery—that it is charged at once by an operation as simple as that of trimming a Davy. To trim a Davy means thorough cleaning, inserting a fresh wick, pouring in new oil. A primary battery means pouring out old and pouring in fresh solution. Occasionally zinc requires renewal, but all these operations are within the intelligence of the collier, and the lamps need not go to the surface. The simplicity of the operation has distinct merits of its own that compensate for the extra cost of the materials used. The chief charm of the electric lamp is not the greater light that it gives, but the power it gives the viewer to examine the roofs of the ways and workings; it is so extremely portable and handy; it can be put anywhere; the battery can be placed on the ground or suspended by a spike to a tree, and the lamp can be fixed in the cap or around the waist; it can be put anywhere and used anyhow. Mr. Sopwith, at Cannock Chase, has been taking heavy batteries to the working face, and using bright five-candle lamps in reflectors, so as to illuminate the working face with a light which in that region is comparable to daylight. The men are charmed with it. The chief defects of the electric lamps are their fragility, the liability of the carbon filament to break, the weight of the battery, and the absence of gas detection; and these defects have been very much enhanced by imperfect construction and injudicious details. Electricians have not spent sufficient time in the lower regions, and practical colliers have no time to go to the laboratory. When the two professions are properly amalgamated, we shall very likely obtain the true safety lamp. The electric lamp is not a fire damp detector, but an electrical appliance is easily added. Liveing and Swan have done this; but it is doubtful whether a more efficient detector than the Davy exists, and whether an apparatus that is so thoroughly understood, and so thoroughly practical, will be superseded for a purpose for which it seems so eminently adapted. I cannot conclude, especially in this place, with more pregnant words than Davy's own: "The gratification of the love of knowledge is delightful to every refined mind; but a much higher motive is offered in indulging in it when that knowledge is felt to be practical power, and when that power may be applied to lessen the miseries or increase the comforts of our fellow creatures."

* Abstract of a paper read by Mr. W. H. Preece, F.R.S., before the Royal Institution of Great Britain, 10th February, 1888.

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PROSPECTS OF ELECTRICITY AS APPLIED TO ENGINEERING.

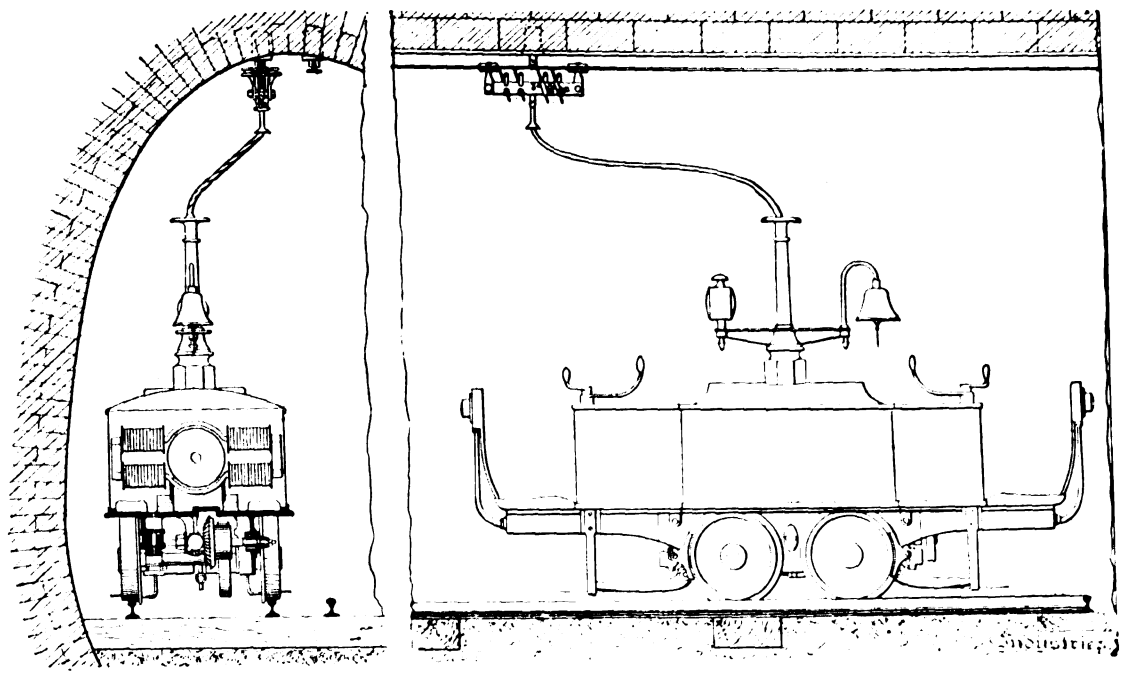


FIG. 2.—END AND SIDE ELEVATIONS.

PROSPECTS OF ELECTRICITY AS APPLIED TO ENGINEERING.*

(Concluded from page 149.)

Underground Haulage.—Electricity has been applied to haulage in various mines. A locomotive car, worked by a current sent through a conductor fixed along the side or the roof of an underground road, could be employed economically wherever the traffic is large and the distance considerable; but there is the objection of requiring a heavy locomotive car, in order to get sufficient tractive power for starting a train of tubs. In a colliery at Zaukeroda, near Dresden, power is generated above ground by a vertical engine, having a 10in. cylinder with 8in. stroke, which drives a Siemens dynamo. The current is led to the shaft, which is about 60 yards distant, by two bare copper wires; then down the shaft to a depth of 120 fathoms by well insulated conductors, to the T irons, which run along the roof of the waggon way and form the contact rails, as shown in Fig. 2. The current is picked off these rails by sliding contact pieces fixed to the locomotive, and is led to a switch, which can turn the full current either through the motor, or first through reducing resistances and then to the motor. A controlling switch with a seat for the driver is placed at both ends of the locomotive, so that perfect control of the speed and of the starting and stopping of the motor is provided. The length of the line is about 700 yards, and the gauge is 22½in. A train consists of about fifteen tubs, each carrying 10cwt. of coal; and the locomotive weighs rather over 30cwt. The journey takes from three to five minutes, the speed varying from five to seven miles per hour. The plant costs a little above £800, including steam engine, dynamo, motor, locomotive car, conductors, and accessories; it has been working successfully since 1882, and was supplied by Messrs. Siemens & Halske, by whom several other mines in Germany have since been similarly furnished. The working cost of hauling 660 tubs per day of sixteen hours is given by Mr. Rowan as follows:—

	s.	d.	s.	d.
Driver's wages	5	3		
Steam	2	3		
Engine driver at surface	3	1½		
Lubrication, &c.	1	1½		
			11	9
Interest and depreciation at 15 per cent. per year of 300 working days			8	1½
Total working cost per day			19	10½

For the output of 660 tubs or 330 tons per day this amounts to only about three farthings per ton.

Telpherage.—The plan of transporting material in skips on overhead wire ropes by means of electricity, introduced under this name by the late Professor Fleeming Jenkin, of Edinburgh, has not so great a field for its use in this country as it may have in less populous regions, because our roads are good, and railways generally near at hand, and we have abundance of water carriage. But in places where material has to be conveyed across hilly districts, or over bad roads, to the railway or water, it will be found more useful. It has been employed with considerable success for the past two years at Glynde, near Lewes, for transporting clay to the railway over a distance of 1600 yards; 270 tons are carried weekly at 7½d. per ton. In our larger cities a modification of this plan might advantageously be applied to alleviate the heavy street traffic. In the place of wire ropes, stiff girders might be used, the cars being suspended from wheels running along a rail or rails fixed on the girder. Such a railway would be economically constructed, in comparison, at least, with the expense of constructing an underground railway; and it would not have any great effect in obstructing the light from the streets, as is the case with elevated railroads for steam locomotives. A general idea of the present position of electric locomotion in Europe and America is furnished by Table IV., which is an abbreviation of one compiled in May, 1887, by Mr. T. C. Martin, President of the American Institute of Electrical Engineers.

III. ELECTRIC LIGHTING.

Of the four branches of electric engineering dealt with in this paper, electric lighting is the one which up to the present has received most attention, called forth the largest outlay of capital, and produced the most beneficial results, if not to so great extent in this as in other countries. Artificial illumination may be considered in the three aspects of comfort, convenience, and economy. As regards comfort, electric lighting proves itself superior to all other methods of illumination. For indoor lighting, the incandescent light may be utilised and toned down to suit almost any requirement. It may be brought near to any object requiring illumination, without occasioning the least inconvenience from heat or dazzle; or it may be far removed in the ceilings or cornices, without risk of fire, or of injury to the decoration. In short, it can be used in any position or for any purposes of illumination for which gas, oil, or candles are available, and for a great many for which they are not available. For outside illumination and large enclosures, the arc light gives a brilliancy and cheerfulness altogether unattainable by any reasonable expenditure of gas or oil. The convenience of the electric light has caused it to be highly appreciated, when it is found that by the mere pressing of a button a light is instantly obtained, which can be shaded over in any manner, without danger of setting fire to the fabric forming the shade. It also does away with the constant cleaning of globes or trimming of lamps. In respect of economy, the electric light does not as yet hold out the same decided advantages that it does in the other two respects just considered. In incandescent lighting, the cost of distribution is still heavy, though by increasing the e.m.f., and the efficiency of lamps, it is being much reduced. In arc lighting, the difficulty of sub-dividing and of reducing the amount of light given by one arc lamp, renders it expensive for general out door street illumination, as compared with the present low prices of gas and oil. For the lighting of main streets and railway stations, or other places where a concentrated light is required, the arc light is beyond question far cheaper than gas; and its cost per candle power is but a very small fraction of that of gas. As the use of electric lighting extends, the cost of working becomes reduced. Installations which four years ago cost 4d. per arc lamp per hour, are now costing only 2d. The chief saving has been in the items of carbons and attendance, though the increased efficiency and durability of the apparatus have also greatly contributed to the reduction. Four years ago, 11mm. or 0·43in. hard carbons cost 4d. per foot. They can now be obtained for 1½d. per foot, or less than one-third. The following figures supplied by the North British Railway respecting the actual cost of working their electric lights at the Waverley Station, Edinburgh, are interesting as showing how much cheaper it is becoming. The installation is worked by their own staff, and consists now of forty Brush arc lamps, supplied with a current of 10 ampères by a No. 8 Brush dynamo, which is driven by a semi-fixed engine.

July to December, 1884, thirty-three arc lamps, 41,884 lamp-hours.

	£	s.	d.
Wages	165	13	9
Repairs	47	2	6
Carbons	125	15	11
Coal	65	19	11
Oil, stores, &c.	27	15	0
Interest and depreciation at 10 per cent.	52	2	2
Equal to 2·77 pence per lamp-hour.	£484	9	3

July to December, 1886, thirty-nine arc lamps, 55,068 lamp-hours.

	£	s.	d.
Wages	195	17	6
Repairs	78	9	6
Carbons	62	17	3
Coal	23	14	1
Oil, stores, &c.	8	15	2
Interest and depreciation	41	10	6
Equal to 1·79 penny per lamp-hour.	£411	4	0

In conjunction with these arc lamps, they are running 148 Brush Victoria incandescent lamps, distributed in the refreshment and waiting rooms, and throughout the whole of the suburban station. For these the total number of lamp-hours for the half year was 171,251, and the cost was £83. 9s. 9d., including all contingencies, equal to 0·12 penny per lamp-hour. There were 113 lamps renewed, which shows an average life per lamp of 1515 hours.

Local Conditions.—The cost of incandescent lighting is especially variable, and affected by the local conditions of the installation. The chief of these are (*a*) the average number of hours of lighting each lamp, and (*b*) the average distance of the lamps from the generating station. The diagram (Fig. 3) shows

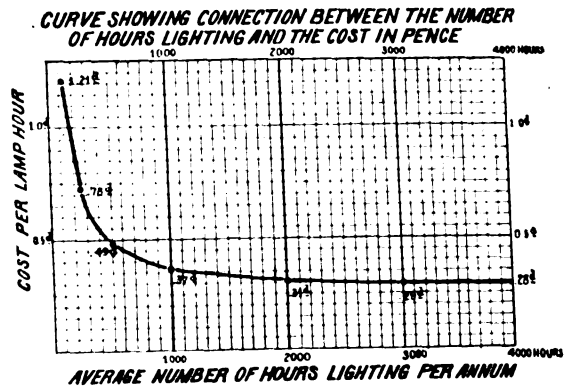


FIG. 3.

how the cost per lamp-hour varies with the number of hours the lamps are alight annually. Where the conditions are favourable, incandescent lighting can already compete with gas; and in a number of installations which have been superintended by the author a large saving is being effected. The following figures, kindly supplied by Messrs. George Jager & Son, show that the yearly cost of lighting their sugar refinery at Leith has been reduced from £347 with gas to £204 with incandescent lamps. The average life of the lamps is about 1400 hours each. The installation consists of 180 Brush Victoria lamps of 17 and 10 candle power, supplied by a self regulating Victoria dynamo, which is driven off the shaft that drives the centrifugal drying machines. The dynamo has been running night and day since it was started two years ago, without failure; it is started on the Monday morning, and runs continuously without stoppage till the following Saturday afternoon:—

	£	s.	d.	£	s.	d.
Previous average cost of gas lighting per annum	332	13	4			
Part of plumber's time	15	0	0			
				347	13	4
Cost of Electric Light, May, 1886, to May, 1887.						
Lamp renewals	46	9	8			
Oil, waste, sundries	17	5	0			
Coal at 3lb. per h.p. per hour, 40 tons at 6s.	12	0	0			
Repairs, including men's time attending dynamo	36	5	3			
Depreciation at 10 per cent.	33	16	0			
Gas consumed on Sundays, and when engine is standing	58	4	5			
				204	0	4
Saving per annum by electric lighting				£143	13	0

In the United States there is hardly a city or town of twenty thousand inhabitants which has not a central station for arc or incandescent lamps; and many towns of three thousand to four thousand are supporting them also. On the Continent large central stations for electric lighting are already in operation in competition with gas; but there the price of gas is generally two or three times what it is in this country. If the power is to be generated by dynamos and used direct, the cost of distribution on a large scale will probably never be reduced as low as with the existing gas supply; seeing that an efficiency of 95 per cent. can now be obtained with the dynamo, and that steam engines are not likely to be materially improved. It is therefore in the lamps that improvement is to be looked for, by making them with a higher resistance and greater efficiency. The accompanying Table V., which is an abbreviation of one previously constructed by the author,* may be interesting here as showing how the economical sectional area of conductor and the economical loss of potential vary for the different conditions of amounts lost in interest and depreciation on the conductors, and in horse power wasted in overcoming the resistance of the conductors. The question of conductors is one which must be left to a very great extent at the discretion of the engineer, in view of what are likely to be the requirements of each individual case; but when the conditions have been settled, Table V. is useful in showing at a glance the size and cost of the conductor, and the ensuing loss of potential.

Transformers.—These are at present receiving a large amount of attention. By their means small high tension currents of electricity, sent from a distant generating station along a small conductor with a comparatively small percentage of loss, can then be converted into large low tension currents for the supply of ordinary incandescent lamps. In some arrangements of

* Paper read before the Institution of Mechanical Engineers, on the 3rd inst., by Mr. Wm. Geipel, of Edinburgh.

* See *The Electrician*, 12th April, 1884, page 522.

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these transformers the loss in conversion is not more than 5 per cent. Unfortunately the alternating system, which has thus far been adopted, cannot be used with satisfaction for driving motors doing practical work or for charging storage batteries. The continuous current transformer has certainly the advantage in respect to the supply of power and to the charging of storage batteries; but it is a question whether the disadvantage of having to keep it continually in motion will enable it in town lighting to compete with the alternate current transformer. The latter is employed in the Grosvenor Gallery central station in London. Some idea of its importance may be formed from the fact that the Westinghouse Company have already in America over one hundred thousand lamps at work on this system, although it is not yet so much as two years since they adopted it. Notwithstanding that the use of transformers enables a great saving in copper to be effected, more especially where the lamps are scattered, as in suburban districts, yet it is to be remembered that the insulation of underground conductors forms a very important item in their total cost. The installations already at work are all worked with overhead conductors, with the one exception at Eastbourne; so far as the author is aware there are no practical data to establish the general applicability of the transformer system for the lighting of large and thickly populated towns where underground conductors may alone be tolerated. The loss owing to induction will also be vastly greater with underground conductors, however carefully installed. Secondary batteries charged in series by a high tension current and discharged in parallel circuit have been tried experimentally; but their practical application is not known to the author. At the same time, now that transformers are becoming more used, strenuous efforts are being made to introduce this system of secondary batteries; and if it can once be demonstrated to be economical, there can be little doubt that it would have a large field of application. Its great merit is of course the reduction of risk of the light failing. It should be borne in mind by electric light companies that the supply of incandescent lamps is not to be their only source of revenue; but as already pointed out, the supply of current should be of such a nature that it may be employed for as many purposes as possible. By the use of efficient boilers and engines, and properly constructed continuous current dynamos, a central station can be so constructed as to be no nuisance whatever, provided proper precaution be taken in selecting the site. In large towns it will not be necessary to extend the conductors very far before a demand will be met with sufficient for occupying an engine large enough to be economical. Above a certain size the cost of working a steam engine becomes practically constant for any increase in size; so that, instead of working from one large central station over a very large area, it is found better to work from smaller stations over smaller areas. The cost of attendance will thereby be increased to only a small extent, because one man cannot fire more than two boilers; therefore when more boilers are required, it is preferable to work them at another station with another fireman. At Leamington an extensive central station is now at work, and the cost of the undertaking is about £30,000. The Bradford Corporation have recently voted a sum of £15,000 for erecting a central station in their town. Both of these are instances of direct supply, without transformers or secondary batteries.

IV. Electric Metallurgy.

This branch of electrical engineering bids fair to become speedily of the highest interest to engineers. The electro-chemical separation of ores on a commercial scale by the electric furnace has but recently been put to the test, chiefly in obtaining aluminium from corundum, its richest ore. Sir William Siemens first turned his attention to the subject, but his death occurred before he had perfected his invention. It was taken up by Messrs. Cowles, who, with the assistance of Professor Mabery, have devised a furnace, in which by the passage of powerful currents the refractory ore is successfully reduced. The furnace is built of fire brick, and lined with powdered charcoal to withstand the intense heat; it is in the form of a box, 5ft. long, 12in. wide, and 15in. deep. Current is conducted through the walls and into the ore by means of a number of carbon rods, 3in. diam. and from 2ft. to 3ft. long. The positive and negative carbons are introduced from opposite ends, and nearly meet in the centre. The ore, mixed with charcoal and granulated copper, is put in so as completely to surround and cover the carbon. The furnace thus charged is closed with a layer of charcoal and a lid lined with fire brick. Without the protection of some such refractory material as charcoal the intense heat causes the fire bricks to run. When the furnace is ready, the current with an e.m.f. of 50 volts is turned on, and is gradually increased up to some thousands of ampères. In a few minutes the metal is melted around the electrodes; and these are then moved farther apart, until the current passes through the entire charge, and the whole is in a molten condition; the corundum becomes gradually deoxidised, the aluminium combining with the copper, while the oxygen with the carbon escapes as carbonic oxide. About five hours suffices to complete the reduction. Current is supplied by large Brush dynamos—a sketch of which was shown at the meeting. This machine was specially constructed for the work, and is capable of giving out 300,000 watts, or over 400 electrical horse power. Its weight is nearly 10 tons; 5424lb. of copper are wound on the field magnets, while the armature has 825lb. of copper on it. Works already in operation at Lockport, U.S., have a capacity of 6000lb. per day; and the cost of the aluminium bronze so made is expected to be less than 1s. 8d. per lb., while Mr. Cowles anticipates the price being reduced to 8d. per lb. Works have also been started at Stoke-on-Trent, where a 500 h.p. dynamo has been fixed for generating the current; the potential is 60 volts. Another electric furnace has been devised by Dr. Kleiner, of Zurich, in which cryolite, a double fluoride of sodium and aluminium, is similarly treated. When it is remembered that the metal aluminium, in addition to many other good qualities, possesses great strength with only one-third the weight of iron, the importance of obtaining it at a reasonable cost will be readily appreciated. It would undoubtedly cause a great revolution in engineering construction. The process of welding by electricity, introduced by Professor Elihu Thomson, is similarly based upon the passage of a powerful current between two electrodes. In this case the two pieces of metal to be welded form the electrodes; they are brought together into close contact, and as soon as the current is sent through the joint its resistance causes intense heat, until the weld is perfectly completed. The process is almost instantaneous, and the heating occurs only at the joint. Tempered steel can be thus welded without in the least affecting its hardness. Another plan of electric welding has been introduced at St. Petersburg by Dr. Bernardo, in which the heat necessary for fusion is caused by an arc. The current is conducted to the weld by means of a carbon rod, which is connected by a flexible cable with the positive terminal of a dynamo or battery, while the metal to be welded is connected with the negative terminal. The action of the arc set up by the flow of current from the carbon to the metal may be likened to that of the blow pipe flame, except that the heating is more intense and sudden, and is therefore more local. The reducing action brought to bear on the metal keeps it clean and unoxidised.

PROSPECTS OF ELECTRICITY AS APPLIED TO ENGINEERING.

Table V.—*Electric Conductors—Sectional Area, Cost, and Potential Fall.*

Cost of conductors.	£100 per ton = 10·71d. per lb.			£150 per ton = 16·07d. per lb.			£200 per ton = 21·43d. per lb.			£250 per ton = 26·79d. per lb.		
Cost per year per electrical horse power.	Area per 100 amperes.	Cost per 100 yards.	Potential fall per 100 yards.	Area per 100 amperes.	Cost per 100 yards.	Potential fall per 100 yards.	Area per 100 amperes.	Cost per 100 yards.	Potential fall per 100 yards.	Area per 100 amperes.	Cost per 100 yards.	Potential fall per 100 yards.
£	Sq. inch.	£	Volts.	Sq. Inch.	£	Volts.	Sq. Inch.	£	Volts.	Sq. Inch.	£	Volts.
½	0·04576	2·378	5·3231	0·03736	2·912	6·5194	0·03235	3·362	7·5279	0·02894	3·759	8·4165
1	0·06471	3·362	3·7640	0·05283	4·118	4·6099	0·04576	4·755	5·3231	0·04093	5·316	5·9514
10	0·20463	10·633	1·1903	0·16708	13·023	1·4578	0·14470	15·037	1·6833	0·12942	16·812	1·8820
20	0·28939	15·037	0·8417	0·23629	18·417	1·0308	0·20463	21·266	1·1903	0·18303	23·776	1·3308
30	0·35443	18·417	0·6872	0·28939	22·556	0·8417	0·25062	26·046	0·9718	0·22416	29·120	1·0866
40	0·40926	21·266	0·5951	0·33416	26·046	0·7289	0·28939	30·075	0·8417	0·25884	33·625	0·9410

Table IV.—*Electric Railways in Europe and America.*

	Place, and mode of working. *	*	Length of line. Miles.	Rolling stock.	Cost of working.
Europe	Lichterfelde, Berlin	R	1·5	2 cars	
	Brighton	R	1	2 cars	1·92d. per car mile.
	Moedling-Hinterbruchl	O	2·8	12 cars	3·42d. per car mile.
	Frankfort-Offenbach	O	4·1	14 cars	3·83d. per car mile.
	Zaukeroda colliery	O	0·45	1 locomotive ... 16 waggons	0·77d. per ton.
	Hohenzollern mine	O	0·47	1 locomotive ... 15 waggons	0·50d. per ton.
	Portrush	Th	6	4 cars	2½d. per car mile.
	Bessbrook and Newry	Th	3	8 cars	4d. per train mile.
	Blackpool	U	2	10 cars	less than 4d. per car mile.
	Brussels	S	—	5 cars	
	Hamburg	S	—	2 cars	
America	Baltimore, Maryland	Th and O	2	6 cars	16s. 8d. per car per day.
	Los Angeles, California	O	3	8 cars	
	Port Huron, Michigan	O	4	8 cars	
	Windsor, Canada	O	2	2 cars	16s. 8d. per day for power.
	Highland Park, Detroit	Th	3½	2 cars	3s. 2½d. per day for fuel.
	Dix Road, Detroit, Michigan	O	1¾	4 cars	
	Appleton, Wisconsin	O	4½	8 cars	
	Scranton, Pennsylvania	O	8¼	3 cars	
	Denver, Colorado	U	3½	7 cars	6s. 2d. per day for fuel.
	Montgomery, Alabama	O	11	18 cars	50 per cent. less than horse and mule traction.
	Kansas City, Missouri		—	—	
	Orange, New Jersey	O	½	1 car	
	Boston, Mass. (short line in sugar refinery)	O	—	1 locomotive .... 3 cars	

* O=Overhead conductor. R=Ordinary rails. S=Storage batteries. Th=Third rail. U=Underground conduit.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

At the ordinary meeting of this Society, held on the 9th inst., two papers were read dealing with the subject of alternating current transformers and the distribution of electricity by means of these appliances. The first of these papers we have already reported in our last issue. The second, which occupied the rest of the evening, was by Mr. J. Kenneth D. Mackenzie, and in it the question of distribution was treated from a general point of view, including dynamos, mains, transformers, and certain matters which might best be described as coming under the title of general principles and administration of electric light stations. These two papers were the first on the subject submitted to a scientific society in England. Information in connection with transformers had up till then been carefully withheld by the makers and users of such apparatus—a state of things probably due to the pending litigation on transformers—and the Society of Telegraph Engineers may be congratulated upon having at last broken the spell by including transformers amongst the subjects treated at their meetings. The paper of Mr. Mackenzie was specially valuable, as this gentleman has had considerable practical experience in the working of transformers. The author distinguished between polar and non-polar transformers, the first being of the type of the original Rumkorff induction coil, whilst the latter are developments of the well known Faraday ring. Messrs. Gaulard & Gibbs were the first to take up the subject on a commercial scale, employing polar transformers which had either a movable core or a fixed core provided with a movable gun metal shield, by which means the e.m.f. and the secondary circuit could be adjusted; but these devices were only adopted in their first experimental installations, when it was thought desirable to have means for readily adapting each transformer for the work it had to do. For permanent installations, however, where the conditions of supply could be settled beforehand, Messrs. Gaulard & Gibbs adopted the non-polar type of transformer and introduced a series of improvements, the object of which was (1) reduction of electrical resistance, (2) maximum induction with a minimun weight of materials, (3) perfect symmetry between the primary and secondary circuits, and (4) an equal weight of copper in the two circuits. Referring to the manner of coupling up the transformers in a general system of supply, the author stated that transformers might be worked in various ways. If in series, the lamps fed from each transformer must also be placed in series, and two years ago he had jointly with Mr. Bernstein made some experiments, which, so far as regulation went, were perfectly successful. The primary current was adjusted to the same strength for each experiment, and those lamps which were not required were simply short circuited. He found it possible to short circuit the whole of the secondary without perceptibly increasing the current, and without any danger of overheating. The difficulty he found was not in the transformers, but in the dynamo. He found it almost impossible to maintain the current of the dynamo constant under varying loads, and considered improvements in this direction very desirable. Transformers might be worked in simple parallel arrangement, as is now customary, or they might be worked on the three-wire system, or on the parallel network system, both the primary and secondary mains being all joined in two networks. This is the system employed by Mr. Westinghouse in America. As regards the mains, Mr. Mackenzie is in favour of overhead wires, these being more

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easily insulated; but he recommends that they should be suspended from bearers, consisting of copper or phosphor bronze cables, by insulated hangers at about every yard. In certain localities the bearers might be steel cables; but in large towns copper or phosphor bronze would be preferable, as not so liable to destruction from atmospheric influences. The bearers should be designed so as to have at least a ten-fold margin of safety against breakage. One of the difficulties he found in connection with bearers was, that on long circuits they became charged with an alternating potential by induction from the mains, and a considerable shock would be felt by touching any of the bearers, although they were insulated from the main. In the early days of the Grosvenor Gallery installation, some difficulty was also experienced from the mains by their inductive effect on the telephone wires, and owing to the number of complaints received from telephone subscribers, the company instructed the author, in conjunction with Dr. Hopkinson, to investigate the subject, and report on the best method to remedy the evil. The installation was then worked on the series system, and the evil was removed by the simple device of running the return main parallel to the outgoing main over the whole of the district. By this means the effect of the current on the telephone wires in one main was neutralised by that in the other main. When the cables are placed underground the author suggests the employment of an earthenware channel, with a cover made as nearly as possible water tight. Within the channel are placed shelves of paraffined wood, on which the conductors rest, and at stated intervals drainage holes are provided for getting rid of water which might find its way into the channel. He does not advocate the use of lead covered cables. In the installation at Aschersleben these cables were used both for the supply and the distributing mains; but it was found that the lead was destroyed by sparks due to a static charge, the cable forming a condenser, and these cables were ultimately abandoned. At the installation in Tours some difficulty was also experienced with underground cables; but since these were laid in earthenware troughs, similar in construction to those suggested by the author, no further difficulties were met with. The author also showed a plan of the port of Spain, in Trinidad, for which he had designed an electric light installation, there being about twenty miles of circuit.

In dynamos for alternating currents considerable improvements have been made during the last few years, the most remarkable of these being the adoption of iron in the core of the armature. In certain cases the author recommends the employment of a low tension dynamo at the generating station, and transforming the current from it by a large transformer into one of high tension, which is sent into the supply mains; but he is opposed to the system of employing dynamos of excessively large dimensions. In this connection he adversely criticised the proposal of one London electric light company to erect dynamos having armatures 42ft. in diameter, and requiring 5000 i.h.p., supplied by quadruple expansion marine type condensing engines. He thinks it far safer to employ a number of dynamos coupled in parallel, the capacity of each dynamo not to exceed about 10 per cent. of the total capacity of the station. There is no difficulty in working alternate current dynamos in parallel, and he has, in fact, done so with Siemens' machines at the Grosvenor Gallery; but he found that the synchronism between the machines was not very stable, and easily disturbed by external influences. With modern machines this difficulty might not prove so great. A diagram of the Kingdon dynamo was exhibited. The peculiarity of this machine is that both the field magnets and the armature form part of the same structure, and that the movable portion of the machine contains iron only, but no wire. Briefly described, the machine which the author and Mr. Kingdon are now building, and which is to absorb 50 h.p., consists of a circular yoke ring, 10ft. in diameter, having a number of short radial magnet cores projecting inwards. Between these revolves the armature wheel, which might conveniently also form at the same time the fly wheel of the engine. Every alternate core is wound with exciting wire, so as to produce north and south poles alternately on the inner end, whilst over the intermediate cores are placed the coils in which the alternating currents are generated. The revolving part consists of a wheel, carrying on its outer circumference a number of soft iron armatures, the width of each being such as to span over the inner ends of two adjacent magnet cores. When the wheel is revolved, these armatures seem to carry north and south lines alternately through the cores on which the armature wire is wound, and by this means alternating currents are generated.

Regarding the placing of transformers, the author is of opinion that to provide a small transformer for each house is only admissible when the number of subscribers is small; but for a general supply and for permanent work the transformer should be kept out of the house, and a sufficient number should be installed throughout the district, so that the maximum distance of any lamp from the nearest transformer should not exceed 120 yards. Great care is to be taken in the wiring of houses, and he deprecated the system of utilising the existing gas fitting for the attachment of lamps. In his own experience, when connected with the Grosvenor Gallery installation, and it was worked on the series system, he has known as many as eight houses plunged into darkness owing to short circuits occurring between the gas fittings and the electric wires in the first and last of these houses. If for reasons of economy it is necessay to use gas brackets, he recommends that their connection with the gas pipes should be interrupted.

THE SOCIETY OF CHEMICAL INDUSTRY.

On Monday, the 6th inst., at a meeting of the above Society, held at Burlington House, Mr. Lewis T. Wright read a paper on "Studies in Coal Distillation." In his experiments he used a Yorkshire coal valued for gas making purposes. An average sample contained 2·26 per cent. of moisture at 100°C., and had the following composition, dried at 100°C.: C 81·92, H 5·39, N 1·28, S 1·97, O 6·88, ash 2·56, total 100·00. In the distillation, temperature observations were made throughout with a Murrie pyrometer with its bulb immersed in the coal; the highest temperature observed was 800°C., and the lowest 600°C. The coal was distilled in a setting of seven double through clay retorts, 18in. by 16in. by 18ft., at various temperatures, requiring from five to eight hours to completely gasify the volatile constituents of the charge of 2cwt. of coal per retort of 9ft. length. The gas yielded varied from 6600 to 12,000 cub. ft. per ton, and the volatile constituents of the coal were gasified at from 50 to 137 cub. ft. per superficial foot of internal retort heating surface per twenty-four hours. The coal was distilled in charges of 2cwt. at temperatures requiring five, six, seven, and eight hours to gasify the volatile constituents of the charge, with the following average results:—

Duration of charge of 2cwt. Hours.	Gas made per foot super. of retort heating surface. Cubic feet.	Specific gravity of tar at 15·5°C.	Fixed carbon in tar. Per cent.
8	50	1·084	8·69
7	62	1·103	11·92
6	91	1·149	15·53
5	133	1·204	24·67

Five samples of tar were drawn off for examination. The specific gravities and yields of gas per ton of coals, on the days when the tar samples were collected, were as follow:—

Specific gravity of tar at 15·5°C.	Coal yielding cubic feet per ton.
1·086	6,600
1·102	7,200
1·140	8,900
1·154	10,162
1·206	11,700

The tars were distilled in a cast iron experimental tar still, capable of dealing with 20 gallons at a charge. The anthracene oils were driven off with steam, and the pitch is not softened, but is hard pitch, not twisting at temperatures under 100°C. The results are here given in weight percentages:—

Specific gravity of tar	1·086	1·102	1·140	1·154	1·206
Ammonia water	1·20	1·03	1·04	1·05	0·383
Crude naphtha	9·17	9·05	3·73	3·45	0·995
Light oil	10·50	7·46	4·47	2·59	0·567
Creosote	26·45	25·83	27·29	27·33	19·440
Anthracene oil	20·32	15·57	18·13	13·77	12·280
Pitch	28·89	36·80	41·80	47·67	64·080

The proportions of the distillates (by volume) coming over at 120°, 140°, and 170° were noted, and the oils volatile up to 140° were re-distilled, and the quantity by volume related to the original crude naphtha coming over up to 100° noted. The results of these re-distillations were given by the author in numerous tables of figures. He also gave the following

Percentage of Pure Anthracene by Weight of Tar.

Specific gravity of tar.	Anthracene. Per cent.
1·086	0·215
1·102	0·267
1·140	0·370
1·154	0·277
1·206	0·232

The creosotes from the 1·206 and 1·154 tar were almost solid with naphthalene. All the other tars yielded perfectly solid creosotes. The oils coming over at 100°C. from the naphthas are at their maximum in the 1·102 sp.gr. tar. The naphthalene makes its appearance prominently in the 1·154 sp. gr. tar. The anthracene is at its maximum in the 1·140 sp. gr. tar. The diminution of the tar acids or phenolic bodies and the middle oils, with increase of temperature, is very marked. Increased temperature tends to destroy chiefly the light oils, intermediating crude naphtha, and creosote.

The author next dealt with the influence of the distillation temperature on the sulphur compounds other than sulphuretted hydrogen occurring in coal gas, saying that gas makers have long understood that such compounds increase as the distillation temperature rises. In his experiments he used gas plant clay retorts. The heat employed may be gathered from the quantity of gas made per ton of coals, stated in cubic feet, corrected to the standards of 60°F. and 30in. bar. saturated with water vapour; the stated sulphur compounds in the washed but otherwise unpurified gas, is given in terms of grains per 100 cub. ft. of purified gas. The author gave his results with the different kinds of coal, and the following with the coal already mentioned:—

	Coal yielding cubic feet per ton.	Grains of sulphur other than sulphuretted hydrogen per 100 cub. ft.	Sulphur other than H_2S per 100 parts by weight of coal.
Average of 8 experiments	11·620	44·17	·033
„ 2 „	10·772	36·93	·025
„ 8 „	9·431	26·75	·016
„ 5 „	8·370	19·16	·010
„ 7 „	6·896	13·91	·006

Lastly, he came to the influence of the distillation temperature on the yield of ammonia from coal. The results were not very determinate, owing to unknown disturbing influences; but at low temperatures the yield is low, at medium temperatures it is at its maximum, and at high temperatures there is again a falling off. The following is a typical case:—

Coal yielding cubic feet per ton.	Ammonia per ton of coal.	Percentage by weight of coal as ammonia.
11,620	7·411	0·331
10,162	7·894	0·352
9,431	7·504	0·335
7,512	6·391	0·285

In this case the maximum of ammonia is with a make of 10·162 cub. ft. of gas per ton of coal.

The Chairman (Mr. Howard) said that they did not know from day to day which one of the products of coal tar distillation would be most in demand for industrial purposes, consequently researches like this would aid gas manufacturers in the future.

Dr. Tidy remarked that in coal distillation if they went much over 10,000 cub. ft. they obtained a large quantity of sulphur; 9500 cub. ft. should be the maximum. Of course gas directors thought that manager to be the best who made most gas, but they would find it to their interest to keep down the make to 9500ft.; when they went on to 10,500ft. they obtained 40 grains of sulphur or upwards, which had to be specially removed. He should like to know the illuminating power connected with Mr. Wright's yield.

Professor Dewar said that the figures given by Mr. Wright indicated that as they doubled the quantity of gas they squared the quantity of sulphur.

Other speakers stated that there was no difficulty in removing a large quantity of sulphur compounds from gas, and in keeping them down to 14 or 15 grains, also that under some circumstances not yet understood, the sulphur vessel will give off more sulphur than it absorbs, which is a matter deserving investigation.

THE RANGE OF MOLECULAR FORCES.

Professor A. W. Rücker, F.R.S., gave an interesting lecture on molecular dynamics at the meeting of the Chemical Society of London, on Thursday, the 2nd inst., The lecture was illustrated by a series of well devised and novel experiments, upon which great care had been bestowed. The author said that the range of molecular forces has two limits—the one determined by the radius of molecular action, which is not a definite physical or mathematical quantity, and the other by the size of the molecules themselves. In investigations on molecular dynamics we must take into consideration the influence of the medium (if any) in which the molecules are placed, and the problem may be possibly comparable to similar studies on the relations of the bodies in the solar system. The law of the inverse square of the distance is applicable, according to Sir W. Thomson, to bodies very close together, and speculations on the molecular forces are based on this law. It is at present impossible to say when the molecules of any two bodies are directly in contact, and measurements of their size and diameter may include the space around each molecule, into which a third one cannot enter. Some of the earliest experiments which throw any light on these problems were those of Professor Bunsen, on the condensation of gases by solids, in which he determined the amount of carbonic acid, which was condensed on glass plates exposed to that gas. Glass plates also condense water on their surface, and this water is held by molecular forces, so that a temperature of 503° is required to remove the last traces of water from the surface. It is possible to distinguish the water condensation into

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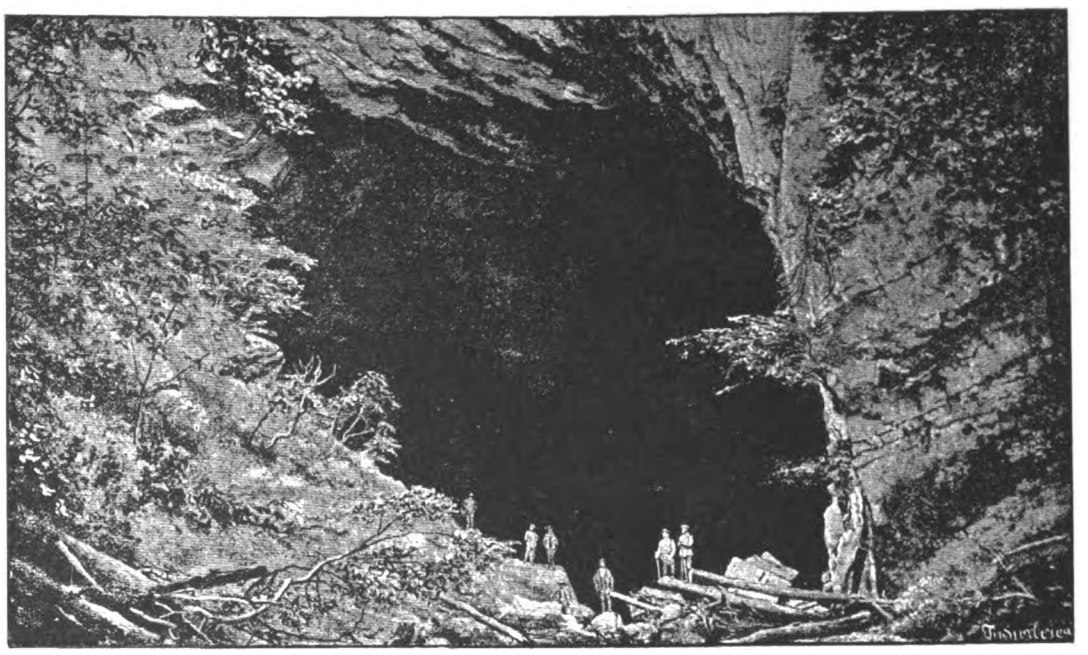
two kinds, viz.: that which is only temporary and can be readily removed by a current of dry air, and that which is permanent and requires this high temperature before the attraction between the water and glass molecules is overcome. The amount of water which condenses on surfaces has been determined by the balance in the experiments of Warburg and Ihmeri, and they have shown that it is possible to detect an alteration of $\frac{1}{10}$th of a millionth of a millimetre of the thickness of the film. The surface influence varies with its condition, as different results were obtained when the spheres were washed before the experiment. They are of opinion that the water is attracted not by a mere physical force, but that there is a loose chemical combination of the water with the free alkali of the glass. With agate, quartz, and impure opal, the thickness of the condensed film is considerably less, so that the permeability of the substance influences the result. Other experiments in the same direction are those of Lahnman, in which the thickness of threads of mercury were similarly determined, and Müller and Erzbach's experiments point to the same conclusion. Plateau, in his investigations on the thickness of soap bubble films, arrived at the number 118M (M=millionth of a millimetre), for the radius of molecular action between the two surface layers of the film, and the half of this number is very near to the experimental numbers arrived at by Reinold and Rücker in their investigations. Quincke's experiments with silvered plates with water between gave, from a measurement of the amount of silver converted into silver iodide, a value of 50M for the radius of molecular action. Professors Reinold and Rücker's own experiments with soap bubbles have already been alluded to in this journal. There appears to be a sudden change in the surface tension immediately before the film becomes black, and there is a range of unstable thickness due to minimum of surface tension. The surface tension begins to diminish when the thickness of the film is about 100M, and 50M is about the value for the radius of the molecular actions.

Many electrical methods have been devised for attacking the same problem, and of these, the first in the order of time were those of Kohlrausch, in his experiments on the determination of the least thickness of the film of gas required to produce the greatest difference of potential. With oxygen, assuming that the gas was at its ordinary tension, he obtained the value 20M. Helmholtz assumes that the double electrical layer between two dissimilar metals in contact is equal to the distance between the two layers of molecules. In Lippmann's capillary engine the change of surface tension gives values for the molecular radii from 1M to 200M. Wiener's experiments on the interference of light between plates of mica, one of which carries a silver mirror as a reflector, shows that when the thickness is 12M there is still some change. Experiments on the polarisation of light by carbon bisulphide inclosed between two electrified cylinders, show that the beam of polarised light passes when the cylinders are electrified. By means of Clausius' formula, the volume of molecules can be determined from the values of the index of refraction or specific inductive capacity, and Exner, in examining these results, considers that $\frac{1}{3}$th of the volume so obtained consists of matter. Other methods of determining the size of molecules from values obtained for the mean free path in diffusion experiments and determinations of viscosity constants, were alluded to by Professor Rücker. The deviations from Boyle's law also, according to Sir W. Thomson, point to 200M as an approximate value for this number. The following table gives a summary of the chief results which have hitherto been obtained:—

M.		
118.	Superior limit to radius	Plateau&Maxwell
96 to 45.	Beginning of unstable thickness of soap film	Reinold & Rücker.
59.	Superior limit to radius	Plateau.
50.	Value of radius	Quincke.
12.	Lower limit of unstable thickness.	Reinold & Rücker.
12.	Action of light on silver plate	Wiener.
10·5.	Thickness of permanent water film on glass at 23°C.	Bunsen.
4 to 3.	Mean distance between molecules in gases at atmospheric pressure and 0°C.	Meyer.
3 to 1.	Thickness of metal films which polarise platinum	Overbeck.
1 to 0·02.	Thickness of electrical double layer	Overbeck and Lippmann.
0·2.	Smallest appreciable thickness of silver film	Wiener.
0·14 to ·11.	Diameter of hydrogen molecule	Exner and Van der Waals.
·07 to ·02.	Mean distance between molecules in liquid	Thomson.
0·02.	Inferior limit to diameter of gaseous molecules	Thomson.

CHROME STEEL.—The artillery officers at Trubia have succeeded in making excellent chrome steel for tools, and are using it in all drilling machines in that establishment.

THE NATURAL TUNNEL IN VIRGINIA.



THE NATURAL TUNNEL IN VIRGINIA.

WE are indebted to the *Engineering and Mining Journal* of New York for the accompanying illustration and description of this interesting natural tunnel. This remarkable freak of nature is situated amongst the most picturesque portions of the Appalachian range. It serves as an underground passage for a noble river, and the South Atlantic and Ohio Railway Company have taken advantage of the means it provides for overcoming the barriers and obstacles presented by the mountains. Some idea of the gigantic proportions of the tunnel will be conveyed by the illustration, which gives a view of one of its entrances. The great natural bridge which spans the cave has a total length of 930ft., and in some places is more than 150ft. broad. About 200ft. from its southern entrance the tunnel expands into a magnificent circular dome of great height; and the approach to the cave at that extremity is through a semi-circular cañon, the walls of which are over 500ft. high, and overhang the water at their base.

Notes.

NEW FLOATING DOCK AT SYDNEY.

THE first half of an iron floating dock was launched on the 30th November, 1887, at the Atlas Engineering Company's Works, Woolwich, Sydney, New South Wales. This half dock can be used by itself pending the completion of the second half, and is capable of lifting a vessel of 1000 tons. When the two halves are connected, the dock will lift a 2500 ton vessel in less than an hour. An advantage of the dock will be that it can be readily converted into two docks, should two vessels of moderate size require repairing at the same time. The construction of the dock, which will be finally completed in March, 1888, has been under the superintendence of Mr. J. R. Thomson. The launch of the first half was most successful, despite the awkward form of the structure.

COTTON GINS FOR CHINA.

THE United States Consul at Shanghai states that he has been informed that if the Americans would make a hand cotton gin for the Chinese it would meet with a ready sale. As the country where it was made would be immaterial, provided the article proved suitable, we quote the following from the Consul's remarks: "There is a Japanese gin of this kind worked by foot; but it does not pick the seed well, and is but partially adapted to its purpose. The Chinese cotton is coarse and very short staple, and the seed is small. The machinery would have to be adapted to these conditions. An American gin, such as is now used in the South, with a crank to turn by hand, could be easily suited to this work. Anything not operated by manual labour would not be taken up by the Chinese."

HOME AND FOREIGN SHIPBUILDING.

AN interesting return has just been issued by the Norwegian Royal Central Statistical Bureau of the business done in different countries in shipping, from which a few extracts will be interesting to our readers. As, for instance, the following figures in which the year 1880 is compared with 1885, which show a considerable decrease in the relative proportion of the steam tonnage built in the United Kingdom in 1885:—

Statement showing the Net Tonnage built in different European Countries in each of the Years 1880 and 1885, and distinguishing Steam and Sailing Vessels:—

	1880.			1885.	
	Steam.	Sailing.		Steam.	Sailing.
United Kingdom	355,716	59,106	...	205,088	202,362
Denmark	2,416	2,489	...	2,538	2,904
Norway	1,385	23,908	...	5,563	14,180
Sweden	2,575	4,887	...	6,577	3,392
Germany	15,559	9,901	...	9,925	12,316
Holland	909	1,804	...	1,422	7,161
Belgium	—	—	...	1,343	—
France	3,951	9,101	...	5,930	10,591
Italy	89	14,323	...	320	9,533
Austria	3,562	4,205	...	3,454	566
Totals	386,162	129,724	...	242,260	263,005
Percentages of total in each year built in Great Britian	92	46	...	80	76

There is another series of returns which show the tonnage of new ships built in the chief shipbuilding countries of the world during the period 1880-85, distinguishing steam and sailing vessels, a synopsis of which is embodied in the following table:—

	Steamships.		Sailing Ships.		Total.		Percentage of total tonnage.
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	
Great Britain	3072	2,633,477	2259	786,966	5,331	3,420,443	79·7
Germany	313	191,672	318	82,292	631	273,964	6·4
Holland	28	24,338	96	19,445	124	43,783	1·0
France	286	143,775	4462*	69,903	4,748	213,678	4·9
Norway	115	25,926	516	102,087	631	128,013	3·0
Sweden	165	32,587	74	16,862	239	49,719	1·2
Italy	33	4,574	1161	79,164	1,194	83,738	2·0
Austria	27	23,857	267	13,957	294	37,814	0·9
Hungary	1	64	25	2,152	26	2,216	0·0
Belgium	5	5,129	—	—	5	5,129	0·0
Denmark	33	20,325	291	13,974	324	34,299	0·8
Totals	4073	3,105,994	9469	1,186,802	13,547	4,292,796	—

* These figures include boats built for the fishing industry.

This on the whole is very satisfactory as regards Great Britain. Another fact which is brought out in these returns is that the United Kingdom builds vessels of larger average tonnage than other countries; the general average of all those built during the above mentioned six years was 761 tons, while the average tonnage for the United Kingdom was 860 tons. The returns for the United States of America are remarkable, and show that thirty years ago these States had one-third of the total tonnage of the world. Now they do not carry much over 12 per cent. of their own ocean carrying trade in American bottoms, and the tonnage of iron ships constructed in the United States has never yet in any one year come up to 40,000 tons, or about the tonnage launched by one of the largest firms on the Clyde or the Tyne.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

3rd February, 1888.

1599. Hallam, W. ..... Looms for macrame lace.
1607. Westley, J. ..... Picker for looms.
1611. Leeming, F. ..... Operating jacquard engines.
1613. Foulis, W. ..... Boilers.
1618. Smith, O. ..... Riveting machines.
1619. Sutcliffe & Longbottom ..... Trap twisting frames.
1621. Benton, C. H. ..... Valve gear.
1625. Cleathero, E. T. ..... Lifts.
1627. Richmond, G. S. ..... Corn grinding mills.
1629. Morris, F. S. ..... Metallic railway sleepers.
1631. Hart, R. A. ..... Machinery for printers.
1632. Cook, W. W. ..... Grinding carding engine flats.
1636. Thomas, J. ..... Sewing machines.
1638. Allchin, H. ..... Weighing machines.
1650. Evans, R. K. ..... Fluid pressure motors.
1652. Standfield, J. ..... Steam ferry boats.
1655. Lake, H. H. ..... Rotary printing machines (*Godchaux & Cie.*).
1660. Blessing, O. ..... Vehicles driven by gas engines.
1661. Dobell & Dobell ..... Sewing machine.
1662. Strachan, T. ..... Kilns for drying grain.
1663. Simpson, W. S. ..... Machine guns.

4th February, 1888.

1668. Wailes, J. W. ..... Shaping heated metal.
1670. Sinnette, F. J. ..... Anchor.
1672. Hawke, F. ..... Bone mills.
1674. Buckley, W. ..... Cylinders for steam engines.
1676. Melling, J. W. ..... Pumping engines.
1678. Mills, E. C. ..... Speed regulators for steam engines.
1686. Webb, F. W. ..... Automatic vacuum brakes.
1687. Knowles & Tatham ..... "Flats" for carding cotton.
1688. Hill, C. G. ..... Sewing machines.
1701. Thomas & Thomas ..... Cross bolt mechanism in drop-down guns.
1705. Crossley, W. J. ..... Compound gas engine.
1706. Crossley, F. W. ..... Compound gas engine.
1709. Ranson & Soderberg ..... Spinning and rope making machinery.
1711. Spratt, C. ..... Speed indicators.
1712. Justice, D. ..... Boiler furnaces.
1716. Brown, W. F. ..... Steam engine indicators.

6th February, 1888.

1720. Foster, T. ..... Wrought fittings for tubes.
1736. Haskins, J. F. ..... Rollers for spinning machinery (*Hoyt*).
1738. Pearce, A. B. ..... Paper machinery.
1741. Cook, W. W. ..... Grinding carding engine flats.
1742. Sage, A. C. ..... Hansom cabs.
1744. Morris, F. S. ..... Buffers.
1756. Brierley, J., & others. Steering apparatus.
1758. Orvis, O. D. ..... Sewing machines.
1759. Haddan, H. J. ..... Expansion regulating gear (*Rademacher & Voss*).
1763. Stanley, R. ..... Tunnelling machines.
1764. Stanley, R. ..... Kilns for burning bricks.
1767. Brogden, G. W. H. ..... Manufacture of pulleys.
1769. Howard, A. H. ..... Rowing machines.
1773. Heggie & Raven ..... Cutting glass tubes.
1776. Poyser, J. ..... Sewing machines.
1778. Kreiss, E. ..... Screw conveyors.
1780. Butler, E. ..... Hydrocarbon motors.

7th February, 1888.

1787. Tugwell, T. ..... Sewing machines.
1788. Sutherland, W. S. ..... Welding plates.
1789. Potter, R. ..... Marine speed register.
1793. Johnston, D. ..... Screw propeller blades.
1795. Richardson, R. ..... Steering gear.
1797. Allred, R. ..... Hoists.
1799. Richardson, A. S. ..... Sewing machinery.
1802. Burdon, C. ..... Breaking up macadam roads.
1804. Selous, W. J. ..... Printing wall paper.
1806. Lane, C. ..... Air guns.
1810. Thomas, F. T. ..... Rotary engine.
1811. Hill, J., & others ..... Grinding carding engine flats.
1812. Kay, S. ..... Automatic railway brakes.
1814. Anderson, F. ..... Mules.
1817. Taylor, G. ..... Shipping coal.
1820. Hopkinson, J. G. ..... Manufacture of boots.
1822. Bondkowski, J. ..... Pumping machinery.
1823. Vyrazil, F. ..... Evaporating apparatus.
1824. Boult, A. J. ..... Steam generators (*Stehlik*).
1825. Childers & Milne ..... Signalling apparatus for railways.
1829. Rookes, G. C. ..... Paper making machinery.
1830-1. Imray, O. ..... Embroidering machines (*Smith*).
1832. Worms, J. ..... Aërial machine.
1834. Bramall, J. ..... Steering boats.
1837. Lake, H. H. ..... Riveting machines (*Saxe*).
1838. Lake, H. H. ..... Ships' masts (*Mansfield*).
1840. Edwards, E. ..... Threshing machines (*Cuhel and Cuhel*).
1841. Lieb, C. A. ..... Automatic grain scales.
1842. Wise & White ..... Machine for trimming brushes.

8th February, 1888.

1852. White, J. P. ..... Submerged water wheel.
1854. Greenwood & Skipworth ..... Weighing machines.
1855. Greenwood & Rigby ..... Windmill.
1858. McConnell, T. ..... Breech loading fire arms.
1867. Howell, S. E. ..... Manufacture of tubes for boilers.
1871. Beveridge, J. ..... Furnaces.
1877. Macpherson, A. ..... Launching ships' boats.
1879. Higham, I. ..... Propelling boats.
1881. Arnold-Forster, H. O. Defending ships against torpedoes.
1894. Farrell, M. D. ..... Machines for corking bottles.
1895. Watson, J. de L. ..... Starters for tram cars (*Watkins*).
1897. McIntyre & McIntyre. Forced blast for furnaces.
1900. Throop, J. W. ..... Straw cutters (*Kendrick*).
1909. Langham, J. ..... Knitting machines.
1912. Barnier, J. ..... An improved motor.
1916. Schonheyder, W. A. G. Caloric engines.
1920. Ruf & Kumpfmiller ..... Lathes.
1924. Warden, G. C. ..... Roofs.
1925. Drake & Muirhead ..... Valves used with pumps.
1930. Woodhouse & Taylor ..... Embossing presses.
1931. Ewing, W. J. ..... Water brakes.

9th February, 1888.

1938. Wotherspoon, J., & ors. Testing boiler tubes.
1941. Turner, W. J. ..... Filling machines.
1943. Turner, W. J. ..... Corking machines.
1944. Turner, W. J. ..... Soda water machinery.
1951. Fox, C. H. ..... Coupling for railway carriages
1952. Barker, G. ..... Wheels.
1953. Sutcliffe, B. ..... Lathe chuck.
1959. Thomlinson, W. ..... Flues.
1962. Cornes, C. ..... Hydraulic presses.
1974. Webb, F. W. ..... Locomotive boilers.
1983. Birkbeck, H. ..... Scaffolding (*Kause*).
1985. Whitfield, G. C. ..... Woodbury type printing.
1987. Thompson, W. P. ..... Roller mills (*Fiechter*).
1989. Walton, T. ..... Manufacture of glass hollow ware
1997. Dupont, E. ..... Construction of walls.
1998. Leigh, H. H. ..... Screw propellers (*Le Solliec*).
1999. Freeman, W. R. ..... Screw propellers.

ELECTRICITY.

3rd February, 1888.

1649. Davis & Turner ..... Incandescent lamp.

4th February, 1888.

1681. Goolden & Atkinson ..... Electrical appliances.

6th February, 1888.

1733. Barber-Starkey, W. J. S. ..... Depolarising the negative elements of batteries.

7th February, 1888.

1798. Laurie, T. ..... Telephonic transmitters.
1803. Rawson, F. L. ..... Electrical switches.
1818. Rhodes, G. W. ..... Tanning by electricity.

8th February, 1888.

1869. Tack, A. ..... Carbons for electric purposes.
1875-6. Hookham, G. ..... Dynamo-electric machines.
1891. Bailey & Warner ..... Flexible battery cell.
1919. Howes, A. J. ..... Arc electric lamps.

9th February, 1888.

1932. Royce, F. H. ..... Electrical switches.
1964. Schmidt, F. T. ..... Electrical switches.
1968. Tilley, W. ..... Secondary battery.
1981. Parker, T. ..... Electromotor.

CHEMISTRY.

3rd February, 1888.

1617. Fenner, H. J., & others. Refining hydrocarbons.

4th February, 1888.

1665. Beveridge, J. ..... Hydrochloric acid.
1693. Nicolle, A. ..... Phosphorus.
1707. Fergusson, H. A. ..... Recovering zinc.

6th February, 1888.

1723. French & Monro ..... Extracting gold, antimony, or tin.
1752. Chapman, A. ..... Evaporating saccharine solutions.

7th February, 1888.

1833. Moritz, E. R. ..... Clarifying beers.
1844. Ellice-Clark & Chapman ..... Production of oxygen and nitrogen from air.

8th February, 1888.

1886. Beck, W. H. ..... Bronze (*Sentex, Maréchal, and Saunier*).
1904. Moon, H. ..... Extraction of metals from ores.
1914 Hornsby & Coupe ..... Separating gold from its ores.

9th February, 1888.

1939. Morris, H. ..... Manganese ore (*Lenczewsky*).
1946. McCann & Edmonson Fermentation of beers.
1991. Hare & Boudreaux ... Nickel electro-types.

MISCELLANEOUS.

3rd February, 1888.

1597. Serbold, M. ..... Belt fasteners.
1598. Greenhalgh & Bamford ..... Flyers for slubbing machines.
1600. Kendrick, T. ..... Metallic bedsteads.
1602. Wakefield, H. ..... Extinguisher for lamps.
1603. Currall, J. ..... Fire places and ranges.
1609. D'Arcy-Irvine, J. ..... Throwing a line for saving life at sea.
1610. Mulliner & Robinson. Springs for vehicles.
1612. Foulis, W. ..... Fire places.
1614. Dey, A. ..... Mechanism for recording times of arrivals and departures of workmen.
1615. Strawson, G. F. ..... Broad cast seed and manure drill.
1622. Preston & Preston ..... Stills.
1623. Pugh, H. W. ..... Illuminated door plates.
1626. Beer, A. ..... Gate springs.
1633. Edmundson & Smethurst ..... Cartridge for mining purposes.
1634. Cox, H. ..... Regulating tap.
1643. Simpson, W. M. ..... Heating stoves.
1645. Germain, V. A. ..... Call bell.
1651. Johnston, B. ..... Money tills for checking money taken.
1654. Lake, H. H. ..... Railway buffers (*Abbotson*).
1658. Poschinger, B. von ..... Stoppers of bottles.

4th February, 1888.

1664. Candy, F. J. ..... Tricycles.
1666. Fisk, T. ..... Hop filter.
1667. Preston, E. ..... Tools for moulding wood.
1669. Mills, S. ..... Puzzle padlocks.
1671. Hewitt, C. J. ..... Ticket punch and counter.
1673. Titley & Kissack ..... Lubricators.
1677. Richter, P. E. ..... Automatic signal funnel.
1679. Smith, T. ..... Cord guides and ship thimbles.
1682. Brown, J. ..... Vehicles for carrying gravel.
1683. Mewburn, J. C. ..... Watches (*Lange*).
1684. Thomas & Skidmore ... Clips for carriage springs.
1685. Brock, A. ..... Ships' signal lights.
1689. Smith, J. C. J. ..... Manufacture of Portland cement.
1690. Church, G. H. ..... Taps for measuring liquids automatically.
1695. Pretty, H. C. ..... Sewing machine needles.
1697. Restall, E. W. ..... Disinfectant discharger.
1702. Cohen & Cohen ..... Stoppers for bottles.
1704. Robertson, J. P. ..... Stopper for gas pipes.
1713. Bucknill, J. T. ..... Firing submarine mines.
1715. Mitchell, A. W. ..... Securing slates to roofs.

6th February, 1888.

1717. Clark, P. ..... Preventing down draughts in chimneys.
1718. Wetherell, F. W. ..... Pulleys.
1724. McNaughtan, A. ..... Fire extinguisher.
1725. Hubbard, J. ..... Oil lamp.
1726. Beck, N. G. ..... Disinfecting tanks.
1732. Germete, A. von ..... Horseshoes.
1735. Burgis, F. W. ..... Balance targets.
1739. Hall, F. ..... Apparatus for making infusions of tea.
1740. Hall, F. ..... Designs upon metal plates.
1745. Hughes, G. ..... Watches (*Kaiser*).
1750. Hansel & Weise ..... Spring bedsteads.
1751. Germeuil-Bonnaud, J. B. ..... Designs on china, earthenware, and glass.
1755. Rhodes, B. ..... Packed cocks and valves.
1757. Newton, H. E. ..... Horseshoe nails (*Burckett*).
1760. Webster, J. J. ..... Cash indicators.
1762. Clough, W. R. ..... Stoppers for bottles.
1765. Robinson J. ..... Velocipedes.
1766. Puckert, H. ..... Gas taps.
1774. Johnson, M. T. ..... Apparatus for stamping letters.
1777. Ballon, R. A. ..... Fire extinguishing apparatus.
1782. Kilsby, W. ..... Lamps.

7th February, 1888.

1785. Stockman, H. ..... Lamps.
1786. Foster, A. ..... Reversible backs for seats.
1790. Mawby, W. ..... Tricycles.
1791. Clegg, G., & others ... Lubricating spindles.
1792. Dowd, T. C. ..... Locks.
1794. Watkin, H. S. S. ..... Instruments for measuring angles and ascertaining distances.
1796. Reynolds, E. ..... Taps.
1800. The Worcester Royal Porcelain Co. & Binns Transfer of designs to pottery.
1801. Macaulay-Cruikshank, G. ..... Astronomical chronometers (*Deichmann*).
1805. Atkin, R. ..... Extinguishing fire.
1808. Rider, E. W. ..... Oil cans.
1813. Priestman & Priestman Paying out chains.
1816. Johnson, D. ..... Drying, storing, mordanting, or ageing fibrous materials.
1819. Lucas, E. ..... T-squares.
1821. Hughes, G. R. ..... Puncturing sheets of paper.
1826. Boult, A. J. ..... Apparatus for recording time and distance (*Bisson*).
1828. Tompkins, A. S., & ors. Apparatus for drying tea.
1836. Jewell, O. H. ..... Filtering water.
1839. Edwards, E. ..... Vent pegs for casks (*Jindrich*).
1843. Mewburn, J. C. ..... Rheostats (*La Société Anonyme pour la Transmission de la Force par l'Electricité*).
1845. Justice, P. M. ..... Bicycles (*Evans, Bigger, & Verdin*).
1846. Wilkinson, A. ..... Treating palm oils.
1851. Johnson, J. Y. ..... Instruments for recording and re-producing speech (*Volta Graphophone Company*).

8th February, 1888.

1860. Roots, J. ..... Oil lamps.
1862. Welch, J. T. ..... Utilisation of slate waste.
1863. Dickie, M. ..... Lubricating spindles.
1866. Robertson, A. ..... Stop cocks for boiler gauges.
1870. Shepherd & Shepherd. Oil burning lamps.
1872. Herbert, J. H. ..... Bicycles.
1880. Harley, J. J. ..... Setting saws.
1882. Hurrell, W. E. ..... Velocipedes.
1883. Robotham, E. ..... Wrenches.
1884. Muirhead, R. ..... Separation of liquids from solids.
1889. Dance & Smith ..... Charging bottles with aerated waters.
1892. Mainwaring, The Hon. W. F. B. M. ..... Hydrocarbon burners.

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1899. Cloudsley, J. L. ..... Dry gas meters.
1901. Shaw, C. ..... Wire netting.
1913. Herrmann, A., & others Dyeing furs.
1915. Varley, J. J. ..... Stoppering bottles.
1921. Gismondi, L. ..... Filter presses.
1922. Larsen, C. F. ..... Cream separators.
1923. Drake & Muirhead ... Filter presses.
1927. Grafton, H. ..... Bucket for excavating.
1928. Beale, W. ..... Manufacture of rubber.

9th February, 1888.

1942. Turner, W. J. ..... Filters.
1954. Spencer, S. ..... Dyeing hanks of yarn.
1958. Tompson, F. W. ..... Sparging apparatus.
1963. Dummer, E. ..... Fire grates.
1966. White & Dewhurst ... Stoppers for bottles.
1971. Calvert & Matthews Stoppering of bottles.
1973. Roberts, F. C. ..... Bottle stoppers.
1978. Joy, W. ..... Manufacture of cement.
1979. Sharpe & Turner ..... Manufacture of cement.
1980. Heys, M. H. ..... Manufacture of lime and of natural and artificial cements.
1982. Gallimore, W. ..... Velocipedes.
1984. Libbrecht, C. ..... Cartridges.
1986. Alstein, A. J. van ..... Testing lubricants.
1995. Williams, S. R. ..... Lamp extinguisher.
2000. Gumbley, W., and The Guernsey Fruit Growers ..... Glass houses.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

11th February, 1888.

66. Prior, M. ..... Economising heat in steam engines.
146. Weekes, C. ..... Taking soundings at sea.
1915. Clark, A. M. ..... Machines for scutching flax (*Casse*).
2368. Thomas, J. ..... Engines driven by gas, steam, petroleum, and the like.
2520. Browett & Lindley ... Gas engines.
2886. Palliser, E. ..... Breech action for fire arms (*Harston*).
3230. Tangyes & Jefferiss ... Centrifugal pump.
3363. Stoppani, E. de ..... Ice making machines.
3509. Brill, E. ..... Manufacture of buttons.
3668. Smith & Lane ..... Joints for steam pipes.
4216. Rowe, O. ..... Manufacture of cartridges.
4437. Stark, A. ..... Self binding harvesters.
4506. Napier, D. D., & others Brakes.
4579. Hardcastle, T. ..... Printing and finishing cotton fabrics.
4634. Fawcett, T. C. ..... Machinery for making bricks.
4689. Preussner, L. ..... Artificial stone.
4963. Bancroft & Wild ..... Boiler furnaces.
4966. Bailey & Lindemann ... Pumping engines.
4972. Parkington, J. ..... Healds for weaving.
4986. Wass & Wheeler ..... Buffers.
5055. Douglas, C. ..... Lowering gear for ships' boats.
5057. Coulthard & Bradshaw Reciprocating toothed racks.
5063. Wetter, J. ..... Stitching sheets of cardboard (*Lasch & Co.*)
5095. Johnson, J. Y. ..... Gas engines (*La Société des Tissages et Ateliers de Construction Diederichs*).
5100. Robinson, T. N. ..... Wood planing machines.
5145. Allin, S. S. ..... Water motors.
5148. Clissold, W. ..... Preparing fibrous substances for spinning.
5153. Clark & Clark ..... Covering iron decks with wood.
5160. Dyer, S. ..... Frames employed in the manufacture of fibrous materials.
5246. Bernard, A. F. L. ..... Sleepers for railways.
5447. Jardine, J. ..... Lace machines.
5520. Green, W. R. ..... Hydraulic lifts.
5635. Penning, G. A. de ..... Steam vessels.
5651. Tuthill, E. ..... Roadways and foothpaths.
5794. Bowns, J. ..... Disc pumps, blowers, and motors.
5841. Graveley, G. ..... Sea water distilling apparatus.
5956. James & Duffield ..... Carriage springs.
6570. Boult, A. J. ..... Magazine guns (*Russell & Brill*).
6679. Haddan, P. ..... Steam engines (*Dake Engine Manufacturing Company*).
6686. Johnson, J. Y. ..... Weigh bridges (*Guillaumin*).
7180. Evans, C. W. ..... Manufacture of boot lasts.
7231. Holland, W. ..... Couplings for railways.
7836. Lasch, C. L. ..... Wire stitching machines.
8073. Noble, J. ..... Stoppers for boiler tubes.
13463. Wood, J. A. ..... Couplings for railways.
13551. Smith, T. ..... Manufacture of boots.
15394. Zisseler, D. ..... Machines for making cement tubes.
15955. Egge, F. ..... Manufacture of chain links.
117. Williamson, D. ..... Rotary engines.
213. Yaryan, H. T. ..... Evaporating and distilling apparatus.
262. Rush, J. T. ..... Stitching machines.
267. Lake, H. H. ..... Manufacture of brushes (*Van Steenberghe*).
275. Abel, C. D. ..... Automatic brake (*Westinghouse*).
321. Hassel, W. ..... Atmospheric hammer.
402. Lake, H. H. ..... Apparatus for dyeing textile materials (*Weldon*).

ELECTRICITY.

11th February, 1888.

3225. Dick & Kennedy ..... Generation of electric energy.
4032. Immisch, M. ..... Brushes of electromotors and dynamo machines.
4322. Hopkinson & Hopkinson Dynamo-electric machines.
4978. Schmidt, F. T. ..... Holder and switch for electric lamps.
4980. Schmidt, F. T. ..... Making and breaking electrical circuits.
5009. Armstrong, J. T. ..... Secondary batteries.
5092. Egger, B. ..... Electrical switches.
5228. Bayley, W. H. ..... Incandescent electric lamps.
5707. Lauckert & Kingston. Electric arc lamps.
6972. Mewburn, J. C. ..... Apparatus for obtaining derived currents of variable intensity from a main electric current (*La Société Anonyme pour la Transmission de la Force par l'Electricité*).

CHEMISTRY.

11th February, 1888.

2963. Brin & Brin ..... Chlorine.
4472. Thompson, S. P. ..... Electro-deposition of cobalt.
8679. Meeze, A. G. ..... Manufacture of gas.
16027. Tripler, C. E. ..... Separating precious metals from ore.
16783. Hengst, C. F. ..... Smokeless gunpowder.

MISCELLANEOUS.

11th February, 1888.

1665. Iliffe, J. A. ..... A unicycle (*Hewitt*).
2127. Brock & Minton ..... Filter presses.
3187. Klein, J. ..... Filtering beer.
3223. Baptiste, J. ..... Cleaning tram rails.
3805. Baker, F. R. ..... Oil lamps.
3976. Walker, C. M. ..... Gas burners.
4300-13. McKechnie & Wicks Plumbers' traps.
4628. Schulhof, J. ..... Cartridges.
4710. Unge, W. T. ..... Measuring distances.
4733. Cozens, R. L. ..... Extinguisher for lamps.
4974. Rylands, D. ..... Glass sleepers.
5004. James & Sturcke ..... Fastening the ends of wires.
5085. Sugg, D. W. ..... Flexible gas tubing.
5110. Douglas, W. H. ..... Clock escapements.
5115. Cowan, D. ..... Stoves.
5176. Waine & Waine ..... Padlocks.
5181. Deacon, G. F. ..... Measuring the flow of water in pipes.
5189. Schmid, A. ..... Fluid meters.
5232. Clark, A. W. ..... Gas lamps.
5245. Perry, T., & others ..... Fastenings for safe doors.
5391. Stevenson, J. ..... Manufacturing the "mail" in weaving (*Absous*).
5424. Bromhead, S. S. ..... Miner's picks (*Wallace & Mace*).
6360. Quick, G. ..... Cartridges for ordnance.
9627. Pilkington, F. ..... Fire proofing buildings.
10243. Boyd, J. ..... Packing for stuffing boxes.
12975. Horn, W. W. ..... Door latch (*Bason & Hazelhurst*).
14892. Lake, W. R. ..... Lubricators (*Seibert*).
16760. Parks & Roquemore ... Nut locks.
17276. Beauvalet & Beauvalet Taps.
17356. Barthel & Möller ... Providing metallic objects with a coating of tin.
17481. Billings, J. D. ..... Horseshoes.
17707. Pike, W. H. ..... Gas stoves.
18021. Nicholson & Allcock Horse rakes.
158. Thompson, W. P. ..... Regenerative gas lamps (*Schmidt, Goulson, Kretschmann, and Schoenberner*).
161. Brewster, F. W. ..... Life saving buoys.
203. Gittus, H. ..... Belt fastener.
212. Pasquet, P. G. ..... Lubricators.
214. Storer, J. ..... Preservation of fresh fruit.
394. Wilhöft, F. ..... Vulcanised rubber.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(*To the 4th November, 1887, inclusive*).

Year 1883.

5113. Bull, H. C. ..... Gas engines.
5117. Gaskell, J., & another. A pipe or tube.
5119. Woodcock, J., & another Treatment of wool, &c.
5124. Davies, G. ..... Thrust bearings (*Jackson*).
5125. Price, A. P. ..... Extraction of precious metals from their ores.
5126. Lake, H. H. ..... Clarification of beer (*Kunheim and another*).
5129. Millén, J. ..... Producing steam or vapour.
5131. Thomas, W. F. ..... Sewing machines.
5134. Forster, J. ..... Clearing roads from snow.
5135. Rogers, J. ..... Signal lamps, &c.
5136. Allison, H. J. ..... Belt cable railways (*California Belt Railway Company*).
5137. Allison, H. J. ..... Combined boiler and steam vacuum pumps (*Riker*).
5138. Pearn, F., & others ..... Steam pumps.
5140. Brookes, A. G. ..... Furnaces (*French*).
5141. Gillett, W. ..... Telephones.
5144. Thornhill, J. E. S., and others ..... Mounting wheels of railway carriages, &c.
5153. Schisgall, S. ..... Electric clocks.
5158. Swan, A. ..... Incandescent electric lamps.
5161. Hill, F. B. ..... Measuring, &c., flow of liquids.
5171. Boys, C. V. ..... A differential driving gear.
5174. Urry, E. C. ..... Moving points of tramway lines.
5176. Somerset, H. A. G., and another ..... Mounting of carriage bodies.
5180. Harrison, F. J. ..... An electric burglar or fire alarm.
5181. Coppinger, H. ..... Fluid pressure engines.
5190. Birks, W. ..... Bobbin net or twist lace.
5195. Coad, T. ..... Galvanic batteries.
5199. Thompson, R. C., and another ..... Bicycles.
5201. Anders, G. L. ..... Telephone transmitters.
5202. Belfield, R. ..... Electric meters.
5204. Garside, H. ..... Producing photographic surfaces.
5206. Browne, W., & another Treating peat.
5208. Baynes, R., & another... Purification of petroleum.
5218. Glaser, F. C. ..... Blowing machines (*Glöckner*).
5223. Tolson, G., & another... Carbonising vegetable matter.
5226. Robinson, G. A. ..... Stationery (*Ogilby*).
5228. Hetherington, J. M. ... Spinning machinery.
5232. Sturgeon, J., & another Pipe systems (*English*).

Year 1882.

5158. Andrews, J. D. F. ..... Producing, &c., electricity.
5183. Woodley, R. H., & ano. Secondary voltaic batteries.
5233. Drewry, F. J. ..... Bathing and vaporising apparatus (*Rosenfield*).
5276. Lake, W. R. ..... Utilising the motive force of waves (*De Souza*).

Year 1881.

4764. Morgan-Brown, W. ... Rock drilling (*Stone*).

Year 1880.

4463. Renney, W. ..... Anti-fouling compositions for ships' bottoms.
4472. Jones, C., & another ... Utilisation of steel rail ends.
4477. Williams, R. P. ..... Junctions of railways.
4481. Scott, F. W. ..... Wire ropes.
4512. Pickles, T. J., & others. Grinding dyewoods, myrabolms, &c.

Year 1879.

4470. Clark, J. L., & another. Constructing piers, breakwaters, &c.

Year 1878.

4438. Truman, E. T. ..... Preparing gutta-percha, &c., for insulating purposes.

Year 1877.

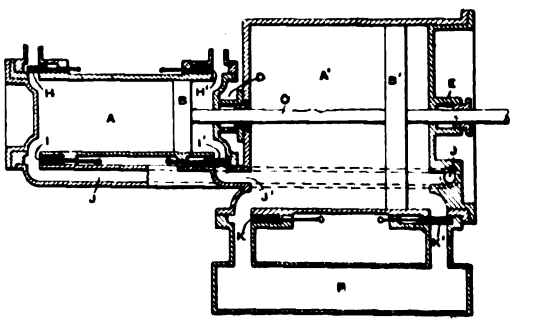
4004. Coleman, H. S., & ano.... Cultivators.
4045. Bache, T. P. ..... Spring mechanism for sewing machines, &c.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Compound Steam Engines.—*A. V. Newton, London.* (*J. Ericsson, New York.*)—The construction of compound engines, which is the subject of this invention, will be understood by reference to the accompanying diagram, which represents a longitudinal section of the important parts of the cylinders. A A¹ are the two cylinders, of which A works with high pressure steam, and A¹ with the exhaust steam from A. The pistons B B¹ are mounted on the same piston rod C, which passes through the two stuffing boxes D and E. The ratio of the diameters of the pistons is as 1 : 3. The valve gear of the small cylinder is so arranged that the cut-off shall take place at one quarter of the stroke, and the total expansion of the steam on the two cylinders will therefore be to thirty-six times its original volume. The condenser is shown at F. The cylinder A is fitted with two valves H I at one end, and with two valves H¹ I¹ at the other, the valves H H¹ being for the entry of steam, and the



valves I I¹ being for the eduction of the exhaust steam from the cylinder A to the cylinder A¹. The ducts J J¹ serve to introduce this exhaust steam to the expansion chambers of the second cylinder, and K K¹ are the final exhaust valves, which allow the steam to escape to the condenser F. The valve gear is not shown on the diagram, and it is allowable to use any convenient form which will operate the valves in the necessary manner. The claim which is made is for a double acting two-cylinder compound engine, organised substantially as described, whereby steam may be used at the highest practicable initial pressure, and with a high rate of expansion in the smaller cylinder; and afterwards may be expanded in the low pressure cylinder to the lowest tension which would be economical.—No. 15795. November 17th, 1887. 6*d*.

Hydraulic Lifts.—*C. F. Archer, London.*—The inventor makes use of three hydraulic cylinders—the pressure cylinder, the accumulator cylinder, and the lift cylinder. The power in the pressure cylinder is exerted by means of its ram on a chain which passes round a fusee. The shaft which carries the fusee also has fixed to it another similar mechanism, and the chains wound thereon cause the accumulator ram of the second cylinder to descend. This cylinder and the lift cylinder are connected by means of a pipe, which allows the water to flow backwards and forwards during the various operations without any appreciable loss of volume. The lift is supported, as usual,

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on the top of the ram of the lift cylinder. The inventor does not confine himself to the fusee for the purpose of supplying a compensating mechanism, and, in some cases, makes use of a rack and an eccentric pinion. The claims are (1) for the combination of the three cylinders as described, and (2) for the fusee or eccentric mechanism between the pressure and compensating cylinders.—No. 3634. March 10th, 1887. 8*d*.

Fluid Meters or Motors.—*H. Frost, Manchester.*—This invention relates to improvements in the construction of the apparatus described in the Specification of Patent No. 2720 of 1883, granted to the same patentee. The appended diagrams represent vertical sections taken at right angles to one another. The outer casing is composed of three pieces A A^1 A^2. B designates the measuring cylinder, B^1 the passages leading from the upper part of the meter to the bottom part of the measuring cylinder, G^1 the piston, N N^1 collars on the piston rod, J the inlet, and K the discharge pipe. The present improvements consist of casting in one piece the supplementary cylinders D D^1 with their ports and passages. The port E communicates by a passage with the cylinder D, and the port E^1 communicates

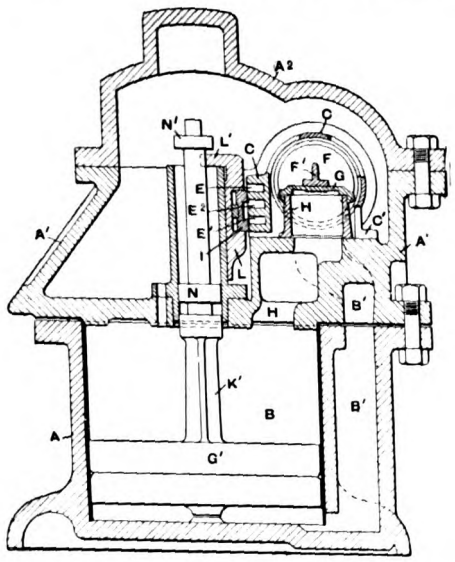


Fig. 1.

by another passage with the cylinder D^1, while E^2 communicates by a passage O^1 in the block C and a passage P in the casing A^1 with the discharge pipe K. The piston rod F^2 is formed to fit over a valve cover G, which controls the three ports in the main valve block H. The three ports respectively communicate with the bottom of the cylinder B, through the passage B^1, with the top of the cylinder B by the passage H^1, and with the pipe K through the passage P. When the fluid under pressure is admitted to the middle port A^1 of the meter through the inlet J, and when the piston G^1 is at the bottom of B, the fluid flows through the first port in H down B^1, causing the piston G^1 to rise. Near the end of the upstroke the collar N^1 catches the projection L^1 on the valve mover L, and moves I upwards, and so uncovers the port E^1. The liquid then flows through E^1 into the cylinder D^1, and moving the valve cover G so as to uncover the second port in H. The piston F is forced inwards and expels the fluid from D through the port E into the discharge pipe K. As the main piston G^1 has attained the top of

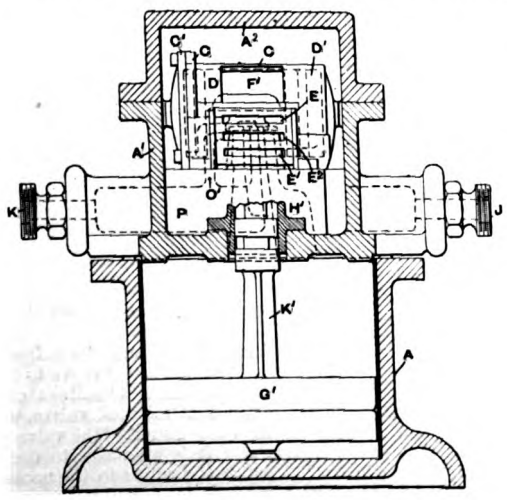


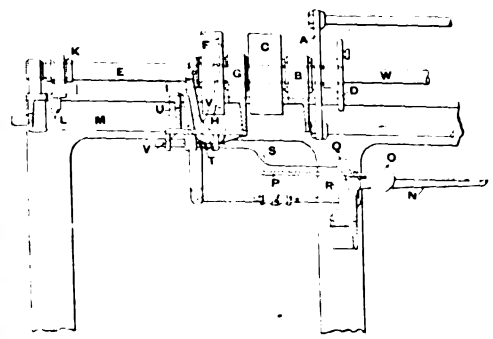
Fig. 2.

its stroke, the fluid flows through the second port in H into the top of the measuring cylinder B and forces down G^1. The fluid on the under side of G^1 is thus expelled up B^1 through the first port in H, under the recessed valve cover G, down through the central port in H, through P, and out through K. As the piston rod K^1 approaches the end of its downward stroke the collar N^1 catches L^1 and moves the valve cover I downwards, and uncovers the port E, thus allowing the fluid to flow through E into D, so that the first port in H is uncovered; and the fluid in D^1 is expelled through E^1 under I, down through E^2 O^1 P, and out at K. The stroke of K^1 is then reversed once more. When used as a meter the apparatus is provided with an indicator, and when as a motor the piston rod K^1 is lengthened and attached to a crank on the outside of the casing. The inventor makes two claims.—No. 2578. February 15th, 1887. 8*d*.

Propulsion of Ships.—*W. MacGowan, Ardrossan.*—The machinery here described is adapted more particularly for the propulsion of sailing ships during calms, and for supplying motive power to a steamer whose main engines have broken down. This object is gained without the machinery proving a hindrance when not in use. The propeller is formed of two nearly flat blades mounted on spindles, which are placed exactly opposite each other. The blades are made nearly circular at the inner propelling part next to their stems, and at the outer part of an unsymmetrical pointed shape, so that when the discs are rotated the water first meets the forward lower part and passes across it in curved lines towards the aft and outer part of the blade. The blades are also provided with a swivelling motion on the arms, in order that they may be set in a line with the keel while out of use. The propeller shaft is made hollow to admit a rod, which by means of suitable mechanism enables an operator in the engine room to adjust the blades to any desired angle. The inventor makes six claims for the general construction of the propelling mechanism, and for the parts as described.—No. 2761. February 22nd, 1887. 8*d*.

Rope and Belt Shipping Device.—*R. Hornsteiner, Prague, Austria.*—This invention relates to a construction of rope pulleys, which is intended to facilitate the shipping of the rope. The flange on the rim of the fast pulley, bordering on the loose pulley, is made to project further from the centre of the shaft than the outside rim, and the flange on the rim of the loose pulley next to this projecting flange is made correspondingly small. In the periphery of the projecting rim of the fast pulley are several depressions where the projecting rim of the pulley is as small as the other rim. The shipping is effected by means of guides, which press the rope against the projecting rim, and when, in the revolution of the pulley, the approaching rope comes in contact with the depressions in the rim, there is no lateral resistance to the rope, which is accordingly shipped on to the other pulley. The inventor claims the method of shipping by cutting down this projecting flange at certain parts of its periphery.—No. 16286. November 26th, 1887. 6*d*.

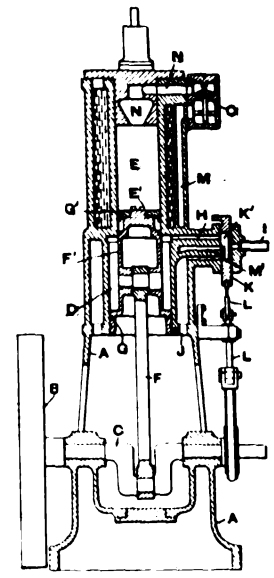
Spinning Machinery.—*A. T. Lawson, Leeds.*—This invention relates to machinery for spinning yarns from flax, hemp, &c., where a drag on the bobbin is required. The apparatus designed for this object is represented in side elevation in the accompanying figure. The flier A is fixed to a hollow axis, which turns in bearings in a block B, and a band pulley or gear wheel C is also fixed to the same axis for the purpose of driving the same. D is a bobbin plate on a traverse tube E, which passes through the hollow axis of the flier, and is supported by the spindle W. A friction pulley F is mounted on a hollow axis, which is carried in bearings in the block G. It is driven by a band, which travels at a speed somewhat less than that of the band which drives the flier. The tube E passes through a loose friction disc H, whose boss has a feather projecting inwards and entering a key way cut lengthwise in the traverse tube. The disc is pressed against F by a lever I, a disc of leather being interposed between the two surfaces. The axis of the lever I is carried by a bracket V. The



end of the traverse tube is coupled to the slide K, and the tooth L projects downwards from the slide and engages with the traverse screw M, in order that the traverse tube may be moved to and fro by this screw. The lever I is coupled at its lower end by a link to the short vertical arm of the lever N. The weight O is mounted on the longer end of this lever, and is capable of sliding along it; P is a toothed rack; and Q a pawl which is carried by an arm R turning freely round the axis of the lever N. The sliding rod S is coupled to R, and is acted on by a spring T, which draws the arm backward from the weight. U is a finger projecting from S. The traverse slide strikes against this finger in its movements to and fro, and thereby shifts the rod S endwise, and causes the pawl to shift the rack and weight along the horizontal arm of N. In this way, as the yarn accumulates on the bobbin, the drag or friction holding between the friction disc and its driving pulley is increased so as to give greater driving power. The difference between the number of revolutions of the bobbin and flier is thus gradually diminished. The inventor makes three claims for the combination of the uniformly rotating flier and the mechanism for gradually increasing the hold between the friction surfaces, and for the arrangement of machinery described.—No. 16725. December 20th, 1886. 8*d*.

Separator.—*A. F. Craig, Paisley, A. Neilson, Inkermann, Renfrew, and J. Snodgrass, Midlothian.*—The object of this invention is to obtain a continuous separation of oils of different specific gravities in the refining process of mineral oils. The apparatus is worked on the centrifugal principle, and is an adaptation of that described in the specification of Patent No. 3749 of 1886, granted to the same patentees. A rotating vessel is placed with its axis horizontal, and is formed of cast iron discs connected with a cylindrical or slightly tapering shell of wrought iron. The shell is strengthened with ribs, which also assist the rotation of the liquid, and the discs are formed with tubular bosses projecting outwards from their centre. These bosses act as bearings for the support of the machine in its journals. The liquid is introduced through a pipe in one of the tubular bosses. On the inner side of the disc an inlet pipe is made with two or more radial branches extending nearly to the circumference, and the ends of these branch pipes are curved in the direction of rotation, so as to deliver the liquid quietly. The lighter oil is led off through a stationary pipe placed near the highest part of the annular layer of lighter liquid, and at the opposite end to that of the entrance of the oil. This oil pipe is held stationary, and the oil rises up the external part of it in consequence of the energy of rotation acquired in the vessel. This elevation of the oil facilitates its conveyance to a tank for accumulation and storage. The heavy portions of the oil pass through syphon passages, or may be delivered from a channel in the disc by means of stationary pipe. A valve is provided for emptying the vessel, as it cannot be conveniently started except when empty. The various parts of the machine are open to more or less modification. The inventors make three claims.—No. 3617. March 10th, 1887. 8*d*.

Gas Engines.—*H. Williams, Stockport.*—In this arrangement of parts, the power cylinders and the charging cylinders are combined and operated by one piston. The cylinder of the engine is bored out with two different diameters, the gas being drawn in by the larger part and compressed and ignited in the smaller end. A new charge is introduced at the instant when the power piston has almost reached the limit of its outward stroke, and at the moment when the products of the combustion of the previous explosive charge are being driven out through the exhaust ports in the power cylinder. The arrangements according to this invention are represented in the accompanying diagram. When the engine is first started, a mixed charge of gas from the pipe 1 and air from the pipe J is drawn through the



passage K^1 and H into the larger cylinder D on the outward stroke of the piston G. The position of the slide valve K is then reversed so as to close the pipe I and the air passage J, and by means of the passage K^1 places H in communication with the reservoir M. As the piston moves inward, the mixed charge is driven from the cylinder D and compressed into the reservoir M, where it is held between the valves O and K until the pistons G G^1 have again nearly reached the limits of their outward stroke. At this moment the pressure on the contents of E will be reduced sufficiently to allow the mixture in M to raise the valve O and enter the cylinder E. The pistons then return on their inward stroke, compressing the mixture into the combustion chamber E, while the charging piston G compresses into M the mixed charge drawn into the cylinder D on the previous outstroke. The instant the pistons reach the limit of their inward stroke, the charge is exploded in the combustion chamber; and on the succeeding outward stroke the piston G draws into the cylinder D through the passage H a fresh charge of mixed gases. When the pistons have nearly performed their outward stroke, the tension on the products of combustion will be reduced sufficiently to permit the new charge to rush from M through O into the cylinder E, thereby sweeping out the products of combustion through E^1. The cycle of operations is then subsequently repeated. The inventor makes three claims for the combination of parts described and shown in the diagram.—No. 16029. November 22nd, 1887. 8*d*.

Joints for Corrugated Metal.—*W. P. Thompson, Liverpool.* (*H. C. Hodges, Detroit, U.S.A.*)—It is the purpose of this invention to provide an improved method of jointing semi-tubular rods which cross at any angle, and for fixing a corrugated roof to the supporting beams. The usual bolts occasion too much strain in the metal when they are screwed up. The inventor employs pieces of metal, which are shaped in convenient forms, for filling the hollows of the corrugations where the metal rods cross each other. The bolts are placed through these filling pieces, and when the bolts are screwed up, the filling pieces take most of the strain on themselves. These pieces are generally to be made of malleable iron. The inventor makes four claims for these improvements.—No. 16426. November 29th, 1887. 8*d*.

Spinning Machines.—*E. Maertens, Providence, U.S.A.*—This invention is designed for the purpose of providing a means of changing ordinary spinning machines into multiple drive and tension machines. The spindles are arranged in sets on each side of the machine, and each set comprises a series of spindles; the band is carried over and in contact with the drum in crossing from one series of spindles to the other at one end of the set, and under and in contact with the drum in passing from series to series at the other end of the set. A tension band is employed, and is applied at such a point that it will not interfere with the driving contact between the drum and the bands where the latter crosses the former. In connection with the band the inventor uses a direct acting tension pulley, which is carried by

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a weight compensating lever, and he dispenses with the usual carrying pulleys. The pulley which receives the tension loop of the band has a shaft which is adapted to a recess in a block of wood. This bearing block is adapted to the recessed outer end of one arm of the tension lever, the other arm of which is provided with a suitable adjustable weight. The lever is hung to a transverse shaft, and the arm of the lever is made in two parts connected by a bolt at right angles to the shaft, so that the arm is free to swing in a plane at right angles to that in which the lever moves. The tension pulley is thereby enabled to accommodate itself to any angle assumed by the tension hoop of the driving band. The hub of the lever is notched, so that it can be easily dropped on to the pivot rod; it is also recessed for the reception of a ring secured to the pivot rod, and a lug projecting into a slot in the hub serves to limit the swinging motion of the tension lever. The ring is provided with a set screw, whereby it is secured upon the pivot rod in any desired position which the variations in the limit of the movement of the tension lever may demand. Various other forms of lever may be used, but the one above described is preferred. The inventor makes eight claims.—No. 6746. May 7th, 1887. 8*d*.

Boiler Flues.—*T. Oldham, Stockport.*—This invention involves a new method of forming boiler flues, with the object of strengthening them sufficiently to prevent their collapse when subjected to external pressure. The tubes are to be made up of rings of short length. The ends of the rings are flanged, and the flanges are welded together. The flange of each ring should be made of slightly greater diameter than that of the next one, in order that they shall fit easily one within the other. These flues will be free from joint. The inventor makes three claims for this invention.—No. 3944. March 16th, 1887. 8*d*.

ELECTRICITY.

Electrical Transformers.—*G. Kapp, W. H. Snell, & J. M. V. Kent, London.*—The object of this invention is to produce a simple and efficient type of apparatus adapted for self regulation when used either in parallel circuit or in series. According to one arrangement the core is formed of a number of U or ⊔ shaped plates, which may be economically stamped out of thin hoop or sheet iron, so that when any number are placed face to face a trough is formed. The plates are insulated, and the coils of insulated wire are placed upon their upright sides or horizontal base. Two such troughs may be placed side by side, forming a double trough, and separated by distance pieces for ventilation; the coils may be then placed over the adjacent sides of the troughs. The primary and secondary coils are separately wound and placed side by side so as to be readily detachable. A cover for the trough is formed of rectangular plates, which are insulated from each other and wound with detachable coils. When placed in series the self induction of the secondary circuit may be reduced by dividing the iron core into sections and providing each one of the sections with a secondary coil, each connected with a distinct circuit. To increase the surfaces of contact of the cover and trough, the cover and upper extremities of the sides of the trough are bevelled obliquely to fit each other. The sides of the trough may be tapered, and by this means the magnetic effect of the apparatus may be varied by varying the depth to which the cover is inserted. The efficiency may thus be regulated by hand or automatically, or the movement of the cover may be utilised for the actuation of any regulating device. In the latter case the apparatus may be used either with alternating or with continuous currents. The inventors make four claims.—No. 1904. February 7th, 1887. 8*d*.

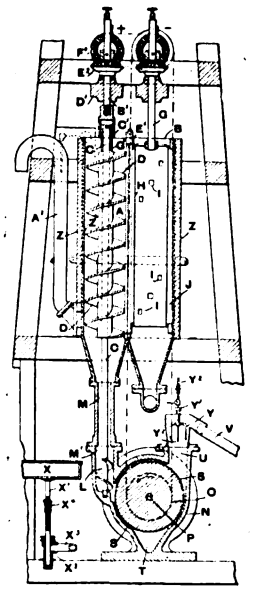
CHEMISTRY.

Paradiamidodiphenyl Sulphonic Acid.—*T. Carnelley, Dundee.*—The inventor produces the acid by treating paradiamidodiphenyl with sulphuric acid, the proportion of the chemicals being one part of diamidodiphenyl to four of the acid. This mixture is heated to the temperature of 130°C. for half an hour. The product is allowed to cool, and is afterwards thrown into cold water. The acid is then ready for use in the manufacture of dyestuffs. The inventor makes one claim for this process.—No. 3890. March 19th, 1886. 4*d*.

Clarification of Sugar.—*A. Brin, London, and L. Q. Brin, Paris.*—The saccharíferous matter is placed in a wooden vessel after having been reduced to a liquid state. The vessel is fitted in its interior with centrifugal beaters or stirrers, and with a steam coil through which steam is introduced for the purpose of heating the contents. The clarification is effected by passing through the liquid a mixture of ozone and electrified chlorine. A small quantity of alumina is added to the solution, and after the action of the nascent oxygen and chlorine the addition of carbonate of soda insures the precipitation of any matters detrimental to the sugar. After the clarification has been effected in this manner another stream of ozone is passed through, in order to deodorise the resulting product. One advantage of this method is that it avoids the possibility of the invertion of the sugar. The inventors make five claims for the application of ozone and electrified chlorine for the purpose described.—No. 2297. February 14th, 1887. 6*d*.

Basic Sulphocyanides of Aluminum, Iron, and Chromium.—*J. Hauff, Stuttgart.*—These chemicals are intended for use in dyeing and printing processes in place of the neutral sulphocyanides which have hitherto been employed. They do not decompose so readily when evaporated in a water bath, and they are otherwise more steady in their behaviour. The aluminium salt forms a good mordant for dyeing. The method of production is by warming the neutral sulphocyanide or sulphocyanic acid with the freshly precipitated hydrated oxide of the metal. The inventor claims the production of these salts in the manner and for the purpose described.—No. 5109. April 6th, 1887. 4*d*.

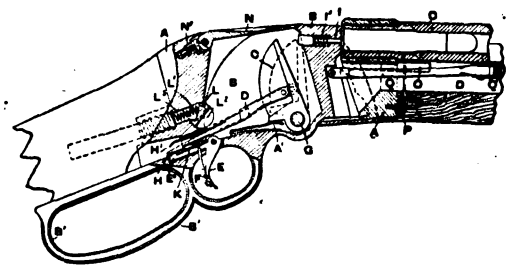
Separating Gold from its Ores.—*G. J. Atkins, London.*—The apparatus illustrated in the accompanying drawing has been designed for separating the gold from its ores by an electrolysing and amalgamating process. The ore is introduced by a hopper into the top of the cylinder A. The chambers A and B contain an electrolysing solution; and the shafts B^1 and G cause the screw D and the drum H to rotate within the two chambers respectively. The current of electricity is led through the solution from the two poles on the shafts B^1 and G. The chambers are separated by a porous plate, which allows the free passage of the electrolyte, but not of the gangue. The screw D turns in such way as to retard the fall of the ore. The part of the ore dissolved by the electrolyte is deposited on the drum H, whence it is swept off by the rubbers J. The amalgamating apparatus is seen lower in the figure. The gangue is fed into the cylinder N, in which revolves the drum O, with a grooved periphery S. Mercury fills up the space between the drum and the cylinder, and unites with the gangue during its



passage through N. The resulting amalgam is led off through the pipe V. In order to regulate the rate of passage of the gangue through the cylinder, an apparatus is designed for lowering or raising the level of the mercury in the cylinder, and thus altering the pressure of the mercury on the gangue. This apparatus consists of a reservoir of mercury X, which may be raised or lowered by the screw X^4; and the pipe X^3 communicates from this reservoir with the bottom of the cylinder N. The mechanism Y helps to abstract the amalgam from the tube V, if it is too thick and pasty to effect its own exit. The inventor makes ten claims for these combinations.—No. 12295. September 28th, 1887. 8*d*.

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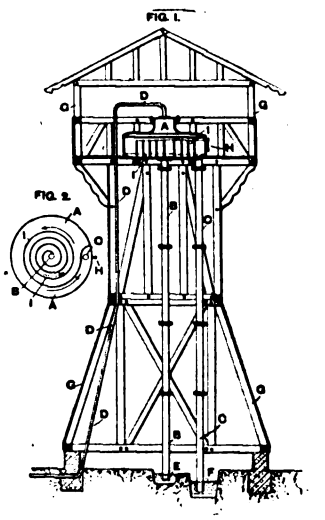
Breech Loading Fire Arm.—*A. Lindner, Berlin.*—The object of this invention is to overcome certain disadvantages incident on the use of rotary block systems, viz., that the cartridge must be driven home into the cartridge chamber before the block can be closed, and that should the cartridge become deformed, it can only be removed from the chamber by means of the ramrod. The arrangements of parts designed to overcome these difficulties will be seen by reference to the accompanying diagram, which represents a vertical section of the breech action. The breech block is closed, and the parts are in the position which they occupy when ready for firing, and the dotted lines show the position they assume afterwards. The breech block B is hollowed out to receive the main spring A^1, the hammer C, the arm D, the trigger E, and the fulcrum G. The part of B which closes on to the cartridge is bored out to



receive the firing pin I. The arm D is at one end fastened to the hammer C, and glides in a groove in the curved surface of B, whilst its extreme rear end moves in a cavity in the butt of the gun, where it is provided with a flat spring H^1 and a hook H pressing on the cavity K. These parts are for holding the mechanism in cocked position. To prevent the block being opened by the force of discharge, a rotary bolt L with recesses L^1 L^2 is arranged on the breech receiver A, and is kept under the influence of the spring L^3. A thumb lever is fixed to the end of this bolt. The flap N is operated on by a spring N^1, so that the loaded cartridge can be fed into the chamber. The extractor consists of a rod O, with the upper end recessed to grip the flange of the cartridge, and with a groove at its forward end. One prong of the fork P gears with this groove. The auxiliary rod Q is pivoted to the breech block, and carries a cylindrical casing Q^1. After the weapon has been fired off the thumb piece on L is to be depressed, and the lever B^1 pushed downwards, so that the block B is compelled to turn on its axis G. During this movement the arm D is pushed to the rear of the cavity, and the flap N is depressed by N^1, so that it remains in contact with B. The rod Q is drawn to the rear, so that a knob on its forward end comes in contact with the end of P. By means of some details of this mechanism, the cartridge is extracted and ejected over the shoulder of the shooter. A loaded cartridge is now introduced, and the block closed. The arm D is depressed, and is caught by K, thus hindering the hammer from moving with the block. As soon as the block is fully closed, the spring L^3 will force forward the bolt to the thumb piece on L, so that L enters a depression in the bolt. The parts are now at full cock, and the rear end of D is above E^1. As soon as E is pressed to the rear, the arm D will be freed from gear with K, and A^1 will propel the hammer against the firing pin I, thus driving it against the cap. The inventor makes six claims for this arrangement of parts.—No. 15043. November 4th, 1887. 8*d*.

Spinning Spindles.—*A. McCulloch, A. Carrie, & D. Ogilvie, Dundee.*—In carrying out this invention the fibrous materials are wound in the form of inverted cops on vertical spindles. This winding takes place on the lower part of the spindles, and the cop is gradually pushed up as it is formed. The twisted material passes on to the spindle over the upper edge of a hollow inverted cone which rotates with the spindle. This cone is carried by a rail to which the up and down traverse motion is imparted. The cone is shaped to fit the conical surface of the cop, and serves to push the cop gradually up the spindle. In one modification of this invention there is a follower or ring placed outside the cone, rotating in the same direction as the spindle. The rotation of the ring is caused to be at a slower rate than that of the spindle by the application of a weighted drag cord; and one or more wire guides are fixed to the ring. The yarn descends and proceeds to the guide wires, and thence over the rounded edge of the cone to the spindle. The rotation of the ring is caused by the action of the spindle through the thread. In another modification a fixed ring with a traveller is employed instead of the rotating ring. The inventors make six claims for the combination of rotating spindle, rotating cone with traverse motion, and rotating follower, together with the modifications.—No. 3635. March 10th, 1887. 8*d*.

Extracting Gases from Liquids.—*E. Luhmann, Niedermendig, Germany, and C. G. Rommenhöller, Rotterdam.*—The apparatus designed by the inventors is shown in elevation in Fig. 1 of the accompanying diagrams. The frame work G, which is preferably about 20ft. or 30ft. high, supports a vacuum pan A, and the pipes B C D. The pipes B and C are connected with the supplies of water E and F, while D communicates with an air pump. In the vacuum pan is a spiral partition I, which is shown in plan in Fig. 2. The object of this division is to increase the distance between the openings of the pipes B and C. When the apparatus is in action, the water from which the gases are to be extracted



is drawn up the pipe B into the pan A, and during its travel in the direction of the arrows is exposed to the suction of the air pump through D. The pipe C acts as an exit for the water. This direction of circulation is insured by the fact that the level of the water in the reservoir E is higher than that of the water in F. This apparatus may be employed specially for the extraction of carbonic acid from water, and also may be employed in the sugar mills for obtaining the syrup in a more consistent state by extracting the steam from it. The inventors make two claims.—No. 14775. October 31st, 1887. 6*d*.

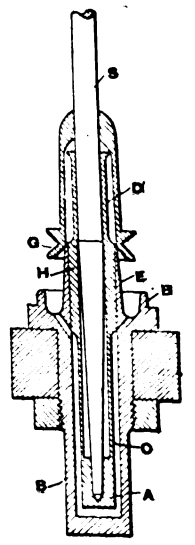
Elastic Fabrics.—*W. Lapworth, Hopedale, Massachusetts.*—The object of this invention is to produce an elastic fabric having a twill on both face and back, the material showing on both twills being composed of the weft instead of the warp, as heretofore. By causing the weft to constitute the visible part of the twills, it is possible to use cheaper threads for the invisible warp. The weft is introduced preferably by one shuttle; but if two shuttles are used, with different coloured weft threads, the fabric may be manufactured with different colours on the face and back. The fabric is woven in a six-time motion, the warp threads are up three and down three, and the fibrous warps are carried by the heddles of three harness frames, while the rubber, or cord warp, is carried by the heddles of one harness frame. The inventor makes one claim for this improvement.—No. 3153. March 1st, 1887. 6*d*.

Alignment of Shaft Bearings.—*E. Stinton, Ipswich.*—One form of the apparatus designed by the inventor consists of a tube fitted with several pairs of different sized collars, by means of which the tube may be mounted in different sized bearings. At one end of the tube are cross wires, and at the other end is an eye piece. In another form of apparatus, the adjusting collars are dispensed with, and in their place are four bars which are parallel to the tube and jointed to it by links. By either of these instruments the true alignment of shaft bearings may be obtained with precision. The inventor makes one claim for apparatus designed for this end.—No. 5472. April 15th, 1887. 6*d*.

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Bobbins for Winding Yarns.—*T. Brown, Sheffield, and W. Pickstone, Radcliffe, Lancashire.*—The object for which the inventors designed these bobbins is to secure both strength and lightness. A sheet of steel is bent into the form of a tube, and to each end of the tube a steel disc or ferrule is fixed. These discs constitute the flanges of the bobbin, and a number of holes are punched in them in order to increase their lightness without diminishing their strength. When the beams or bobbins require to have a longitudinal slot along their length, the sheet out of which the bobbin is constructed is made, before it is bent, with its two end parts at the edge projecting beyond its middle, so that when the sheet is bent until the two edges meet at the ends there is left an opening between the edges, and the flanges are fixed on that part of the tube where the two edges meet. In some cases the sheet may be bent not quite into the shape of the tube, thus leaving a slot along the whole length. The discs in those cases are made with feathers projecting into the slot, which are secured to the tube by T headed bolts. The inventors have designed several alterations in the details of this mechanism, and what they claim is: The construction of bobbins or beams for winding yarns and textures, with their cylindrical parts made of steel plate bent round to tubular form, and provided at the ends with steel flanges, ruffles, stiffening rings, and struts of various sections and sizes as described.—No. 3282. March 3rd, 1887. 8*d*.

Spindles and Bolsters.—*H. H. Lake, London.* (*C. H. Chapman, Groton, Massachusetts, U.S.A.*)—Spindles having a sleeve whirl cannot be easily held in a vertical position while running at high speeds. The inventor proposes a construction for the spindle and bolster which will overcome this defect, and the accompanying figure represents a section of the designed apparatus. The step bearing A is suspended within the bolster case B by means of the thin connecting sleeve C. The walls of this sleeve are made of such a thickness that they are elastic and

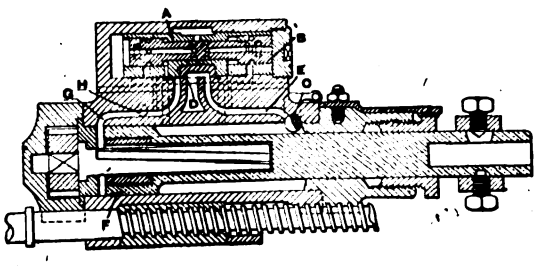


will spring sufficiently to permit the step bearing to yield to the lateral pressure of the foot of the spindle S. The support C also presents sufficient resistance to the motion of the spindle to prevent any gyration. The spindle S is tapered upward to a point above the bolster neck E, so that the entire bolster bearing surface shall be above the rigid lateral support of the neck. The bearing D is thus much less dead to the pressure of the spindle, and is also enabled to yield slightly by its own elasticity and conform to the movements of the step below. The bolster bearing D is fixed to the bolster case by means of its lower end H, which is driven firmly into the neck E. The inventor also specifies a modification designed to attain the same end, and he makes six claims for the whole invention.—No. 2376. February 15th, 1887. 8*d*.

Briquettes of Waste Fuel.—*L. A. Brode, Glasgow.*—The coal waste is ground to a powder and placed in a mixing machine. There is then added a sufficient quantity of a solution produced by the combination of boiling water with silicate of soda and ground rice. The whole, being mixed, produces a thick, clayey substance, which is then moulded into bricks and dried. The inventor makes one claim for this process.—No. 2092. February 10th, 1887. 4*d*.

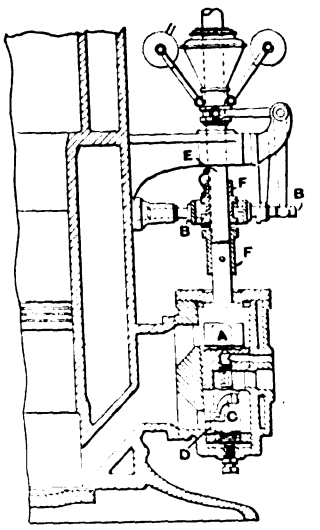
GERMAN PATENT ABSTRACTS.

Rock Drill.—*M. Kuzel, Penzberg.*—This invention relates to improvements in the valve gear regulation and locking apparatus of rock drills worked by compressed air. The valve gear consists



of an ordinary slide valve D, actuated by the pistons A and B, and so arranged that B slides in A, while A slides in the casing. The pistons are moved to and fro by compressed air entering alternately through the air passages shown in the pistons. The locking apparatus is formed by the shaft C, which, at the end of the stroke of the piston F, is turned in such a manner as to completely close the air passage E. The regulation is effected by a throttle valve H inserted in the air passage G and actuated by hand.—No. 41729. May 18th, 1887.

Gas and Hot Air Engines.—*F. Wrede, Bielefeld.*—This invention relates to a new governor for gas and hot air engines. A is a rotating valve which admits the explosive mixture from the cylinder through the passage D into the space C, where it is



ignited and conveyed back into the cylinder. This valve A is connected to the spindle E of the governor by a coupling F. When the speed of the engine exceeds a given limit, this coupling is disengaged by the lever B, the connection between A and E is thereby broken, and A admits no explosive mixture into C until the speed has become normal again, when the coupling F engages and A is actuated.—No 41976. June 28th, 1887.

UNITED STATES PATENT ABSTRACTS.

Lifeboat.—*J. A. Aniello, Biloxi, Missouri.*—The new feature in the construction of this lifeboat is the arrangement side by side of three longitudinal air tight and water tight chambers. The middle chamber runs the length of the bottom of the vessel, and the side chambers are placed symmetrically at the outside of the vessel, and separated from the middle chamber and slightly above it. The three chambers are united at their ends, and passenger compartments are provided fore and aft. The inventor makes four claims for this lifeboat.—No. 376935, dated 24th January, 1888.

Double Doors.—*B. I. H. de Vry & J. Schreiber, Chicago.*—This invention supplies a method of simultaneously opening the two wings of a double folding door. Extensions are fitted to the pivot pins of the hinges, and chain wheels are fixed to these extensions where they pass underneath the floor. The chains which connect these wheels cause the simultaneous motion of the chain wheels, and hence the simultaneous opening of the two wings of the door.—No. 376947, dated 24th January, 1888.

Roofing Tiles.—*H. Schulhoff, New York.*—The tiles for the roofs are designed with an upwardly projecting tongue on one side, and with a groove corresponding to the tongue on the other side. At one end of the tile is a downwardly projecting tongue, and a portion of the opposite end extends beyond the end of the tongue and groove in the sides. In placing the tiles on the roof, the downwardly projecting tongues enter the crevices between the roof boards. The overlapping end portions and the upwardly projecting tongues and grooves on the side are caused to interlock and form a firm surface. The inventor makes three claims for these tiles and the method of arranging them.—No. 376918, dated 24th January, 1888.

Driving Belt and Wheel.—*P. Adie, London, and W. G. Henderson, Washington.*—The peripheries of the wheels are made with alternately reversed circular corrugations to fit the driving belt. The belt is composed of three longitudinal strips of metal, the two outer ones being plain and straight, and the middle one being corrugated. The outer strips are secured to the sides of the corrugated strip, so as to form continuous chords of the circular sections of the corrugated strip, for the purpose of keeping the belt in shape and preserving the shape of the corrugations. The object of this invention is to increase the grip of the belt on the pulley. The inventors make three claims.—No. 376975, dated 24th January, 1888.

Insulation of Electric Conductors.—*T. Egleston, New York.*—The wire or conductor is enveloped by an insulating fibrous covering, which is impregnated with fire proof metallic oxides and with a binding material to keep it rigid. The usual exterior coating of lead or other fusible metal is made use of for the purpose of protecting the insulator from the deleterious action of water. The inventor makes one claim for this arrangement.—No. 376818, dated 24th January, 1888.

Churns.—*W. G. Patterson, Claysville, Pennsylvania.*—This invention reduces the manual labour required to work an ordinary vertically reciprocating churn. A frame is attached to the upper part of the churn, and a horizontal lever, pivoted to this frame, is connected with the vertical piston rod of the churn. A handle at the extremity of this lever is worked up and down by the operator, and both the improved position of the operator with regard to the churn, and the extra leverage obtained by this mechanism, considerably reduces the labour exerted. There is one claim for this improved form of churn.—No. 376752, dated 24th January, 1888.

Machine for Making Collar Buttons.—*G. Krementz, Newark, New Jersey.*—In this machine the metal blanks are held in their places and rotated gradually, while a series of dies operate on them one after the other. The annexed figures show the details of the essential features of this invention. Fig. 1 represents a sectional plan of the devices for rotating the blanks, and the bars for shifting them from one die to the next; and Fig. 2 is a front view of part of the same mechanism. The die holders P and Q are fixed respectively to the reciprocating bar B¹ and to the sliding platform R. The metal blanks A¹ are held in their places by the rod K, and by the india-rubber caps G³ on the shafts G¹. The blanks are placed in their positions at the left hand end of the series of dies, and they are operated on by each die successively; the size of the dies gradually decreases from the left to the right in the figures. The apparatus in the box G serves to rotate the blank. The mechanism E E¹ E² F causes the shafts G¹ to revolve intermittently. These shafts are geared together, and are surrounded by springs which tend to press the caps G² and their india-rubber heads G³ outwards. This pressure

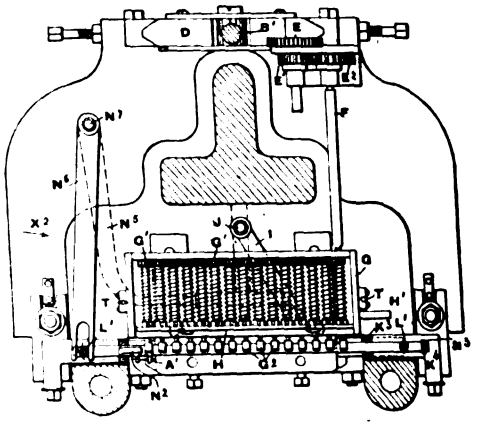


Fig. 1.

is sufficient to turn the blanks, and they are thus exposed to the pressure of the dies at all points of the circumference of their necks. The sleeves of the shafts G¹ all pass through the bar H, which is connected with end rods and cam arms. At certain periods of the action of the machine, these cam arms are actuated in such a manner as to cause the rod H to compress the springs on the shafts G¹, and so relieve the pressure on the button blanks. In front of the box G are two bars K and L. The pins L¹ project downwards, and rest on the ends of the wings M¹ of the plate M. The pins K¹ pass through apertures in L, and springs K² surrounding the pins press the bar L downwards. The bar K rests in slots in the supports K³, in one of which a vertically sliding pin N is pressed downwards by spring N¹. The arm N² projects over a part of the top edge of K, and the stop N⁴ on K³ prevents the spring from depressing N² more than a certain

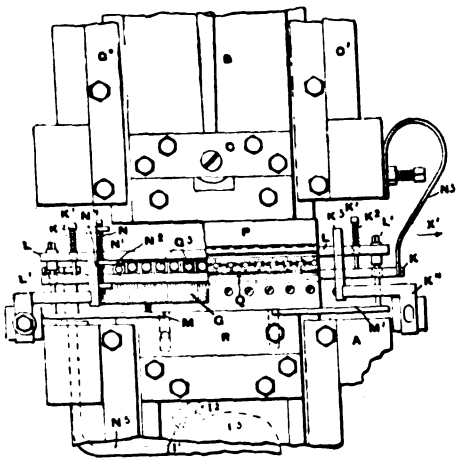


Fig. 2.

distance. The spring N³ is fastened to the frame A, and one end of it to the bar K, thus drawing K to the right. The arm N⁶ is fixed to the upper end of the shaft N⁷, and one of the pins N³ passes through a notch in the bottom of N⁶. The shaft N⁷ has a curved arm N⁸, which rests against the rim of the disc I¹. The cam I² serves to gradually raise the lower plate Q, and the sudden projection I³ allows the dies to separate during the alteration in the position of the blanks. This mechanism allows the blanks to be shifted one place to the right between two series of operations of the dies. The inventor makes nineteen claims for the reciprocating dies, for the method of rotating the blanks, and for means of shifting the blanks one position onward in the manner described.—No. 372683, dated 8th November, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery.

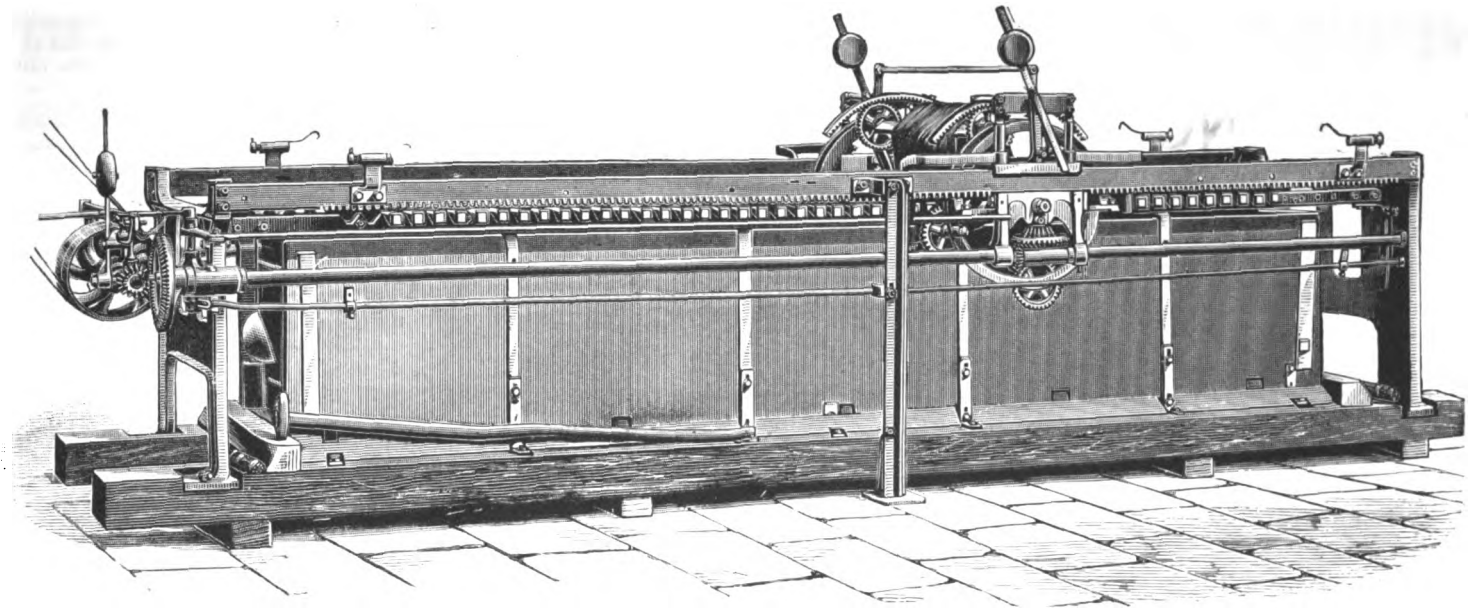


Fig. 54.

THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery *(continued from Vol. III., page 659).*—Having produced the yarn by one of the machines described, it may be used for various purposes. Broadly speaking, the machines exhibited for the subsequent treatment of the yarn were intended to prepare it either for weaving or thread purposes. In weaving, the weft may be used in the cop, as produced on the mule, or on the pirn, as formed on the ring frame. It may also be dyed, in which case it is wound into hanks by a process known as "reeling," and dyed, being subsequently formed into spools or pirns. The warp is wound on to bobbins with large heads, and is transferred from these on to the warp beam, on which is placed the right number of threads to form a warp for any width of cloth. Before using the warp it must be sized; and as this process is practically universal, a special form of machine is made for the purpose. If the yarn is to be made into thread for sewing purposes, it is almost always the practice to wind it from the cop on to bobbins in a special machine provided with detector mechanism, so that the required number of ends are found throughout the entire length of the bobbin. The two or more ends referred to are then twisted together in a doubling machine, and when the finished thread is produced it is wound on to reels, or made into balls for the market. If the thread be intended for lace purposes it is passed, after "doubling," through a gas flame in a "gassing" machine, by which means the projecting fibres or "ooze" is burnt off, and a smooth yarn left, or if the yarn is to be used for hosiery purposes it is wound into taper-shaped spools for use in the hosiery machines.

It is not necessary to refer to all the machines used in the various processes referred to, as some of them do not present any features of novelty. The reeling machine is well known, and does not require any special remark. It is the practice in exporting yarns to wind them in hanks on the reel, and subsequently form packages of these hanks weighing 5lb. or 10lb. each by means of a press similar to that illustrated in Vol. III., page 502. The process of dyeing the hanks was demonstrated by a machine of French origin which is known as Corron's patent, and was exhibited by Mr. Arthur Bates, of Manchester. This machine is illustrated in Fig. 54, and consists of a dyeing vat, over which a carriage, which rests on longitudinal rails, traverses. The motion of the driving belt is communicated by means of the gearing and side shaft shown to a pinion, which engages with a rack formed at the under side of the longitudinal rail. This arrangement is duplicated, and the carriage is consequently traversed equally at each side of the machine. The pinion is fixed in a stud, which is attached to the carriage, and it follows that the revolution of the pinion is followed by the traverse of the carriage. A rail with a number of V grooves is fastened to each side of the vat, the rods carrying the hanks being thus sustained. On the stud carrying the pinion a disc is mounted, and is also revolved from the side shaft. Four pinions, with their bosses shaped into sockets or holders, are suitably carried by discs, and when the latter revolve, two of the holders lift one of the hank rods out of the V in which it rests. The hank so lifted is carried forward by the revolution of the disc, during which operation the holder pinions engage with two quadrant racks, shown, and are thus revolved for a short distance. The effect of this is that a fresh portion of the hank is submitted to the action of the liquor when the hank is released by the holder. The carriage traverses at a definite rate so as to permit the holders to lift the hanks consecutively, and a stop motion is provided by which the traverse of the carriage is reversed when it has reached either end of the machine.

The machines for winding the yarn on bobbins scarcely require explanation, being generally well known. The bobbins on to which the material is wound are usually formed with a cylindrical body and circular heads or flanges, the distance between the flanges being known as the "lift." The "lift" is usually about 4½in., and the diameter of head about 4in. Messrs. Butterworth and Dickinson, of Burnley, exhibited a machine of this class. When the bobbins have been filled they are placed in a V creel to the required number, and each end is passed separately through an eye to the "beam" or roller on which the warp is wound. In the machine made by Messrs. Butterworth & Dickinson (Fig. 57), Brimelow's stop motion is used. The eyes previously mentioned are formed at the upper end of wires which, while the yarn is passing, are sustained by it. When an end breaks or fails, the wire held up by it falls and comes in contact with a revolving wiper, which is stopped in its revolution. At the end of the wiper shaft is a V clutch, the driving half of which is forced outwards when the motion of the wiper ceases. The lateral movement of this part of the clutch is transmitted to the strap fork, the machine being thus stopped. By an ingenious arrangement, as soon as the machine stops the whole of the pins are lifted, thus relieving the threads from the weight of the former. Messrs. John Dugdale & Sons, Blackburn, and Messrs. William Dickinson & Sons, also of Blackburn, both exhibited machines in which stop motions similar in principle but varying in detail to that described were used.

After the yarn has been wound on to the weavers' beams it is treated in the sizing machine. The purpose of sizing is to stiffen the yarn sufficiently to weave well, and not primarily for the purpose of adulterating the cloth, although this is one of the uses to which size is put. The sizing mixture consists of flour, tallow, wax, china clay, and other ingredients, which are used in various proportions. As the construction of the beaming machine is such that not more than five hundred ends can be wound on to one beam at a time, and as the number of threads in the warp of most widths of cloth will be five or six times as many, it is necessary to place a corresponding number of beams in the creel of the sizing machine. The yarn is drawn from the beams in such a way that all the ends are delivered to the size box from one point. The size box, which is placed between the creel and the drying cylinders, is kept well supplied with size, and is fitted with a copper roller, the under side of which is always in the size. The roller is vertically adjustable by means of a rack. After passing through the size the warp is taken between two rolls, the lower one being usually made of copper, and the upper of iron. The purpose of these rolls is to squeeze the superfluous size out of the warp, and also force the size into the yarn. After being sized, the warp is traversed around two cylinders, to which steam is admitted, and made with iron ends, and shells of tin plates or copper sheets. The course of the warp is shown in Fig. 55, this being the method ordinarily adopted. Fig. 56 shows an improved plan exhibited by Messrs. Wm. Dickinson & Sons. It will be observed that a much greater

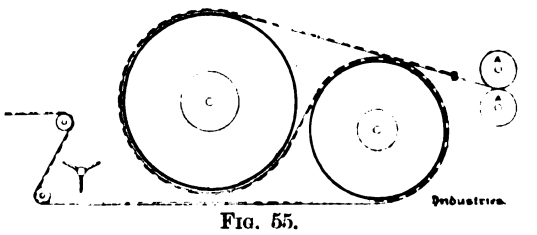


Fig. 55.

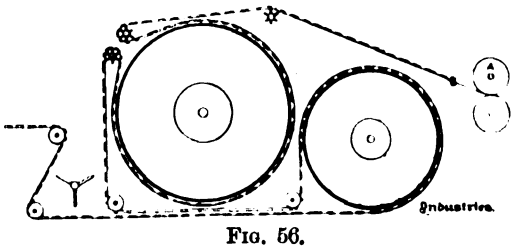


Fig. 56.

length of drying surface is secured by the latter method than by the former. Special provision is made in the construction of the cylinders for insuring the thorough removal of steam condensed in them. Messrs. Howard and Bullough showed a cylinder in which the copper shell is flanged at the ends, the flange being turned inwards at right angles to the surface. The shell is held by this flange between the cylinder end and a ring fitted inside it. The cylinder revolves on a shaft securely fixed in the ends. This firm make their bearings of a number of rollers, which are free to revolve on their own axes and round that of the cylinder. When dry, the warp is passed over a number of revolving four winged wooden fans, which are the same width as the machine. In this way the sized material is not only effectually dried, but it is also cooled to some extent. The yarn is kept in tension by means of a number of rods, and is passed through an expanding comb, after which it is carried over a roller positively driven. The weaver's beam is a roller with a wooden body and large circular iron ends, and is made wide enough to receive all the threads in the warp when laid side by side. This beam is driven by gearing through the intervention of friction plates, which will be referred to hereafter at greater length. The delivery roller is suitably driven, and the speed at which it travels regulates the amount of sizing and drying. By means of a side shaft and bevel wheels an equal velocity is given to the copper roller in the size box, so that between these two points no tension is put upon the yarn,

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THE MANCHESTER ROYAL JUBILEE EXHIBITION.

TEXTILE MACHINERY.

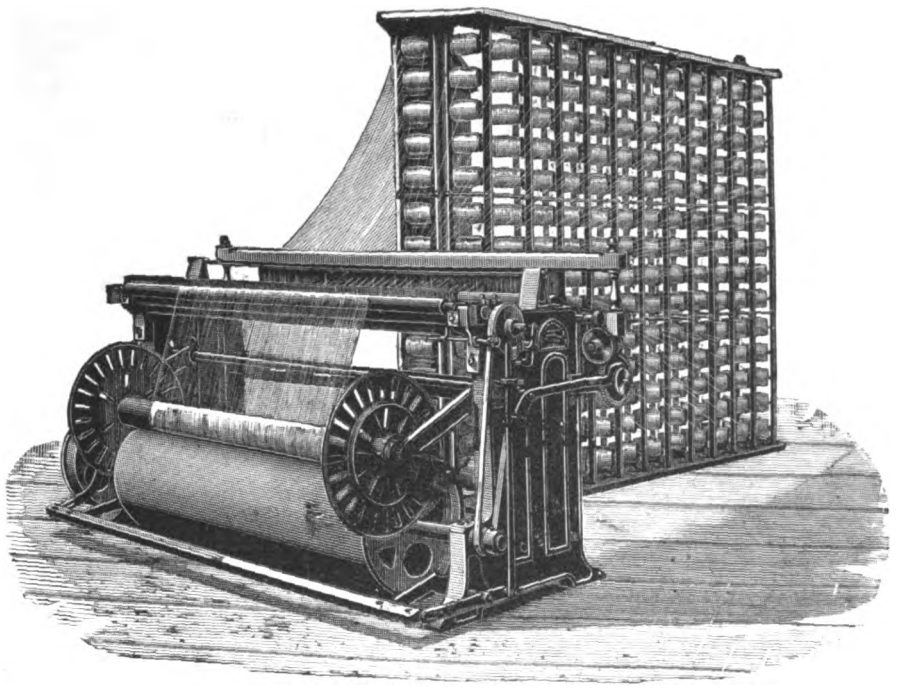


FIG. 57.

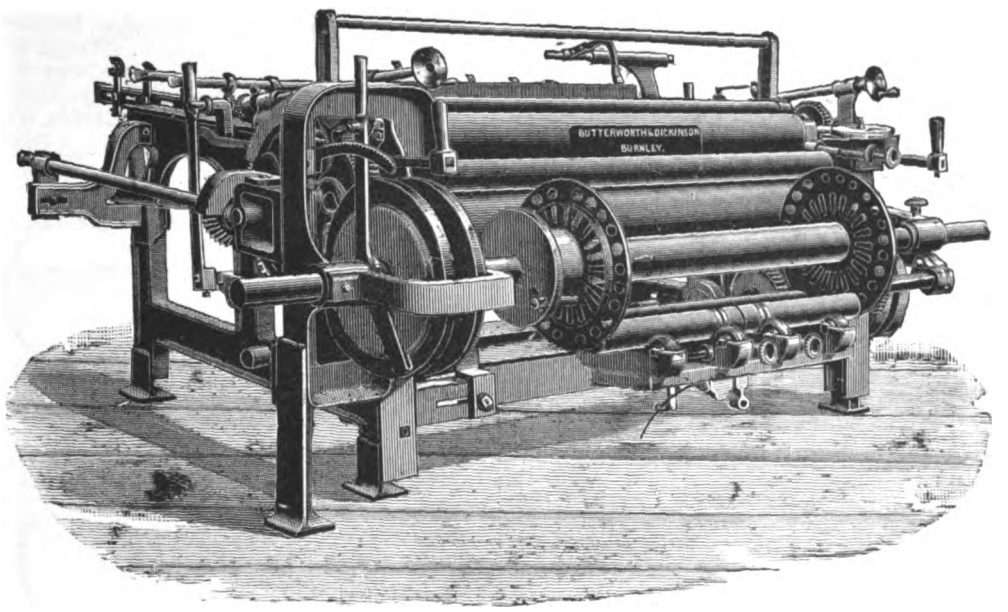


FIG. 58.

the feed being equal to the delivery. The motion is communicated to the delivery roller by means of a pair of cone drums, by altering the position of the strap on which the rate of revolution and the traverse of the yarn is altered as required. A slow motion is fitted, by which, when the weaver's beam is filled and is being replaced, the speed of delivery of the warp can be lessened. It is necessary to keep the warp always in motion, otherwise that on the cylinders would dry and bake, and thereby rendered useless. In a suitable position underneath or above the yarn on the beam are pressers, in some cases rollers and in others rods, a detailed description of which will be given hereafter. The length of warp necessary to make a piece, or "cut," being fixed, a mark is put upon the warp by a trip hammer arrangement, the fall of the hammer being obtained from the revolutions of a cam surface. The velocity of the cam is regulated by a special arrangement, to which an indicating apparatus is attached. In addition to a "cut" marking motion, there is also one for marking the shorter lengths used in making scarfs for the Indian market, known technically as "dhooties."

The friction plates referred to are placed at the end of the weaver's beam, and consist, in the case of the machine exhibited by Messrs. Howard & Bullough, of two steel discs suitably fastened to the shaft, on each side of which a disc of flannel is placed. Between these two steel discs is a double flanged wheel with a pinion in its centre, the flanges being slightly larger than the discs. With this pinion the wheel driving the arrangement gears, and two circular cast iron plates placed respectively outside each of the steel plates are arranged to be driven from the flanges of the wheel. The steel plates are fixed into a cast iron holder fastened to the shaft, on which the wheel referred to revolves. The frictional contact is preserved by a forked lever pivoted at its lower end, and weighted in a suitable manner—by this means all the surfaces are pressed together. Now it is obvious that as the wheel is revolved along with the cast iron plates, the frictional contact of the flannel surfaces will rotate the beam. When the latter is empty, or nearly so, it is not in any way retarded; but when it begins to fill it takes up at every revolution an increasing length of yarn. As the delivery roller only allows a definite amount of warp to pass, it follows that the velocity of the beam is retarded by the pull of the yarn, and the effect is that a certain amount of slip takes place in the friction gear. The taking up is constant, and a well wound beam is produced. In the machine made by Messrs. Butterworth & Dickinson (Fig. 58) the friction plate carries a bow spring, which is passed over the shaft. Alongside the spring is placed a lever, pivoted on the shaft, and having a large boss formed at its lower end, which is provided with a coarse thread. The boss fits the inside of the bracket sustaining the shaft, and in this way, as the lever is partially rotated, it moves longitudinally along the shaft and puts more or less pressure on the friction plate. The lever is furnished with a catch, which is in engagement with a notched quadrant, so that the lever can be easily set. By this device any pressure which it is desirable may be put on the friction plate.

Below the beam there are placed rollers sustained by a suitable frame, which, in Messrs. Howard & Bullough's machine, are arranged to traverse laterally, so as to alternately press the warp at each end of the beam. Messrs. Butterworth & Dickinson employ rollers, each of which is grooved at one end and rests upon narrow bowls, which can be adjusted so that the roller will come close up to the flanges of the beams. The marking hammers are driven by means of cams, the rate of revolution of which is controlled by change wheels. In the machine

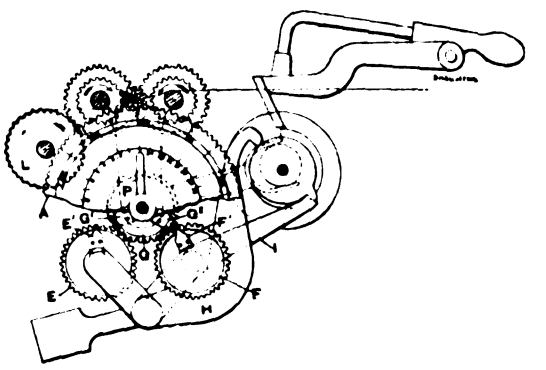


FIG. 59.

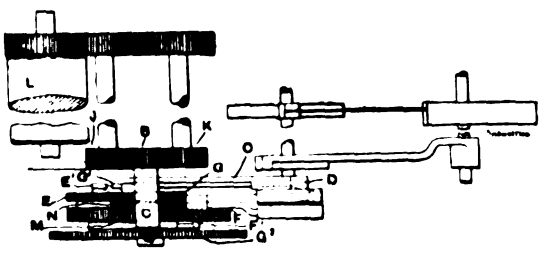


FIG. 60.

which was shown by Messrs. Howard & Bullough, and which is the invention of Mr. Alfred Hitchon, the marking motion is fitted with a new indicator, which possesses many features of merit and is very ingenious. It is illustrated in side elevation in Fig. 59, in plan in Fig. 60, while Figs. 61 and 62 show some of the details The essential part of the mechanism consists in a dial

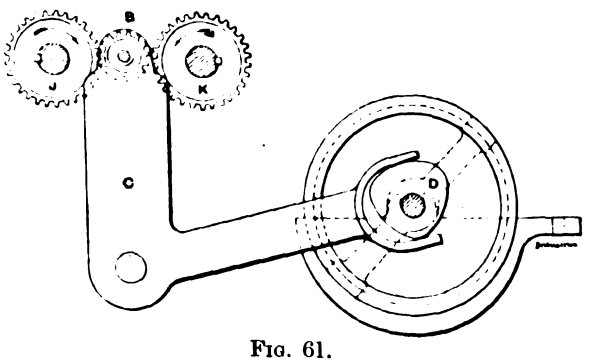


FIG. 61.

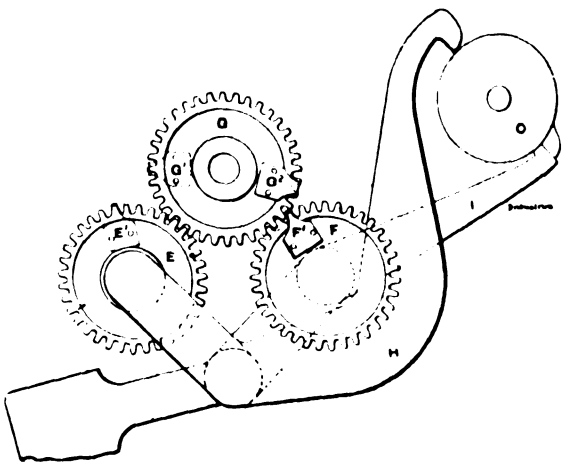


FIG. 62.

plate A, which is marked with divisions representing the number of inches of yarn passed from 1 to 100, and with other divisions each of which represents 100in., the latter set of marks being formed in a smaller circle, as shown. The edge of the dial plate A is toothed, and is in gear with a small pinion securely fixed at one end of a spindle, to the other end of which a second pinion B is fastened. The spindle and pinions are carried by a boss formed at one end of the lever C, shown in detail in Fig. 61. The other end of this lever is forked, and a cam D revolves in the fork. The cam D is fixed on the same spindle as the colour wheel,

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THE SCOTTISH HERRING FISHERY.

1886.

	Length of Keel.	Breadth of Beam.	Depth of Hold.	Draught, Light.	Draught, Loaded.	Weight of Ballast. Tons.	Burden. Tons.	Cost of Boat, with Sails, &c. £	Cost of Nets, Buoys, &c. £	Number of Crew.
Stornoway	54ft.	17ft.	9ft.	3ft. 6in.	7ft.	14	50	350	140	7 men
Wick	50ft.	17ft.	8ft.	5ft.	7ft.	10	25	300	200	7 „
Fraserburgh	58ft. to 59ft.	18ft. to 18ft. 6in.	9ft. 4in. to 9ft. 9in.	3ft. 10in. to 4ft.	7ft. 6in. to 8ft.	20 to 25	55 to 60	400	144	6 „ 1 boy
Peterhead	54ft. to 56ft.	17ft. 6in. to 18ft.	7ft. to 8ft.	2ft. 6in. to 4ft.	4ft. to 6ft. 6in.	8 to 12	20 to 30	230 to 340	150 to 190	6 and 7 men
Ferryden	58ft. 6in.	16ft. 9in.	8ft. to 9ft.	5ft. 6in.	9ft.	16	46	340	210	7 men
Port Seton	59ft.	18ft.	8ft. and 9ft.	5ft.	7ft. 6in.	14	40	360	300	7 „
Pittenweem and Anstruther	58ft.	17ft. to 18ft.	8ft.	5ft.	7ft. 6in.	12	30 to 36	360	250	7 „
Eyemouth	50ft. to 56ft.	17ft. to 18ft.	7ft. to 8ft.	4ft. to 4ft. 6in.	7ft. to 8ft.	12 to 15	40 to 50	340 to 370	160	7 „

1848.

	Length of Keel. Ft. in.	Breadth of Beam. Ft. in.	Depth of Hold. Ft. in.	Draught, Light. Ft. in.	Draught, Loaded. Ft. in.	Weight of Ballast. Tons.	Burden. Tons.	Cost of Boat ready for sea. £	No. of Crew.
Wick	31 0	13 0	4 9	2 2	4 6	1¼	24	64	5
Buckie	30 0	13 0	4 9	2 9	4 9	1	23	60	5
Fraserburgh	32 0	13 6	5 0½	2 9	5 0	3	27	75	5
Peterhead	34 0	13 6	4 0	2 9	4 6	1	26	68	5
Aberdeen	32 6	12 6	4 3	2 6	4 9	2	22	65	5
Newhaven	32 0	13 3	4 3	2 6	5 0	2½	25	80 to 85	5
Dunbar	33 6	13 9	4 3	2 9	5 0	?	28	90	5
Berwick	33 0	13 9	3 10	2 3	5 6	2	24	95	6

which is placed so that its under side revolves in the colour box. Referring now more particularly to Fig. 62, the wheels E, F, and G carry four additional teeth E^1, F^1, G^1, and G^2, two of which are fixed and two adjustable, all the four being set so as to project beyond the points of the teeth of the wheels. The wheels E and F are sustained by the ends of links or levers H I, each of which is suitably formed at the end to engage with the catch on the disc O. The cam D and the disc O are fastened to the same shaft, which is driven by a special arrangement of pulleys. O is held by either of the levers H I; its release by one of them will be followed by its rotation until the other engages with it; and it will therefore make a half revolution. The result is that the colour wheel is turned up so that it is in proper position to mark the warp when the hammer strikes, and also to remove the pinion B from its engagement with one of the wheels J or K, and establish a contact with the other. In this way the motion of the dial is reversed. The necessary depression of the levers H I is caused by the contact of one of the pairs of extra or projecting teeth. The pointer or finger P is attached to the boss of the wheel N, which has one tooth less than the wheel M, and derives its motion through the train of wheels shown, the pinion M being fixed on the boss of the dial A. This gear is differential, and the effect is briefly that the finger advances one figure for every 100in. measured by the roll L. When starting, the teeth F^1 G^2 are put into contact, and the dial is set to indicate the number of inches intended to be marked. Thus, if it were required to mark every 2050in., the dial would be revolved until the pointer was midway between the 20 and 21 on the smaller circle, and the mark 50 on the outer circle was at the top. The teeth E^1 G^1 would then be set in contact, the wheels re-fastened, and the machine started. The revolution of the dial would continue until the zero point was reached, when the other pair of teeth F^1 G^2 fixed on the pair of wheels F G would engage, and, by depressing the lever I, allow the cam D to make a half revolution, when the motion of the dial would be again reversed. As soon as the same length had again passed, the teeth E^1 G^1 would again come into contact, and the motion of the dial A would be once more reversed. This alternate reversal goes on so long as required, and it is thus possible to mark any length accurately and automatically. Although apparently somewhat complicated, the motion is found to be effective and reliable in practice.

(To be continued.)

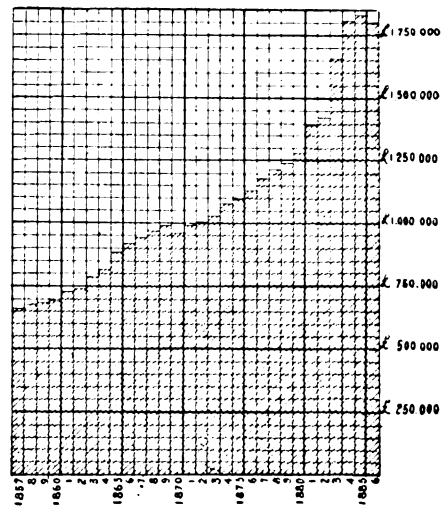
THE SCOTTISH HERRING FISHERY.

II.

(Concluded from page 157.)

It may naturally be asked, what has led to the present state of the fishing industry? Much is due to the fostering care of the Fishery Board, who have jealously guarded the interests of the fishermen, and aided them by the formation of small harbours at the most dangerous parts of the coast. Though conservative, if not obstinate, in introducing improved methods of prosecuting their calling, much has yet been effected by the fishers themselves, who are a thrifty, hardy race of good seamen, our Naval Reserve being almost wholly drawn from the fishing class. Bounties were at one time given to encourage the fisheries, but they ceased more than half a century ago, and the fishermen—thrown entirely upon their own resources—have been able out of their savings to invest £1,794,000 in boats and fishing appliances. Notwithstanding the serious losses incident to the nature of their vocation, the capital invested in boats and fishing gear, as shown by the annexed diagram, has had a steady upward tendency. In 1857 the sum thus invested was £657,800, and in 1886 it had reached the very large amount of £1,794,900. This latter sum, however, includes the value of 109 beam trawl vessels, which, in some cases, are the property of companies. About forty years ago, what was then considered a good fishing boat could be purchased for £47; now, however, owing to the increased size of the craft, five or even seven times that sum is considered a small price for a boat fully equipped and ready for sea. In his report "On the Loss of Life and on the Damage Caused to Fishing Boats on the East Coast of Scotland in the Gale of 19th August, 1848," the late Admiral Washington gives information regarding the dimensions, cost, and crew of the fishing boats then in use. The largest boats did not exceed 34ft. keel, and all of them were open; while many of those used on the coast of England were either whole or half decked. The fishermen generally on the East Coast had a rooted aversion to anything but open boats, and it was long before their prejudices were overcome. The first full decked boat was built at Eyemouth, little more than thirty years ago, and it was such a decided success as regards safety in heavy weather, and greater shelter and comfort to the men, that others speedily followed. The above tables give the dimensions of boats at various places as used in 1886 and 1848.

Value of Boats, Nets, and Lines, from 1857 to 1886.



Between 1848 and 1885 the boats greatly increased in length of keel, from 34ft. to 50ft. and even 59ft., with a relative increase in the draught, carrying power, and cost. Instead of costing only £60 to £95, the prices now vary from £200 to £400. Twenty years ago there were 13,132 fishing boats in Scotland, the tonnage of which was 101,909; while in 1855 there were 5309 of 30ft. keel and upwards, with an average tonnage of 17·9; 4311 of 18ft. to 30ft. keel, and 5807 of 18ft. keel and under. This shows a healthy state of the industry, since the boats have not only increased in size, but are better equipped and manned; they carry a larger fleet of nets, and can go to distant fishing grounds previously untried. At one time only the inshore waters were fished; now, however, distant ventures are made, with a correspondingly larger catch. One objection to decked boats has yet to be fully met; the want of permanent or temporary portable bulwarks to prevent the men losing their footing and being washed overboard in heavy weather is still unsupplied. Various expedients have been suggested, but as yet the fishermen have not been induced to do much in this direction, the allegation being that the proper working of the nets will be interfered with. Nothing can be simpler than a set of temporary standards with eyes through which a chain might be run, and these could be removed when not required. Some change will certainly require soon to be made in this respect, as the loss of life due to the want of some bulwark protection is considerable.

The use of steam or other motive power will doubtless have a wider application than at present, notwithstanding the fishermen's objections to its use. Steam power is used for collecting and taking to market fresh fish, and also for towing the boats to sea and bringing them back to harbour. A more liberal use of this means of getting the boats quickly to port is desirable, especially when the fish are to be cured for branding. At Eyemouth, during the height of the season of 1884, no fewer than twenty-six steam tugs were employed towing the boats, at a cost of £1,100 a week; and it may be stated that the catch in the Eyemouth district for that year was higher than formerly, and amounted to 84,112 crans, about one-fourth being sold fresh and the remainder cured. A valuable fishing is often lost owing to the boats being becalmed, especially when they are at the distant fishing grounds. Not only have the boats been greatly increased in size, but the nets have been also increased in length and area, so that the means of capture of each boat have been augmented five-fold. Until about twenty-five years ago the nets were made of hemp twine, 40 yards long by 6 to 7 yards deep, and each boat carried twenty-four. Now the nets are of cotton, each of the value of about £3; they are 60 yards in length by 10 yards in depth, and each boat carries sixty to seventy of them, presenting 36,000 square yards of surface. This increase in the drift of nets has not, however, added to their weight. There are frequently 5000 to 6000 boats fishing in the North Sea, the nets of which, if extended in one line, would go four times the distance between Liverpool and New York. The size of the mesh, which should be 1in. from knot to knot, is still in dispute, and the proper size to admit of shrinkage after "barking" has not been defined.

There is a dark side to this picture of progress. From the nature of his calling, the fisherman is often in peril. Much property and many valuable lives are lost annually in the prosecution of the fisheries. A sudden gale may sweep over the coast, bringing ruin in its train; and though sudden calamities are happily few in number, yet every year has its victims, the annual tribute being about fifty men, and, unfortunately, sometimes more. These disasters have, however, led the men to pay more heed to the indications of the barometer. The gale of October, 1881, was unmistakably indicated by the state of the barometer, and its warning voice was disregarded, with fatal consequences. The gale of 1848 led Admiral Washington to suggest improvements in the build, size, and better equipment of the fishing boats, and these improvements have been steadily adopted. But there is a limit beyond which the size of the boats cannot well be pushed; for, as most of the East Coast harbours are dry at low water, or nearly so, the boats may require, in certain states of the tide, to leave the fishing grounds earlier than they would do if the harbours had the requisite depth at the entrance to enable them to enter at all states of the tide. Closely connected with the proper prosecution of the fisheries is the provision of adequate harbour accommodation. This subject was fully reported on by the "Harbour Accommodation Committee, 1882-84." The committee recommended the provision of deep water accommodation, but this most desirable object is not easily attained on the eastern seaboard of Scotland, unless at great cost entirely beyond the resources of the fishing community, even aided by a grant from the Fishery Board out of the £3,000 annually placed by Parliament at its disposal. This vote, small though it be, has, by stimulating local effort, enabled the Board to provide small harbours and quays at some of the most necessitous parts of the coast, and has resulted in immense benefits to the fishermen. Much, however, remains to be done in providing suitable harbours. Before concluding we should state that the figures on the right of the diagram shown on page 156 represent hundreds of thousands, and not millions, as incorrectly stated in our last week's issue.

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RAILWAY CARRIAGE AND WAGGON WORKS.

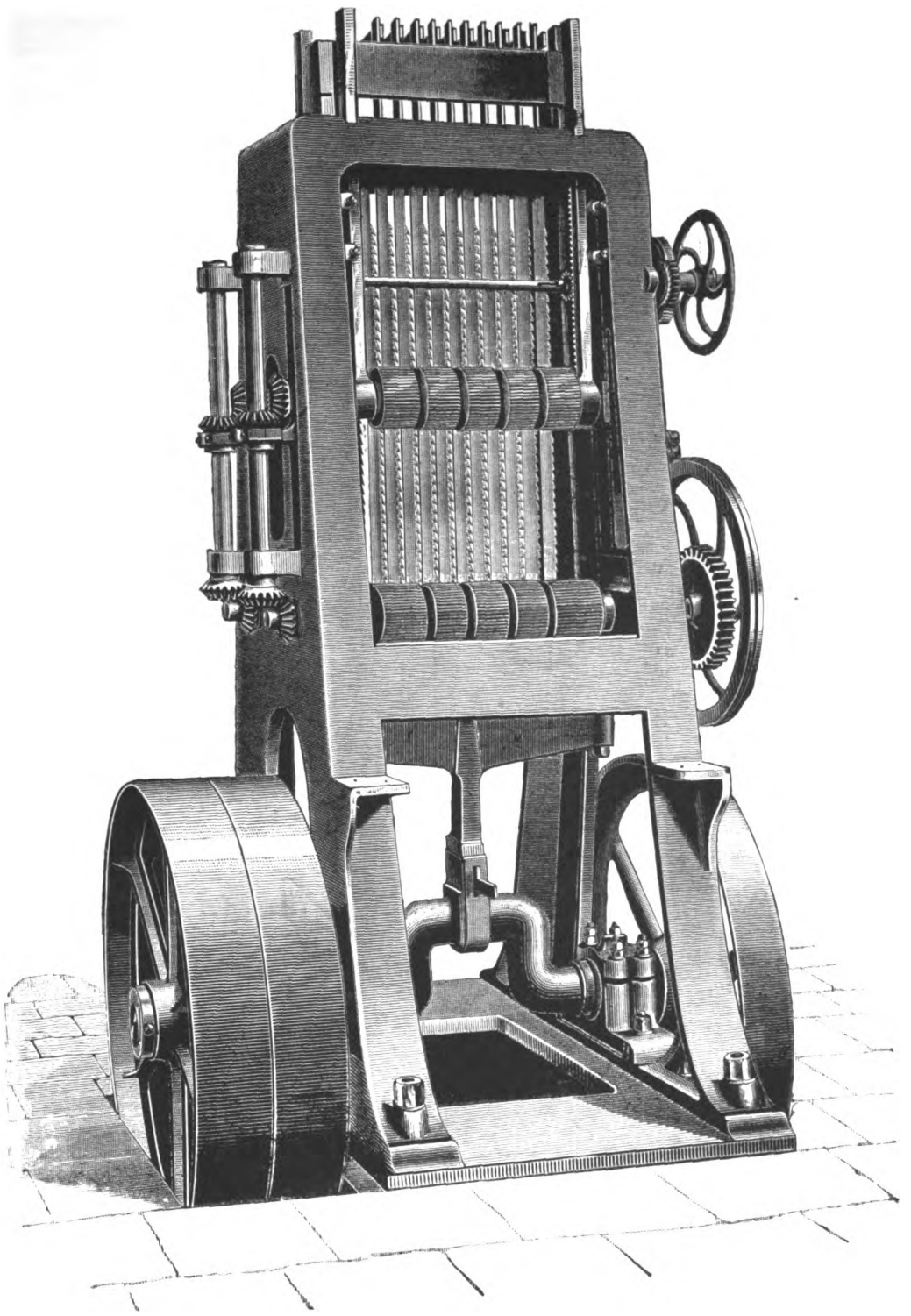


Fig. 5.

RAILWAY CARRIAGE AND WAGGON WORKS.

By M. Powis Bale, M.Inst.M.E., Assoc.M.Inst.C.E.

II.

(Continued from page 159.)

The combined log, deal, and flitch frame can be used in sawing the carriage and waggon soles, sheathing, &c., as well as cutting flitches, planks, and boards. The main frame of this machine should be of massive construction, to withstand the great strain and absorb the very considerable vibration of working found in all wood working machines with a reciprocating motion. The base of the frame should be extended. The best form of crank shaft—which should be made either of good wrought iron, free from seams, or of steel—is the double or bell crank, with a bearing placed well up to the crank on either side. An additional bearing should be placed on the outer side of the driving pulleys. Cranks bent by hydraulic pressure are considerably stronger and to be preferred to the block crank. In the best practice the crank shaft is connected to the saw frame by a pair of rods, one on either side of the frame. This arrangement secures the advantage of a long connecting rod, with increased strength and ease in working, the power being applied directly when it is required, viz., when the saws are cutting. This plan has also the advantage of lessening considerably the depth and cost of the foundations necessary. The saw frame should be of steel, and combine, as far as possible, strength with lightness. Steel of hollow section can be recommended, and in calculating the compressive strain the swing frame has to bear, the maximum number of saws the frame is proposed to work must be allowed for with a considerable margin for contingencies, or the frame may be found to spring in work. The stress on the saws is very great, often amounting to five or six tons per blade. The bearings in which the swing frame works should, by preference, be made of phosphor bronze, and be adjustable for wear. The connecting and side rods should be fitted with straps and cottars and with bearings of phosphor bronze. A very important point in log frames used for connecting native and hard woods is the feed gear. I can, from experience, recommend what may be termed a multiple roller feed, which I believe was first introduced in Austria, and consists briefly of two pairs of top and bottom feed rollers, all of which are driven, being geared together. In this arrangement a most powerful feed is obtained, obviating slip when sawing difficult or frozen timber. The illustration (Fig. 5) represents a compound roller feed log frame, from the designs of Messrs. Haigh and Co., Limited, of Oldham. The chief point of interest in this machine is the feed gear, which consists of duplex sets of rollers, the whole of which are driven by positive gear, thus almost entirely doing away with the chance of the log slipping, even if of a difficult nature or in bad condition. The feed gear is so arranged that its speed can be increased or reduced whilst the log is being sawn. In this machine the old plan of weighting the top rollers by means of levers and weights fixed on the top of the machine has been dispensed with, and the weighting apparatus is now applied on either side of the frame and within reach of the sawyer. The sweep crank shaft is of steel, and is fitted with two balancing fly wheels, one on either side of the frame, and the saw frame is driven by means of side connecting rods.

A matter of great importance in the effective working of log frames, steam mortising, and other machines with a vertical reciprocating motion, is the foundations. These should be carefully made of stone or brick work, to overcome the vibration and punching action of the machines when at work. Stone is preferable to brick work, and should be carefully dressed. If the dressing is badly done, and the pressure is uneven and severe, foundation stones are liable to fracture. Blocks of stone of long dimensions in proportion to their thickness should not be used, as with heavy machines with a reciprocating motion, and sometimes with a positive stroke or dead blow, the risk of breakage is considerable. A safe rule is to make the length of the block about three times the thickness, and the width one and a half times. Great care should be taken that the stone is accurately levelled, and set as nearly as possible perpendicular to the direction of the stress. The top blocks should be cramped together and filled in with molten lead. The framing of the machine should be made to combine as far as possible, and be made integral with the foundation. The quantity of the work turned out, and the longevity of the machine, depend more on the stability of the foundations than is generally imagined. In machines where there is a constant punching action going on, the dead weight on the foundation should not exceed one-sixth of the crushing load, and a course of timber balks should be put over the masonry, so that the machine does not rest directly on the stone or brick work. A sheet of lead placed between the machine and the foundation will lessen vibration. The foundation bolts should pass entirely through the masonry.

For breaking down heavy logs, large band sawing machines have latterly come into extended use. They possess several advantages over circular saws, the chief of which are that they take much less power to drive, and waste much less wood. The chief difficulty experienced in working large band saws is keeping them to a true vertical line; but this may be overcome by fitting special guides where the saw enters and leaves, and by proper arrangements for receiving the back thrust of the blade. The main frame of the machine should preferably be a cored casting, made in one piece to secure freedom from vibration in working. A very important factor in efficient working lies in the construction of the saw wheels. These should combine as far as possible lightness with strength, and be of not less than 6ft. diam. In the best practice they are made of wrought iron or steel. They must be perfectly in balance and mounted elastically. For heavy machines the author prefers to arrange the saw wheel spindles each to run in two pairs of adjustable bearings, instead of allowing the wheels to run overhung on studs as is sometimes done. If the work is difficult, and the saw is found to run out of line, in addition to the ordinary saw guides, two pairs of movable steel rollers, placed immediately above where the saw enters the wood, and below the table, may be used with advantage. It is found in practice that a thin gauge saw will stand better than a thick one, and one with rounded gullets better than one with angular gullets, as these latter are much more liable to commence cracking at the roots of the teeth. It is important that a constant and even tension be given to the saw blade; but this must be elastic and not rigid, to allow for the expansion of the saw by becoming hot in working, and its contraction whilst cooling. Saw blades should always be slackened out after finishing work. For sawing oak, ash, elm, and hard woods generally, a saw blade with more teeth should be used than to saw soft wood, and these filed further back. For woods with a woolly fibre saws with deep teeth and coarse space should be employed, to allow of easy clearance to the saw dust. With large band saws a blade speed of 5000ft. per minute for soft wood, and 4000ft. for hard wood, will generally be found suitable. The illustrations Figs. 6 & 7 represent a vertical band sawing machine for cutting heavy logs into flitches, boards, &c., made by Messrs. Haigh & Co., Limited, of Oldham. The main frame of the machine is a strong hollow casting made in one piece. The saw wheels are of wrought iron, covered on the face with hard wood, and an outside covering of india-rubber for the saw blade to run on. Each saw wheel spindle is mounted in double bearings adjustable for wear. The top saw wheel is arranged to rise and fall, and fitted with a canting arrangement, and also a weighted

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RAILWAY CARRIAGE AND WAGGON WORKS.

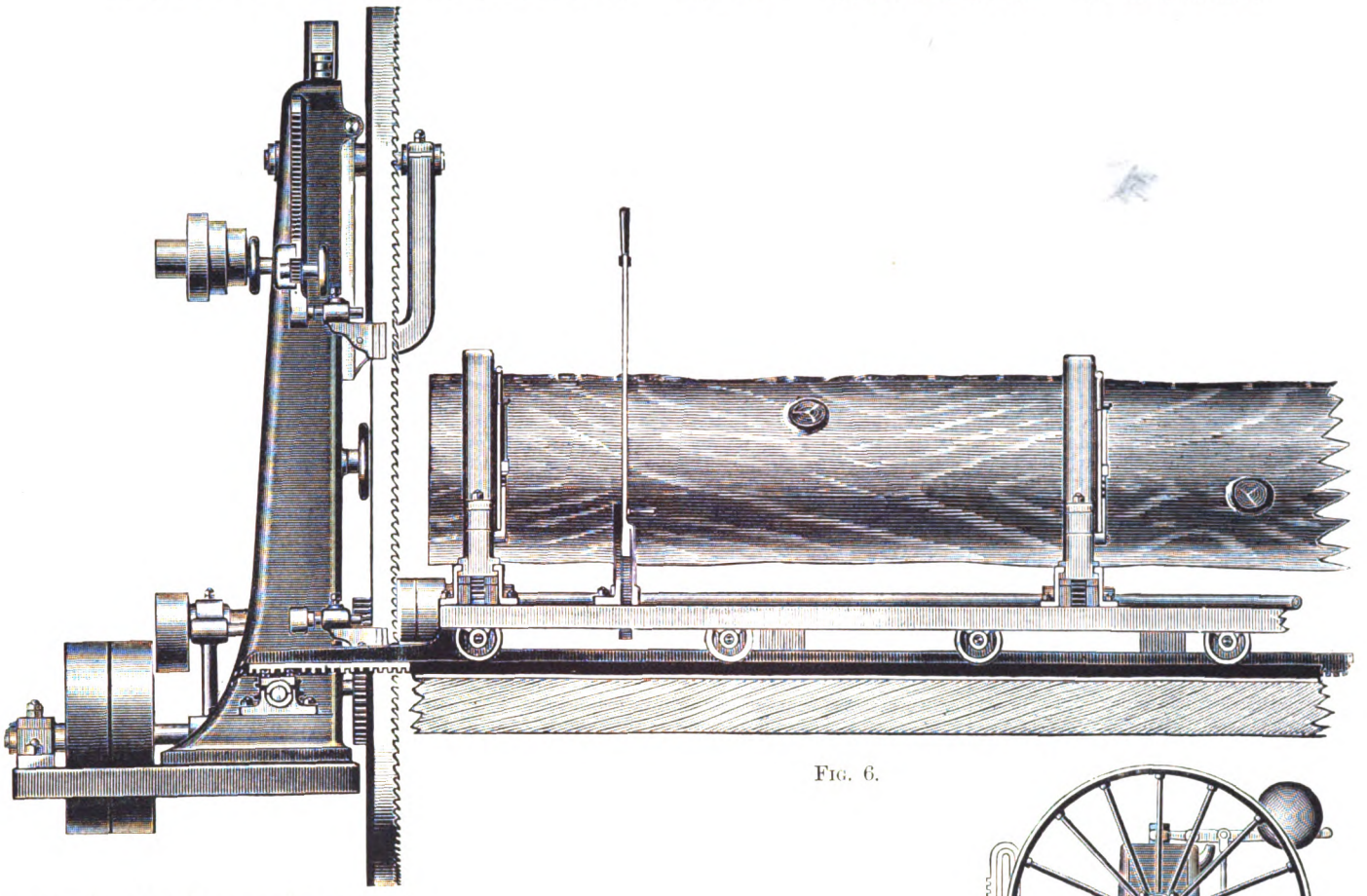


Fig. 6.

tension apparatus, to allow for the expansion or contraction of the saw blade. The saw guides consist of anti-friction rollers of steel, which receive the back thrust of the blade, and hard wood adjustable packing pieces placed on either side of the saw where it enters and leaves the cut. The log to be sawn is mounted on a wrought iron travelling carriage driven by worm gearing, which can be thrown in or out of motion by means of a friction clutch and lever. Three rates of feed are arranged to suit different kinds of wood. The log is held in position by means of adjustable dogs attached to sliding heads. These can be brought into action simultaneously by means of a lever, or separately should the log be crooked. For breaking down heavy timber, a combination of the rack feed circular saw bench and a band sawing machine has recently been introduced with considerable success. In this combination the same travelling table for carrying the timber is employed for both machines, and either the circular or band saw can be used as desired, or as the nature of the work demands, the rate of feed being regulated accordingly.

The horizontal single bladed frame is found particularly useful in opening out logs, cutting panels, and more especially when the wood is valuable, as the attendant is enabled to examine the figure and soundness of the wood after each cut; and should a defect or unsoundness be found, the machine can be stopped, and the log converted to better advantage into scantling or other pieces. The machine takes little power to drive, and as a thin blade can be used, very little wood is wasted.

(To be continued.)

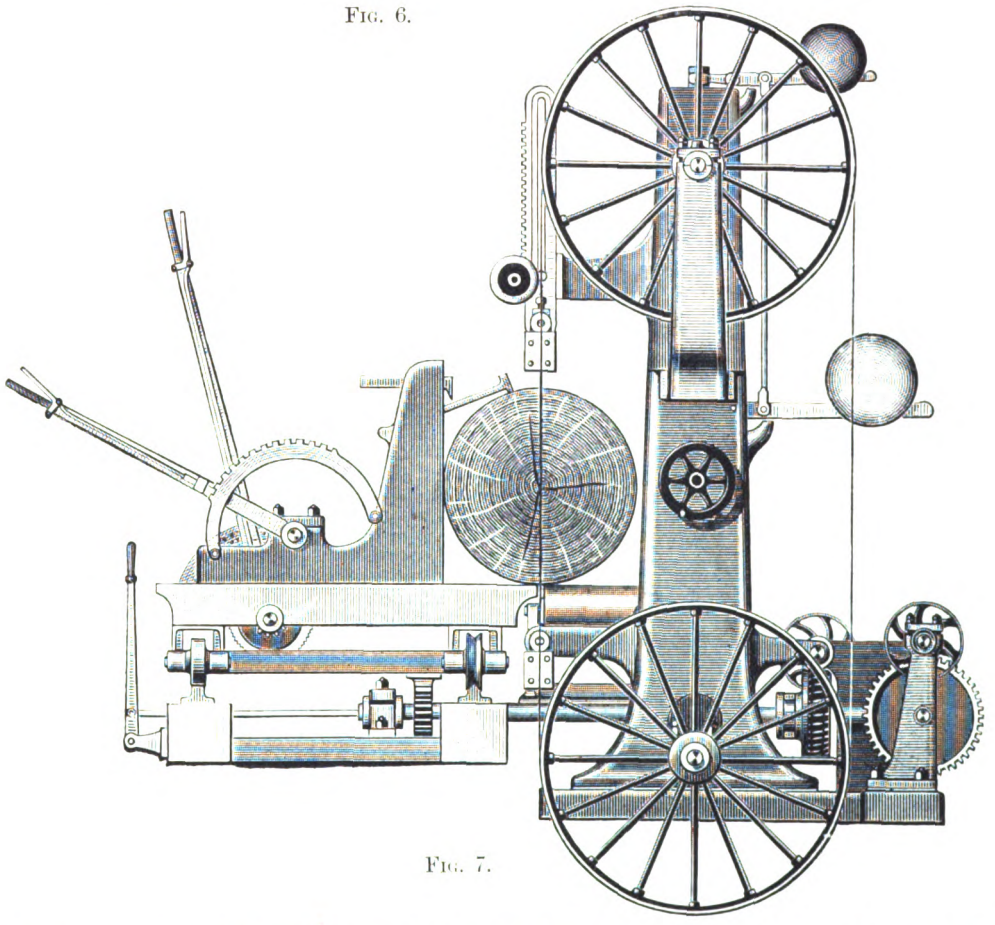


Fig. 7.

MOULDS' PATENT COAL GETTER.

Mechanical coal getters are not so plentiful in the collieries of this country as on the Continent, partly owing to certain physical exigencies and partly to the purer atmosphere which, as a rule, prevails in the mines here. The tendency of modern legislation and of current public opinion, however, is to dispense with the use of powder for getting minerals, and although the inventions of water and gelatinous surroundings have provided a comparatively satisfactory safeguard in this connection, there can be no doubt that the introduction of an efficient mechanical arrangement for breaking down coals without resort to the use of explosives would be a boon to the mining community; although our experience goes to show that no small proofs of its competence and efficacy would be required before the prejudice—amounting almost to bigotry—which exists amongst both managers and men in favour of explosive force could be overcome. Mr. Enoch Moulds, manager of the Whitebarn Colliery, Newcastle, Staffordshire, has recently patented a coal getter which is certainly worthy of trial by colliery proprietors as a substitute for explosives, more particularly in gaseous or dusty mines. The machine is constructed on the wedge system, only with this difference between it and the ordinary application of that principle—instead of working with a forward action, involving the liability of breaking away the front of the coal only and thus getting it bit by bit, this appliance is so constructed as to exercise an outward pressure, *i.e.*, a pressure from back to front. Supposing the coal to be holed, the piston cylinder of the getter, 3in. in diameter, is inserted, and by means of inclined planes the coal is gripped at the far end of the hole and then rifted backward to the face by the aid of hydraulic pressure. The result is an increase of the proportion of large coals obtained, and the shattering influence of an explosive is obviated. The quantity of water required to work the hydraulic jack is three quarts, and by an ingenious self containing arrangement one supply is sufficient for an indefinite period. The parts of the getter are few in number, simple in construction, and of great durability, being made of annealed steel. One great drawback to the extensive adoption of mechanical contrivances for coal getting has been the weight and unwieldy proportions of those hitherto tried; but as the machine now under notice only weighs altogether 102lb., no exception can be taken to its portability. With regard to the question of cost, the patentee claims that in spite of the necessary original outlay required for its adoption, the use of his coal getter has pecuniary advantages over that of explosives, regardless of its important bearing upon the proportionate yield of large coal and slack.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 21st February, 1888.

The Iron Market.—The iron market has developed no new feature since my last report. There is steady progress visible all round, both in the demand and in the movement of prices. The Paris trade in building iron is strong and active, and promises to become more animated as the season advances. The latest accounts received from the provinces show that there is a cheerful tone in nearly every branch of the iron industry. The growing demand for crude iron has occasioned great activity in the Longwy district, where the blast furnace owners are rapidly increasing their output.

The Copper Trade.—Much uneasiness is felt by manufacturers concerning the future of this trade since it became known that the syndicate had succeeded in the project of bringing about a combination among the principal mine owners. The prospect is now one of high prices for some time to come, and of restricted trade in consequence and a subsequent disorganisation of the market by over production of copper. It is hard to see how the mine owners can obtain more than a temporary and very brief advantage from such a combination—an advantage for which they will have to pay dearly later on. The declaration of the Government that they will take proceedings against the syndicate if a case of monopoly be proved in this matter, has given general satisfaction.

The Sugar Bounties.—In previous letters I have expressed my conviction, resulting from observation among the manufacturers and agriculturists of the North, and information of a trustworthy character, obtained here, that the French Government will not agree to the proposal emanating from the British Government, to abolish the bounties system. Every day brings fresh proof of the strong feeling against this measure, and shows more clearly the weight of the opposition which would have to be encountered. A petition to the Ministers of Commerce and Industry and of Agriculture is now being signed—and that itwill be signed by all the manufacturers and agriculturists interested, there can be no doubt—from which I extract the following clauses: "These projects (the increase of 10fr. per 100 kilo., and the abolition of the bounties), the immediate effect of which has been to stop short all dealings between beet growers and sugar manufacturers, have called forth grave apprehensions on our part. The first is indeed a flagrant violation of the contract concluded between the beet growers and the State, on the faith of which numerous business engagements have been entered into by the growers and the sugar manufacturers. The second, which is directed exclusively against France by foreign competitors, would ruin our agricultural industry, which has of late made every possible effort to struggle against its strongly protected foreign rivals, and which would in a few years recover its position, if only assured of that security without which no progress is possible. We protest therefore, first, against the Bill of the Minister of Finance; and, second, against every notion of an international convention with England in this matter of the sugar trade. England is in this business the accomplice of Germany, and the project has been put forward with a view to check the development of our sugar industry. We therefore pray that the law of the 14th July, 1884, may be preserved in its integrity."

BERLIN, 20th February, 1888.

The Iron Market.—The most important event which has recently taken place in the iron market is the union between the Silesian and Westphalian sheet makers, the immediate result of which was a rise of 2s. per ton. Sheets are now quoted at 150s. The home market will now be shared by the two groups in the following way: The eastern portion of Germany will be exclusively supplied by the Silesian makers, the western portion by Westphalian makers, and the strip between by both. An agreement was also arrived at by the different associations of wire nail makers on the basis of 150s. per ton. In Upper Silesia no change has taken place in the crude iron market, and the number of furnaces in blast remains at twenty-eight, as in the previous week. There is a brisk demand for iron ores, notably for the brand known as "Minette," which is raised in Lorraine, and which is specially suitable for the Thomas process. Ores from the Siegerland and the Nassau districts are also in good request, and have slightly risen in price. Business in crude iron remains satisfactory, and the syndicated works have now sold their production to the end of the second quarter. They do not accept orders at present prices further ahead, and are practically masters of the situation, since the stocks of crude iron are completely cleared. Foundries are well employed, especially with pipes for mining purposes. In wire nails the home market is good, but the export trade shows no tendency to improve. Steel rolling mills are busy, in consequence of the recent orders for rails received from the State railways. In other railway material our own manufacturers do not seem to be able to exclude foreign competition. Only a week ago an order for six third-class passenger coaches was carried off by Messrs. F. Beynes, of Harlem, at £460 each, delivered free at Cleves, whereas the old established firm of Herebrand, of Cologne, quoted £467. The fact that such a trifling difference in price turned the scale shows that our railway administrations do not allow patriotic motives to influence them in their business. The Düsseldorf Railway Supply Company has recently obtained an order for eight first and second class passenger coaches at £730 each.

Electric Lighting.—The first central station in which accumulators are used has been recently started in Berlin, at No. 37, Neue Friedrichstrasse. The plant consists of two 45 h.p. Babcock & Wilcox boilers (manufactured by Messrs. Schmidt, of Küstrin), two steam engines of 35 h.p. each, and two 18 kilo.-watt dynamos. The current is not supplied direct from the dynamo, but from a battery of flat tray pattern Khotinsky accumulators, each cell having 600 ampère-hours' capacity. The principal customer at present is a restaurant situated under the elevated railway, and a total of five hundred lamps is now installed; but applications for the light from neighbouring places have been received, and to provide for the extension the battery boxes have been made deep enough to admit additional plates, by which the capacity can be increased by another 600 ampère-hours. The lamps used are 150-volt Seel lamps, and the total cost of the central station and mains was £3,500, that is, at the rate of £7 per lamp fixed.—A few weeks ago I gave particulars of the electric light installation in what is known as the German theatre of this town. I am now enabled, by the courtesy of the engineer in charge, to give you details of the installation and working expenses. When gas was used in this theatre, the cost for lighting varied from £4 per day in summer to £5. 10s. in winter; but now, with the electric light, the working expenses do not materially vary with the season, as the items of attendance and interest on the plant is a constant. The total cost of the installation was about £3,000, and this contains the following items: Engine house and chimney, £500; boiler and engines, £940; dynamos, wiring, and accessories, £905; electric light fittings, £250; and regulator for the stage, £150. The consumption of coal in winter is about 16cwt. daily, costing 18s.; attendance, 8s.; lubricant, 3s.; and interest on the capital outlay 20s., reckoning this at 10 per cent. for three hundred working days. The installation has been in use too short a time to estimate accurately the cost of renewal of lamps, but this could hardly exceed 10s. a night, so that the total expense for the electric light may be taken as £3 per night, which is considerably below the sum previously paid for gas.—At a meeting of the Town Council, held on the 16th inst., it was resolved that the wiring of private houses may be left to open competition, but that the work in connection with bringing the current into the house and the installation of the meter must be undertaken by the Berlin Electric Company.

VIENNA, 20th February, 1888.

The Coal Market.—After a week of comparative stagnation, the coal market is again beginning to revive; but during the last few days severe snowstorms have somewhat interfered with the traffic. The coal traffic on the Northern railway is a fair gauge of the general prosperity of the manufacturing trades, and in this connection it is satisfactory to note that the consignments of coal re-exported from the Northern goods yard have, during the past month, been greater than they have ever been before. As much as 5000 tons were dispatched in a single day, the average for previous years being about 2000 tons per day only. The increase in traffic is partly due to the recent reductions of freights on this line, which were resolved upon mainly with a view to enable the Southern railways to obtain Silesian coal. This has caused some stir among colliery owners in Styria, who have hitherto supplied the Southern lines, and the Government has been asked to protect them from the competition of their northern rivals. The Minister of Finance, however, seems unwilling to interfere. The interest threatened is, moreover, not of very great importance, as the total quantity of coal raised in Styria averages only about 1,700,000 tons annually. At the present moment the exports of coal from Vienna are greater than the imports, and stocks are decreasing in consequence. The total traffic on the Northern railway amounted during 1887 to 838,000 tons, of which 127,000 tons were taken by the Imperial Continental Gas Association of this town. The average quantity of coal and lignite raised annually throughout Austria amounts to about 15,000,000 tons, the value of which is estimated at nearly £3,000,000. In this sum Bohemia participates with about 50 per cent., Silesia with 17 per cent., and Styria with only 14 per cent.

The Iron Market.—The general feeling of the iron market is hopeful, and the revival of trade is confidently expected. At the present time, however, there is comparative stagnation, owing to the lines being blocked by snow and the bad condition of the roads. There is a good demand for crude iron at previous prices, and in bar iron there has been a rise of 7s. per ton. For sheets, both black and tinned, the demand is very brisk. A few weeks ago I reported the important contracts between the State railways and the Alpine Company, the Tetschen Works, and the Witkowitz Company for the supply of rails during 1888, and the first batch of orders has now been given out at the price then stipulated. There is a good prospect for railway contractors, and at the present time the following mileage is in course of construction: Private lines, 285 miles; Government lines, 122 miles; total, 407 miles. The total number of hands employed in these works is 18,000.

Textiles.—Notwithstanding the drop in the price of raw cotton, spinners are unwilling to make concessions, and keep the prices of yarns at the previous quotation. The same is the case with thread. Spinners have a good many orders on hand, and are thus enabled to resist a demand for a reduction in price until they have filled their present contracts. Wool has declined, but in silk goods trade is becoming more brisk. The linen market in Trautenau is firm, and large transactions have taken place.

Exhibition of Railway Material.—As I reported at the time, an exhibition was held last year at Buda-Pesth for the purpose of bringing before Hungarian manufacturers a collection of the various accessories required in the working of railways, with a view to their being eventually manufactured in the country. This exhibition has been a success, and the experiment is to be renewed at the forthcoming Jubilee Exhibition at the Rotunda. Railway appliances have been shown at all previous exhibitions, but more or less scattered about in the various sections. Now, however, the intention is to bring all such exhibits together in one group.

Electrical Engineering.—Herr Fischer, a civil engineer of this town, has obtained a concession for an electric railway between Vöslau and Rauhenstein, near Baden, and from there to Leopoldsdorf. The length of the line being considerable, Herr Fischer will probably use storage cars; Julien accumulators are now being tested in the Electrotechnical Institute, and a trial of these cells for tramway work in competition with Reckenzaun cells will shortly take place. A central station for the supply of electricity has recently been erected at Neuhaus, in Bohemia. The contractor is Count Czernin, a landowner in that district, and he has arranged for the supply of light to the Commune for twenty years. Power is obtained from a turbine, and there are at present two dynamo machines installed. The distribution is on the three-wire system with feeders. All the leads are carried on poles overhead. The streets are lighted by eighty-five 16 c.p. glow lamps, and in private houses there are at present 365 lamps fixed, but the demand is constantly increasing. To provide against breakdown a battery of 1000 storage cells is now being laid down.

BRUSSELS, 21st February, 1888.

The Coal Market.—Prices continue very firm, and colliery owners decline to make contracts for forward delivery at the current rates, which are 15s. 2d. to 16s. 8d. for large household coal, 8s. 10d. to 9s. 7d. for unscreened household coal, 5s. 9d. to 8s. for unscreened coal for industrial purposes, 9s. 7d. for small coal, and 11s. 2d. to 12s. 10d. for coke. The exports of coal from France to Belgium are increasing, and French coal is specially gaining ground in the Escaut and La Lys valleys, with Ghent as the centre of consumption, and the Hainault collieries are losing their customers in these districts. The progress of Belgian exports to France is not so marked. Last year 100,000 tons more were sent to France than in 1886; but the latter year showed a decrease compared with 1885, owing to the Northern and Eastern railways of France having reduced their rates, and thus having enabled French coal to replace Belgian in some of the French markets.

The Metal Market.—Business is very satisfactory, and orders continue to flow in, especially to rolling mills. No. 1 bar iron is quoted at 80s. per ton, girders at 88s., No. 2 sheets at 116s., steel rails at 88s., steel tyres at 108s., and steel axles at 116s. Blast furnaces are busy. New and important contracts for the Belgian State railways are announced. Negotiations are in progress for the purchase of the works of the Société du Midi, at Charleroi, by the Thy-le-Château Company; the works include two blast furnaces in working order, and one hundred coke ovens. The price is £24,000. A syndicate is being formed at the Brussels Exchange to work the mines of the Orange River Free State, and to establish there some leading Belgian industries. The construction of the railways required for the development of this scheme would furnish employment for our works.

The Brussels Exhibition.—The contractors for the buildings have during the last few days been pushing on operations more actively, and the machinery section and the horseshoe building are rapidly being finished. Good progress is also being made with the annexes. A private Belgo-German syndicate is busy arranging the aquarium, casino, and German breweries which are to be included in the Exhibition. The Paris Hippodrome has contracted to give daily performances, and will use their own lighting plant from Paris, which is chiefly remarkable for its great complications, there being a separate dynamo for almost every arc lamp.

Tram Cars at the Brussels Exhibition.—On the tram line in the gardens of the Exhibition mechanical traction will be employed, the system adopted being that of M. Charles Legrand, of Mons. In the buildings and annexes, cars of the type known as Jardin d'Acclimation, in which the passengers sit back to back, will be used. The weight of this car, including eleven passengers, is 33cwt. The accumulators weigh 6cwt., and the motor and gearing about 5cwt. For these small cars, which will travel at the rate of about 4½ miles an hour, the energy required is estimated at 800 watts, or slightly over 1 h.p. For the convenience of changing the cells the latter are arranged in four groups, which are inserted and withdrawn from the ends of the car. There will be forty cells, each weighing complete 16½lb., and containing 13lb. of plates. The maximum discharge current is 10 ampères, or about three-quarters of an ampère for every pound of lead. The speed will be regulated by changing the grouping of

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accumulators so as to obtain either 20, 40, 60, or 80 volts. The type of the accumulator chosen is that of Somzée; the motor will be either a Mourlon, Pieper, or Dulait machine. M. Halot will supply the track and car.

Sewage Disposal.—A new system of purifying sewage and the waste water of factories has been invented by M. Defosse, of Brussels, which is very simple, and the cost of which it is claimed is more than covered by the value of the extracted matter. The process consists of three stages. In the first, the solid matter is precipitated in settling tanks, by means of some cheap chemicals. The second stage consists of filtration through a bed of turf, specially prepared, and capable of being cleaned and used over again for an indefinite number of times. In the third stage the product is passed over a bed of spongy iron. The purified water passes away to the river through a channel containing broken limestone. The chemicals employed are oxidising agents capable of precipitating not only the matter held in suspension, but also a part of that in solution. The precipitate is removed by special machinery.

DÜSSELDORF, 20th February, 1888.

The Coal Market.—The coal market is still characterised by extreme animation. All classes of coal are in strong demand, and prices are slowly but steadily advancing. The activity in the iron trade occasions a large consumption of the industrial kinds, particularly coking coal. But the return of wintry weather has so stimulated the house coal trade that it is for the moment scarcely less animated than that in the classes suitable for industrial purposes. Great efforts are being made to obtain a reduction of the railway rates to Hamburg and Bremen, where Westphalian produce comes into competition with English. The increase in exports of coal in 1887 was nearly balanced by the increase in the imports, the additional quantities being 126,140 tons for the former, against 114,450 tons for the latter. But the coke imports were less by 1358 tons, while the exports increased by 84,480 tons. These changes indicate growing activity in the coke making industry. Nearly the whole of the falling off in the imports of coke is to be found in the trade with Great Britain.

The Iron Market.—The iron market exhibits no symptom of weakness. The demand continues brisk for all classes of goods, increases even in some directions, and prices have an upward tendency. There are no indications of a reaction. Manufacturers appear to have no misgivings concerning the course of trade in the near future. The prevalent belief is that the current year will be throughout a period of uninterrupted activity. The German iron market forms a striking contrast to the English, the continued weakness of which is a cause of surprise here; but it does not give rise to apprehension. Crude iron of all sorts is in strong demand. Spiegel is less inquired after on home account, but more important transactions have taken place of late for export. Forge pig continues to be the class most sought after; it can no longer be bought at the syndicate base prices. Some large dealings have been reported within the last few days at 53s. for delivery in July. White steel pig is quoted at 52s. Bessemer is now more inquired after, and prices exhibit a tendency to advance. Business in finished iron and steel has lost none of its animation, but manufacturers complain loudly of the present prices, which, since the last rise in crude iron, leave but a small margin of profit. As for the export trade, that is wholly profitless. Plate makers are doing better since the rise of 5s. as also reported last week. This rise has not checked the demand for plates, which for the moment are the class of goods most actively dealt in. The wire nail syndicate has issued a circular to customers, requesting them to address all inquiries and orders either to the sales bureau at Berlin or to that at Hamm. The former, Delbrück, Leo, & Co., Nos. 63-65, Mauerstrasse, Berlin, W., is for the home trade, and for Denmark, Sweden and Norway, Roumania, Servia, and Bulgaria, exclusive of East Roumelia; the latter is the export bureau for all other countries. The proposed combination of the Silesian with the Rhenish-Westphalian sheet rolling works is now an accomplished fact, so that the whole of the German sheet iron trade is controlled by syndicates.

Flax and Yarn Market.—A better demand has sprung up for the coarser flax yarns, and spinners have been able to obtain higher prices. Low yarns are specially sought after. The finer numbers are for the moment neglected. On the whole the markets are not animated, but there is a steady course of business. There is great activity in Russian flax, the low rate of exchange being favourable to buyers.

LILLE, 21st February, 1888.

Textile Manufactures.—There is not much to be said of the business in textile goods this week. The markets generally have been lifeless, partly on account of the carnival, and partly in consequence of the wintry weather which has set in again. The current week will probably show better results. Letters I have received from Roubaix show a complaining tone. It is said that the situation of woollen goods is scarcely as satisfactory as it was. The markets are dull and heavy, and there are no indications of immediate revival. Fortunately the export trade continues active. Excepting the case of cotton fabrics, the January exports exhibit a marked improvement compared with the same month of last year. The following are the declared values, the figures within brackets denoting the values for January, 1887: Woollen goods, £1,051,240 (£829,040); silk goods, £704,560 (£688,240); cotton goods, £319,240 (£364,360); linen and hemp goods, £32,680 (£28,080); and jute goods, £6,240 (£7,400).

Flax and Yarn Markets.—Activity is still the characteristic feature of the flax market, so far as home grown produce is concerned, and prices are strongly in favour of sellers. The demand is chiefly for Walloon flax from Douai and Bergues. Russian is not much inquired after, and prices exhibit a tendency to recede. The Ghent market is animated and strong for home grown flax, and spinners are again buying Russian more largely. There is some business doing in tows, but principally in the fine numbers. Yarns are in fairly strong demand. Spinners have some difficulty in delivering fast enough to meet contracts in hand. Prices are very firm. Jute yarns are still much sought after.

The Iron Market.—The rise in prices which followed the establishing of the syndicate of manufacturers in this district is now confirmed by the adhesion to the combination of the manufacturers of other localities. Buyers no longer hold out for concessions on the current rates, on the contrary they are eager to purchase in anticipation of a further advance. The important order for 20,000 tons of pig iron, bars, and plates, obtained for the Panama Canal Company by the firm of Eiffel, has had a stimulating effect upon French industry. Founders are very busy. The founders' syndicate for the arrondissement of Lille held a meeting last week to consider a proposal to extend the combination over the whole region of the North, and this proposal was unanimously adopted.

The Coal Industry.—The coal industry of the North of France exhibits a constant growth, and the statistics of production for 1887 are very satisfactory. The output of the department of the Nord amounted to 4,274,726 tons, against 3,978,175 tons in 1886, while that of the Pas-de-Calais increased in the same time from 6,463,214 tons to 7,146,666 tons. Thus the total production in 1887 amounted to 11,421,392 tons, nearly a million tons more than in 1886, or an increase of 9·4 per cent.

Production of Sugar.—The official statistics of the production in January afford additional proof of the accuracy of the estimates based upon a low yield of roots in 1887. The total production now amounts to 319,766 tons, against 388,218 tons last year, a falling off of 68,442 tons in refined sugar. Reduced to the crude, these quantities represent about 373,000 tons, against 453,000 tons in 1887, a difference of 80,000 tons. It now seems hardly possible that the whole production of the year will reach 400,000 tons of crude sugar.

AMSTERDAM, 21st February, 1888.

The Transvaal Gold Fields.—A Dutch syndicate has purchased large tracts of auriferous land in the Transvaal, and has sent Mr. Hulshoff, a pupil of the mining school at Clausthal, to Pretoria to make the necessary arrangements for working the mines in an economical and methodical manner.

The Utilisation of the Dutch Moors.—In some of our provinces there are large tracts of heath and moorland which at present have no value whatever, although once covered with dense forests. An effort is now being made to utilise these moors, and several land owners have combined to form a company, whose object it will be to attempt a gradual fertilisation of the soil by re-planting trees. How much good such an enterprise can work under careful management is shown by a similar undertaking in Denmark, which has been in existence for the last quarter of a century. The Danish society for the fertilisation of heaths and moors, chiefly by forestation, has now some 4000 members, among whom may be found the principal agriculturists of the kingdom. It enjoys large subsidies from the Government and from the agricultural societies, so that it has been enabled to start some four hundred "concessions," or plantations, in different parts of Denmark. In the Netherlands it is proposed to work the scheme upon similar lines.

MADRID, 20th February, 1888.

Sale of Mines and Iron Works.—The Quiros Coal Mines and Iron Works are offered for sale at £50,000. They cost the French company, which at present owns them, about £200,000; but the business has never proved remunerative, the management having been bad. The site is very good, and phosphoric iron could be made at a price which would compete favourably with the best Cleveland. Under English management, ores would not cost over 2s. 6d. in the furnaces, and coke could be made on the Simon-Carvés system at 9s. per ton, allowing for the value of the tar and ammonia.

Spanish Coals for Italy.—Signor Gandolfi, an Italian engineer connected with the Terni Steel Works, is visiting the principal coal basins in Spain, in order to ascertain if Spanish coal would be available for the 300 Simon-Carvés coke furnaces which it is proposed to erect at the works. It is, however, very doubtful whether we could export coal to Italy, as the coals in the North cost more to obtain than English, while those of the South, though cheaper, have a long land carriage before they can be shipped. In my opinion Spanish coal will never reach Italy unless there is a general rise in English coal of at least 2s. per ton, or unless a large company were formed to acquire southern collieries, which would build its own railway to a seaport. Scanty and dear food is also one of the causes why the cost of production of coal is above that of England.

Telephony.—Telephone systems are being adopted rapidly by our principal towns, and offers are now invited by the Government for an exchange station at Cordova. So far we have no long distance lines, and a network uniting Madrid with the large seaports, such as Barcelona, Cadiz, Bilbao, and Carthagena should prove profitable.

Electrical Company.—The Sociedad Española de Electricidad, which was established some years ago with a capital of £400,000, and which has been a losing concern from the first, is to be re-organised. It is doubtful, however, if the proposed arrangement would leave the new capital free from the consequences of the mistakes which have been made in the past.

NEW YORK, 11th February, 1888.

The Coal Market.—From the trade standpoint the anthracite market could not be in better condition, the strike in the Schuylkill region having caused, until within the last few days, an almost entire suspension of production, and this, together with the stoppage in the Lehigh Valley, has thrown the demand entirely on the Wyoming district. All the collieries there are running full time with increased force, and even then are unable to meet the demand. The fact that violence is being resorted to by the miners who have struck is a pretty sure indication that in a short time they will be again at work. A good trade is being done in bituminous coal at fair prices. Coke is in good demand; many of the iron works heretofore using anthracite coal are now obliged by its scarcity to use coke, thus opening temporarily a new market for the surplus production of the coke regions.

The Iron and Steel Market.—Business during the past week has been of a decidedly favourable character, resulting in largely increased orders for specialties; but it is not likely that the current prices will be maintained after the miners' strike is ended. In pig iron the scarcity of good brands is becoming very marked, and although there is plenty of iron in the market it is difficult to obtain the quality which customers are in the habit of using. This scarcity will probably increase, as many furnaces are banking up, the complaint being poor coal. This month finds more furnaces in the Lehigh Valley out of blast than at any time since 1884. There are now twenty-one furnaces out of blast and thirty-two still in blast, but some of these may be blown out any day. With the discharging of men from the blown out furnaces there has been a corresponding decrease in the demand for ore, and a consequent shutting down at the mines or a partial suspension of work. The cost of producing pig from such fuel as can now be obtained is estimated at from 4s. to 6s. per ton more than it is usually, and an inferior quality is also produced. Prices are about the same as last week. A leading company which a year ago had booked orders for over 100,000 tons has now sold only 25,000 tons ahead, and this is to supply one contractor for the whole year. There is a good deal of inquiry for manufactured iron, but the amount actually placed is not very great. Prices are steady, owing perhaps rather to increased cost than to increased demand, and are 1·9 to 1·95 cents per lb. for best refined bars. The steel rail mills have pretty generally sold the allotment of 800,000 tons made by the committee last summer, and some of them are unable to take any orders until a new allotment is made. Prices are 131s. to 137s. per ton; but the lower rates are very unsatisfactory to makers. The total sales to date for 1888 delivery amount to between 350,000 and 400,000 tons.—The official report of the imports of iron and steel for last year includes 340,000 tons of scrap iron, an increase of 2·50 per cent. over 1886; 137,829 tons of steel rails, an increase of 240 per cent.; 310,551 tons of steel ingots, &c., an increase of 530 per cent.; and 21,675 tons of cotton ties, a gain of 110 per cent.; pig iron imports have increased 30 per cent., bar iron 25 per cent., tin plates and wire rods each about 10 per cent. — In the Bill to be introduced by Chairman Mills, of the Ways and Means Committee of the House, to "reduce taxation and revise the tariff," it is proposed to reduce the tariff on pig iron from $6·72 per ton to $4·50. There will be strong opposition even among Democrats to the change in the iron duty, and it is not probable that this feature of the Bill will become law.

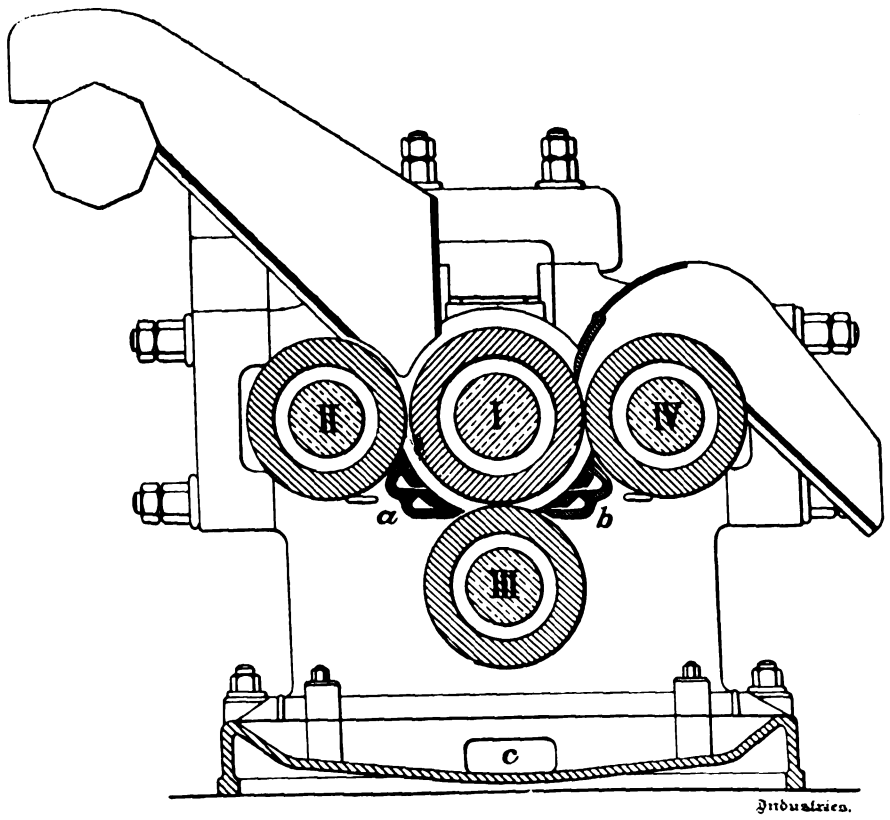
The Metal Market.—The price of copper still remains at 16·5 to 17 cents per lb. for present delivery, with a fair amount of business, and there seems to be no prospect of a fall in price. Sales to the amount of 100 tons have been made in tin at prices ranging from 35·9 cents per lb. for spot to 33·10 to 34·50 for futures. Lead is quiet, with but little business, prices varying from 4·90 to 4·97½ cents per lb.

Manufacturing Works in Baltimore.—The City of Baltimore is attracting the attention of large manufacturing interests. The new steel works at Sparrow Point, within easy reach of the city, have attracted the attention of other manufacturers. There is some talk of moving the Strong Locomotive Works to that city, and Mr. Simpson, of dry dock fame, contemplates starting a large establishment there.

Trial Trip.—The new steel steamship "Owego," of the Union Steamship Company, which recently made a trial trip on Lake Erie, is one of the largest and most powerful boats on the lake. She measures 352ft. over all, 41ft. beam, and 25½ft. depth of hold. She is fitted with triple expansion engines.

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IMPROVED FOUR-ROLLER CANE MILL.



FOUR-ROLLER CANE MILL WITH MACERATION APPARATUS.

In the ordinary three-roller cane mill the sugar canes are supposed to receive a preliminary crushing between the first and second roll, and the final crushing between the second and third roll; but in many cases the first roller is little more than a feeder, thus leaving the entire grinding or crushing to be done at one pressure by the megass roll. In the improved mill, which we illustrate above and on page 192, and which is made by Messrs. George Fletcher & Co., of Poplar, London (Fletcher & Leblanc's patent), the cane is subjected to three distinct pressures, viz., the first between rolls II and I; the second between I and III; and the third between I and IV; thus dividing the work into three stages and insuring a greater yield of juice. The opening between the rollers for the first pressure is from $\frac{3}{4}$ to $\frac{7}{8}$ of an inch as in the ordinary mills; the opening between the rollers for the second pressure is about $\frac{1}{8}$ of an inch, and that for the third pressure may be $\frac{1}{16}$ of an inch or less. The juice is collected in the base plate, and taken off by the channel C, and if maceration be desired it can be commenced in the mill itself by injecting steam into the hollow trash turners *a b*, situated at the back of the megass knives. The three outer rolls are made adjustable by means of wedge blocks set up by bolts. The wedges are also made adjustable by worm gearing and hand wheels, so that when the mill is working a "choke" can be avoided. The stresses are not taken directly by the cast iron frame, but are resisted by wrought iron bolts, so that in case of accident the damage is limited to the breakage of a few bolts. Should any accident occur to one roll this only becomes disabled, and the mill can still be used as an ordinary three-roller mill. As will be seen from the perspective illustration, on page 192, the axle of the middle roll is driven in the usual way, the power being transmitted to the other three rolls by spur gearing.

One of these mills has been tested on the Alexandria estate in Cuba, and we learn from a report of Mr. Francisco de Arrieta, a local sugar mill engineer, that the yield of juice was 78·3 per cent., and of megass 21·7 per cent. The cane was of fourteen or fifteen months' growth, rather hard, short jointed, and scarcely one inch thick. Judging from its appearance, Mr. Arrieta estimates that it contained 13 per cent. of fibre and 87 per cent. of juice. The bagasse on its delivery from the mill formed a perfectly homogeneous layer composed of small pieces of fibre so free from moisture that it could be used directly as fuel without previous drying. He considers that the Leblanc & Fletcher's mill will enable the planter to compete successfully with the producers of beet root sugar, owing to the increased yield of juice, which he estimates at from 15 to 20 per cent. over the yield obtainable with the ordinary cane mill.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting, held on Tuesday, the 14th of February, a paper was read on "The Economic Use of the Plane Table in Topographical Surveying," by Mr. Josiah Pierce, jun., M.A., Assoc.M.Inst.C.E. The author stated that the plane table, being one of the most ancient of surveying instruments, needed no introduction. However, he desired to direct attention to its wide and economical use on nearly all Government surveys, and to the fact that experience had proved that, within certain practical limits, plane tabling was the most rapid, accurate, and economical method of executing topographical work. The modern plane table, when properly constructed, was an altazimuth instrument of precision; with it the horizontal projections of existing angles were recorded graphically, free from errors of record, adjustment, and plotting. The problem of plane tabling was, simply: given a board and a ruler, construct a map. The most important geometrical laws applied in practice were those of similar figures. Three or more points being joined on the map, the requirement was that the figure thus produced should be the horizontal projection of the lines joining similar points in nature. Also, if lines were drawn from any other point joining the points of this polygon, a similar point should exist in nature where the observed angles would be exactly the same. This important condition was theoretically fulfilled when homologous sides in the two figures were parallel. To prove the necessity of placing the plane table "in meridian" at all stations, the problem of orienting by three known points was demonstrated mechanically, and a working model was exhibited to illustrate all cases of the three-point problem. When a triangulation existed of the country to be mapped, a projection was laid down on the plane table sheet, on a given scale, of the network of triangles, provision being made for the convergence of the meridians by suitable projection. In American practice the trigonometrical system thus projected was tested and corrected graphically before being accepted as a sufficiently accurate base for the detail. Radial lines to salient points were drawn, with corresponding vertical angles in all directions from the stations occupied. The intersection of two rays on the same point being an elementary location, a third ray through the same point in a well-conditioned intersection placed beyond doubt the accuracy of its position. Thus, in the operation of plane tabling, constant opportunities occurred of checking locations without calculation, and the scale was ever present in all directions to control the amount of detail to be gathered; in addition, a complete record of the area surveyed appeared, advantages which were to be found in no other system of mapping. When the scale of map was large, minute details could be more profitably located by the stadia rod in horizontal position and altitude with surprising accuracy and rapidity. Whether by method of intersection alone, or combined with linear measurement, the operations were continued until a sufficient number of points had been located to satisfy the requirements of the map, beyond which it was purely an artistic sketch. Between the points located in altitude, as well as in position, equal-interval contours were interpolated, drawn and corrected from nature; this system was almost universally applied, and was especially valuable in mountainous regions. To illustrate the character of the topographical work done in the United States, typical maps and sketches were exhibited, showing almost every variety of physical feature, constructed either on the plane table, or on plane table principles. An unavoidable source of error peculiar to the instrument was the atmospheric or hygrometric effect on the paper or instrument used. In the United States a favourable climate had added not a little to the success of the methods pursued. The requirements of a plane table of precision were the same as those of any other type of altazimuth surveying instrument. By comparison of a number of types, the maximum stability and portability appeared in the U.S. Coast and Geodetic Survey pattern, and for mountain service a simple and efficient instrument, recently adopted by the U.S. Geological Survey, deserved examination. The theoretical requirements in setting a plane table over a station were: (1) That the plane of the board should be horizontal. (2) That the station on the map should be vertically over the point on the ground. (3) That the meridian of the point on the plane table sheet should be in the plane of the meridian of the station. Of these requirements the first was met by proper construction, the third by adjustment in azimuth. To meet the second—the adjustment for eccentricity—numerous mechanical contrivances had been designed, of no practical value, and only lending additional weight and increasing the liability of error. The plane table was not well adapted for traversing, owing to the difficulty of eliminating the eccentricity, which produced serious azimuth errors at short range; but by proper precautions the error could be confined to one of geographical position, inappreciable on any common scale. To secure accurate results in plane tabling, it was necessary to confine azimuth errors to minute quantities, not exceeding 1″ or 2″, which would pass unobserved within the limits of the plane table sheet. This degree of precision could only be secured by proper construction of the levelling movement alidade. An examination of the sources of error in measuring azimuth angles with a theodolite or plane table, showed that the most serious source of error arose from an inclination of the transverse axis which supported the telescope. With an alidade in proper adjustment, practically the same errors would be produced if it was used on a plane table not properly levelled. The effect of the board being out of level and the telescope confined to a horizontal plane, was that the rule and telescope would only indicate the same direction at four points, which case was illustrated mechanically by Hooke's joint. In such a case the board might be out of level 15° before the maximum error in azimuth would amount to 1°, which showed that a rough reconnaisance plane table should give good results in a flat country; but for mountainous regions an accurate levelling movement was required. For measuring altitude angles the alidade designed by Professor Hilgard was most accurate. Recent results and improvements showed beyond doubt that a far greater degree of precision could be obtained from simple graphic triangulation than was commonly supposed, amply sufficient for purposes of mapping, and with a degree of economy unequalled by other systems. The colonial engineer and student could ill afford to lose sight of a valuable and simple instrument, with which he could, alone and unaided, construct a topographical map on any scale, with a degree of precision only limited by the scale, and in the same time that he would occupy in taking observations with other instruments. An appendix to the paper contained, among other matter, statistics gathered from official reports relating to the use of the plane table, and an account of a plane table survey of the Lake Mono region, illustrating the construction of an accurate map entirely on geometrical principles, without reference to scale or linear measurement. In illustration of the paper, a collection of instruments was exhibited, comprising several varieties of plane tables, Portuguese alidade, alidade with solar, Porros' tacheometer, Jähn's vielmesser, Howlett's stadiometer, Francis' clinometer, omnimeters of various sizes, Edgworth's surveying instrument, Colonel Richard's cavalry sketching board and others, dipleidoscope, prismatic compass, theodolites, and other instruments used in topographical surveying.

OUR BIG GUNS.

Our readers may recollect that we made some remarks on this subject in our issue of the 10th inst. In *The Times* of Friday last there appears an important letter from Mr. E. H. Carbutt, President of the Institution of Mechanical Engineers, on the same subject, which we give below:—

You stated on the 1st inst. that an accident had occurred at Woolwich at the proof butts to a 10in. gun—viz., that the lining tube had been blown out to the rear. No official statement has yet been made, but I understand that the gun really burst. The inner tube or lining being in two pieces, the gun gave way at the junction, and the jacket or covering opened up; the whole of the rear of the gun was blown off. That is to say, the gun exploded just forward of the trunnions, and was shattered for its whole length beyond them. Now, sir, I have previously called attention to this faulty method of constructing the lining tube in two pieces, which was certain to cause accidents sooner or later. The gun was made to the Woolwich design by Messrs. Armstrong. Is the defect due to design or workmanship? It is, indeed, a very serious thing that one of our newest 10in. steel guns should have burst; but if the report which is now current about our guns is true, we are indeed in a lamentable position.

It is reported that the A tube or liner of every one of the new 9·2in. guns which has been sent to proof has split. I cannot find out how many, but understand that nine guns have so failed. And, further, that one of these 9·2in. guns which had passed the proof and was lying on the wharf, ready to be shipped to one of our colonies, when lifted up by the crane to be put on board the ship showed a crack the whole length of the gun, not in the A tube or liner, but in the jacket. Not being in Parliament, I cannot ask if these reports are true, but I have ventured to send them to you (as they reach me from two entirely different sources) in the hope that the Secretary of State for War will give the public a full and correct account. On the 22nd of March, 1886, I moved for a Committee of

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the House of Commons to inquire into the whole question of our guns. The then Secretary of State for War, Mr. Campbell-Bannerman, declined to open up the question of design, saying they were so satisfied with our design that they could not allow the subject to be inquired into. Within a month the 43-ton gun of Her Majesty's ship "Colossus" burst.

The authorities at once ordered all the remaining 43-ton guns which had been issued to be returned to Woolwich to be rebuilt, and greatly strengthened them and also the new guns by chase-hooping them. Now that the present series of accidents has occurred, may I again ask, is the present Secretary of State for War satisfied that our design is right? Lord Morley's Committee (of which I was a member) was prevented going into the question of design, but we went very fully into the question of manufacture and the control of the Government workshops. The main conclusions of the Committee (I believe I state correctly) were that inspection should be separated from manufacture, and that it should be the same for private firms as for the Government works; that military men should manage military matters; and that engineers should be responsible for mechanical or constructional matters. Let me quote the first two recommendations, which were approved and signed by every member but two of that Committee:—

"1. That a superintendent of ordnance factories should be appointed, holding office under the Director of Artillery and Stores. He should be an officer of the Army, and should reside at Woolwich. He should be the sole channel of communication between the War Office and the manufacturing departments. In addition to the general superintendence of the factories, he should be the head of the designing and drawing office.

"2. Subject to the control of this officer there should be a chief mechanical engineer, holding a civilian appointment, who should be in charge of and responsible for manufacture in all its branches. His subordinates, also civilians, should take charge of the various departments."

I learn with regret that the Secretary of State for War is making the whole system more military than ever. In the end it will be more expensive and not more effective than the condemned system. A military superintendent of ordnance factories has been appointed at a salary of £1,800 a year, with two military assistants, one at £700 a year and the other at £500 a year, with a large staff of clerks and writers. This military superintendent is not subject to parliamentary control (except for finance), as the office of Surveyor-General of Ordnance has been abolished. He is responsible to the military heads at the War Office. But the chief mechanical engineer, who should be in charge of and responsible for manufacture, has not been appointed, so that the newly appointed superintendent has not the effective assistance which would warrant the nation in having confidence in the department. This want of confidence is assisted by these repeated failures, not only in the material and design of our guns, but by faulty mechanical details. Let me give one example. A gun was ordered from one department and a Vavasseur carriage for it from another. The size and weight of gun were given, so that the carriage could be properly designed. When the two were brought together it was found that the gun was 5 tons heavier than had been stated, and before the carriage could be made to work it had to be altered at a cost of about £500. It is a minor detail, but one is anxious to know to what account this £500 was charged, as I feel sure the Treasury would not grant an extra payment for it. The Surveyor-General of Ordnance was accountable to Parliament for the spending of £8,000,000. The Financial Secretary to the War Office stated on the 1st of February that in appointing a member of Parliament to the post it was considered of no importance whether he happened to know the breech of a gun from the muzzle or not. But whose fault was that? I think a grave error has been committed in abolishing the office, thereby replacing military for parliamentary control.

SHIPBUILDING NOTES.

On the 13th inst. there was successfully launched from Messrs. Robert Thompson & Sons' Southwick yard, Sunderland, a steel screw steamer for the Nippon Yusen Kaisha Steamship Company, of Tokio, Japan. The following are her dimensions: Length, 331½ft.; breadth, 42ft.; depth, 28¾ft. She is built to class 100 A1 at Lloyd's, under special survey. The vessel has cellular double bottom for water ballast, six bulkheads, four large hatchways, with cargo ports, four horizontal steam winches and donkey boiler, Clark, Chapman, Parsons, & Co.'s patent windlass and steam steering gear, and large house on deck aft for captain and passengers, protected by a neat cape covering the stern. The bridge amidships is 70ft. long, for the accommodation of officers and engineers, and a large topgallant forecastle is provided for the crew. The engines are by Mr. John Dickinson, Monkwearmouth, and will indicate about 1400 h.p., and be capable of driving her 10½ knots. She has extra large boilers.

Messrs. Raylton, Dixon, & Co., of Middlesbrough, recently launched a very handsome screw steamer, built to the order of Messrs. Rathbone Brothers & Co., of Liverpool, for their Star Line of Calcutta steamers. The vessel is 352ft. long, and has a dead weight capacity of 4500 tons. She is beautifully fitted up for thirty six first class passengers, and electric light is used throughout.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Saturday, 25th February, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

PHYSICAL SOCIETY.—Saturday, 25th February, 3 p.m. Note on "The Efficiency of Incandescent Lamps with Direct and Alternate Currents," by Professors W. E. Ayrton, F.R.S., and J. Perry, F.R.S.; "Observations on the Height and Length of Ocean Waves," by the Hon. Ralph Abercrombie; "Experiments on Electrolysis," by Mr. W. W. Haldane Gee; and "On the Temperature at which Nickel Begins to Suddenly Lose its Magnetic Properties," by Mr. Herbert Tomlinson.

NEXT WEEK.

CLEVELAND INSTITUTION OF ENGINEERS.—Monday, 27th February, 7-30 p.m. Ordinary meeting. Paper to be read on "The Working of the New Patent Law," by G. J. Clarkson, F.I.P.A., Stockton.

SOCIETY OF ARTS.—Monday, 27th February, 8 p.m. Cantor lecture on "The Modern Microscope," by Mr. John Mayall, jun.—Wednesday, 29th February, 8 p.m. Ordinary meeting. Discussion on Mr. Swire Smith's paper on "The Technical Education Bill."

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 28th February, 8 p.m. Ordinary meeting. Papers to be read on "Manganese in its Application to Metallurgy," and "Some Novel Properties of Iron and Manganese," by Mr. R. A. Hadfield, Assoc.M.Inst.C.E.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, 29th February, 7 p.m. Paper to be read on "Our National Defences," by Mr. William C. Street, A.R.I.B.A.

ARCHITECTURAL ASSOCIATION.—Friday, 2nd March, 7-30 p.m. Ordinary meeting. Paper to be read by Mr. F. M. Simpson.

GEOLOGISTS' ASSOCIATION.—Friday, 2nd March 8 p.m. Ordinary meeting.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, 2nd March, 9 p.m. Lecture on "Poisons and Poisoning," by Dr. C. Meymott Tidy.

JUNIOR ENGINEERING SOCIETY.—Friday, 2nd March, 7-45 p.m. Paper to be read on "Practical Electro-plating with Various Metals," by Mr. F. N. Lewis, Stud.Inst.C.E.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 2nd March. 3 p.m. Paper to be read on "The Native Army of Bengal: its Constitution, Organisation, Equipment, and Interior Economy," by Major-General J. J. H. Gordon, C.B.

PRICES CURRENT, 23RD FEBRUARY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/4	Cash
Scotch Warrants, m/n		39/2	„
Hematite Warrants, m/n		41/10	„
Stocks in Stores. Scotch	948,998—Inc. for week,	2416	Tons
Middlesbro'	337,239—Dec. „	5981	„
Hematite	211,919—Dec. „	112	„

Exclusive of stocks in makers' yards.

Market quiet, and little new business offering.

Scotch shipments 5232 tons, against 8063 tons for same week last year.

	No. 1.	No. 3.		
Coltness	48/9	42/6	f.o.b.	Glasgow.
Gartsherrie	45/6	41/9	„	„
Dalmellington	41/-	39/-	„	Ardrossan
Eglinton	39/9	38/-	„	„
Glengarnock	44/6	40/3	„	„
*Derbyshire	—	38/-	f.o.t.	Works.
*Lincolnshire	—	33/-	„	„
*Lancashire	—	38/-	„	„

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.	Best.	
Middlesbro' Bars	£ 4 17 6	£ 5 7 6	f.o.t. wks
„ Angles	4 15 0	5 5 0	„
„ Plates	5 0 0	5 10 0	„
Staffordshire Bars	5 5 0	5 15 0	Manch'r.
„ Angles	5 15 0	6 5 0	„
Crown Sheets	6 15 0	7 0 0	„
„ Hoops	5 10 0	5 12 6	„
"Siemens-Martin" Steel Boiler Plates		8 0 0	„
„ Ship and Girder		7 15 0	„

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	10	0	to	£19	15	0
Copper: British Cakes and Ingots	80	0	0	„			
„ Chili Bars	78	0	0	„	78	2	6
„ Manufactured (strong)	90	0	0	„			
Lead: Common Pig	15	0	0	„	15	5	0
„ English Sheet	16	0	0	„	16	5	0
Tin: Straits	166	0	0	„	166	10	0
„ Australian	167	0	0	„	167	10	0
„ English Ingots	162	0	0	„	163	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER:—Chili bars have been sold rather freely at from £77. 12s. 6d. to £78. 5s. per ton for sharp cash parcels, and the market appears to be steady thereat. Manufactured—quotations are unchanged; but new business is scarce as yet.

TIN continues to be well held, and quotations have ruled during the past week from £166 to £167 per ton.

LEAD slightly weaker.

SPELTER.—The demand is easier, and prices a trifle lower; but a recovery is looked for.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	28	0	0
„ Ceylon	„	24	15	0
Cottonseed	„	20	5	0
Cod	„	18	0	0
Lard	„	41	10	0
Linseed	„	18	12	6
Palm, Lagos	„	21	10	0
Rapeseed: English	„	24	15	0
Seal: Pale	„	23	0	0
„ Brown	„	17	0	0
Sperm	„	42	0	0
Whale	„	14	0	0
Turpentine	per cwt.	1	10	6
Coal	per gal.	0	0	6
Petroleum (Refined)	„	0	0	6½
„ Spirit	„	0	0	7½

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
„ „ Liquid	gal.	0	1	2	—	0	1	6
„ Citric	lb.	0	1	7½	—	0	1	8
„ Oxalic	„	0	0	4	—	0	0	4½
„ Sulphuric	ton	1	5	0	—	1	10	0
„ Tartaric	lb.	0	1	6⅜	—	0	1	6¾
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
„ Muriate (Grey)	ton	23	0	0	—		.....	
„ „ (White)	„	26	0	0	—		.....	
„ Sulphate	„	12	5	0	—	12	10	0
„ Liquor	lb.	0	0	3½	—		.....	
Bleaching Powder	ton	7	15	0	—	7	17	6
Bisulphide of Carbon	„	13	0	0	—		.....	
Borax	„	30	0	0	—	33	0	0
Benzole (90%)	gal.	0	3	6	—	0	3	9
„ (50/90%)	„	0	2	6	—	0	2	9
Copper Sulphate	ton	21	10	0	—	22	0	0
Copperas	„	1	10	0	—	2	0	0
Kieserit	„	1	12	6	—		.....	
Lead: Nitrate	„	23	0	0	—	23	10	0
„ White Sugar	„	28	0	0	—	29	0	0
„ Brown „	„	23	10	0	—	25	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
„ Caustic	ton	22	0	0	—		.....	
„ Carbonate	„	17	15	0	—		.....	
„ Chlorate	lb.	0	0	6	—	0	0	6⅛
„ Prussiate (Yellow)	„	0	0	7⅜	—		.....	
„ Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	3	6	—	0	3	7
„ White	„	0	3	5	—	0	3	6
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	„	3	5	0	—	3	10	0
„ Glauber	„	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	„	9	0	0	—	9	10	0
„ Recovered	„	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
„ Caustic (White, 70%)	ton	7	0	0	—		.....	
„ „ „ 60%)	„	6	0	0	—		.....	
„ „ (Cream, 60%)	„	5	17	6	—		.....	
„ Crystals	„	2	10	0	—	2	12	6
„ Bicarbonate	„	5	10	0	—		.....	
„ Hyposulphite	„	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	2	—	0	1	3
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

MR. HENRY FAIJI, M.Inst.C.E., has removed his offices from No. 4 to No. 2, Great Queen-street, Westminster.

MR. B. H. THWAITE, Assoc.M.Inst.C.E., has arranged to read a paper on "Mill Engines," before the Yorkshire College Textile Society, on Tuesday next, the 28th inst.

MESSRS. WALTER T. GLOVER & Co., of Salford, have taken into their service Mr. Edward Whalley—late with Messrs. Thomas Unsworth & Co.—to superintend work connected with winding, twisting, laying, cabling, and balling, with which he has had a large experience.

THE Frictionless Engine Packing Company (Messrs. Small and Parkes), late of 27, Exchange Buildings, St. Mary's Gate, Manchester, have removed their works and offices to Cable Mills, Glasshouse-street, Oldham Road, Manchester. This removal has been rendered necessary on account of their late works at Wilmslow being too small to meet the demands of their present business.

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HOME INDUSTRIES.

MANCHESTER, 23rd February, 1888.

The Engineering Trades.—Nothing of great importance has occurred since our last report. Stationary engine builders remain fairly employed, but at very low rates; with some exceptions the same remark applies to millwrights. There is not quite so much being done in the Burnley district, and the weaving sheds being built are not likely to be followed by others at present. There are ominous signs that the supply of cloth has now overreached the demand, and it is not likely that any extensions of weaving power will take place. Machine tool makers are obtaining more orders, and their prospects are gradually improving. The old established firm of Wm. Collier & Co., of Manchester, is to be offered for sale by auction as a going concern in the course of a few days. Boiler makers continue to be well employed, and find work plentiful. This business is probably in a more prosperous condition than any other branch of engineering, and does not appear to suffer at all by the depressed state of trade. Machine makers are also well employed, and almost without exception continue to find orders. The prospects of this trade would be very good, if it were not for the unreasonable competition to which we referred a week or two since. The constructional iron work makers have not much work on hand. An instance of the present cutting of prices is given in the quotation accepted for a number of cast iron gutters employed in the erection of a weaving shed in the East Lancashire district. The gutters are of the usual section, and the contractor had in delivering them a charge of 5s. a ton for carriage; the contract also included the erection. The accepted price was 4s. 10d. per cwt., a rate equal to about 3s. 6d. or 3s. 8d. at works for the castings, without painting.

The Iron Trade.—With the lower prices now ruling in the pig iron market, the amount of buying in this district has fallen off very considerably. During the rise most consumers bought very freely, and the result is that they are well supplied with material. Makers' prices of local and hematite irons are higher, in proportion, than the quotations for Scotch and Cleveland iron; hematites being specially firm, owing probably to the large contracts entered into during this month. There are, however, low rates being given for all classes of iron, mainly from middlemen, who are doing the bulk of the business transacted. Bar iron is also being sold in very small quantities, although makers' prices are fully maintained. The competition of second hand lots in this department is also much felt. Steel bars and plates fully maintain the recent advance, and are finding a fair sale.

The Ribble Scheme.—It has now been decided by the Preston Town Council that the engineer to be called in to report on the above scheme shall be Mr. Jas. Abernethy, M.Inst.C.E. The terms of the reference are very large, and amount to asking for a report on the whole scheme. With reference to the dock proper, there is no difference of opinion, the crux of the question being the dredging of the channel. There is a long length to dredge; but we believe it is a fact that so far as this has been carried out, the advantage to the channel has been very marked, the additional scour having greatly improved it up to and behind the actual place where operations are being carried on. Mr. Abernethy's great experience in works of this kind will enable him to form conclusions which will be generally accepted.

LONDON, 23rd February, 1888.

The Money Market.—The money market gained a little more life during the past week, but this is gradually ebbing away again. The inanition of the stock markets is very marked, and the Stock Exchange is waiting upon the news from San Remo. Mining shares move up and down in a weak and uncertain manner, with an inclination to fall away. The only class of shares which show a tendency to rise, and maintain the rise, are those of the Indian gold companies. A little more interest is now being shown in, and energy expended upon, these gold companies, the one movement encouraging the other, so that both in the prices of the shares and the character of the work done in the mines there is a marked improvement. Of new issues the most important is that of the Naval Construction and Armaments Company.

Companies.—Since our last report the following new companies have been registered: Joshua Smith, Limited, with a capital of £40,000, to carry on business as cotton spinners, &c.; Liddiard & Wordley, Limited, with a capital of £10,000, to carry on business as ironmongers; the Carbonising Syndicate, Limited, with a capital of £3,100, to carry on the business of carbonisers of sugar scum, &c.; F. W. Oliver & Co., Limited, with a capital of £30,000, to acquire a business carried on in decorative glass, and patents in connection with the same; the Norwegian Zinc Company, Limited, with a capital of £56,000, to acquire a zinc mine in the neighbourhood of Sandeforth, Stavanger, Norway; the Aberthaw Pebble Lime Company, Limited, with a capital of £10,000; Tregeale Tin Mining Company, Limited, with a capital of £20,000; Bryceson Brothers, Limited, with a capital of £11,000, to purchase the business of organ builders and wood working machinists carried on at Charlton Works, Islington; Tower Fibre Dressing Company, Limited, with a capital of £2,000; Eastern Oregon Gold Mining Company, Limited, with a capital of £250,000; St. Neot's Paper Mill Company, Limited, with a capital of £30,000; Australian Broken Hill Consols, Limited, with a capital of £500,000. The prospectus of the Naval Construction and Armaments Company, Limited, a new undertaking with a capital of £600,000, states that the principal objects of the company are to build ships of war in England and Spain, and to develop new inventions connected with coast defence. Arrangements have been made for the purchase of a shipbuilding yard and engine works at Barrow, and it is proposed to erect as a branch establishment a shipbuilding yard in Spain, with a view to obtain a part of the orders from the Spanish Government for men-of-war. Our Madrid correspondent, it will be remembered, explained some time ago that preference would be given to local yards, and advocated the association of English shipbuilding firms with Spanish works. In the present instance Messrs. C. de Murrieta & Co., of Bilbao, will co-operate with the company.

Copper.—The demand has been poor for all descriptions of copper except Chili bars, and the rates have been considerably out of proportion to the price of the latter. Purchases are being restricted, and quantities of old copper are being used. At the same time larger supplies are coming to hand from the mines which have not contracted with the syndicate, so that it is doubtful whether the artificial rates can be kept up.

Textiles.—The Colonial wool market has been somewhat weaker since our last report, and, generally speaking, rates are on a par with those ruling at the close of the last series of sales. Woolled sheepskin sales will be held on the 9th of March.

Produce.—The sugar market continues depressed, and buyers hold back; but owing to the deficiency in the beet harvest it is probable that the present low rates will not last. Owing to increased supplies of coffee having come into the market, but little progress has been made, and the higher prices obtained at the beginning of last week could not be maintained.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 12th February, amounted to £1,118,071 on 15,831½ miles, as compared with £1,089,973 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 122¾ miles or 0·7 per cent., and in the receipts of 2·5 per cent.

The Navy.—An official trial has been made of the engines of the composite ship "Buzzard," with satisfactory results. On a previous run in the Medway the port engine broke down. Trials are in course of progress at Portsmouth with the "Severn," which has been fitted with the torpedo launching gear of Captain May, R.N., which we briefly described in our issue of the 18th October, 1886. By this appliance the torpedo is projected under water, while the vessel is steaming at a high speed. It is announced that the forthcoming programme of the Admiralty will include the construction of three new men-of-war. One of these will be the "Barracouta," the first of a new type of steel sloops designed by Mr. W. H. White, which will have a displacement of 1580 tons. There will also be a new sloop of the "Buzzard" type of 1040 tons displacement, and with engines of 1200 h.p.; and a fast gunboat of the "Bird" type of 805 tons displacement and 1200 h.p.

Our Big Guns.—We re-produce this week Mr. Carbutt's recent letter to *The Times* on the bursting of a 10in. gun while under proof at Woolwich, to which we referred on page 142, and since then the Secretary of State for War has been questioned on the subject. The official reply is that the cause of the failure is now under investigation by the Ordnance Committee. The gun had been designed at the Royal Gun Factory, but the design was modified during manufacture, the gun being chase hooped and lined, in accordance with the proposal of the Elswick Ordnance Company, who made it. Mr. Stanhope considers that a marked distinction should be drawn between failures at proof and failures on service. He fears that severe criticism in Parliament might produce a tendency to pass into actual service guns which had not been scrupulously tested.

Canals.—A conference will be held by the Society of Arts in May on the subject of canals and inland navigation. Papers will be received on the history of canal and river navigation, canal engineering, uniformity of gauges, systems of haulage, methods of construction, locks, and hydraulic and other apparatus for raising and lowering barges.

GLASGOW, 23rd February, 1888.

Railway Traffic.—Last week the railway traffic showed a conspicuous advance. In the goods traffic of the Caledonian and of the North British Railways the increase was respectively £2,628 and £3,032. These figures, coupled with the recent traffic returns of the same railways, are satisfactory evidence of a greater movement of commodities.

Iron.—Two furnaces were blown in last week, though the price of pig iron is not encouraging, the extremely low figure of 38s. 11d. per ton having been touched last week.

Steel.—The steel makers are all much occupied at present, new furnaces being in course of erection at some of the largest works. For some time past users of large quantities of steel have been finding it extremely difficult to procure the quantities required in the necessary time limits. Existing steel producing plant is strained to its utmost extent.

Coal.—The depression in the iron trade is perhaps even more seriously affecting coal. The pit-head heaps are accumulating, and work is far from continuous. Prices, both for steam coal and for shipping coal, are low; the former is quoted at 7s. 3d. to 7s. 6d., and the latter at 5s. 6d., delivered at the terminus.—The Admiralty are reported to have asked four of the Slammanan coal firms to send estimates for five hundred tons of steam coal. This quantity is required for the preliminary trials of Scotch coal, upon which the Admiralty had determined before Lord Charles Beresford left office.

Shipping.—Freights are still firm, especially to India and the East generally. Home freights from Eastern ports are also being maintained, and in some cases advanced considerably.

Porterage Rates by Clyde Shipping Lines.—The Allan Line, the Anchor Line, the State Line, and Messrs. Donaldson Brothers have been approached by the importers of flour by their steamers, upon the subject of the charge for master porterage. The usage has been for many years for the ship's agents to discharge the duties, and levy the rates for master porterage. These rates have been fixed for some time at 1s., less 7½ per cent. per ton. The flour importers offered to pay 10d. per ton, but no more, the difference being 1⅛d. per ton. The shipping companies offered to submit the question to arbitration; but this proposal was rejected, and the companies have now given notice that they will not permit anyone except their own agents to discharge the duties of master porterage for goods arriving by their steamers, and that they will adhere to the current rates. The question is a serious one, since the claiming of such a right by shipping companies might conceivably lead to abuses.

Cotton Spinning in Glasgow.—The directors of the Glasgow Cotton Spinning Company have just issued their report for the quarter ending 31st January. They announce a dividend of 3s. per share for the quarter, being at the rate of 10 per cent.; the profits having been £1,770. This is an evidence of improvement in the cotton spinning trade, which has been in a very depressed condition in this district for some time.

Naval Architecture.—Professor Jenkin, who occupies the Chair of Naval Architecture in the University of Glasgow, delivered the first of a course of evening lectures on "The Strength of Ships," on Thursday last. The lectures are to be delivered in the new class rooms, provided for the Chair of Naval Architecture by Sir William Pearce, Bart. The building materials were removed from the old college buildings, in the High-street, on their demolition by the North British Railway Company.

The Money Market.—On Monday evening, Mr. Charles Gairdner, manager of the Union Bank, and President of the Economic Section of the Philosophical Society, delivered an address upon "The Constitution and Course of the Money Market." He discussed the question of the appreciation of gold, argued against bimetallism, and described the effect of the expansion of credit upon the monetary requirements of commercial nations.

(From our own Correspondents.)

LIVERPOOL, 22nd February, 1888.

The Overhead Railway.—There is every probability of this work being carried out at an early date, for there will be practically no opposition to the Bill now before Parliament for an extension of time and for leave to transfer the powers to a company.

The Vessels Sunk in the Mersey.—The operations of blowing up the "Baroda," which was sunk at the entrance to one of the docks about two months ago, have only just been completed, the work being much more difficult and costly than was anticipated. Preparations are now being made for blowing up the "Rollas," recently sunk at the entrance to the Duke's Dock. It was this vessel, when under the name of the "Murillo," which ran into the "Northfleet," some years ago, and caused the frightful disaster in the English Channel. It seems remarkable that a rich body like the Mersey Docks and Harbour Board should not have efficient apparatus for raising wrecks, instead of either having to pay enormous sums to contractors to undertake the work, or to resort to the dangerous and inconvenient method of blowing them up. Over £15,000 was paid for raising the "Locksley Hall," the actual cost to the contractors not exceeding £2,000, and several thousands will be expended in blowing up the above two vessels.

SHEFFIELD, 22nd February, 1888.

Iron and Steel.—The condition of local trade is still satisfactory. Makers and merchants have done a good business during the past few days in iron and steel. Bessemer and crucible are in great request, and although there have been fluctuations, yet on the whole the material has maintained its price. The strike at the works of Messrs. Charles Cammell & Co., at Workington, has fortunately terminated, the manager's conditions being accepted by the men. It is fortunate that the dispute is over, for the output of steel rails at Workington is enormous, especially on foreign account. At two or three of the large Sheffield works considerable attention is being given just now to improvement in plates and projectiles; but the firms that have put down plant for the manufacture of ordnance at great cost, are beginning to think that the orders they understood they were to obtain from the Government are coming in

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very slowly. Sheffield is just now doing a satisfactory trade in railway material, not only in rails on foreign and colonial demand, but in axles, railway springs, and tyres. The waggon builders are also busy; and makers of shipbuilding material, engineers, and iron founders are very well employed.

LIGHTER BRANCHES.—The continued frost has caused a great demand for skates. In cutlery there is no complaint of depressed trade. America is not ordering so largely; but the home demand for best descriptions of table cutlery is increasing, in spite of the high price of ivory. The Continent is taking a vast quantity of table and pocket cutlery, as well as surgical instruments; and there is both in Germany and Austria, and also in Russia, a growing inquiry for Sheffield manufactures of good quality. The electro-platers have not been so well off for orders for some months past. This branch of Sheffield trade has expanded enormously during the past ten years, and some of the best known local firms send their work in silver and electro-plate to all parts of the world.

COAL.—At a number of the collieries the men are working five and six days a week. The call for coal of all kinds is extensive; but particularly for manufacturing and shipping, and for the London market. The colliers have abandoned their agitation for an advance of wages and are wisely continuing their work at the old rates.

LEEDS, 22ND FEBRUARY, 1888.

THE HEAVY INDUSTRIES.—A steady trade is being done in manufactured iron. The output of Bessemer steel is satisfactorily increasing, and prices keep firm. The engine builders have lately obtained some good orders for locomotives and engines for tramway work. All descriptions of railway material are more eagerly called for, and tyres and axles are being turned out rapidly for immediate needs. The heavy snowstorms have done damage to permanent ways and rolling stock, and a good deal of material has been ordered for renewals. Leeds is developing a trade with China, whither she is sending engines and plant for various purposes. A better Colonial trade is also being done. For hydraulic machinery, boilers, and shipbuilding there is an extensive demand; indeed, it is difficult to say what particular branch of local industry is not in a more prosperous condition at present than it was at the end of the year. For engineers' tools there is an extending market; and cut nails are selling more readily week by week. In the lighter branches of Leeds trade there is not much change to report, except that the severe weather has greatly increased the demand for woollens and warm clothing of every description.

BIRMINGHAM, 22ND FEBRUARY, 1888.

THE IRON TRADE.—This trade is fairly busy, especially in the finished branches. The demand for pig iron is rather quiet; unmarked bars are most in demand, at about £5 to £5. 10s., and sheets for galvanising purposes go off freely at £6. 5s. and upwards for singles, and £6. 15s. to £7 for doubles. The price of galvanised sheets at the ports is £12. 10s. to £13 for 24 gauge. The Australian Colonies are taking an increased quantity of this class of goods, and they also find ready sale in other Colonial markets, especially those of the southern hemisphere. A movement is in progress towards the replacement of sheet iron by steel for galvanisers' use, and this alteration will have an important influence upon the relative position of the two metals in South Staffordshire. Already a considerable quantity of sheets are employed where formerly iron was used. In the netting departments of the galvanising trade there is more being done, and in such branches as bucket, bath, and pail making, there is a fair activity. Business is rather restricted in the pig iron market, Northampton and Derby irons being in most demand at 40s. to 41s. Staffordshire hot blast all-mine is selling at 52s. 6d., and second qualities at about 40s. Final arrangements have been made for re-starting the Bromford Iron Works, which were closed some time ago in consequence of the failure of Messrs. John Dawes & Sons. About twenty-two puddling furnaces will be re-lighted this week, and a staff of workmen numbering one hundred are now engaged in preparing for the start.

LEICESTER, 22ND FEBRUARY, 1888.

HOSIERY TRADE.—Business in this industry has not developed to the extent anticipated at the beginning of January, and trade generally is not so active as it usually is in the middle of February. There are more buyers moving amongst the houses, and it is hoped that good orders will result from their visits. Cashmere goods are fairly in demand, and some houses are busy with contracts for cottons and merinos. Competition is extremely keen, and prices quoted are at very small profits.

WOOL SPINNING AND YARN TRADES.—The condition of the wool trade continues to be very unsatisfactory, and is full of uncertainty. The London sales of Colonial wool increased prices somewhat; but this has not affected the local market to any extent, and prices are much as they have been since the opening of the year. Growers and country dealers, whilst not anxious to dispose of their generally small holdings, are now more commonly disposed to make a reduction to effect a sale. Consumers apparently have very little faith in the stability of the present quotations, and buy but very sparingly, usually for immediate requirements. Staplers therefore are not moving, and the turnover is light all round. The spinners are not in a very good position; their orders are scant, and there is much more going into stock to keep the machinery employed than is satisfactory. Buyers hold out for lower quotations, and to obtain orders business has to be done with a very small margin of profit. Yarn merchants are not doing very much.

NORTH STAFFORDSHIRE, 22ND FEBRUARY, 1888.

THE COAL AND IRON TRADES.—The retrogressive movement which has occurred during the past four or five weeks still continues, and prices have fallen back to their old level. On the whole the volume of trade has somewhat increased. The critical time is approaching which will determine the price of pig iron. If makers were only strong enough to hold off the market until the third week in March is passed, consumers would be forced to pay higher prices for their pigs; but it is becoming more apparent that the reverse will be the case, and probably the early part of next month will see many contracts booked for delivery to June at little, if any, above 1887 prices. Earl Granville has blown in another furnace at his Shelton iron works this week. The severe weather is exercising a beneficent influence upon the course of the coal trade, and those collieries producing good fuel for domestic consumption are unable to meet the demand upon them; but prices are low, and not very remunerative.

SOUTH WALES, 22ND FEBRUARY, 1888.

NEW PATENT FUEL WORKS.—The Crown Patent Fuel Company, promoted by Mr. Samuel Butler, is about to erect extensive works near the Old Sea Lock at Cardiff, for the manufacture of patent fuel. It is stated to be the intention of Mr. Butler to commence operations with an output of 100 tons per day, although the plant will be designed to turn out twice this quantity.—It is announced that a new tin plate works and a pottery are shortly to be started at Llanelly, in connection with both of which several influential names are mentioned.

SWANSEA HARBOUR TRUST.—Mr. John Dixon, of Clifton, Bristol, formerly the general manager of the Avonmouth and Sharpness Docks, has been chosen out of a large number of candidates to fill the vacant superintendentship of the harbour. The salary is £800 per annum.

THE "SUNBEAM" INCANDESCENT LAMP.—Messrs. Walker and Olliver, of Cardiff, are introducing this electric lamp into South Wales, and have it already at work in several collieries. This lamp is simply a large glow lamp, in which a carbon thread takes the place of the thin filament used in the small lamps. As the lamp is made to give from 200 to 1500 c.p., it is intended to take the place of the arc lamp, which in some of its forms has so many drawbacks. The "Sunbeam" can be worked upon any existing electric light circuit, and, of course, requires no attention except when it has to be renewed.

BARROW-IN-FURNESS, 22ND FEBRUARY, 1888.

IRON AND STEEL.—There is a steady trade in hematite pig iron, and orders are offering very freely both for pig iron and steel. Prices of the former are steady at 43s. 6d. to 45s. per ton net f.o.b. for Bessemer samples, although hematite warrants have changed hands at 42s. to 42s. 6d. per ton. Stocks in makers' hands are small, and are not increasing. There is a brisk trade in all classes of steel, and the market for rails is much better than it has been, prices remaining steady at £4 per ton net f.o.b. for heavy sections. The demand for ship building material is brisk. There is a large output of both plates and angles, and arrangements are in progress to further increase the production on local as well as on general account. There is a good business being done in shipbuilding material, and shipbuilders themselves are also much better placed for business than they have been for some time. There is also a growing activity both in boiler making and engineering, and good orders are expected both on marine and general account.

MIDDLESBROUGH, 22ND FEBRUARY, 1888.

TEES CONSERVANCY RETURNS.—The revenue of the Tees Conservancy Commission for January shows a total receipt for dues on ships and goods of £5,330. 16s. 8d., against £4,618. 5s. 4d. in the similar month last year, being an increase of £712. 11s. 4d. On the total revenue for the first quarter of the financial year just ended there has been an increase of £1,305. 2s. Both Middlesbrough and Stockton take part in the improvement, but chiefly the former.

PIG IRON.—The Cleveland pig iron market remains quiet but steady, and it is showing signs of reaction in favour of an advance. Indeed, the general condition of business certainly warrants such an expectation, and had it not been for some late reckless speculation, there is but little doubt the advance would have been an accomplished fact. The average price for No. 3 G.M.B. is 31s. 6d. per ton for early, and 31s. 9d. for April-June delivery. Warrants are 31s. 3d. per ton cash for Connal's No. 3 G.M.B., and 42s. 6d. nominally for Connal's hematite, mixed numbers. It is a favourable sign that Connal's stores have been decreasing of late at the rate of some 6000 tons per week on the average.

IRON AND STEEL.—Finished iron has quieted down, although some report that inquiries are as numerous as ever. Still there is not the same pressure, and the inquirers are content to wait for more favourable terms. Plates £5, angles £4. 12s. 6d., bars £4. 17s. 6d., engineering angles £5, girder plates £5. 5s. on trucks at works, cash, prompt delivery, less the usual discount. Puddled bars £3. 2s. 6d. net. In steel there is the same pressure for steel plates, the ship yards not being so well supplied as they would like. Rails, however, are not so much in demand, and 5s. per ton less has been taken to secure an order. Ship plates are £6. 15s. and ship angles £6. 10s. on trucks at works, less the usual discount. Rails are £4 to £4. 5s., ordinary sizes.

SUNDERLAND, 22ND FEBRUARY, 1888.

SHIPBUILDING.—Work in a number of the shipbuilding yards is being retarded by the slow delivery of material from the steel makers. Messrs. Bartram, Haswell, & Co., South Docks, have only one vessel visible in their yard, but have other work which will be proceeded with shortly. The Sunderland Shipbuilding Company, Limited, are more fortunate, having all their berths occupied. Messrs. William Doxford & Sons, Pallion, have three vessels in progress of construction, and are making preparations for laying down a fourth. Messrs. Robert Thompson & Sons, Southwick, are framing a steamer; Messrs. Short Brothers and Messrs. Joseph L. Thompson & Sons continue to have their yards fully occupied; Messrs. W. Pickersgill & Co., Southwick, have one steamer framing, and will shortly commence on the China river steamer; Messrs. J. Blumer and Co., North Docks, are rapidly completing the vessel on the stocks, and are also preparing the blocks for another steamer; Messrs. Osbourne, Graham, & Co., North Hylton, are making steady progress with the plating of their vessel.

MINOR INDUSTRIES.—The quarries and lime-kilns at Fulwell continue to be fully worked, but there is not so much animation at present in the sheet glass manufactories. The Hendon Plate Glass Works have resumed operation under the new management.

NEWCASTLE, 22ND FEBRUARY, 1888.

CHEMICALS.—There is a diminished demand for all kinds of chemicals, excepting for caustic soda, which is a special product of Messrs. Allhuson's works, Gateshead, and prices have shown a corresponding tendency to decline. The last named firm are utilising existing resources to the uttermost to satisfy the demand for caustic, and the new works, which are to be erected with a view to the extended manufacture of this commodity, will very shortly be proceeded with. The firm have this week temporarily stopped the manufacture of chloride of lime, as the stock at present on hand is somewhat heavy. The stoppage is likely to continue for a month. Trade is dull at most of the other factories on the river.

CEMENT.—The demand for cement, both on account of home requirements and for export, is still satisfactory, and at all the works in the district the present output is quite up to the standard of the busiest periods in the past.

COPPER.—Shipments of product from the Tharsis Copper Company's works at Hebburn have been unusually light since the beginning of the month, but this circumstance has not caused any diminution of activity in the manufacturing departments. Stocks are consequently pretty heavy, but will no doubt soon be reduced to the ordinary level.

LEAD.—There is comparatively little being done in the manufacture of sheet lead, but in other departments of this industry business is fairly good.

PAINTS, COMPOSITIONS, &c.—The different paint manufacturing establishments in the district are very busy at present, new outlets for consumption having arisen since the opening of the year. Messrs. S. T. Taylor & Sons have several important orders for their patent boiler covering composition in course of execution, and their works are now quite busy. Messrs. M. Holzapfel & Co., manufacturers of patent anti-fouling composition for ships' bottoms, are experiencing so large a demand for their specialty, that they are finding it necessary to increase their productive resources. They are adding a large building to their present manufacturing premises on the South Shore Road, Gateshead, and in the course of a few weeks will be able to increase their output to an extent which it is hoped will be sufficient to meet even the larger demand which is anticipated.

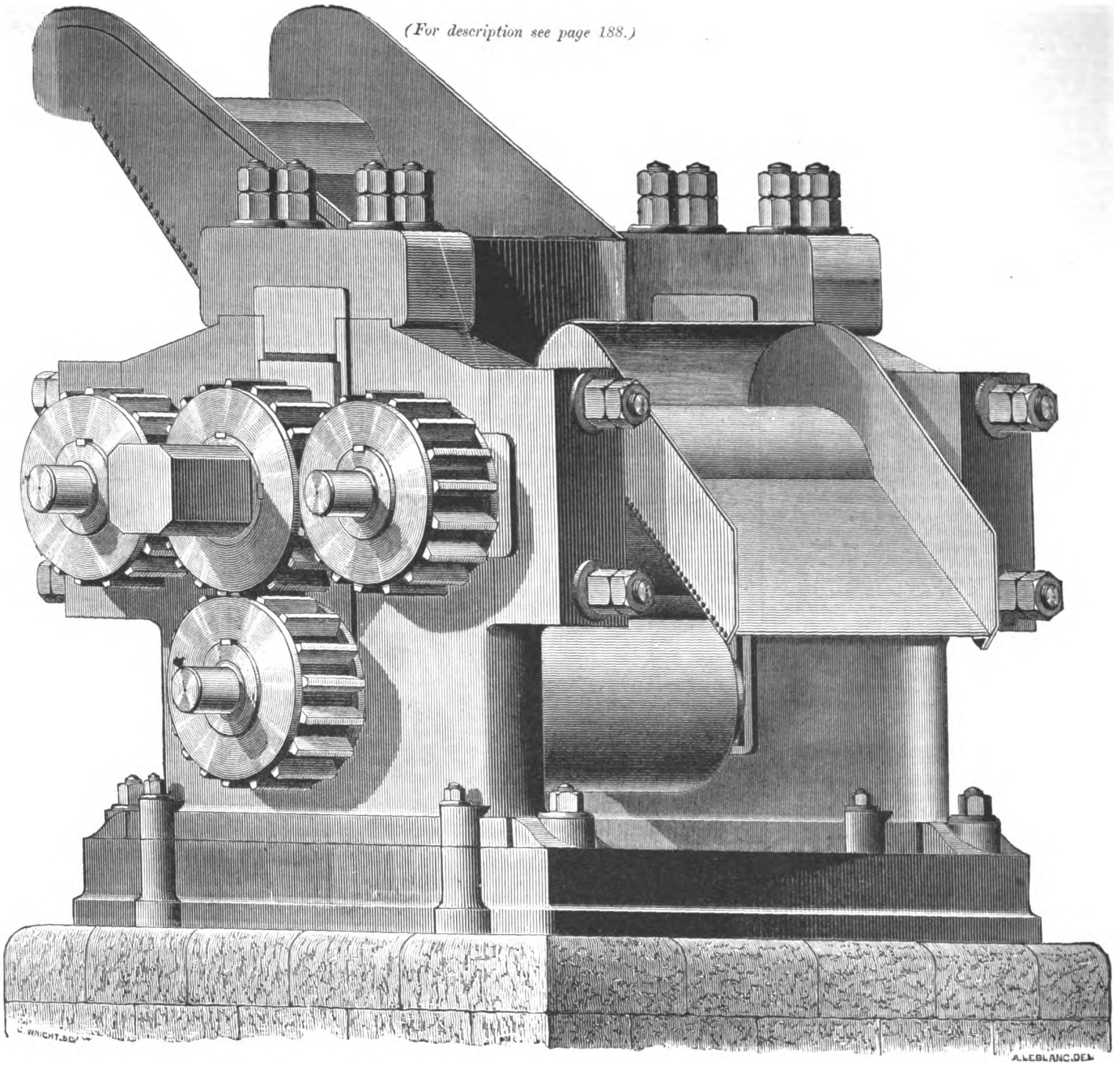
BELFAST, 22ND FEBRUARY, 1888.

SHIPBUILDING.—Shipyards still continue to be well employed, and new orders are regularly booked. Mr. C. J. Biggar, of Londonderry, has secured an order from Messrs. A. A. Laird & Co., Glasgow, for a steel screw steamer of 600 tons, for their cross-channel passenger trade; this yard has in addition two large vessels on the stocks, which, with some good repair work in hand, will keep them busy for some time. The s.s. "Oceana," built by Messrs. Harland & Wolff, for the Peninsular and Oriental Company, left Belfast on the 18th inst. in tow for Liverpool. She presented a very fine appearance when finished, and as she is the largest vessel yet built in Belfast so she will be one of the largest in the P. & O. fleet. Her sister ship, the "Arcadia," will be ready in a few weeks. Mr. De Cobain, M.P. for one of the Belfast divisions, is about to introduce a Bill into the House of Commons making weekly wages compulsory throughout Ireland, which, if passed, would specially affect the shipbuilding trade. Engineers and boiler makers are fairly well employed on past orders, but the amount of new orders is not so satisfactory.

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IMPROVED FOUR-ROLLER CANE MILL.

(For description see page 188.)



OUR FOREIGN TRADE.

THE comparison of what business we are doing in foreign markets, with the progress made by Germany, is usually not looked upon as a matter calculated to give unbounded satisfaction to our own manufacturers, and it is therefore a refreshing novelty to come across a report on this subject in which optimistic views are held with respect to our position. Such, however, are the views of Mr. R. Giffen, who, in a report prepared for the Board of Trade, which it is intended shortly to present to Parliament with detailed tables, maintains that the popular impression given by reports from our Consuls in foreign countries that German trade is gaining ground everywhere at the expense of English trade, is largely due to the fact that from British possessions we receive no consular reports. He says that the reiteration of particular facts from many little places as to German competition, while the larger trades are not reported on, produces the illusion that the trade of the United Kingdom is giving way at every point, whereas the actual facts are entirely different, and that though the particular facts stated are in all cases important in their own places, the inference as to the general course which English export trade is taking is too hasty. This sounds somewhat like special pleading; and therefore Mr. Giffen supports his theory by means of figures, of which he is admitted to be a skilful manipulator. In undertaking the inquiry into the subject, the country to which most attention was given was Germany; but France and the United States, as formidable manufacturing rivals, have also been taken into consideration. Comparing the periods 1875-77 and 1884-85, our imports were the same, viz., £381,000,000; those of Germany fell from £241,000,000 to £229,000,000; those of France rose from £185,000,000 to £203,000,000; and those of the United States from £100,000,000 to £130,000,000. The exports in the same periods were respectively: From England, £207,000,000 and £223,000,000; from Germany, £130,000,000 and £151,000,000; from France, £145,000,000 and £126,000,000, and from the United States £112,000,000 and £151,000,000. Commenting on these statistics Mr. Giffen says, "Such as they are, these figures do not by any means suggest that German trade generally has been developing enormously in comparison with the development of the trade of the United Kingdom, while the increase in French imports is more than set off from the point of view of the present inquiry by the exports. The increase in the trade of the United States is great and conspicuous, but apparently the trade is not of a kind which comes into competition with that of the United Kingdom, and, as far as the exports are concerned, is largely an increase to the United Kingdom itself." This looks rather as if Mr. Giffen had set about his task with the preconceived idea of proving that our foreign trade is progressing as satisfactorily as can be desired; whereas it is evident that this is not so, for the rate of increase in the exports of Germany during this period is double ours, and that of the United States four times ours. We are therefore not making the headway that we should, and this point is well worthy of notice. At the same time it is undoubtedly the case that outside Europe our trade is predominant, and it is also pointed out, with justice, that the countries in whose trade the imports from the United Kingdom preponderate are the largest traders. The exports of the United Kingdom to each of our three great competitors also much exceed the exports from each of any two of these competitors to the third. Taking the two periods already referred to, the proportion of imports from the United Kingdom to European countries, Egypt, the United States, Argentine Republic, Uruguay and Chili, China, Japan, and British possesions is given, and Mr. Giffen in this connection congratulates this country on the fact that the proportion of our business has in no important case sensibly diminished, while the amount of the business, owing to the general increase of the imports of the countries named, must have largely increased. This is no doubt true; but still the fact remains that there is a decrease in the proportionate rate of imports from Great Britain, varying from 1 to 10 per cent., and that in no case is there an increase in our proportion, whereas German trade with the same countries shows an increase all round. Mr. Giffen's opinion is rosy, and his general conclusion is that Germany has not been gaining in common markets of late years at the expense of English trade, that her gains have been of a special character, and that our predominance in the great common markets remains substantially what it was ten years ago.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
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Telephone number: 684, MANCHESTER.
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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I. & II.

July to December, 1886, and January to June, 1887.

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Industries:

FRIDAY, 24TH FEBRUARY, 1888.

THE PROTECTIVE POLICY OF ITALY AND BRITISH TRADE.

AT a time when many of our foreign markets are being restricted or partly closed against us, by the imposition of heavier protective duties, it is pleasing to learn that the new Italian tariff will conduce rather to the extension of our trade with Italy than to its contraction. That such a result must follow, it is not difficult to show, at least in the cases of the iron and coal trades. The Italians are resolved to have their own iron industries, and of late years the Government has encouraged the erection of new works, and has given active aid in developing them. Hitherto these works have been designed with a view chiefly to prepare the finished products, that is, manufactured iron and steel. The plan followed has been to import the half wrought material, leaving the development of this branch of the industry for a later period. We cannot contemplate the actual position of the native industry without being struck with the progress already made. In various parts of the country, and always in situations favourable to their growth, important works have been established, and in every case they exist in a vigorous and flourishing state. To foster their growth, the Government has applied the system of protection, imposing heavier duties as the young native industry grew stronger, till now it has decreed a prohibitive tariff, manifestly designed to crush out the import trade in the finished products of iron and steel. In many cases the imposts have been doubled. Bars and rods of more than 7mm. diam. or side are henceforth to be taxed 65 lire per ton; those between 5mm. and 7mm., 75 lire; while for those below 5mm. the rate is 90 lire. Rolled wire will thus be subject to a duty of 75 lire, or £3 a ton, so that the duty and freight will together amount to more than the cost of production. For plates of 4mm. and over in thickness, the new duty is 70 lire per ton; between 4mm. and 1½mm., 100 lire; and below 1½mm., 120 lire. Even these high rates will, through a fine distinction in the official description, be increased by 10 lire for most classes of plates that do not strictly satisfy the conditions laid down for fine plates. Further, the duties on steel have been greatly augmented. For steel in bars, the new tariff imposes a rate as high as 120 lire. Obviously, these additional impositions must restrict the import trade in the materials of manufacture within very narrow limits. But the new protective policy goes further, and imposes fresh burdens upon manufactured goods. Thus, steel springs, for example, are made dutiable to the extent of 180 lire per ton, and this rate applies equally to heavy railway and to light carriage springs. So protected, Italian manufacturers may be expected to speedily find the means of adequately meeting the demands made upon them.

Of the import trade in finished iron and steel and manufactured goods, which is directly aimed at in the new tariff, the Germans have the largest share. Their exports of these classes of goods to Italy in the year 1887 amounted to 101,271 tons, exclusive of machinery, a quantity much larger than that which we sent thither. Bars and angles figure in this total for 33,754 tons, against the 17,825 tons tabulated in the Board of Trade returns as exported from this country. Of rails we sent a larger quantity, some 18,000 tons, against 13,000 tons from Germany; and we have the advantage also in the trade in plates, viz.: 13,128 tons, against 9715 tons. But we drop behind so rapidly in other classes of goods, that the total falls far short of the quantity attributed above to our rivals. In addition to the finished material and the manufactured goods which make up the foregoing total, the Germans exported to Italy 10,222 tons of half wrought iron and steel, that is, blooms, ingots, puddle bars, &c.; 14,153 tons of scrap; and 2991 tons of pig iron. We also sold to our Italian customers considerable quantities of half wrought materials and scrap; but the imperfect information afforded by the Board of Trade returns leaves us unable to draw a comparison in these particulars with the more complete, and therefore more useful, statistics collected by the German Customs Office. The defect has been partly remedied in the January issue of the returns; for we there find a fuller description of the trade with Italy than we have hitherto been given. From this issue we learn that in the first month of the current year our exports of scrap iron to Italy amounted to 8131 tons, while those of manufactured goods reached 6145 tons. The important point, however, in our argument is clearly set forth, viz., that while our trade with Italy is relatively small in the finished products of our iron works, our blast furnaces have been sustained by a rapidly growing demand, which reached last year the large total of 122,994 tons.

It is in this circumstance that our strength lies, and here we find the proof of the proposition with which we started, viz., that the new tariff will do us good service. The Germans are so heavily handicapped by the high rates of the St. Gothard Railway, as well as those of the Italian lines, that they cannot offer us, who have the great advantage of cheap sea carriage, any serious competition in the crude iron trade with Italy. This fact is clearly visible in the figures we have already quoted. Circumstances are so much in our favour that we are able to retain this trade against all rivals, and to continue to furnish the Italians with practically all the crude iron they need above what they themselves are capable of producing; and when their blast furnace industry has attained a degree of importance sufficient to justify the Government in excluding crude iron by the means now to be applied to the finished product, there will remain to us an immense and growing trade in coal, capable of affording us some compensation for the loss of the iron markets. Thus the prospect in the near future is cheering. Whatever contraction may result to the trade in finished iron and steel and manufactured goods—a loss that will be distributed among the German, British, Belgian, and French industries—a corresponding expansion must follow in the demand for the crude material, the whole of which increase will fall to our share. Therefore, great as our trade in pig iron now is, and rapidly as it has grown of late, we may reasonably hope to see it undergo further development in the course of the next few years, and this renewed vigour will be attributable to the protective measures which have occasioned so much alarm among our Continental rivals. As for the coal and coke trade, this obviously must increase with the capacity of the native industries. Already it has attained to colossal proportions, our exports to Italian ports in 1887 amounting to 3,186,854 tons, against only 77,823 tons from Germany. But the greater needs of the Italian works, due partly to natural growth and partly to the gradual extinction of the import

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trade in iron goods through a prohibitive protective tariff, will insure a constant growth for many years to come. In this matter again we have the advantage of cheap over-sea transport, against which our rivals in the same trade will struggle in vain. In view of these favourable circumstances, existent and in prospect, it will be a safe prediction to assert that before the end of the current century Italy will have become our best customer for coal, a position hitherto held by France. Thus we can afford to look on complacently while the Italians labour to develop their iron industry, even if their method involve the application of the system of extreme protection, assured that whatever the consequences may be to other nations, to us they must be a cause of considerable gain for a time in iron, and for an indefinite period in coal.

PROFESSOR HUXLEY AS A CONTROVERSIALIST.

Professor Huxley is a born controversialist. His lusty strokes for Darwin in his fight with the critics of "The Origin of Species," confirmed a reputation which had already begun to be made. And from then till now he has never shrunk from a literary duel when the theory of natural selection has been called in question. It was only the other day that he ransacked the pages of the Jesuit fathers to prove that Mr. Mivart was at fault in his knowledge of the scientific teaching of his own church. His controversy with Mr. Herbert Spencer upon "Administrative Nihilism" is familiar to every student of the functions of the State. And recently he has made use of a famous phrase as the text of an essay upon the need for technical education, if we would keep our foothold in the international "struggle for existence."

In his recent paper Professor Huxley promulgates what he calls a programme, and in its first part he pipes to a gloomy enough tune. The rate of increase of the population alarms him. He finds ahead only intenser struggle, domestic and international, and nothing but an increasing accumulation of misery at one pole and wealth at the other. It would be a foolhardy experiment to interrogate Professor Huxley on the biological basis of his argument, yet the question is worth asking whether the rate of increase of population may not be expected to decrease as organic evolution goes on. Mr. Herbert Spencer's laws of multiplication mean nothing if they do not mean this. Professor Huxley might at least have given us this ray of hopefulness, for after all it is the quality of the race and not its quantity which is the important point. If by improving its quality we at the same time place the only effective check upon its excessive increase in numbers, a new hopefulness is infused into the minds of those who see no reason to doubt the general law of multiplication—the tendency of population to outrun subsistence—and yet believe in the folly of folding their hands in helpless hopelessness. It seems a pity that Professor Huxley, treating the question as he does in discursive and popular fashion, misses so large a modification of the bare law of increase, for the omission places his whole argument upon a distinctly inferior plane. Indeed, the omission of this important element involves him in an obviously inconsequent line of reasoning. He starts from the discredited assumption of Hobbes that the normal state of mankind is one of war, and he argues that the history of civilisation is the record of escape from this position. Yet he goes on to show that, instead of escaping from this struggle, we are ever becoming more deeply involved in it, and that so long as "reckless Istar, non-moral Nature" has the government of things, the struggle for existence must continually grow more intense. He sees nothing but catastrophe looming in the distance, for although he does not indicate the alternative, it is clear, unless there be some biological law which makes for preservation as powerfully as the tendency to reproduction makes for destruction, that there can be nothing ahead but catastrophe. At this point it was surely Professor Huxley's plain business to examine Spencer's laws of multiplication, and to show their practical bearing. As it is, he leaves the question where Malthus left it, and for that reason his essay may be said to have been born out of due time. Malthus' idea was to persuade the hare, symbolising the increase of population, to go asleep in order that the tortoise, symbolising the increase of subsistence, might gain ground. Professor Huxley's is not quite so hopeful a project. He proposes to spur the tortoise, and to let the hare go on. The method may be a good one; but if the fundamental assumption of the unlimited rate of increase be accepted, it looks at first sight somewhat ineffectual if taken alone. Yet defective as Professor Huxley's argument seems from a rigid point of view, it is sufficiently suggestive, and harmonises sufficiently well with popular currents of thinking, for his advice to attract attention, and probably do much good. But this good will be done in spite of the rather weak reasons by which the advice is supported. It goes without saying that international competition becomes increasingly keener. But there are other elements in the case besides the mere fact of competition. Commerce is exchange of products, and unless one party in an exchange is despoiled by the other, there must be an approximately equal exchange of services. Both domestic and foreign trade, therefore, involves barter, and consequently production on two sides. Our rivals are our customers; and however from the point of view of individual traders we may wish the man in the next street in some distant clime, in order that he may not undersell us at our own door, we do not wish the street deserted, for we know very well that desertion would mean ruin. In precisely the same way we should find ourselves in a serious case if by any means we checked the contemporaneous expansion of foreign nations. Their growth in the main contributes to our own, and their destruction, unless we could immediately re-people their countries, would mean our ruin. Nothing is clearer than that international commerce involves international dependence. So long as we were a self-sufficient community, we might view with equanimity the destruction of a neighbouring nation; but now that the commercial interests of all civilised nations are bound together, whatever affects one affects all. Trade movements in Illinois have prompt reciprocal movements in our own markets. The steamboat and the telegraph have contributed towards making the "perfect market," and towards bringing about the ideal of what has been called cosmopolitan economy—a condition in which trade is carried on by a vast number of individuals competing with each other, national barriers being practically removed. This can hardly be said to be realised; yet so far as the individual trader is concerned, commercially, it makes little difference to him whether his competitor be a fellow townsman, a fellow countryman in the Colonies, or a foreigner. From the national point of view, our plain duty is to see that we effect a fair exchange of our own products against the products of other nations. From the cosmopolitan point of view, one can see that the struggle for existence among the nations is determined largely by conditions other than industrial conditions, for although industry supplies the sinews of war, the most industrious nations have never been the most warlike; and although the most warlike nations have not been the most enduring, military power in the present state of the world is one of the conditions of national existence. That vast military power may exist alongside of indifferent industrial development is evident from the case of Russia.

Although Professor Huxley seems to have treated "the struggle for existence" from the point of view of his own science of biology, in which he is justly acknowledged as a master, with incompleteness as well as discursiveness, his practical suggestions are worthy of careful attention. He suggests two necessary conditions of progress—first, that our produce should be better than that of other nations: second, that society should be stable. In other words, that industry and politics should be as highly organised as possible. There is nothing specially fresh in these suggestions. They have been made before; but Professor Huxley states them with his customary lucidity. The second part of Professor Huxley's paper is indeed a noteworthy contribution to the attempt which has been made during the past few years to establish political economy on a biological basis. There is admirably expressed truth in the propositions, that "a population whose labour is sufficiently remunerated may be physically and morally healthy and socially stable, but may fail in industrial competition by reason of the dearness of its produce. On the other hand, a population whose labour is insufficiently remunerated must become physically and morally unhealthy and socially unstable; and though it may succeed for a while in industrial competition, by reason of the cheapness of its produce, it must in the end fall through hideous misery and degradation to utter ruin." So clear is it that labour like other things cannot be permanently supplied at less than the cost of production. Professor Huxley goes on to discuss educational methods, advocating the adoption of a system of education which should cultivate the powers of observation to a much greater extent than is now done. The branches of special training commonly called technical education, are specified by Professor Huxley as—First, preliminary scientific education, comprising branches of science and art peculiarly applicable to industrial pursuits; second, instruction in special branches of applied science and art, or technical education proper; third, instruction of teachers in these branches; fourth, capacity-catching machinery. As regards the administrative machinery, Professor Huxley holds views similar to those already expressed in these columns when dealing with the Technical Instruction Bills in September last. These are that the School Boards have quite enough to do, and that there are other existing bodies better fitted for the work. On the question of State-provided technical education, Professor Huxley repeats some of the arguments he employed in 1871 in criticising Mr. Spencer's "Social Organism." In quoting from Hobbes, Professor Huxley guards himself against any misconception as to his disagreement with his master upon the sacredness of the sovereign power. Hobbes' views on absolute government he distinctly repudiates; but of the general strain of Hobbes' theory of the State he approves, as against the contention of Mr. Herbert Spencer, that the less we are governed by external agency the better. But here Professor Huxley executes a strategic movement. In 1871 he had argued for the reasonable expansion of the sphere of State action, and had even, by sundry comic analogies, succeeded in throwing some ridicule upon the argument for individual liberty of Mr. Spencer. Then he thought that the State, having accepted the principle of payment by results, could not legitimately stop there; and, having given grants in aid of primary education, could not refuse to give grants in aid of higher education. He had nothing to say then about technical education; but his view as to education generally was that it should be State-aided. Mr. Spencer has to congratulate himself upon a convert. In "repeating and emphasising" his views of 1871, Professor Huxley turns his back upon them. He has become convinced of the fatuity of trusting in State action, so far at any rate as one department of education is concerned, and he has had the courage to say so. "I entertain," he says, "a strong conviction that, in this country at any rate, the State had much better leave purely technical and trade instruction alone." He goes on to say what is very obviously true, that "all methods of technical training are at present tentative, and to be successful, each must be adapted to the special peculiarities of the locality. This is a case in which we want twenty years, not of strong government, but of cheerful and hopeful blundering, and we may be thankful if we get things straight in that time." With these eminently reasonable views, it is surprising to find that Professor Huxley defends the flimsy and unsatisfactory Technical Instruction Bill which was brought in and then abandoned by the Government last session. The Bill did precisely what Professor Huxley has laid down as bad in principle, viz., it handed over to the School Boards, the Education Department, and the Science and Art Department, all of them arms of the State, the control of technical education. This is practice, very different from the principle that the State ought to leave technical instruction alone. It would almost appear as though Professor Huxley's conversion were too recent, and as though he required time to consolidate his views.

PROGRESS IN THE SHIPPING INDUSTRY.

The proceedings of the delegates of British ship owners at the Cannon-street Hotel, London, on the 10th inst., have an interest outside the circle immediately concerned. Our industrial and commercial life is so largely dependent upon the capacity and efficiency of our merchant navy, that whatever affects the latter is more or less felt in every branch of industry, and throughout all grades of society. An occasion like that of the annual meeting of the Chamber of Shipping of the United Kingdom could not, therefore, pass without giving rise to anxious thought and some speculation concerning the future of trade, even if there had been no particular combination of circumstances to render the event specially interesting. But we are just emerging from the gloom of a long period of depression, and our shipbuilding yards are exhibiting evidence by unusual activity of more vigorous life. Moreover, Mr. Scrutton, the newly elected president, had a story to tell of an altered state of affairs, of new conditions to be complied with, and of changing habits and practice. And in all this he was able to discern, and to set forth for the contemplation of his representative audience, steady and constant progress, tending ever, not merely to the well-being of our seamen, a matter in itself of the highest importance, but also to the wider extension of our foreign trade, and the further development of the iron and the engineering industries of this country. It is in this latter relation that the questions raised by Mr. Scrutton will recommend themselves to our readers.

The most striking fact brought forward by the president in his very instructive address was the necessary substitution of steamers for sailing vessels. Of course all are aware that this change is taking place, and has been going on for some years past. But we did not all know, to use Mr. Scrutton's words, which he says express a conclusion drawn from a wide induction of incontrovertible facts, that "sailing vessels, even of the larger type, are found unable to compete with the newest type of steamer." This being so, it follows that the transformation from sailing vessels to steamers will henceforth be made as speedily as possible. Direct evidence was adduced to show that the transformation is, indeed, being rapidly effected. We learn from *Lloyd's Register* that at the end of 1886 the total number of vessels employed in that year was

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17,917, of which 27·4 per cent. were steamers. Since then further changes have occurred in favour of steam, and judging from the character of the new vessels now on the stocks in exceptionally large numbers, the end of the current year will bring the proportion of steamers up to fully one-third. This is the relative position of steam and sailing ships in point of numbers. But if we estimate their relative importance according to tonnage, we shall find that steam occupies a much more prominent position. Mr. Scrutton justly regards this result as "evidence of the earnestness with which the British ship owner is ever ready to avail himself of the most efficient means and the most approved modes of construction, even though he thereby depreciate his existing property." To the marine engineer the prospect here held out is encouraging. The demand for engines must constantly and rapidly increase, and the need for the utmost attainable degree of economy in these times of keen competition will serve as a powerful stimulant to urge inventors and manufacturers to apply the teachings of modern science, with a view to the production of a more efficient motor. If, when all things are taken into account, triple or even quadruple expansion be found advantageous, that system will establish itself in favour. What the future has in store for us in this direction, it is hard to predict. But the tendency of events seems to be towards a further development of the steam engine; and nothing would so aid the movement as a heavy and growing demand for marine purposes. The evidence presented to the ship owners' delegates on the 10th inst., will, for this reason, be eagerly scrutinised by thousands who have no direct interest in the shipping trade. Of scarcely less importance is another conclusion arrived at by Mr. Scrutton, after a careful investigation of the facts recorded in *Lloyd's Register*, namely, that wood, as a material for shipbuilding, is fast giving place to iron, and that of the latter the form known as steel is most in favour. Here the transformation is being effected more rapidly than in the case of steam against sailing vessels. Mr. Scrutton assures us that composite and wooden sailing ships are no longer being built. An inspection of the building yards at the present time forces home this truth, which our informant deduces from the records of Lloyd's. The origin of this state of things dates back but a few years, and we may see in the rapidity with which the change is being effected a guarantee of its permanence. For this haste in substituting iron or steel for wood, would obviously not be made had the former not proved itself in practice greatly superior to the latter. The demand for iron for shipbuilding must, then, in the future be heavy, and, like that for marine engines, constantly increasing. The prospect before the iron manufacturer is thus a pleasing one, and sufficiently encouraging to invest with interest for him the statements made on this head to the delegates at the meeting of the Chamber of Shipping. The preference shown for steel suggests other questions to which the iron master will not fail to give attention. Following closely upon the re-establishing of basic steel in public favour by the reports of the surveyors of Lloyd's and the Admiralty, the information given on this point is calculated to stimulate into more vigorous life that branch of the iron industry in which we have allowed ourselves to be left behind by our Continental rivals. For the Middlesbrough district the matter is of the highest significance.

THE ELECTRIC LIGHT IN THE CITY OF LONDON.

The decision arrived at by the Commission of Sewers on Tuesday, the 21st inst., with regard to the electric lighting of part of the City, is to be regretted both on account of the electric lighting industry and of the many probable customers in that district, who will thus be deprived of having the electric light in their offices. Some time ago the Brush Company elaborated a scheme for electrically lighting the City between the Exchange and Fleet-street in the north, and Queen Victoria-street and the Embankment in the south. It was proposed to light the streets by means of about 170 arc lamps of 2000 n.c.p., and the houses by incandescent lamps. The annual charge for maintaining an arc lamp was fixed at £26, the company hoping to recoup themselves for possible losses in the arc lighting by the profits made in the private incandescent lighting. It was stipulated that the City should grant the company the exclusive right for laying cables in the streets. The proposal was practically accepted by the committee appointed to inquire into the details of the scheme; but against all expectations the Commission of Sewers did not act upon the advice of the committee, and rejected the proposal. The cost of the public lighting by electricity, if carried out on the principle suggested by the Brush Company, was estimated at £4,400 annually, whereas the gas lighting now in use only costs about half that amount. However, for the extra expenditure of about £3,000 the actual amount of light obtained would have been thirty times that now of gas, and this consideration alone should have secured the adoption of the committee's report. Moreover, business men would have gladly availed themselves of the opportunity thus offered of obtaining electric light from a central station. On their own premises, and where the interests of buyers and sellers of a commodity are virtually identical, there need be no fear of setting up a monopoly. It was, indeed, not on this consideration that the report was referred back to the committee for further investigation, but because a rival offer had been made by the Maxim-Weston Company, who proposed to erect eight hundred arc lamps of 450 n.c.p. at a total cost of £15,000 for the plant, and to work the installation at an additional annual charge of £3,875. Whether this offer be a more advantageous one than that of the Brush Company is a matter of comparatively small importance; but the question before the committee is now, which company can do the work in the most approved manner both as regards public and private lighting. As, however, business men can more easily put up with gas lights in the streets than in their offices, preference ought to be given to the company most successful as regards private lighting. As already remarked, the matter was referred back to the committee, and we trust that the next time their report is presented to the Comission of Sewers they may be able to agree with it, and allow actual work to be started.

Letters to the Editor.

COMPULSORY INSPECTION OF STEAM BOILERS BY BOARD OF TRADE OFFICIALS.

To the Editor of "Industries."

Sir,—The deep feeling of interest I have in the prosperity of the steam using public, and the very serious fear I have of that prosperity being injured and its continued progress hampered by useless, foolish, and uncalled for restrictions, induced me to write you my first letter on this subject, and I do not feel inclined to be led away from the real question at issue by any expressions from Mr. Powis Bale personal to myself. If I am astray in my statements, I will thank him or any other person who will be good enough to set me right; but I expect that the particular statement objected to will be pointed out and proved to be wrong—mere assertions such as contained in Mr. Powis Bale's letter I do not propose to notice. I rely on my facts to speak for themselves without any testimonal from myself as to the length of my experience "amongst boilers" or what schemes I have hitherto advocated, and if they will not do this my advocacy will, I fear, do little to aid their force. I am not the author of a book, but yet all my particulars are taken from the best and most accurate sources bearing upon the subject; such, for example, as the preliminary reports of the Board of Trade officials and the Bill introduced last year. I have quoted verbatim from these in my former letters. But enough by way of explanation, and I am sorry to have been so far diverted from my path, as I want, if it is at all possible, to keep this question entirely free from unnecessary writing.

It is correct that "inspections under the new Act need not be made by the Board of Trade officials themselves," and Clause 8, paragraph 2, is correctly quoted by Mr. Powis Bale, but it is quite misleading to say "that this practically leaves the inspection of steam boilers as it is at present, viz., in the hands of the various boiler inspecting associations," or that it is the intention of the Bill and its promoters that it should be so, as paragraph 3 of the same clause goes on to say: "The Board of Trade, when *satisfied* that in any place in the United Kingdom there is no adequate provision *by any approved boiler inspection society* for the proper survey of boilers under this Act, may from time to time appoint competent surveyors of boilers under this Act, for the purpose of inspecting boilers in that place." It is, therefore, left entirely in the hands of the Board of Trade officials at any time to set down in any part of the kingdom their own inspectors; and what their feeling is in regard to the present boiler inspecting societies, and the probability of their harmoniously working with them, may be gathered by reading those preliminary reports upon explosions of boilers where these societies have been interested. According to Lord Stanley, in his speech made in proposing the second reading of the Boiler Registry and Inspection Bill in the House of Lords, 70,000 of the 150,000 boilers in this kingdom are under the inspection of these societies, and deducting say 5000 as being under the care of the only inspecting association not called an insurance company—which is a greater number than is enrolled in this association—would leave 65,000 boilers coming under the inspection of various boiler insurance companies.

The Assistant Secretary of the Board of Trade, in his report upon the working of the Boiler Explosions Act, 1882, up to 30th June, 1886, states that "inspection by insurance companies does not prevent explosions." If that is a truthful statement, it must follow that it would be requisite "to appoint competent surveyors of boilers" wherever these boiler insurance companies now work, as their inspection could scarcely "be approved" if it fails in the very object for which the proposed Bill is professedly being thrust upon the steam users of this kingdom, viz., "to prevent explosions."

As I have already said, some impression of the feeling of the Board of Trade officials towards the boiler insurance companies may be gathered by a perusal of the preliminary reports written by the Board of Trade inspectors. Of these 243 have been issued to date; and according to the inspectors' statements, 35 relate to the explosion of boilers, kiers, and other vessels and appliances connected therewith, which were under the care of boiler inspecting societies. A thorough analysis of these cases has already been made, and published by the chief engineer of one of the boiler insurance companies, from which it appears that four of these reports (Nos. 68, 89, 145, and 151) refer to the Manchester Steam Users' Association, the one society already referred to which professes that it does not insure boilers, and, consequently, although I must confess I do not at all see why, as four explosions are placed to their credit or discredit, do not come within the Assistant Secretary's unfounded charge. Of the remaining thirty-one cases, it will be found on examination that seven (Nos. 10, 64, 78, 96, 141, and 153) were not boiler explosions at all. Twelve cases reported upon will be found due to causes entirely beyond the control of the boiler insurance companies' inspectors, viz., those given in reports Nos. 29, 39, 41, 56, 60, 79, 93, 104, 105, 134, 159. and 184. Eight other cases—Nos. 25, 35, 90, 94, 116, 118, 140, and 160—could have been avoided if the influence of the boiler insurance company had been sufficient to command attention, and their suggestions had been carried out. No. 83 was reported by the Board of Trade inspector to have been caused by sudden admission of steam into a kier and the corroded state of the bolts of the cover. Of the remaining three cases, Nos. 13 and 23 possibly may, in some degree, have been due to want of sufficient care on the part of the inspector, but it was not proved that such had been the case. Finally, the cases reported under the preliminary reports Nos. 58 and 92 were not under the inspection of any boiler inspecting societies of any kind. In the case of No. 58 the boiler had been proposed to a boiler insurance company, but declined; in that of No. 90, the insurance had lapsed two years previous to the explosion.

If the Board of Trade officials were acting impartially, and were really intending that the boiler inspection of this kingdom should remain in the hands of all the boiler inspecting societies, would the Assistant Secretary to the Board of Trade go out of his way in his report to make this most injurious attack upon boiler insurance companies? This attack appears to be entirely inexcusable, as the Board of Trade inspectors had all the particulars before them, and were well aware that the boilers were not under the care of the insurance companies. Still the Assistant Secretary repeats the charge in his report which is written long after the explosions, and with the real facts before him.

Although the attention of the Board of Trade officials has been drawn to the fact that Nos. 58 and 92 were not under the inspection of any boiler insurance company, and the facts of both cases brought within their knowledge, no admission of error, or apology for the wrong done, has, so far as I can gather, yet been made.

It will no doubt be admitted by thinking men that the facts of the case, as here described, are ample to show the disposition of the Board of Trade, and the extreme improbability of the long continued existence of boiler insurance companies should the Boiler Registry and Inspection Bill unfortunately become law. "Inspection by insurance companies does not prevent explosions," says the Assistant Secretary to the Board of Trade, after five years' experience. Could the Board of Trade stultify itself by appointing boiler insurance companies to survey boilers after such a conclusion? Again, it must not be overlooked that, even were it possible that the Board of Trade lion and the boiler insurance companies' lamb would lie down together peacefully (or, say, with the lamb inside the lion), the position of the steam using public would not be one whit the better—the same rules, regulations, and restrictions would be enforced, otherwise the boiler insurance companies would not be "approved." The boiler insurance companies or inspecting societies would merely become tools in the hands of the Board of Trade officials, and mere mechanical executors of their will. It is further assumed by Mr. Powis Bale that I should "probably not deny that *thousands of boilers are in use that ought to have been on the scrap heap years ago.*" If that is intended to mean that thousands of boilers are in use that are not safe to work, or in any way dangerous either to limb or life, I do most emphatically deny it; but if it is merely intended to convey a fact which has no relation or interest to us with regard to the question before us—that there are thousands of boilers which for motives of economy or superiority in working might be replaced with advantage, I should admit it cheerfully.

The question of certificating attendants is not before us, and can be dealt with at the proper time.

Compulsory inspection of steam boilers is at present in force in America, France, Germany, and Switzerland; but the returns of boiler explosions show that the number of explosions exceed those in this kingdom both in number and fatality. I need not at this juncture enter into this part of the question, but will merely remark that the old fable of the fox that had lost his tail does not appear to be fully appreciated by some persons even yet; those who are acquainted with the working of boiler legislation in America will appreciate my allusion. My contention is that no case has been made out for compulsory inspection by the Board of Trade officials; that no further legislative interference is necessary; that the present Boiler Explosions Act of 1882 is ample for the work required, and the result of the last four years' experience has shown most conclusively that all that is needed is to put its provisions in force, and that explosions (except those due to inevitable accident) will cease to occur.

Yours, &c.,

Manchester, 18th February, 1888. Economiser.

PROPOSED LEGISLATION FOR STEAM BOILERS.

To the Editor of "Industries."

Sir,—I have read with much pleasure your able article on this subject in your last week's issue, also the very able letter of your correspondent "Economiser," and with your kind permission I would like to say a few words on the same subject. The first question to be considered is, do we, or do we not, stand in need of further legislation? Up to the present there would seem to be a feeling that we do, while the members of a very representative association, viz., the Oldham Chamber of Commerce, have voted almost unanimously that we do not. On the other hand, another equally representative body, the Blackburn Chamber of Commerce, can see no objection to the proposed Bill, beyond that the cost of working is not very clearly stated. No doubt the Blackburn Chamber can see no objection to a Bill to enforce that which they have voluntarily adopted with great advantage to themselves, viz., independent inspection by those who have made boiler keeping a specialty; consequently boilers in their district are well kept, economically

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worked, and practically free from explosion. The Oldham Chamber, however, observe everything that is bad in the proposed Bill; but why the members view it in such an evil spirit I fail to understand, as my experience of the Oldham district is that, with the exception of perhaps one large firm and a few very small ones, the shoe is not at all likely to pinch steam users, because the Oldham boiler owners generally have voluntarily adopted the course the Bill seeks to enforce, and had any other gentleman occupied the chair the result might have been different. The chairman seems to have had a dread—quite unfounded, in my opinion—of the Bill creating a vast trades union of certified boiler attendants, which would of course be a tender string to play upon in the presence of a body of employers. The Bill, however, proposes nothing of the kind. It is time, I think, that something was done for the public safety, either by more effectually applying the present law, or amending the same. The unscrupulous cannot be allowed to go on for ever holding the lives of the public in their hands, and by simply pleading ignorance escape justice, as has been done in scores of cases since the passing of the Act of 1882.

In your article you mention the fact that in Section VII. of the Act, "the court may order the cost of preliminary inquiry or formal investigation," &c., &c. This is correct according to the Act, a copy of which I have now before me, but nevertheless it is a most misleading clause. In fact it appears to be impossible to carry it out, for Mr. Gray, in his fifth report on the working of the Act, says: "By the terms of the Act a court of formal investigation has power to order costs and expenses of inquiries or investigations;" and further on he says, "but no provision of this kind is made in cases in which only a preliminary inquiry is held." This fully explains what has often been asked, "Who pays the cost?" Mr. Gray tells us that "these have to be borne by the Government, while the person really to blame finds himself exempt from all liability as regards cost." I think there are few of your readers but will admit that some alteration is required here. Your correspondent "Economiser" appears to be one of the very few who peruses the various reports. I hope he may not be as unfortunate as myself, as I have to *buy* mine; and it is buying them, too, for I have them all, and with the exception of the first few reports, I do not hesitate to say that they are the most expensive and most uninstructive literature in my house. Still I get them—partly for amusement, and partly to see how inconsistent a public body can be. "Economiser" refers to the explosion dealt with in report No. 145. I would, however, draw your readers' attention to report No. 79, in which it is stated that a Cornish boiler had a weak flue, and was fed with water of a corrosive nature. The inspector for the insurance company under whose care it then was, advised in December, 1882, "that a ring should be fitted round the centre of the flue to strengthen it." The flue collapsed in March, 1884, at which time we are told in the report that "the boiler was not insured." Mr. Loxdale, of the Board of Trade, who reported that the above advice had been given, remarks: "From the evidence, I find that everything was considered to be in satisfactory condition." And in a few lines further on he states: "I am of opinion that if the boiler had been inspected by some one competent to do so, the defects would easily have been seen, and the explosion prevented." But how does he reconcile this with the fact that the firm had been actually advised to strengthen the very part that had failed? Even Mr. Traill himself says: "The recommendation of the insurance company was not attended to with reference to strengthening the flues." I might here ask, how would the inspector have fared had he neglected to advise the strengthening of the flue?

If anyone would like to investigate a mass of probable perjury and intimidation before an official tribunal, let him take a glance at report No. 129. Here he may see how easy it is for skilled malice to plead ignorance and escape justice.

Up to the present the Act has been carried out by special men rather than by men of special experience, and in many of the cases inquired into, the condition of, or omission of, a fitting that might have caused or prevented the explosion, has not been so much as mentioned. For instance, by referring to report No. 89, we see that the furnace collapsed through shortness of water and consequent overheating, the boiler was fitted with fusible plugs and low water valve, but we are not told that any inquiry was made into their condition. Report No. 184 refers to a similar case, still the low water valve was not mentioned except to show that it was there. In the recent explosion at Tinwell, in Rutlandshire, it was clearly shown that it was a case of shortness of water, still Mr. Woodthorpe does not suggest a fusible plug or low water valve as a preventive in such cases against overheating and collapse.

The latest feature of inconsistency is to be found in report No. 244, just issued. A boiler 31½in. diam. by 7ft. long, with flat ends, had one of them blown out. Mr. Watson, in searching for information, or a parallel case, refers to an experiment carried out by Mr. R. Wilson on a similar boiler, and states: "With the exception of the shell being 1½in. less in diameter, the end was practically identical with that of the exploded boiler when new." . . . . "The end plate gave way at a pressure of 371lb. per square inch." Although the exploded boiler only worked at 30lb. Mr. Traill remarks: "This is a case where the grooving of the end plate was due to working the boiler at a greater pressure than the end was fit for."

These are only a few cases out of many which are given simply to show that whatever is done by way of legislation, the Board of Trade authorities have not as yet shown that knowledge of land boilers and their working, to lay claim to the confidence of the public in the framing of a Bill. What is somewhat singular in this connection is, that to become a Board of Trade surveyor, one must apply young, and have what is thought the very necessary qualification of having been "five years at sea in charge of engines." How this will help the surveyor at a cotton mill or other land boiler explosion, I fail to see; still such is the constitution of the body who would now take over under their control *nearly all* our land boilers. One of your correspondents, who claims an experience of twenty-three years, gives me much surprise when referring to the length of time a boiler can be considered safe. I have nearly lived in boilers and flues for the last twenty years, and have seen some of their worst cases, and studied their worst diseases; still, under ordinary conditions, I should have no hesitation in stating whether or not a boiler was safe for twelve months, or whether it was not safe at all. Unfortunately, whenever the grinding stone is being turned by an unsuspecting philanthropist, there is sure to be some one ready with an axe to grind. The Board of Trade reports show most conclusively that if there is to be legislation at all, it must be for the boiler and not for the man, as we now have far more *skilled malice* than *ignorance*. Taking ignorance and negligence together, they only affect nineteen cases out of 223 explosions, and, strictly, seven of these were outside the control of the attendant, thus reducing the actual number to 5 per cent. But the first question, "Do we need further legislation?" should be settled before criticising too much the present Bill, or deciding who shall frame the next.

Apologising for troubling you with a letter of this length,

Yours, &c.,

Manchester, 18th February, 1888. CHALK LINE.

To the Editor of "Industries."

SIR,—Another attempt to extend the objectionable system of State intervention in the commercial and industrial organisation of the country is likely to be made this year. On the 15th August, last year, on the motion of the President of the Board of Trade, the Boiler Registry and Inspection Bill was read a second time in the House of Lords, and thus in principle at least adopted. It was then withdrawn, but will probably be introduced again this session, after having been considered by a Select Committee of the Upper House.

The Bill is promoted by the permanent officials of the Board of Trade, and, if allowed to become law in its present shape, will place both boiler makers and boiler owners utterly and absolutely at the mercy of the Board by inaugurating a system of inspection and control, the severity and comprehensiveness of which will probably astonish those who have formed their opinions from the Parliamentary intelligence in the daily papers, without a knowledge of the text of the Bill itself. It is to this ignorance of the true character of the Board of Trade's proposals that the absence of any combined and public opposition to the Bill must be attributed. Indeed, the occurrence of such expressions as "The Board of Trade should be assisted by a committee of experts from all the different interests," "Government inspection was not proposed," "It was desired to extend the benefits of the existing inspecting associations," in the reports of Lord Stanley's speech of the 15th August, were so likely to mislead, and convey so entirely false an impression of the real objects of the measure, that some further explanation is required to rouse manufacturers and tradesmen to a true sense of the danger that awaits them. What, then, do these expressions really mean? Take that relating to the appointment of the committee. A manufacturer reading only the newspaper report of Lord Stanley's speech might reasonably conclude that, although the President of the Board of Trade would be the official head of the new system, a really representative committee would be appointed to do the work in framing rules, supervising inspections, and safeguarding the interests of boiler owners; but if he turned to the Bill itself he would soon become aware that the promoters intended themselves to be the sole authority, and had accordingly taken all requisite precautions against being foiled by a committee, or coerced by outside influence. The Bill, in fact, provides (Clause 15 [1]) that the Board of Trade may make, rescind, and vary rules with respect to the mode of survey of boilers, the conditions under which certificates may be issued, the forms to be used, the fees, allowances, and expenses to be paid, and any other matters authorised or directed by the Act to be prescribed. Also (Clause 7 [1]) that, for the purpose of "*advising*" only on any rules for the survey of boilers, the President of the Board of Trade (in reality the permanent officials) *may* (not shall) appoint a committee, each member of which shall be nominated by him for a period of two years (Clause 7 [3]). If the members so nominated are sufficiently subservient they may be re-appointed, but (Clause 7 [3]) if the committee prove recalcitrant it may be packed by the addition of such persons having special knowledge of the construction and use of boilers as the President may select; and finally, to make assurance doubly sure (Clause 7 [5]), the constitution of the committee may be altered indefinitely by an order of the Queen in Council.

Is it uncharitable to conclude that the committee is a solemn sham? got up to hoodwink the public and disarm opponents in the first place, and afterwards to be a scapegoat to bear the odium which the enforcement of the Board's rules, regulations, and changes will inevitably excite. Nor are the statements that "Government inspection was not proposed," and that it was "desired to extend the benefits of the existing inspecting associations," less delusive. The naked truth is told in Clauses 4, 6, and 8, which state that every "boiler," *i.e.*, "every closed vessel which is used for generating steam, or for heating water, or for heating other liquids, or into which steam is admitted for heating, steaming, boiling, or other similar purposes, with all the setting equipment and fittings," used within the United Kingdom, whether on land or afloat; and every boiler used within the territorial waters of the United Kingdom on board of any British ship (with some exceptions to be noticed further on) shall be *registered by an officer of the Board of Trade*, and shall be surveyed once at least in twelve months by a surveyor appointed by any society, company, or body of persons, *whose rules for the time being are approved by the Board of Trade*, or *by a surveyor directly appointed by and removable at the pleasure of the Board of Trade*, and shall not be used without the certificate of such surveyor. Having regard to the provisions of Clause 15, referred to above, it is difficult to see how inspection under these conditions differs from the "Government inspection," which is "not proposed," or how the present employment of societies, companies, and bodies of persons to carry out the rules which the Board may formulate, can be considered as a guarantee that the *status quo* of the existing inspecting associations shall be maintained. On the contrary, the demand for powers to make all rules and regulations, to appoint and dismiss surveyors, to appoint inspectors (a sort of superior surveyor), to fix payments and allowances, to constitute itself sole arbitrator in disputes between owners and surveyors, together with the assumption of the right to forbid the prosecution of anyone for offences against the Act, would seem to show that the Board is aiming at monopoly of inspection, and that as soon as it has appointed and organised the necessary staff, it will make short work of the societies and let loose on boiler owners a swarm of officials, who, whether competent or incompetent, honest or dishonest, courteous or overbearing, will be completely masters of the situation.

The reason of the desire expressed to extend the operations of the existing inspecting associations now becomes apparent. In the extended sense adopted by the Board, there are probably about 500,000 "boilers" to be inspected in twelve months; therefore, even if boilers are laid off with strict impartiality, regardless of the convenience of the owners, at least 1370 must be inspected daily. Well may the Board of Trade propose to delegate the business of inspecting to existing bodies, at least until the latter have evolved a system capable of grappling with the work, and have borne the odium of licking the astonished boiler owners into shape. And what are the reasons alleged for all this fuss? Simply the statements of the Assistant Secretary of the Marine Department of the Board of Trade, that he has discovered that the "term 'accident,' as applied to boiler explosions, is a misnomer," and that he has found that during the last five years the numbers of lives lost from explosions of such "boilers" as would come within the scope of the new Act has averaged thirty per annum. These at least are the reasons put forth by Lord Stanley in his speech. The loss of thirty lives a year is doubtless a serious calamity; but does the Assistant Secretary wish it to be inferred that he has discovered means by which, if he gets the powers he demands, boiler explosions will be entirely prevented, and thirty lives a year now sacrificed will be preserved? If this be true he is to be congratulated, for hitherto it has always been believed that no system of inspection, least of all Government inspection, would entirely prevent explosions. Otherwise his statements cease to have a logical connection with each other, and forfeit the claim to originality, which they possess when taken conjointly. They degenerate, in fact, into the tiresome repetition of a well worn commonplace, followed by an abortive effort to make a mountain from a mole hill, in order to extenuate the unwarrantable plot to foist upon the nation a new department, with additional berths for place seeking officials, in direct opposition to the deliberate opinion of the Select Committee of 1871, and in the absence of any public agitation or demand for such a step.

But even if further legislation were a recognised necessity, the present measure would stand condemned, not only by the objectionable character of its clauses, but by the palpable inconsistency of its promoters. If the principle affirmed by the House of Lords were carried into practice, all boilers should be subject to the Board of Trade; but in Clause 24 of the Bill, we read that this Act shall not apply to the boiler of any ship for the time being classed in Lloyd's registry of shipping, to any boiler belonging to or used exclusively in the service of Her Majesty, to the boilers, stationary as well as locomotive, belonging to any of the railway companies, or to any boiler used exclusively for domestic purposes.

Why should these boilers be excepted? Simply because the promotors knew that to include these would insure the shipwreck of their Bill. Lloyd's Committee had declined their interference, Her Majesty's Navy would not sail under the Assistant Secretary's flag, the railway companies would not be engineered by the Board of Trade surveyors, the public generally would not admit the paternal government official within its doors. The Board's defeat by Lloyd's Committee is instructive. These boilers were originally included in the Bill; but the committee got wind of this, held a meeting, and plainly declared that Board of Trade inspection should not be for them.

Lord Stanley covers the Board's defeat by justifying the exemption on the ground that these boilers are already subject to inspection. If this be a sufficient reason, why were they ever included in the Bill? And why has the Board included the 70,000 boilers which Lord Stanley says are inspected by the various boiler inspection companies, whose inspections the Assistant Secretary himself admits "have in the main been conducted on a satisfactory system?" Why? Because the owners of the latter are private firms or individuals, incapable in their isolation of dangerous resistance. Let, then, isolation and indifference cease; unite in opposition to the Bill before it is too late; declare, with no uncertain voice, that you will not submit to an official despotism, seeking to magnify its own importance and extend its influence at your expense; let the chambers of commerce, your trade associations, and your Parliamentary representatives be your spokesmen. The Select Committee and the House of Commons will listen to them.

Yours, &c.,

20th February, 1888. PRO BONO PUBLICO.

P.S.—Since the above was written I have read the letter from the author of a "Hand Book for Steam Users" in your last issue, in which the opinion is expressed that the Bill practically leaves the inspection of steam boilers as it is at present. It certainly would seem as if he, rather than "Economiser," had misunderstood the import of the Bill.

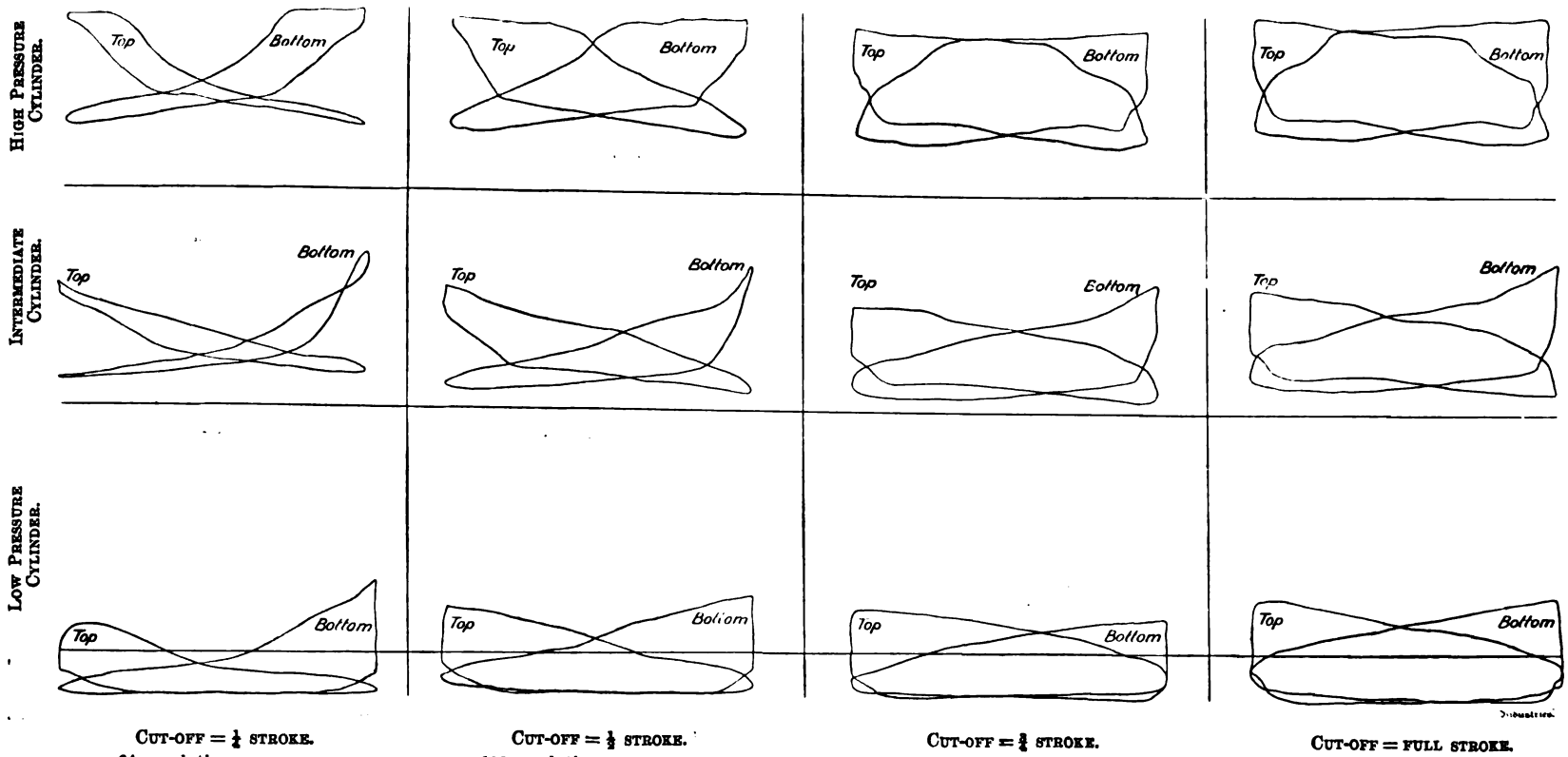
To the Editor of "Industries."

SIR,—I have read with much interest your able leader on the above subject, and your correspondents' letters. It always appears to me that a vast amount of unnecessary labour and, in some cases, failure and annoyance might be avoided if our legislators, and those whom in any particular instance their measures more immediately concern, would condescend to carefully study what has been done in other countries in the same direction, instead of trying to work out *de novo* problems which have been already wholly or partially solved by others. I am well aware that the legislation suited for one nation cannot be advantageously adopted wholesale by another, but must be altered to suit varying conditions. Still this is no excuse for ignoring foreign experience and blundering along blindly in insular self-sufficiency, a course which, it seems to me, we are as a nation too prone to follow. While believing that your correspondent "Economiser" is too sweeping in his condemnation of the proposed legislation, I quite agree with him that to impose any hard and fast rule as regards the factor of safety for boilers would be an irrational and uncalled for proceeding, and would afford no satisfactory guarantee against risk of explosion. While one boiler may be perfectly safe with a factor

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ENGINES OF THE STEAM YACHT "CASSANDRA."

DIAMETER OF CYLINDERS, 9IN., 14IN., AND 22IN.; STROKE, 15IN.



CUT-OFF = ¼ STROKE.
64 revolutions.
140lb. steam pressure.
54lb. pressure in receiver.
15lb. in L.P.
27in. vacuum.

CUT-OFF = ½ STROKE.
100 revolutions.
138lb. steam pressure.
50lb. pressure in receiver.
11lb. in L.P.
28in. vacuum.

CUT-OFF = ¾ STROKE.
124 revolutions.
134lb. steam pressure.
44lb. pressure in receiver.
10lb. in L.P.
27½in. vacuum.

CUT-OFF = FULL STROKE.
136 revolutions.
130lb. steam pressure.
52lb. pressure in receiver.
10½lb. in L.P.
25½in. vacuum.

of 4, another with one of 6 may be a menace to life and property. This depends on the nature and condition of the material of which the boiler is made, as well as on the method of construction and the setting; both the latter are very important items determining the life of a boiler. No factor of safety, however high, and no material, however excellent, will entirely compensate for bad design.

According to the German official regulations, all boilers intended to work with a pressure not exceeding 74lb. per square inch are tested by water to twice this amount, and in all other cases to a pressure exceeding that at which they are to be used by five atmospheres. When thus tested there must be no permanent alteration of form—no set, in fact. For the purpose of measuring the extension, and ascertaining whether any set takes place, an ingenious and simple instrument has been devised by one of the official inspecting engineers. This method, if thoroughly carried out, is, as far as it goes, far preferable and more rational than any arbitrary regulation as regards the factor of safety; it really insures the working stress remaining well within the limit of elasticity, and if the test be repeated at sufficiently short intervals, it undoubtedly gives a very reliable indication of the condition of the boiler. By its use, deterioration of the material, damage to the plates by corrosion, cracking at the rivet holes, grooving and bulging, could all be discovered by the increased or unequal extension and deformation of the boiler, if the investigation were carried out with sufficient thoroughness, in conjunction with a careful inspection. The good or evil results of legislation of the kind in question depend to such a large extent—it would scarcely be an exaggeration to say *entirely*—on the competency of the inspectors. The latter must be men of knowledge, experience, and judgment, which they should be at liberty to use, unimpeded by red tape, to the best of their ability. On the one hand there must be no wooden uniformity of rule applied without regard to circumstances to all boilers alike, on the other no mere perfunctory officialism. I would venture to suggest that instead of the appointment of Government inspectors, inspection by authorised private associations should be made obligatory, and the responsibility for explosions brought home to the latter by heavy fines; the maximum fees to be charged must, of course, be settled officially with regard to the statistics of boiler explosions, so that the occurrence of an accident to a boiler under the care of any inspecting company would very sensibly reduce the profits of the latter. Before, however, any fresh departure in boiler legislation is taken, it certainly seems only reasonable—as you suggest—that the Board of Trade officials should be called upon to make a fuller use of the powers they already possess.

Yours, &c.,
G. R. BODMER.

14, Delahay-street, Westminster,
20th February, 1888.

THE VALVE GEAR ON THE GUNBOAT "CERAM."

TO THE EDITOR OF "INDUSTRIES."

SIR,—I have noticed in your issue of the 20th ult., an illustration of a set of triple expansion engines built for the Dutch Colonial Navy by the Shipbuilding and Engineering Company of Flushing, in which one of the special features was that the three valves were worked by only two sets of valve gear. Will you allow me to draw the attention of your readers to the illustrations and description of a set of triple engines having the same peculiarity, and which appeared in the issue of *Engineering* for 18th February, 1887? For this system of working the three valves of a triple engine by only two sets of valve gear (employing "link" or any other gear), I have patents in England, and such other of the continental countries as I thought would pay for the expense of patenting; and I have already had several sets built on this plan, which have given entire satisfaction. One set now under construction will indicate about 3500 h.p. For Holland I did not take out a patent, so the engines you illustrate do not concern me commercially. Technically they do, however, interest me, as I have found that this system, which I have worked in connection with my ordinary valve gear, gives most satisfactory results. The distribution of steam is exceedingly good, as your readers can see for themselves by the annexed series of diagrams of the engines of the steam yacht "Cassandra," taken at various points of cut-off. It will be seen that throughout the series the middle valve, which depends for its motion on the combined motions of the other two, produces as correct and efficient a distribution of steam as either of them. So far therefore as the action of the gear is concerned, it is quite satisfactory. It also saves a number of parts, and is very simple; but it has the drawback, which no doubt limits its wider adoption, that all three of the engines are not complete and independent in themselves. Though in my arrangement I make each of the outer engines complete by employing my ordinary valve gear, which is naturally in the plane of the valve spindle, the middle one is yet dependent on the other two. In the Dutch engines the whole three mutually depend on their connection through the floating lever, and a failure of any part of this combination would be fatal to the whole, while a similar failure in mine would affect one or at most two only of the cylinders, leaving one to struggle on, but that one perfect.

Yours, &c.,
DAVID JOY.

London, 11th February, 1888.

THE GROWTH OF ELECTRIC LIGHTING IN THE UNITED STATES.

STATISTICS recently published by the New York *Electrical World*, afford a striking example of the rapidity with which new industries are taken up and developed in the United States. We learn from the above source that at the beginning of 1886 there had been established 450 local electric lighting companies, whilst at the present time the number has increased to one thousand. These are companies running central stations for the supply of arc and incandescent lighting to subscribers. The total number of such stations now running in England is probably below twenty. In addition to these stations, there are said to be three thousand isolated plants at work. The total number of arc lamps in use throughout the United States is roughly estimated at 200,000, whilst about 1,250,000 incandescent lamps are nightly in use. The greater part of the arc lighting is done from central stations, whilst the larger share of the incandescent lighting falls to isolated plants. It is estimated that 150,000 arc lamps are supplied from the thousand central stations, whilst only 500,000 incandescent lamps are supplied by them. If we estimate the life of incandescent lamps at one year, the lamp renewals alone would amount to 1,250,000 lamps, representing an annual expenditure of £250,000, in addition to the cost of the current. The charge for an arc lamp varies between £15 and £30 annually, and, taking £20 as a low average, this would represent a gross income to the central stations of £3,000,000.

THE PHOTOGRAPHIC EXHIBITION AT THE CRYSTAL PALACE.

ON Monday, the 20th inst., an Exhibition of Photographs, and of apparatus connected therewith, was opened at the Crystal Palace. The artistic aspects of the Exhibition are not within our province; but in their scientific aspects the pictures may be divided into four great classes, viz.: (1) Silver prints upon albumenised paper, which, although very beautiful, are likely to fade in more or less time; (2) developed silver prints, which are more permanent; (3) carbon prints, in which the colouring matters are in ordinary pigments, so that the pictures are relatively permanent; (4) platinum prints, in which the pigment is platinum black, a substance more durable than the paper on which it is supported, so that such pictures may be taken and preserved for historical purposes; and they have an engraving-like beauty.

As regards apparatus, Messrs. Marion & Co., of Soho Square, London, have amongst their exhibits a new lamp for the production of the magnesium flashing light, for photographic purposes; it consists of two Argand oil burners, through the centre of which a weighed charge of magnesium powder may be blown by means of a pneumatic ball and flexible tube. Another feature at their stall is a kind of cabinet designed by Mr. A. Cowan, which when opened displays a porcelain sink with taps for water supply, shelves with bottles of chemicals, non-actinic lantern, drawers, and all kinds of useful accessories for developing negatives.

Mr. W. W. Rouch, of the Strand, London, has among his exhibits a "detective" camera, simple in its details, and free from the weight of a number of dark slides to hold the plates, which latter are stored close together, and brought successively into position, partly by what is known as Mr. Samuels' plan, and partly by an addition thereto by Mr. Rouch. These cameras are carried under the arm of the operator, who by touching a spring takes pictures instantaneously. In a large tourist's camera, exhibited by Mr. Rouch, the front consists of a wooden cross panel carrying the lens, and of leather, which can be folded, whereby the weight is reduced.

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Messrs. Mawson & Swan, of Newcastle-upon-Tyne, exhibit among other things, a simplified photomicrographic camera, which is a common camera of long range, with a flange adapted to the standard objective screw of the Royal Microscopical Society; two little rods project from the lower part of the flange, and carry a sliding stage, upon which the object to be photographed is placed. The object is then lighted with the usual lamp and condenser.

Messrs. R. & J. Beck, opticians, London, exhibit a detective camera, fitted with a Newman's shutter and an iris diaphragm, which are two useful contrivances in practical work. Among their exhibits is a nickel pocket case, measuring 4in. by 3in. by ¾in., containing three bottles and a measuring glass. The bottles contain solutions concentrated enough to develop sixty quarter-plates; this is designed for the use of tourist photographers, with whom saving of weight is usually a great object

The Paget Dry Plate Company, of London, have a large store of their plates. Mr. B. J. Edwards, of Hackney, London, shows orthochromatic plates, which give colours more in their true monochromatic relation than do other plates. With the latter, yellow may come out black in the positive, and dark blue nearly white; in orthochromatic plates this photographic defect is largely remedied. Two or three years ago Messrs. Braun, of Dornach, were selected to photograph the pictures in the National Gallery, because at that time no English photographer could do the same quality of work; this arose from their not having then fully recognised and studied the various discoveries made on the Continent in orthochromatic photography.

The Dresden Albumenising Company, of Dresden, exhibit samples of their albumenised paper, and of good photographs produced thereupon. Messrs. G. Haughton and Son, of High Holborn, London, exhibit a cabinet washing sink, and a portmanteau, tin lined, in which the camera, accessories, and chemicals can be packed. When empty, it may be used as a developing box, and one half of the tinned interior serves to catch the washing waters and drippings incidental to developing operations.

Mr. J. H. Steward, of the Strand, London, exhibits a new gas regulator for use with the bottles of condensed gases employed for the oxyhydrogen light. It consists of a bellows working against a spring, the tension of which regulates the position of the needle which controls the flow of gas. At our visit, the gas pressure in the bottles was stated to be 120 atmospheres, and the regulator was adjusted to work at the pressure of 12in. of water. Among Mr. Steward's exhibits were two flat rods, or "platforms," with adjusting screws, to be placed in the optical lantern, and to carry two slides of plain glass, with opaque cross lines ruled on each. The object of this arrangement is, that when dissolving views are to be exhibited, the views from the two lanterns shall be accurately placed in relation to each other on the screen, and without some such device the making of the adjustments is a matter of time and difficulty.

Messrs. J. Swift & Son, of Tottenham Court Road, London, exhibit a photomicrographic camera for the difficult work of photographing bacteria and other objects requiring extremely high powers.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

The discussion on the two papers dealing with transformers, which were read before this Society on the 9th inst., was opened at a special meeting on the 16th inst., by Professor Ayrton, who referred to the difficulty of accurately determining the energy developed in a circuit by an alternating current when that circuit contains self induction. In the early days of transformers it was customary to measure the potential difference between the terminals of each coil by a high resistance dynamometer, and the current by a low resistance dynamometer; but this introduced errors from two causes. In the first place, the high resistance dynamometer had itself a considerable self induction, and the current passing was not a true measure of the potential difference which it was intended to measure, and, in the second place, even had this cause of error not existed, the product of potential difference and current so measured would not represent the true work. Other methods must, therefore, be employed, which the speaker subsequently described. He was of opinion that, apart from the lag in the electric circuit, there is a distinct lag in the magnetic circuit, owing to which the magnetisation takes place later than the current which produces it. Having referred to the employment of the electrometer for measurements of alternating potential differences, which was first employed by M. Joubert, and to the improvement upon this method, due to the speaker and Professor Perry, by which the true work in a circuit containing self induction could be found, he stated that this method, although perfect in theory, is only applicable if the law as generally assumed for the electrometer is correct; but, inasmuch as most electrometers do not follow this law, the method is of little practical use, and he preferred to measure the work of an alternating current, not electrically, but by use of a calorimeter. Such measurements were recently carried out by the third-year students at the Central Institute on a transformer which was lent him by the author of the paper. The arrangement was as follows: The transformer was soldered up in a closed metal box, the top of which was provided with a tube, through which projected the four leads for connection respectively to the dynamo circuit and to the lamp circuit, having no self induction. In the tube there was also room for the insertion of a thermometer, by which the interior temperature of the calorimeter could be ascertained. The inner box was placed within another box, and the intervening space was filled with water, a continuous stream being maintained which entered at the bottom and issued at the top. The work done in the secondary circuit could be ascertained by the usual electrical measurements, and that converted into heat in the calorimeter was ascertained by taking the difference of temperature between the inlet and overflow water, and the quantity of water flowing per second after the conditions had become constant. To show how far the old methods of measuring were erroneous, the speaker also inserted in the primary circuit an ordinary wattmeter, a Siemens dynamometer, and a Cardew voltmeter. The wattmeter would of course indicate at a glance the apparent watts, the readings of the Siemens dynamometer and the Cardew voltmeter would, if multiplied, also be an indication of the apparent work, but both these measurements are necessarily too high. The calorimeter gave exactly the energy lost in transformation and converted into heat, and the electrical measuring instruments in the secondary circuit gave exactly the energy flowing through that circuit. By adding the indication of the calorimeter to the energy in the secondary circuit he obtained, therefore, with great accuracy the work supplied to the transformer from the machine. The following table gives some of the figures obtained:—

Measured by wattmeter.	Measured by dynamometer and voltmeter.	Measured by calorimeter.	Energy in secondary circuit.	True energy supplied to primary circuit.
136·9	182·2	53·2	—	53·2
1764·0	1559·0	55·6	1484·0	1539·6
3305·0	3035·0	118·8	2773·0	2921·8

The transformer was nominally of 2 h.p., but the speaker found it quite feasible to work it up to 3 and nearly 4 h.p. without any difficulty, and he thought that the author of the paper in making transformers seems to have followed the custom of agricultural engine makers, who classify their engines by a nominal horse power, which is much below the actual.

The next speaker was Captain Cardew, who explained his safety apparatus by comparing the iron box to a trap for any stray volts leaking out of the primary circuit, and the aluminium foil to the bait. It is important that these foils should be perfectly flat, and for this purpose a supply of spare foils is carried in a gun metal case. When taking one out it must be handled at the end which is to remain in contact with the bottom of the box, so that the other end which lies below the disc and is attracted by it may not be in any way deformed. The speaker showed one foil which had been used several times over, and the only damage it had sustained was the burning out of two small pieces, one at the circumference of the disc, and the other a little way down on the shank. Referring to the question of hysteresis treated by the author, he compared this phenomenon to the molecular friction which takes place in a spring when deflected, and which is quite distinct from the energy stored in the spring. If the spring is alternately deflected to opposite sides the energy required in one movement is given back in the next, but that absorbed by molecular friction which heats the metal is lost. The same distinction must be made in magnetising the core of a transformer. The energy of the magnetic field is given back at each reversal, but that required to overcome hysteresis is lost. He did not approve of the Kent dividing sheet, because of setting up an unnecessary strain in the insulation of the primary circuit. The same objection might be urged against the device of grounding one terminal of the secondary circuit, which was mentioned by Professor Ayrton as a better safety device than either Mr. Kent's or Captain Cardew's appliances. The reason of his objecting to the grounding of one point on the secondary circuit is that the insulation of this circuit is at once lowered, and a strain is set up in the insulation between the primary and secondary circuits.

Mr. Bernstein was of opinion that the series system had many practical advantages over the parallel system of working transformers, not the least of which was that the potential difference between the terminals of the primary coil of each transformer could be kept within fairly low limits, say from 50 to 100 volts. In the parallel system this potential difference is necessarily high, 2000 volts or more, and the difficulties of insulation are correspondingly increased. He objected to the Kent dividing sheet as a safety appliance on account of its leading, so to speak, the primary current into temptation. When about a year ago he showed his contact plug to some of the members, Professor Forbes at once suggested that this would form an excellent safeguard against a leak from the primary to the secondary circuit in a transformer. One side of the plug would be connected to any point of the secondary circuit, and the other would be connected to earth. As long as the potential in the secondary circuit remains within reasonable limits, this circuit would remain insulated from earth; but as soon as the potential increased owing to a leak from the primary circuit, the plug would act and put the secondary circuit to earth, so as to prevent all danger to persons touching it.

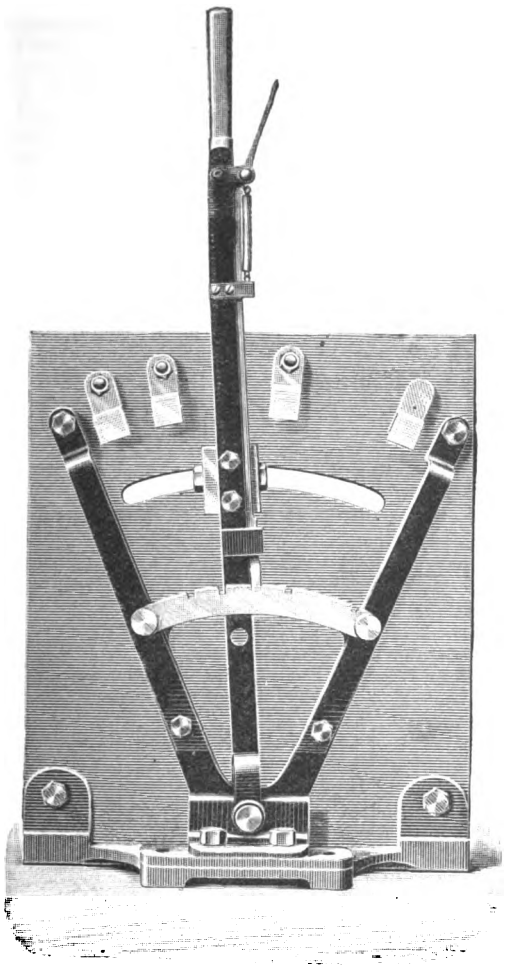
Mr. Atkinson criticised the Kingdon alternate current dynamo, which seemed to be very large for its output, and the arrangement of armature and field cores on the same yoke would probably throw a great strain upon the exciting dynamo, owing to the alternating electromotive force, which must necessarily be set up not only in the armature but also in the field coils. He thought that the advantage of using the armature as the fly wheel of the engine was only a theoretical one. Engine builders are very conservative, and object to the slightest alteration in their designs, and very few would be found willing to take off the fly wheel and put the armature of the Kingdon dynamo on instead. The advantage of being able to alter the coupling up of the armature coils whilst the machine is running is also illusory, since no person could be justified in allowing such work to be done when a high potential is on the wires. In experimental machines such devices are admissible; but now-a-days, when we know exactly what we require in the shape of potential and current, we can build the machine accordingly from the first, and need not make alterations after the machine is started. The adoption of iron in the cores of alternating current machines is certainly an improvement, but care must be taken not to saturate the iron to the same extent as with continuous current machines. The makers of multipolar disc machines have already found out that the core of the armature is much more liable to heat than with cylinder or drum machines, this being due to the more rapid and frequent charge of magnetism. Taking the figures given by the author for hysteresis as his starting point, he made a calculation to find what would be the permissible limit of induction in a sixteen pole alternate current machine running at 600 revolutions per minute, if the heat generated in the armature core is not to exceed that generated in a six pole continuous current machine running at the same speed. Taking fourteen lines (the author's measurement) per square inch in the one case, he found that only nine lines could be allowed in the other case, and this is about the induction in a machine, of which he exhibited a large photograph, and which was designed by Mr. Kapp and made by Messrs. Goolden and Co., of Halifax. The machine gave a current of 30 ampères at a pressure of 2000 volts, the speed being 600 revolutions, and the total weight 2½ tons. The armature is of the disc pattern, made partly of iron ribbon and partly of iron wire, and the copper coils are held in place by gun metal chairs so as to resist the mechanical strain brought upon them by the current. The value of these fastenings has, during a recent test, been demonstrated when the machine was accidentally short circuited pulling up the engine, without, however, moving a single wire on the armature.

Dr. Fleming gave the result of some experiments made at the Inventions Exhibition with two Zipernowski transformers, which were fed from a Ganz self exerting alternate current dynamo, at a potential of about 1000 volts. He and Mr. Zipernowski then used a wattmeter specially constructed for the purpose, the movable coil of which was about 2ft. high, and coupled in series with a non-inductive resistance. The results were, however, not satisfactory. At small loads the efficiency was found very much less than it ought to have been, which was, no doubt, due to the imperfect method of measuring, whilst at high loads the efficiency was probably ascertained with fair accuracy, the maximum being 92·2 per cent. Regarding magnetic lag, the speaker thought that this subject required careful investigation. He had no doubt in his own mind that magnetic lag was a reality, and he suggested to call it magnetic impedence, being a property of the magnetic circuit analogous to impedence on an electric circuit. He thought that experiments should be made to find the permeability curves of iron at different periodicities. He also sketched on the black board a proposed arrangement for interrupting connection between the lamp circuit and the transformer, in case potential difference between the secondary terminals should rise beyond a certain limit. This arrangement consists virtually of a double pole switch, held close by a fuse wire, which is electrically connected to the two mains. On the other side of the switch is a spring, tending to pull it open, and if upon a rise of pressure in the mains the wire fuses, the spring will pull open the switch, and thus interrupt the current at both mains. The discussion was adjourned until the 23rd inst.

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MAIN SWITCH FOR ELECTRIC RAILWAYS.

Our illustration represents a main switch for electric railways, manufactured by the United Electrical Engineering Company, Albert Embankment, London. The great difficulty met with in switches for electric traction work is that of excessive sparking. This is due not only to the large power which has to be transmitted through the switch, but chiefly to the fact that the circuit necessarily has much self induction. When an electric current is used only for lighting, the self induction is comparatively small, and may, in the case of glow lamp installations, be quite negligible. A fairly strong lighting current may therefore be interrupted by a switch of ordinary construction without excessive sparking; but when the current is used to operate an electromotor in which the self induction of the field magnets and armature is considerable, a heavy flash is produced upon breaking the circuit. It is, of course, impossible to entirely avoid sparking with any construction of switch, and the only advantage which the designer of a switch can employ is that of letting the spark be produced in a place where it is not injurious. In other



words, the spark must not be allowed to take place between the working contacts of the switch, but between special sparking pieces which may be easily replaced. Such sparking pieces are now also put on the better class of electric light switches, where they are of metal; but in the switch we illustrate the sparking pieces consist of short and stout carbon pencils. We may mention that, some years ago, Messrs. Siemens introduced a switch designed on the same principle; in this the connection was first broken by the working contacts on the face of the switch, and afterwards between two carbon pencils behind the face. Switches for electric tram cars or railways must be designed to permit of the breaking of a considerably larger current than that nominally required to work the car. When first starting the car, the current is necessarily in excess of its normal value, and if, a few seconds after starting, it should be required to switch off, the switch must be able to break this excess current without being injured. The switch we illustrate is intended to break a current of 200 ampères flowing under a potential difference of 300 volts. The face of the switch board is of slate, set in a cast iron frame about 2ft. by 3ft., and there are five contacts on the face, four of them with terminals at the back, which take the leads to the artificial resistances in the usual way. The switch lever is pivoted at the bottom and provided with a spring catch and segment similar in construction to that used on locomotives. About the middle of the lever there is an insulated piece forming one pole of the switch. This piece is in connection with the metal contact piece behind the lever, but in front of the face of the board, and with a carbon pencil behind the board, the metal stud which carries the carbon holder passing through the segmental slot shown in our illustration. At the back of each of the four contacts is another carbon holder, and the carbons are so set that the carbon on the lever cannot pass them without deflecting each through a certain arc, a spring attachment on each carbon holder being provided to bring it back to the radial position after the lever has passed. By this means the break on the back of the board occurs after the working contacts on the face have already been separated. The switch board is intended to be fixed on the front platform to the right of the driver, so that he may work the lever with his right hand, as is done on locomotives.

COX-WALKER'S TELEMETER.

A telemeter is an apparatus by means of which the slow movement of the revolving hands of any indicating instrument in one place may be reproduced at a distant place by the movement of a similar hand, thus conveying the indications of the primary apparatus to one or more recording dials conveniently situated for inspection. Various instruments of this kind, in which electricity is applied as the transmitting agent, have from time to time been invented; but the difficulty has always been with the contacts. These should be absolute and positive, so as to insure a current of the right strength to be sent to the distant recording dial, and they should also be definite. The number of steps made by the hand on the receiving instrument should be exactly the same, and in the same direction, as those of the hand on the sending instrument, and for this reason it is absolutely necessary to prevent double contacts by jarring or other irregularities in the sending instrument. An ingenious device fulfilling these conditions was brought before the British Association meeting at Manchester last year, by Mr. F. R. Upton. This paper was descriptive of Mr. C. L. Clarke's telemeter system, and a reprint of it will be found in our issue of the 30th September last. Mr. Clarke's system is applicable not only for transmitting the movement of a wheel slowly revolved by mechanical means, but even for transmitting the small movement of the needle of a metallic thermometer, pressure gauge, or other delicate instrument. It has, however, the drawback of being somewhat complicated, and for the transmission of slow movements produced mechanically, the telemeter recently devised by Messrs. Cox-Walker & Co., of Darlington, seems preferable, on account of the greater simplicity and strength of its working parts. This apparatus has been specially designed for recording the water level at the bottom of a mine on a dial placed at the surface, and its construction will be readily understood from our illustration. At any convenient spot at the bottom of the mine is fixed the sending instrument (Fig. 1), consisting of a

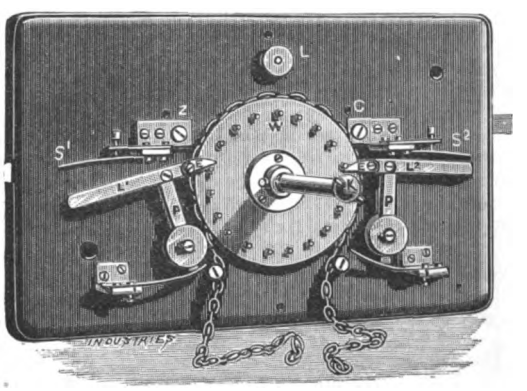


Fig. 1.

chain wheel W with pegs on its face, revolving on a stud set on a board. One end of the chain, which passes round its grooved circumference, is provided with a float, and the other is counterweighted. Where the locality does not admit of this board being fixed vertically over the well, a similar wheel can be fixed in that position, and its axis coupled with that of the wheel W by means of the universal joint K. To the right and left of this wheel W are fixed levers L^1 L^2, having spring catches E at their short ends, and counterweighted arms P at right angles. If the wheel be slowly revolved from left to right, the pegs as they strike the spring catches of the lever L^2 simply depress them, without producing any movement of the lever; but on the left side, when striking the spring catches from underneath, they raise the short end of the lever and deflect the counterweight to the right, as shown, until the pin has passed the end of the catch. The lever, now released, swings back, and its long arm strikes with considerable force the spring S^1, electrically connected to the terminal Z. If the movement is from right to left, the lever L^1 remains at rest, and the lever L^2 is similarly swung back each time that a peg has passed the spring catch, making contact with the spring S^2, which is electrically connected to the terminal C. The springs below the counterweights have no electrical function, and serve merely to steady the back swing of the levers. On the same board is a terminal L, which is electrically connected to both pivots on which the levers oscillate. Near this board is placed an ordinary battery, the zinc pole of which is connected to the terminal marked Z, and the carbon or copper pole to the terminal marked C. The

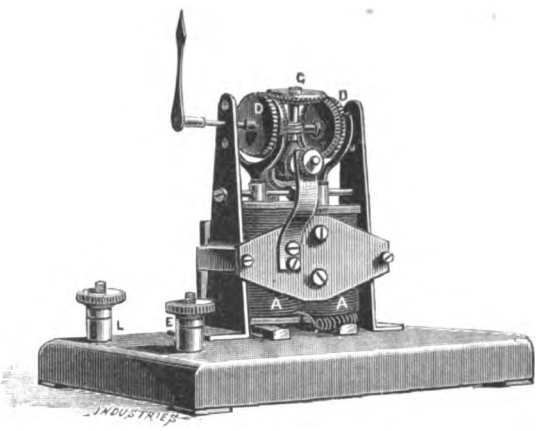


Fig. 2.

centre of the battery is connected to earth. From the terminal L there goes a single line wire to the surface, where it is connected to one terminal of the recording apparatus, which we shall presently describe, whilst the other terminal of this apparatus is connected to earth. It will now be clear that at each contact only half the battery is at work, sending either a negative or positive current to the line, according to which lever has touched its contact spring, and this negative or positive current produces either a forward or backward step on the recording apparatus. Certainty of contact is insured by the

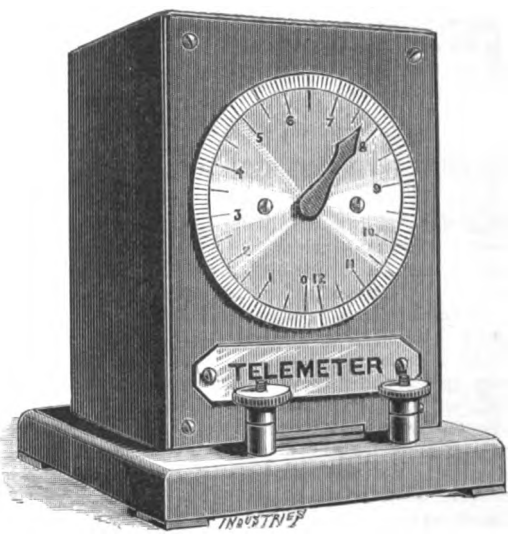


Fig. 3.

energetic movement of the counterweight, and the contact surfaces are kept clean by the slight scraping which takes place at each contact. The receiving instrument is shown in Fig. 2, with the case removed so as to render the mechanism visible, whilst Fig. 3 shows the appearance of the instrument when in actual use. As already mentioned, the line wire is connected to terminal L, whilst terminal E is connected to earth. The current passes through both coils of the electromagnet A A, and imparts movement in one direction or the other (according to its sign) to an armature polarised by means of permanent magnets, which are fixed in the base of the instrument. The armature carries driving anchors, which separately engage with the ratchet wheels D D, having teeth in opposite directions. The cores and anchors are kept permanently in position by means of spiral springs. The ratchet wheels impart movement to bevel wheels, into which gears a third bevel wheel C, forming a combination familiarly known by the name of "jack-in-the-box." The movement of the axis of the wheel C is reproduced by the pointer at the end of the spindle. It will be clear that the pointer only records the differential movement of the ratchet wheels, or, in other words, the algebraic sum of electrical impulses received. Thus, if positive and negative currents alternate, the pointer

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FRIERN BARNET SEWAGE WORKS.

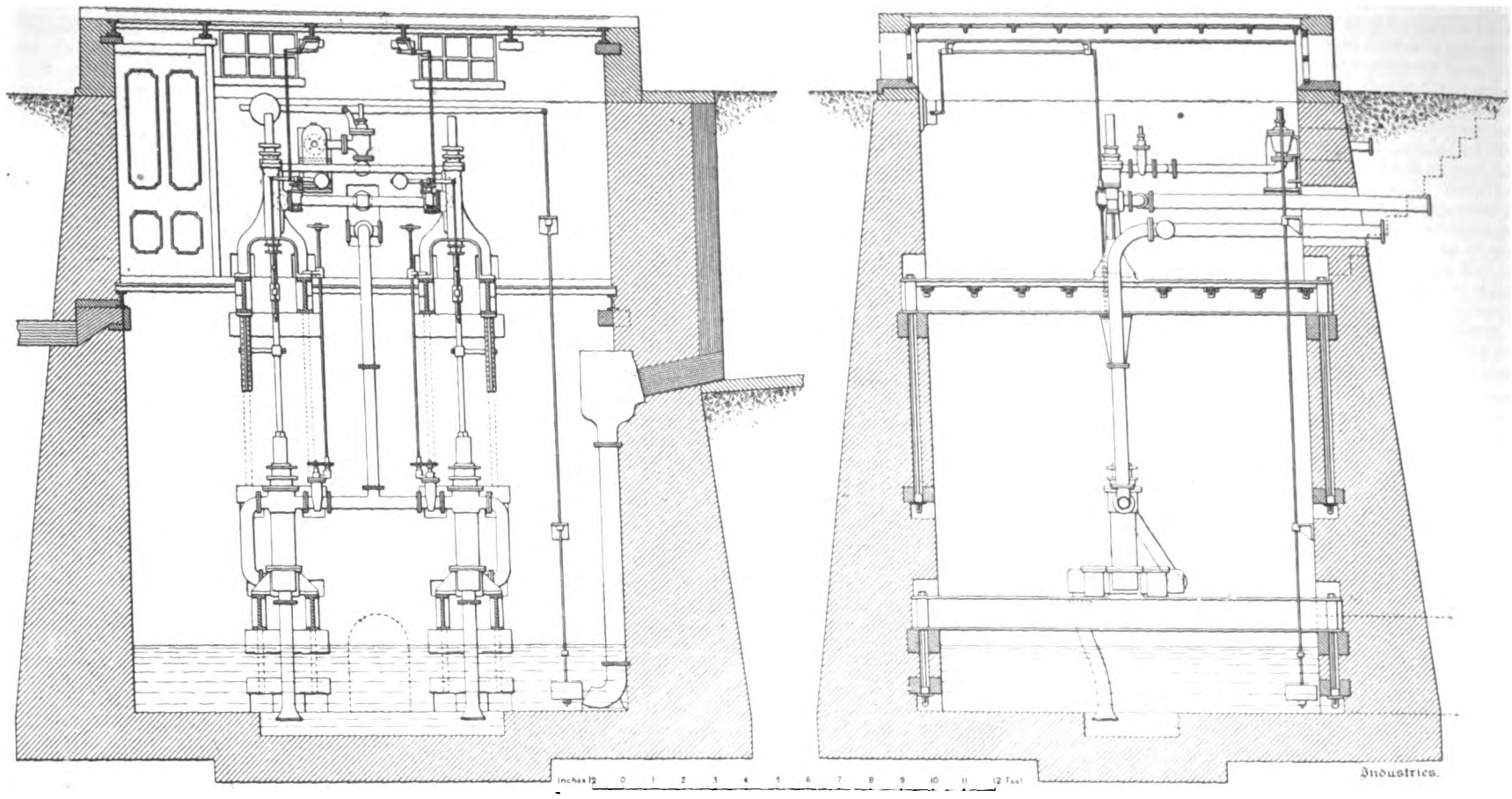


FIG. 1. FIG. 2.

remains at rest; but if one kind predominates over the other, the pointer will move, indicating the difference. By suitably dividing the dial, the recording instrument may thus be made to indicate the level of water in a distant mine, dock, harbour, or reservoir, as the case may be.

FRIERN BARNET SEWAGE WORKS.

WHERE there is no natural and immediate outlet for the sewage into a large river or into the sea, the drainage of small areas and the disposal of the products are problems which have exercised for some time past the powers of Local Boards in all parts of the kingdom. The difficulties of the problem are enhanced when the area to be drained is practically level, or when one part is considerably below the rest, so that continuous suitable gradients cannot be obtained to allow the sewage to gravitate to one main station. In drainage schemes for large areas, main stations can be erected at intervals, and steam engines and pumps employed to raise the sewage from one station to the next. In small areas, however, it would be too costly to employ steam engines and pumps at each station with the necessary staff for working them, and the question therefore arises, how shall the sewage be lifted from one point to another in order that it may gravitate to the central or main station? Such a question had to be decided by the Local Board of Friern Barnet, one of the suburban districts of North London. The Board had to drain 1304 acres which could be done by gravitation to one main station; but the difficulty was how to drain, in addition, low lying area in the Finchley district of 28·5 acres, about a mile distant from the main station. At present about five acres of the low level area are closely built upon, and the lift of sewage without allowing for friction is 47½ft., or with friction about 54ft. from the bottom of the tank at Ely Place to the invert of the high level sewer. Acting under the advice of their engineer, Mr. Baldwin Latham, M.Inst.C.E., the Board decided to employ in the low lying district hydraulic power for pumping the sewage up to the main station. The machinery adopted for this work is in principle the same as that applied by Mr. H. Davey for pumping in mines.

Before describing Mr. Davey's system of water pressure engines and pumps, we will give a brief sketch of the method of treating the sewage at Friern Barnet. As indicated above, the whole of the sewage is ultimately brought to one main station, where the Local Board have purchased about twenty acres of land, at a cost of £300 per acre. The larger portion of this land will be employed for tillage purposes, about two acres is used for filter beds, and another two acres for settling tanks, the buildings for the engines and machinery, and other necessaries for the chemical treatment of the sewage. The sewage is received at the main station in a fairly diluted state, and is conducted to a large revolving sieve or extractor wheel, where the solid parts are separated and fall into a receptacle fixed below the centre of the wheel, from whence they are lifted by an archimedean screw to a height sufficient to allow a trolley to be run under the outlet to catch them. When the trolley is full it is run off on tram lines, and another trolley substituted in its place; sufficient powdered lime is added in the trolley to thoroughly deodorise the solids, which, however, do not amount to much compared with the volume of sewage received. The sieves of the extractor wheel are kept clear from choking by a series of oscillating jets of water acting upon them. The sewage as received is slightly alkaline, and immediately after passing the extractor wheel it is rendered more alkaline by the addition of lime and water previously mixed in a special mixer. The sewage then flows on to a breast wheel, which acts as a most efficient mixer, and at the same time provides motive power for driving the extractor wheel and the distributors of chemicals (the lime already mentioned and sulphate of alumina). The distributors are small horizontal cylinders with a piston working in each, the cylinders and piston being of vulcanite to resist the action of the chemicals, and the connections consist of earthenware cocks and lead piping. The distributors measure out definite quantities of chemicals, lime water on one side of the water wheel, and water and sulphate of alumina on the other. The sewage now rendered neutral flows on at a lower level, through a kind of salmon ladder, by which it is turned about from side to side, and the chemicals are thoroughly mixed with it. It next passes on to the settling tanks (of which there are three), built of brick work, each tank being divided into two by a cross wall. Here the thick sediment settles, and the surface water is drawn off and filters through coke, once downward and once upward, flowing onwards in thin sheets (so as to present as much surface as possible for oxidation) into the channels, which conduct it to four filter beds occupying nearly two acres. Here the effluent is filtered through 6ft. of filtering material, comprising: First, 6in. of soil (a sandy loam); secondly 3ft. of fine ballast and soil; and thirdly, the bottom layer, 2ft. 6in. of rough ballast, consisting of pieces of burnt clay about 1 cub. in. each. The effluent is allowed to stand from two to three days, according to its state, to deposit any sediment that has not been deposited in the settling tanks. It is then permitted to filter through the beds and flow off to a natural stream. The clear and sparkling water flowing over the weir into the stream presents a striking contrast to the same liquid in the settling tanks. On the occasion of our visit the water of the stream below the outfall was decidedly clearer than the same stream a few yards above the outfall. When a glass full of the effluent water flowing into the stream is examined and held up to the light, it is seen to be perfectly clear, and free from the slightest odour, thus proving that the deodorisation has been complete.

To return, however, to the settling tanks. When the surface water is drained away to the extent of two-thirds of the depth of the tank, the remaining sludge is conducted by channels from the bottom of the tanks to a sump just outside the machinery house. We may remark that the tanks slope to the centre, where a semi-circular channel permits the whole tank to be completely emptied. From the sump the sludge is pumped up by two of Murray's chain pumps into a sludge well, where it is mixed with lime. From here it is pumped by three-throw hydraulic pumps (of which there are two sets), at a pressure of 100lb. per square inch, into filter presses, where the liquid is forced out, flowing back to the incoming sewage, to again go through the same cycle of operations, whilst the solid portion is retained in the filter bags in a plastic state. These cakes from the filter presses are sold as manure, or employed upon the land which will be farmed by the Local Board. The filter presses are supplied by Messrs. Johnson & Co., of Stratford, E.

In addition to the machinery mentioned for treating the sewage, there are three mortar mills, one for grinding the lime for the sludge well, one for grinding the lime for the incoming sewage, and the third for grinding the sulphate of alumina. There are also four mixing tanks, two for lime, and two for sulphate of alumina. The machinery is all driven by leather belts from a line of main shafting, which is driven by a pair of 14 h.p. horizontal engines, with expansion valves working on the back of ordinary slide valves. Each engine is capable of working independently of the other. Two Cornish boilers supply steam for the engines. The coke we have referred to as having been used for filtering purposes is burnt in the furnaces of the boilers. The contract for the sewage works has been carried out by Messrs. Thos. Vernon & Co., of Worcester and London, at a cost of £8,000 to £9,000. The buildings are conveniently arranged for the engines, boilers, and machinery, and the whole forms one of the most compact works we have seen.

The special novelty at Friern Barnet is the application of Mr. H. Davey's system of pumping at a distance from the motive power, by means of hydraulic pressure derived from an accumulator at the main station; the starting

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and stopping of the pumps being automatic, thereby dispensing with the services of an attendant. The illustrations give two views of these automatic hydraulic pumps, from the design of Mr. H. Davey. They have been fixed at Friern Barnet for raising the sewage of the low level district to the main disinfecting station already described. The pumps are fixed in a well, into which the sewage flows by gravitation through the culvert shown dotted in Fig. 1. The surface water of the immediate neighbourhood drains into the same well by the pipe shown on the right of the figure. Fig. 2 is a section at right angles to Fig. 1, showing another elevation of the engines and pumps. As will be seen, the well is divided into two storeys by a floor carried upon iron girders. The water pressure engines are fixed at the level of the floor upon strong cast iron girders, built at the ends into the masonry forming the sides of the chamber, and placed directly below the water pressure engines are the pumps which lift the sewage. These pumps are also bolted to strong cast iron girders built into the walls of the chamber, both sets of girders being anchored securely by holding down bolts as shown. The pumps are automatically started by the float shown. When the sewage rises in the well above a certain level, the float is lifted, and, acting through a connecting rod, lifts one end of a starting lever, to which the main valve is attached. Directly the valve is lifted, water, at a pressure of 300lb. per square inch, is admitted to the water pressure engines through the top row of pipes, and the engines start. The pumps, which are connected to the piston rods, begin to lift, and continue working until the sewage falls below the starting level. The second or middle row of horizontal pipes takes off the exhaust water from the engines, which is discharged into a flushing tank at a distance, and employed for flushing the sewers automatically by means of a syphon. This arrangement saves the Local Board the cost of purchasing water from the water works at a cost of 1s. 3d. per 1000 gallons. The water used for working the water pressure engines is the effluent from the filter beds. The lower line of pipes is the rising main common to both pumps, and which conducts the sewage to the main station. Each engine and pump is capable of being worked singly, or they can work together, suitable valve arrangements being provided for this purpose. The pumps are double acting, of the ram and piston type, the ram being 5¾in. diam., and the piston 8in. diam. The water pressure cylinder is 3¾in. diam.; but the area upon which the pressure acts is reduced by a rod or ram passing through a stuffing box 3in. diam. on the top, and a piston rod 1¾in. diam. on the bottom, the extra total pressure on the upward stroke being required for lifting the weight of the moving parts. The stroke of both engines and pumps is 18in. The small rods and levers seen at the top are provided for driving indicators recording the number of strokes made by the engines. Each pump, when working at ten strokes per minute, lifts 100,000 gallons per day. The chamber is mostly underground, the roof being but a few feet above the ground level, and access is obtained to the machinery by a flight of steps shown in dotted lines in Fig. 2. The accumulator at the main station has a ram 12in. diam. by 6ft. stroke, and is lifted by a pair of pressure pumps driven by belts from the main line of shafting, each pump being independent of the other. When the accumulator rises to its full height it strikes a tappet and lifts a relief valve, thus stopping the action of the pumps, and notifying to the engine attendant that the pumps may be thrown off. The whole arrangement of the hydraulic gear has been well thought out, and it does its work efficiently. At the recent visit of the Margate Corporation, referred to in our impression of the 23rd December last, at which we were present, the machinery performed its work in a satisfactory manner.

DUTY FREE ALCOHOL.

At a recent meeting of the Society of Chemical Industry in Edinburgh, Mr. Dott drew attention to the serious disadvantages under which the British chemical manufacturer labours in not being able to obtain duty free alcohol, as in other countries. Not only pharmacists, but many manufacturing chemists require alcohol of pure quality for the successful production of many important preparations; and it has been found that methylated spirit fails in many respects to meet the wants of the chemical manufacturer. We some time ago referred to this question (see *Industries*, Vol. II., page 92). The preparation of most of the alkaloids, of chloral, chloroform, salicylic acid, and pharmaceutical tinctures cannot be undertaken in this country except at a considerable loss to the manufacturer, and consequently most of these and many other fine chemicals are imported into this country. The recent regulation of the Inland Revenue Board restricting the purchase of methylated spirit for use in any manufacture or industry from a licensed maker of the spirit, makes it still more difficult for manufacturers to obtain the substitute for absolute spirit, which they have hitherto been compelled to use. Efforts have been made within the last few months by a committee of the chemical section of the London Chamber of Commerce to induce the Excise to make certain concessions in the spirit duty to those who employ it for such manufacturing purposes. We understand that although British made tinctures are in general use in this country, few are exported, as the English manufacturer finds that he can buy in Hamburg and elsewhere abroad similar preparations which have been manufactured from duty free spirit, and exports them to our own colonies in the place of those which are made in this country. The committee referred to have been endeavouring to obtain a drawback on tinctures and other preparations in which alcohol forms an important constituent exported in bottles from this country, and we hope that the Revenue authorities will see their way to grant this concession. Even should this be granted, the British manufacturers will still be handicapped as compared with those on the Continent, as there is always a certain loss of spirit in the manufacture, and, therefore, a loss of duty, which cannot be recovered in the drawback. Mr. Dott, in his paper before the Society of Chemical Industry, suggested that the manufacture of chemicals in which alcohol is employed, should be conducted "in bond," and we hope that some such plan as this may be finally adopted. In Germany the Revenue authorities give special permission to manufacturers, and these exceptions have been found not to affect the revenue in any way, while at the same time it has given considerable encouragement to the development of new manufactures. The comparatively important industry of the manufacture of coal tar colours, of new febrifuges and antiseptics, is consequently almost entirely in the hands of the Germans. Fulminating mercury, to take another example, is not made to any large extent in this country, whereas on the Continent the manufacturers of this substance are allowed to use absolute alcohol to which a small quantity of turpentine or bone oil has been added, instead of the ordinary methylated alcohol or duty paid spirit. In the new German spirit law alcohol for use in medicinal and scientific purposes was declared exempt from its principal clauses, and remained free from the increase of duty until special concessions, such as those we have alluded to, could be made. In America, before the law relating to the use and manufacture of methylated spirit was passed, similar disadvantages were experienced by manufacturers; but their representations were not sufficient to cause the authorities to allow them the same privileges as have been obtained in Germany. The importance to this country of being able to compete with foreign countries in the manufacture of new chemical preparations is so obvious, that we are sure that the Inland Revenue will be willing to come to a satisfactory arrangement with the committee of the London Chamber of Commerce on this subject; and we hope that at the same time the question of the use of duty free alcohol by other manufacturers, and in institutions where chemistry is taught, or where scientific investigations are being conducted, will be considered, and that the proposals that these manufactures should be allowed to be carried on in bond will be acceded to.

Notes.

MINING IN SYRIA.

The mining interests of Syria are wholly neglected, and the United States Consul at Beyrout states that no exploration is being made of the iron, coal, lead, copper, or silver deposits which exist in that country. The bitumen mines in the Hasbeya district, which were very profitable for a number of years, have been abandoned, the contract with the Turkish Government having expired and the immediate supply being apparently exhausted. In the Latakia district a mine producing chromium has been opened up.

MINING IN COLOMBIA.

In the course of a general report upon the resources of the United States of Colombia, Consul Dickson, of Bogota, points out that this republic possesses rich mines of gold, silver, iron, copper, and lead. The total value of the precious metals produced in Colombia since its conquest by the Spaniards in the sixteenth century is estimated at £130,000,000. The production of gold from the beginning of the century up to 1884 amounted to £42,200,000, and of silver to £3,000,000. In almost every part of the country alluvial gold is to be found, and a circular issued by the Colombian Minister for Foreign Affairs states that foreigners can acquire mines on the same conditions as natives. It is therefore not unlikely, in view of the favour with which mining speculations are at the present looked upon by the investing public, that attention will be directed to this portion of South America by mining company promoters.

BELGIAN COMPETITION IN TURKEY.

Consul-General Blunt, of Salonica, in his report on the trade of that port during 1886, which has been delayed owing to his ill health, states that the total value of British goods imported was about £510,000, a falling off of £90,000, partly caused by low prices and partly by Belgian competition. He states that Belgian manufacturers continue to make headway at Salonica and the interior, owing to their cheapness and to the long credits allowed to the importers by Belgian firms; and that most of the metal goods, such as rails and railway fittings, girders and cast pipes, which used to be obtained from Great Britain, now come from Belgium.

FOREIGN PRODUCTION OF IRON AND STEEL.

At a meeting recently held in Glasgow for the reform of our fiscal system, Mr. Neilson, of Mossend, quoted some figures to show the relative production of iron and steel in Britain and foreign countries, which will be of interest to some of our readers. We therefore give some of them, although we do not express an opinion in the meantime on the deductions which were made from them. Taking first the production of pig iron during the past ten years, we find that in America, with its tariff of 28s. per ton, the production had been raised from 2,066,549 tons in 1877 to 5,075,485 tons in 1886, or an increase of 3,008,891 tons, equal to an increase of 145·59 per cent. Germany, with its tariff of 10s., in 1877 produced 1,421,667 tons, and in 1886 3,339,803 tons, or an increase of 1,918,136 tons, equal to 134·92 per cent. Belgium, with its tariff of 4s., in 1877 produced 470,888 tons, and in 1886 697,110 tons, an increase of 226,222 tons, equal to 48·04 per cent. Austria-Hungary, with its tariff of 8s. 9d., in 1877 produced 409,000 tons, and in 1886 620,000 tons, or an increase of 211,000 tons, equal to 51·59 per cent. Great Britain in 1877 produced 6,608,664 tons, and in 1886 6,870,665 tons, an increase of 262,001 tons, equal to 3·96 per cent. Thus the United States shows an increase of 145·59 per cent., Germany 134·92 per cent., Austria-Hungary 51·59 per cent., Belgium 48·04 per cent., and Great Britain 3·96 per cent. In Bessemer steel the United States produced 500,524 tons in 1877, while in 1886 they produced 2,026,062 tons, an increase of 1,525,538 tons, equal to 304·78 per cent. Germany in 1877 produced 391,110 tons, and in 1886 1,185,000 tons, an increase of 793,890 tons, equal to 202·98 per cent. Russia in 1877 produced 40,000 tons, and in 1886 270,000 tons, an increase of 230,000 tons, equal to 575 per cent. Great Britain in 1877 produced 750,000 tons, and in 1886 1,570,256 tons, an increase of 820,529 tons, equal to 109·43 per cent.

BRITISH FOREIGN TRADE.

A short time ago, Mr. J. W. Wells, C.E., in an address before the London Chamber of Commerce, took a very gloomy view of British trade, and showed by statistics that while our industries are decaying, those of foreign countries are on the increase, and some of the examples he quoted were striking enough. For instance, when railways were first laid down in South America, every railroad in Brazil, as elsewhere, was British throughout—capital, engineers, contractors, materials, rolling stock, and general principles of administration, were all British; and now one hears of a Brazilian railway built by Brazilian engineers and contractors, paid for with Brazilian capital; the locomotives and iron bridge work supplied by Americans, the cars by Germans, the rails by Belgians, the workshop machinery by French, and nothing English in the whole of the line. The Americans secured the order for locomotives and iron bridge work, not because they were less expensive than English work, but because they were of a type and character best adapted to the necessities of an economical railway in a semi-wild country. The Germans obtained the orders for the cars because they had adopted the American type, and turned them out at a less price than the Americans asked; while the rails and shop machinery were bought from France and Belgium because these goods were pushed by agents from those countries in a land where British manufacturers are practically unrepresented. The report of the British Vice-Consul at Venice refers to the energetic and successful competition of the German and French manufacturers with British exporters. British goods which were once in great demand, have been supplemented by German and French articles, and the Vice-Consul gives as the chief causes of this, the cheapness of French and German goods, which, although of much inferior quality, bear a certain appearance of being as good as the English; and further, that the French and Germans employ active commercial travellers, through whom they are accurately informed of the wants of buyers, and are prompt to adapt their supply to the nature of the demand; and finally, the long credit, generally three or six months, which is given by Continental exporters. It is so far satisfactory, however, to know that British goods still enjoy a high reputation for their workmanship and lasting qualities, and would certainly be given the preference by the buyers but for the great difference of price.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

10th February, 1888.

2008. Morris, H. ..... Railway signalling.
2011. Ashworth & Ashworth Carding engine.
2015. Hannay, J. B. ..... Signalling apparatus.
2016. Rankine, J., & others... Plates for furnaces.
2017. Gaskell, J. ..... Cranes.
2018. Bothams, J. C. ..... Armour for vessels of war.
2022. Frew, J. ..... Automatically preventing over-winding.
2024. Tordoff, J. H. ..... Furnace tubes.
2027. Harrison & Gilson..... Cartridge loading machinery.
2034. Cotsworth, G. G. ..... Pulleys and drums.
2038. Buchanan, A. ..... Punching apertures in plates.
2047. Watson, J. ..... Horticultural boilers.
2050. Lawrence, J. P. ..... Refrigerating apparatus.
2055. Jolibois & Bonsor..... Boiler furnaces.
2061. Long, H. S. ..... Knitting machines.
2062. Tolhurst & Oddie..... Furnaces.
2064. Kapteyn, A. P. ..... Automatic brake.
2065. Harston, C. G. ..... Cartridge magazines.
2068. Thatcher & Ritchie... Machinery for making envelopes.

11th February, 1888.

2074. Hollingworth, E..... Jacquard mechanism of looms (*Hutchins.*)
2075. Sauvée, A. ..... Carriage for quick-firing guns (*Canet*).
2076. Hearfield, J. W. ..... Friction pulleys.
2078. Schofield, W. ..... Boiler furnaces.
2080. Robinson, J., & others Rotary engines.
2081. Hill & Hill..... Saw sharpening machine.
2082. Baharie, J. T. ..... Lifeboat.
2083. Perrin, J. ..... Veneering felt hats.
2088. Gilchrist, J. G. ..... Dynamometers.
2089. Williams & Williams.. Automatic steam dryer.
2090. Gibson, J. ..... Obtaining power from railway trains.
2094. Cockshott & Jowett... Shaft couplings.
2100. Hutchison, J. ..... Type writing machines.
2106. Killin & Masson ..... Paper making.
2112. Appleby, H. ..... Blast pipes.
2114. Katz, R. ..... Double engine ploughing.
2116. Raworth, J. S. ..... Shaft couplings.
2117. Carson, J. ..... Seeding machine.
2118. Bayrer, W. J. ..... Shears for metal.
2121. Barter, A. ..... Coupling railway waggons.
2123. Dietz, H. ..... Pneumatic separator.
2124. Hodgkin & Hodgkin ... Steam and vacuum pumps.
2127. Aldridge, C. H. ..... Knitting machines.
2129. Heucke, A. ..... Ploughs.

13th February, 1888.

2132. Blacker, G. ..... Apparatus for raising water.
2133. Sturgeon, J. ..... Hydraulic hoists.
2134. Urquhart, W. W., and others ..... Cloth finishing machines.
2136. Woodward, E. M. ..... Running rolling stock from broad to narrow gauge.
2143. Hollingworth, E..... Jacquard mechanism in looms.
2145. Smith, W. R. W. ..... Consuming smoke.
2146. Flather, A. ..... Jacquard machines.
2148. Blamires, T. H. ..... Carding engines.
2149. McInnes, T. S., & others Engine indicators.
2150. McInnes, T. S. ..... Testing spiral springs.
2154. Martin, M., & others... Dressing hides.
2158. Moore & Wallwork... Manufacture of hats.
2165. Marshall, J. ..... Thrashing machines.
2166. Pieper, H. ..... Repeating fire arms.
2168. Worrall & Lawrence. Finishing cut pile fabrics.
2169. Gass, W. G. ..... Winding yarns or thread.
2172. Penrice, H. N. ..... Rock tunnelling.
2173. Aldridge, C. H. ..... Knitting machinery.
2175. Justice, P. M. ..... Spinning machines (*Metcalf*).
2176. Hill, J., & others ..... Railway signal apparatus. (Received 13th February, 1888. Ante-dated 25th January, 1888, under International Convention.)

14th February, 1888.

2184. Story, E. ..... Manufacture of glass.
2185. Askew, A. J. ..... Wringing & mangling machines.
2189. Williams, T. ..... Sewing machines.
2201. Kiddie, A. W. ..... Propulsion of small boats.
2203. Evans, R. ..... Cartridge chargers for machine guns.
2204. Simpson & Porter ..... Excavators.
2205. Pickles, J. ..... Looms.
2208. Scott, J. ..... Manufacture of paper.
2209. Smith & Fishwick ..... Looms.
2215. Newall, G. W. ..... Steam engines.
2216. Moyer & Youlls..... Car axle boxes.
2232. Wells & Pallett ..... Hot air motors.
2233. Downing, G. ..... Manufacturing buttons (*Scherding & Ruger.*)
2237. Logan, W. P. ..... Post anchors.
2238. Snelgrove, W. ..... Weighing machines.
2243. Claret, J. ..... Liquid meters.
2244. Essington, H. M..... Sewing machines.
2245. Husberg, N. G. K. ..... Propelling mechanism for vessels.
2247. Larivière, J. ..... Copper plate printing machines.
2249. Tuck, N. L. ..... Block printing oil cloths.
2252. Imray, O. ..... Duplex pumps (*Dow*).
2255. Martin, G. ..... Carding machinery.

15th February, 1888.

2265. Tweedale, S. ..... Carding engines.
2266. Platt & Fidler ..... Grinding the "flats" of carding engines.
2267. Smith, W. ..... Copying lathes.
2268-9. Crighton, J., & others. Fans for exhausting and propelling air.
2270. Burton, S. ..... Mules.
2271. Bleasdale & Hargraves ..... Steam engines.
2278. Schmidt, W. ..... Boiler feeding apparatus.
2279. Elliott, G. W. ..... Boring machines.
2281. Forknall, T. ..... Carding engines.
2283. Liversidge, H. ..... Steam engines.
2286. Bee, T. ..... Thrashing machines.
2294. Webley, T. W. ..... Ejector fire arms.
2295. Hunt, T. ..... Screw cutting rods.
2301. Muncaster, H. ..... Expansion gear.
2312. Vavasseur, J. ..... Moving guns on board ship.

16th February, 1888.

2321. Eke, R. J. ..... Spinning fibres.
2339. Fawcett, T. C. ..... Pressing woven fabrics.
2340. Mason, S. ..... Stone breaking machines.
2342. Henderson, C. J. ..... Boilers.
2343. Harding, T. W. ..... Reels for holding pile fabrics.
2346. Batley, J. F. ..... Shuttles for looms.
2349. Booth, J. ..... Thread winding machines.
2355. Norris, T. ..... Manufacture of spades.
2358. Simmins, S. ..... Railway rails.

ELECTRICITY.

10th February, 1888.

2002. Thorp, T. ..... New electrical tool.
2073. Iwanowski, A. C. ..... Electric alarm.

11th February, 1888.

2125. Rowbotham, W. ..... Arc lamps.
2130. Muirhead, A. ..... Electric telegraphs.

13th February, 1888.

2170. White, F. W. ..... Electric switches.
2178. Boyd, R. N. ..... Secondary batteries.
2179. Wheeler, M. ..... Electric lights.

14th February, 1888.

2235. Bryce, J. A. ..... Electric conductors.
2239. Mayfield & Todman ... Electrical door and window contact.
2246. Lake, H. H. ..... Dynamo-electric machines (*Eickenmeyer*).
2250. Linville, J. H. ..... Printing telegraphs.
2251. Graham, A. ..... Switches for electric circuits.
2259. Mestern, H. ..... Thermo-electric and furnace batteries.

15th February, 1888.

2308. Coerper, C. ..... Dynamo-electric machines.
2313. Ferranti, S. Z. de ..... Dynamo-electrical machines.
2314. Ferranti, S. Z. de ..... Electrical safety fuses.
2315. Ferranti, S. Z. de ..... Electrical mains.
2316. Ferranti, S. Z. de ..... Dynamo-electrical machines.

16th February, 1888.

2320. Blackmore, S. P. ..... Arc lamp clutch.
2368. Bailey & Warner..... Secondary batteries.
2369. Orme, J. ..... Electrical signalling.

CHEMISTRY.

10th February, 1888.

2004. Staveley, W. W. ..... Alkali carbonates and phenol.
2019. Perino, J. ..... Extracting copper.
2025. Mason, A. N. ..... Separating metals from their ores.
2059. Hoffmann & Ebert ... Treatment of beer wort.
2070. Hauff, J. ..... Aluminium salts.

11th February, 1888.

2071. Lake, H. H. ..... Refining of metals (*Hayden*).
2084. Studer & Liebmann ... Colouring matters.
2096. Dinsmore, J. H. R. ..... Manufacture of gas.
2099. Soberon, H. de ..... Liquor resembling brandy.
2104. Deacon & Hurter ..... Chlorine.

13th February, 1888.

2182. Sinclair & Smith ..... Metallic compounds.

14th February, 1888.

2200. Williamson, T. ..... Gas producers.
2236. Lawson, A. J. ..... Causticisation of sodium carbonate.

15th February, 1888.

2282. Rylance, F., & others... By-products in the manufacture of gas.
2306. Wilke, O. H. von ..... Soap soluble in sea water.
2311. Deacon & Hurter ..... Chlorine.

16th February, 1888.

2353. Zahn, W. ..... Tanning.
2372. Abel, C. D. ..... Production of beer (*Van Leenhoff, Wernicke, Welhemi, and Kohlmann*).

MISCELLANEOUS.

10th February, 1888.

2003. Barbour, J. ..... Sliver conductors for drawing rollers.
2005. Stopford, W. H. ..... Shaft guard.
2006. Redfern, R. R. ..... Saggars, quarries, pans, and other vessels requiring smooth surfaces.
2009. Crowley, J. S. ..... Belt fasteners.
2013. Cole, G. ..... Oil cans.
2021. Duncan, R. ..... Bottles.
2030. Tabrar, J. ..... Stoppers for bottles.
2032. Muir, R. L. ..... Miners' tools.
2042. Brigg, M. A. ..... Guards for wheels.
2044. Evrard & Cornevin ... Fire escapes.
2046. Newton, P. A. ..... Production of wood fibre (*Steimmig.*)
2053. Roell, C. F. A. ..... Pleating of fabrics.
2057. Peck, H. J. ..... Disinfecting materials (*Downton*).
2058. Fletcher & Clare..... Improvements in gas lamps.
2060. Stoneham, W. G. ..... Automatic tap.
2063. White & White ..... Blocks for polychromatic printing.
2066. Lagerman, A. ..... Justifying printing formes.

11th February, 1888.

2072. Steel, J. ..... Self venting taps.
2077. Scholte, J. T. ..... Lamps.
2087. Davis & Dawson ..... Velocipedes.
2092. Malcolm, D. R. ..... Heat indicating apparatus.
2093. Lee, F., & others..... Dyeing fibrous substances.
2105. Springuel & Bollinekx Removing liquid produced by condensation.
2107. Whatley & Partridge Tool for extracting broken screws
2111. Humes, J. J. R. ..... Manufacture of vapour.
2113. Lane, J. ..... Vessels for heating fluids.
2115. Neale & Smalpage .... Signalling at sea.
2119. Nichol, J. C. ..... Lubricator.
2120. Twist, C. H. E. ..... Square tin boxes.
2122. Bensinger, A. ..... Printing on celluloid.

13th February, 1888.

2139. Brown, C. ..... Securing and releasing lids of packing cases.
2142. Pasley, W. H. ..... Automatic extinguishers for oil lamps.
2157. Coleridge, Hon. S. ... Mooring torpedoes.
2160. Watson, G. S. ..... Heating of railway carriages.
2162. Hawkins & Barton ... Regulating gas burners.
2164. Wimpey, G. ..... Joint for stoneware pipes.
2167. Kincaid, J. ..... Points for tramways.
2171. Ludwig, B. ..... Decoration of wood.
2177. Sickels, F. ..... Locks.
2183. Boggett, W. ..... Combustion of petroleum.

14th February, 1888.

2186. Graham, J. ..... Setting sewing machine needles.
2187. Barry, J. H. ..... Precipitating sewage.
2191. Gillingham and Hodgeson ..... Cutting mitres.
2196. Dutton, E. L. ..... Safety bicycles.
2197. Lawless, P. C. ..... Couplings for flexible piping.
2206. Aynsley H., & others... Firing pottery ware.
2212. Wallace & Smillie ... Prevention of corrosion in propellers.
2214. Crawford, R. ..... Heating revolving cylinders by air.
2221. Megill, E. L. ..... Gauge pin for printing presses.
2224. Wright, C. C. ..... Fastener for gas or lamp globes.
2234. Wheatley, W. H. ..... Lubricators (*Faas*).
2241. Fitch, W. B. ..... Glass bottles.
2258. Fowler, A. B. ..... Heel burnishing machines.
2261. Tabrar, J. ..... Bottles.

15th February, 1888.

2262. McKay, M. ..... Hydrocarbon lamps.
2263. Bashall & Box..... Holders for cutting tools.
2272. Bassett & Seydé..... Fire proof ceilings.
2273. Johnson, H. T. ..... Gas lamps for increasing the illuminating power and to improve ventilation.
2276. Mallinson & Speight... Cutting leather straps.
2277. Wethered, E. R. ..... Locks.
2280. Rylands & Stoner ..... Glass bottles.
2290. Slade, C. G. ..... Cartridge pouches.
2293. Messenger, T. ..... Compressing substances.
2296. Leaver, J. R. ..... Joints of pipes.
2298. Jetten, J. ..... Rafters for greenhouses.
2300. Marchetti & Mellor... New pile fabric.
2302. Johnson, S. A. ..... Ship filters.
2305. Cook & Buchanan ..... Shaping of the parts of boxes.
2307. Pillivant, F. T. ..... Boxes formed of cardboard.

16th February, 1888.

2318. Adams, J. B. ..... Bottles.
2319. Morton, J. ..... Manufacture of umbrella frames.
2322. Terrace, J. B. ..... Fire clay gas retorts.
2323. Wishart, J. ..... Valves to shut off steam or water on the bursting of a pipe.
2324. Saul, D. H. ..... Gas fire.
2327. Lévy & Milland..... Preserving fermentable substances.
2328. Martin, J. W. ..... Designs upon pile fabrics.
2329. Chilton, H. H. ..... Spring mattress.
2333. Howe, C. J. ..... Locking pipes.
2335. Parish, J. ..... Printing from stencils.
2336. Scott-Moncrieff, W. D. Explosive.
2338. Baxter, J. ..... Gas lamp lighters.
2341. Mycock, W. ..... Apparatus for dyeing.
2344. Somers, W. S. ..... Drying oils.
2347. Morris, T. W. ..... Fire escape.
2351. Payne, W. J. ..... Heating water.
2352. Wallwork, R. ..... Gas burners.
2359. Elste & Stoll..... Treatment of loofah (*Wickel*).
2361. Pearce, W. J. S..... Drawing off the surface of liquids from cooling vats.
2362. Dade, D. H. ..... Drying tea.
2363. Came, C. J. ..... Gearing for the transmission of power.
2365. Wickel, H. ..... Rollers for stretching luffa.
2366. Snelus, G. J., & others. Cement.
2367. Marx, J. ..... Separating matters by osmose.
2370. Lee, R. A. ..... Gas burners.
2373. Stern, W. ..... Gas lamps.
2374. Kahl, A. ..... Winding of spring motors.

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2376. Bongendre & Bongendre..... Envelopes.
2377. Kelsey, J. R..... Ironing hat brims.
2378. Brown, W..... Apparatus for carburetting air or gas.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

18th February, 1888.

316. Haddan, H. J. ..... Air ships (*De Bausset*).
461. Lake, H. H. ..... Looms (*Thomas & Thomas*).
2084. Cutlan, J..... Machine for stitching the soles of boots.
2757. Whitaker, T. ..... Machinery for excavating.
3734. Mellor, H. J. M. ..... Knitting machinery.
3746. Storey & Poore ..... Supporting torpedoes.
3747. Storey & Poore ..... Submarine vessels.
3876. Frost, W. S. ..... Sewing machines.
3932. Westmacott, P. G. B... Loading coal.
4045. Tille, J. ..... Reciprocating saws.
4320. Maxim, H. S. ..... Manufacture of guns.
4344. Ainley & Hollingworth ..... Warping and beaming machines.
4582. Hulse, W. W ..... Planing and shaping metals.
4777. Dohis, P. A. ..... Sewing machines.
5112. Riley, J. ..... Steel pipes.
5231. Orr & Brown ..... Sheet metal structures.
5272. Darbyshire, J. ..... Automatic couplings for tramway.
5277. Porteous, D. W. ..... Rudders.
5279. Hodgson, R..... Spring axle box.
5312. Parsons, Hon. C. A. ... Rotary motors.
5323. Neale & Everitt ..... Brakes.
5327. Willis, R..... Speed indicators.
5336. Bernhardt, W. ..... Regulating apparatus for gas motor engines.
5347. Brill, E. ..... Manufacture of buttons.
5357. Smith, G. ..... Indicating pressure.
5404. Richardson, T. H. ..... Signalling apparatus for railways.
5407. Mathieson, J. ..... Drop box motions for looms.
5417. Hocking, F..... Condensing steam.
5469. Dickinson, A. ..... Condensers.
5485. Hargreaves, J. ..... Internal combustion engines.
5540. Harper, J..... Attaching helical bars to an axial shaft.
5561. Bowie, J. ..... Washing machines.
5571. Nicholson & Mather... Grinding mills.
5584. Wardale, J. D..... Pumping engines.
5585. Warburton, J. S..... Indicator for steam engines.
5598. Mewes, R. W. ..... Starting locomotives.
5660. Thomson & Black ..... Sugar cane mills.
5673. Raper, J., & others..... Manufacture of brushes.
5727. Wilson, A..... Plates of iron and steel.
6013. Street & Tangyes ..... Governors.
6364. Redfern, G. F..... Harvesters (*Huntley*).
6579. Lowe, J..... Stoves.
7301. Oswald, J..... Looms for cutting pile fabrics.
7555. Crighton, J., & others... Air propeller.
8396. Marquand, A. J. ..... Preventing corrosion of steam boilers.
8536. Simpson, A. H..... Operating torpedoes.
8821. Hemington, J..... Pumps.
8958. Steinfeldt & Koch ... Balances.
9897. Nasch, I. ..... Sewing machines.
10907. Heidmann and others... Machine for making buttons.
11143. Shroeder, E. ..... Machines for pulling hairs from skins or furs.
11530. Cabry & Kinch ..... Steel sleepers for railways, &c.
12136. Olver, A. L..... Haymaker.
15454. Kynoch & Schlund ... Projectiles.
16896. Parkes, C. R. ..... Hydraulic crane.
17672. Barthel, A. E. ..... Manufacturing articles from slotted sheet metal.
60. Hall, W. P. ..... Railway sleepers.
400. Lake, H. H. ..... Sewing machines (*Tucker*).
401. Harvey, H. A. ..... Low steel.
461. Hett, C. L. ..... Turbine governors.
512. Sington, T. ..... Gas engines.
485. Hoeborn, H. ..... Paper making machines.
619. Böttcher, E. ..... Sewing machines.
675. Morgan, D. J. ..... Pistons for steam engines.
719. Boult, A. J..... Mining machines (*Westbrook*).
730. Weidenbusch, A. ..... Machinery for making paper bags.
749. Lake, H. H. ..... Spooling machines (*Wilkins*).

ELECTRICITY.

18th February, 1888.

2563. Stuart, G. ..... Electrical primers.
2598. Hewitt, T. P. ..... Electric gas lighters.
5096. Kapp, G. ..... Dynamo-electric machinery.
5365. Barnard, W. T. ..... Telegraphy.
5583. Liepmann, H. ..... Galvanic batteries.
100. Lake, H. H. ..... Generating electricity (*Humans*).
623. Gülcher & Pintsch ... Thermo-electric piles.

CHEMISTRY.

18th February, 1888.

4243. Majert, W. ..... Colouring matters.
4881. Majert & Richter..... Production of hydrogen gas.
5393. Hermite, E..... Bleaching and disinfecting liquor.
5460. Schuhmann, A..... Manufacture of dextrine.
5532. Edwards, E..... Disinfectant (*Jeger*).
5824. Knights & Gall..... Carbolic acid.
7657. Weirich, J. ..... Auriferous minerals.
10057. Pass, E. de ..... Extraction of aluminium (*Bernard & Bernard*).
678. Nipper, J..... Distemper colours.

MISCELLANEOUS.

18th February, 1888.

2136. Pasley, W. H. ..... Oil lamp stoves.
2423. Wells & Howard ..... Treating rhea bark.
4054. Elmore, F..... Coating pieces of metal.
4892. Fraser, W..... Lubricator.
4941. Newton, H. E..... Manufacture of comfortables from continuous fabrics (*Palmer*).
4970. Tupholme, B..... Roasting coffee.
5128. Bradshaw, J. B. ..... Bale ties.
5134. Mullan, W. ..... Couplings for pipes.
5454. Garlick, J. S. ..... Internally stoppered bottles.
5458. Fiège, R. G. ..... Vice jaws.
5528. Goodall & Webster.. Straining pulp.
5546. Snell & Sanderson..... Lamps for velocipedes.
5560. Brogan & Malloch..... Designs upon plate glass.
5582. Scott, J. W. ..... Decorations on glass.
5678. Redman, C. ..... Raising and lowering circular saw benches.
5762. Panario, T. ..... Water waste preventers.
5777. Tellier, C. ..... Aerating and filtering waters.
5973. Farquhar, W. ..... Locking nuts.
6035. Morris & Birkbeck ... Terne plates.
6486. Hill, G..... Metallic buckets.
13445. Grawitz, W. J. S. ..... Dyeing textile materials.
14348. Inglis, H..... Sheet metal cans.
17377. Hazlehurst & Hazlehurst ..... Stoppering bottles.
17619. Wallis, W. H..... Connecting taps to pipes.
18019. McHugh & Ward ..... Embossing plastic materials.
79. Fairweather, J. I..... Ball valve.
169. Langen, C. J. ..... Drying granular substances.
436. Thomas, A..... Swing bucket for loading ships, &c.
457. Forsaith, T..... Double hand saw.
666. Bennetts, W. ..... Safety fuses.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 11th November, 1887, inclusive.)

Year 1883.

5238. Haddan, H. J. .... Electric generators (*Bain Electric Co.*).
5242. Pass, E. de ..... Waterproofing fabrics (*Lèbre*).
5247. Lake, H. H. ..... Rotary devices for advertisements (*Chapin*).
5249. Hunt, T..... Locomotive steam engines.
5251. Allison, H. J. ..... Telephones (*Robertson*).
5254. Larrañagay Loyola, L. Carriage with multiple luminous protections.
5257. Payne, G. ..... Obtaining glycerine.
5264. Lake, W. R. ..... Gear wheels (*Noye & others*).
5269. Day, C. A. ..... Lined conduits (*Detrick*).
5272. Fairfax, J. S. ..... Production, &c., of electric and magnetic forces.
5275. Teague, W. ..... A counterpoise brake.
5276. Jefferson, J. C. ..... Winding machinery (*Meinicke*).
5277. Rawsthorne, T. ..... Mules for spinning.
5282. Hamand, A. S. ..... A vacuum brake.
5301. Carver, J..... Multiple drilling machines, &c.
5306. Walker, G. B..... Pulp.
5309. Turner, L. ..... Elastic webbing, &c.
5311. Fisher, J..... Extract from bark (*Allen*).
5317. Schmidt, W..... Hot air engines.
5319. Tatham, R., & another. Preparing, &c., fibrous materials.
5324. Sachs, J. J. ..... Surfaces for printing, &c.
5325. Wavish, J., & others. .... Carbons for lamps.
5326. Lake, W. R. ..... An antiseptic (*Briethaupt*).

Year 1882.

5297. Smith, H. C..... Treatment of fibre bearing leaves, &c.
5346. Jameson, J. ..... Incandescent electric lamps.
5382. Marceuil, L. ..... Lace.

Year 1881.

4861. Whiteford, J..... Permanent way of railways, &c.
4901. Phillips, R. E. ..... Velocipedes.

Year 1880.

4534. Fecken, J. M. J. ..... Chamfering the ends of leather belting.
4536. Margetson, A. G., and another ..... Tipping waggons and vans.
4549. Heap, J..... Bands for transmitting power, &c.
4566. Lake, W. R. ..... Horseshoe nails (*Putnam*).
4592. Tucker, F. O. ..... Looms for weaving.
4604. Waring, G. E..... Construction of sewers, &c.
4608. Heinrichs, C. F. ..... Generating, &c., electric currents.
4614. Siemens, C. W..... Electric lamps.
4632. Williamson, W. S..... Puddling furnaces.
4643. Abel, C. D. ..... Explosive compounds (*Sanlaville and another*).
4647. Mayell, S. ..... Sifting Portland cement, &c.

Year 1879.

4545. Little, G., & another... Combing fibres.
4581. Shaw, H. F. ..... Locomotive engines.
4589. Heinrichs, C. F..... Generating electric currents, &c.

Year 1878.

4461. Lake, W. R. ..... Pipes or tubes (*Radde*).

Year 1877.

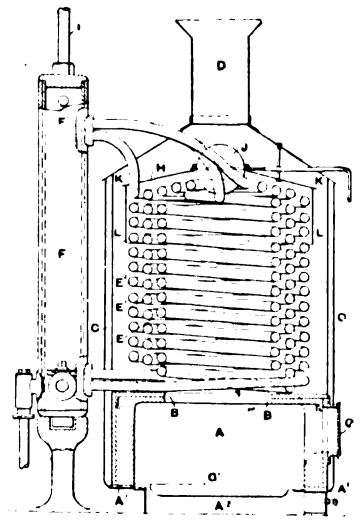
4121. Haarmann, H. A. ..... Laying railway rails.
4172. Haddan, H. J. ..... Lozenge machines (*Robertson*).
4176. Huxtable, J. ..... Turn wrest ploughs.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Steam Boilers.—*J. A. Batley, London.*—In that class of boilers where steam is generated by passing the water through coils which are directly exposed to the heat of the furnace, it is found that the steam supply is too intermittent to afford a constant force for practical purposes. The object of this invention is to remedy this defect, and also to arrange a more efficient indicator of the pressure of the steam and water within the generator. The method pursued by the inventor will be understood by reference to the accompanying figure. The apparatus consists of three separate vessels, the boiler C, the water reservoir F, and a steam reservoir placed behind F, and connected with it by a pipe F^1. The water is forced by a pump into the vessel F, from whence it passes through the coils E E^1 E^2, and rises through them into the top of the chamber F. The steam which has been generated during the travel of the water, is led into the steam



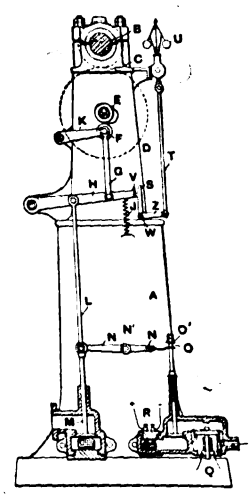
chamber through the pipe F^1, where it forms a constant source of fluid pressure, while the water which has not been altered is allowed to fall to the bottom of F, where water again joins the supply. A gauge is placed in the vessel F, just below the opening F^1, to enable the attendant to ascertain the state of the water and steam within. The cylindrical portion of the casing C consists of two thicknesses of sheet metal, between which a non-conductor is interposed. Of the three coils E E^1 E^2, the coil E^1 contracts at its upper end to a diameter smaller than that of the innermost coil, and thereby presents an intense heat to the contained steam immediately before its passage out of the boiler. Above the coils a curtain H is situated, being supported by bolts hanging from the coned part of the casing. This curtain is formed of a slightly dished annular plate, with a flange L for the purpose of directing the flames and gases through the outermost coil into the chimney K when the damper J is closed. The furnace A consists of a cylindrical casting, resting on the bed plate A^1, and upon the same plate the fire bars G are carried. The coils are supported on the plate B, and, in order to facilitate their junction with the receiver F and to break up the lateral draught of the gases of combustion, the outermost and innermost are made in the form of a right handed helix, and the other one is laid in the reverse direction. The inventor makes two claims for this apparatus, designed to make the supply of steam constant.—No. 2967. February 25th, 1887. 8*d.*

Construction of Steel Beams.—*F. Pilkington, London.*—In order to strengthen a plain steel beam, and to render it more or less fire proof, the inventor uses angle iron or T iron supports. These irons are fixed to the girders in the usual way as in plate girders, and their ends are made to overlap and surround the flanges of the beam. In some cases the overlapping irons serve to keep a layer of fire proof material, such as concrete, in its position between the flanges of an I beam; and sometimes they serve to support a layer of concrete between the girder and the buttress on which the beam rests. The inventor makes three claims.—No. 15131. November 7th, 1887. 8*d.*

Traction Engine and Road Roller.—*S. Eddington & J. E. Steevenson, Chelmsford.*—The object of this invention is to construct a traction engine in such a way as to permit its conversion into a road roller at any time. In order to make the machine useful as a roller, the front pair of wheels must cover the same breadth of ground as is covered by the large wheels. The roller wheels are to be located in advance of the smoke box, so that rollers of any size may be used. In converting the machine into a roller, the front pair of wheels and the swivelling part of the fore carriage are removed, and they are replaced by a cantilever frame, which takes a bearing beneath the front part of the smoke box. The rear end of the frame is received in a socket fixed beneath the boiler; and the front end projects beyond the smoke box in the form of a horizontal ring frame, in which the roller wheels are mounted. The rear wheels of the traction engine are to be replaced by heavy roller wheels in the ordinary way. The inventors claim the application to a traction engine of roller wheels mounted so as to swivel about a vertical axis, in combination with a cantilever frame that takes an upward bearing beneath the front part of the boiler, and a downward bearing at a point in the rear, the roller wheels being situated in advance of the upward bearing.—No. 3463. March 7th, 1887. 8*d.*

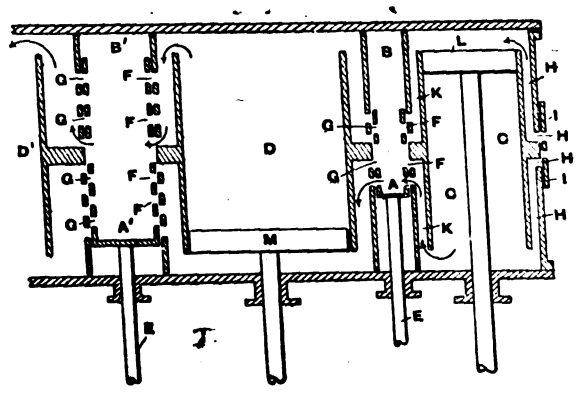
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Gas Engines.—*E. Körting, Hanover.*—By this invention several improvements are introduced into that class of gas motors whose governor keeps the exhaust port open when the speed is too high. The first improvement consists of establishing a connection between the exhaust valve and the induction valve, whereby, when the exhaust valve is opened, the induction valve is kept closed for the purpose of preventing the entrance of the combustible mixture into the cylinder. The second improvement consists of new apparatus for keeping the exhaust port open when the speed is too high. An elevation of the proposed valve gear is shown in the accompanying diagram. On the crank shaft B is the wheel C, which gears with D. A cam E is fixed on the shaft driven by D; a lever K with a roller F, and the rods G H L N, and the spring I serve to transmit motion to the exhaust valve M and to the admission valve P. The valve Q serves to mix the gases and the air in definite proportions. The connection between the exhaust and admission port is



effected by means of the rocking lever N. One end of it slides in a slot in L, and the other end carries a spring which gears with the nut O^1. When the valve M is fully open the valve P will be pressed against its seat. The cam plate E during its revolution causes the rods G and L to move downwards intermittently. That motion opens the exhaust port M and closes the admission port P. A pawl S Z, with its fulcrum at W, is connected to the rod T and the governor U. When the rod T is drawn up to a certain position by the governor the pawl S catches the end V of the arm H, and prevents the spring I from restoring H to its former position after its depression by the cam E. The exhaust port is thus kept open altogether and the admission port is closed, so that the piston pushes the combustion gases to and fro without being able to draw any more combustible gases through the valve P. When the speed of the engine is sufficiently diminished the pawl is withdrawn from the catch V, and the usual series of operations are proceeded with. The inventor makes two claims: (1) For the combination of the apparatus N O with the valves M and P, and (2) for the method of connecting the governor with the exhaust and induction valves.—No. 5981. April 25th, 1887. 8*d.*

Slide Valves.—*T. J. Simmons, London.*—This invention relates to the slide valves of compound engines, and it consists of a new construction of the valve, with the object of reducing the amount of heat wasted while the steam passes from one cylinder to the other. The valve is made in a hollow tubular form, and has two sets of ports on each side, to correspond with a similar series in the sides of the valve chambers. The disposition of the valve chambers and the valves will be seen by reference to the annexed diagram. The steam issuing from

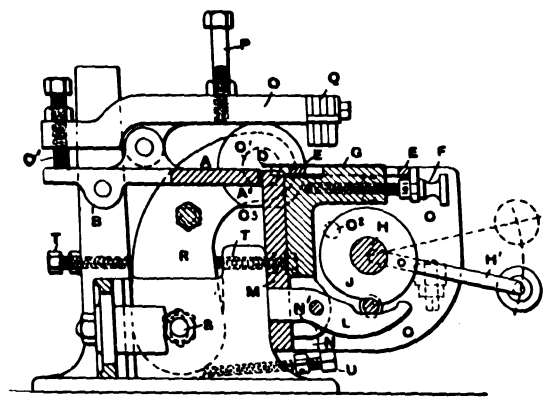


either end of the high pressure cylinder C passes along the duct K, and escapes in the direction of the arrow through the open ports of the valve A into the supply passage of the second cylinder. The same process takes place when the steam is exhausted from the second cylinder. The inventor makes three claims for the construction of the hollow tubular valve with ports in its sides to correspond with similar ports in the valve chambers, for the purpose described.—No. 3900. March 15th, 1887. 8*d.*

Wood Planing Machines.—*J. C. Humphreys, Braxton, Virginia, U.S.A.*—This invention involves a new and improved construction for the cutter bars used in wood planing machines. The knives are of a convex shape, and are fitted eccentrically on the bars; the number of knives is preferably three on each bar, mounted equidistantly from each other. They extend half the length of the bar, and the set of knives on the other half of the bar are arranged in the same way, with their edges advanced one-sixth of a revolution round the circumference of the bar. In this way the knives on the two parts come alternately into action on the wood, and the great strain on the bands and driving gear is thus diminished. The knives may be set at an angle of 15° with the wood, so that their action on the wood is more of the nature of planing than in many machines of the kind. The inventor makes three claims for the arrangement of the two different sets of three convex knives, as described.—No. 17040. December 10th, 1887. 8*d.*

Pulverising Machinery.—*E. Wilson, Exeter.*—The case of the improved machine is in the form of a short cylinder, with its axis horizontal, and mounted on suitable supporting frame work. The cylindrical surface consists of a gauze wire work, which allows the pulverised material to escape through it when sufficiently disintegrated. The two ends of the case are provided with iron ribs, which run radially part of the way, and then turn in a different direction. The beaters are mounted on an axle, which passes through the axis of the cylinder, and the ribs are placed so as to approach the beaters as near as is consistent with utility. A hopper is fixed to one side, and it feeds the material into the centre of the cylinder. The centrifugal force of the beaters throws the material against the ribs and the cylindrical surface of the case. Part of the material goes through the gauze, and the remainder falls down once more towards the centre, whence it is again thrown with great concussion against the ribs and the gauze until the pulverisation is complete. The inventor makes three claims, for the construction of the case, for the ribs, and for the method of mounting the beaters on the axle.—No. 3443. March 7th, 1887. 8*d.*

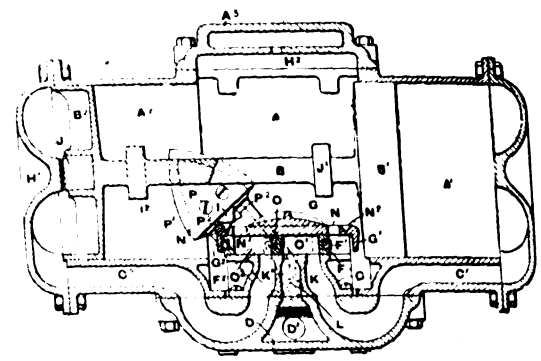
Metal Folding Machine.—*S. Stevens, London.*—This machine is intended for bending metal plates at any desired angle, and provision is made for adjustment in case of wear or of alteration in the work. The accompanying diagram represents a section of the machine taken at right angles to its length. The table A is pivoted at B to the supporting standards, and the frame C C^1 is fixed to supports which enable it to rotate round the axis D. The regulator frame E is capable of being adjusted according to the required width of the bend by means of the set screw F, and the knife G is placed with its edge coinciding with the axis of oscillation of the frame C. The shaft H may be partially rotated by the handle H^1, upon which the cam J is keyed. The motion of this cam acts on the lever jaws L, and raises the gripper plate M, which grips the metal plate between itself and the edge of the knife G. The whole frame C rotates about D as an axis, and in so doing bends the plate, because the table A prevents its



rotation with the frame. Just before the frame arrives at the end of its oscillation, the flat C^2 comes uppermost, and allows the lever O to fall; the table, no longer held up by the stud O^1, also falls, and the plate may be removed. During the latter portion of the rotation of C, its weight rests on the handle H^1 in such a direction as to cause the shaft H to return to its normal position; the cam J follows with the shaft, and thus the lever L is unlocked. The surface N^1 of the lug N, which is fixed on the gripper M, comes to rest upon the stud P. This action removes the gripper from the knife, and the plate may be removed. If a small amount of bend is required, the pins C^2 on each cheek of the frame C are made to come in contact with one of the adjusting pieces Q. As shown in the drawing, the pieces would allow the pin to clear and complete half a revolution; but if they are turned so as to rest in a horizontal position, they project into the path of the pin, and so prevent the further motion of C. If they are all placed horizontally, the plate will be bent at right angles. In case the knife or the edge of the table wears, the adjustment may be effected as follows: The axis D is pivoted on the brackets R, which are pivoted at S; by moving these brackets to the right or to the left by means of the set screws T, the frame C may be caused to recede from or approach the edge of the table A. Should the table A be not parallel to the knife, either end may be raised or lowered by the set screws U. The inventor makes four claims for the combination of rotating table and gripping jaws as described, and for the means of its adjustment.—No. 1878. February 7th, 1887. 8*d.*

Boiler Furnaces.—*R. Marshall, London.*—The air is made to pass in thin strata immediately beneath the under side of the fire bars, so that it becomes heated by radiation before coming in contact with the fuel. The combustion in the furnace is thus rendered more perfect, and a higher efficiency is obtained. For this purpose a plate is fixed underneath the bars, and the air in passing to the furnace has to travel some distance towards the inner end of the fire box before it can turn the corner of the plate and rise up to the bars. Doors are arranged in the outside casing of the furnace for the insertion of tools, in order to clear the plate of ashes. The plate may also be made of folding or swinging blades, and the ashes are then caused to fall off by turning the plate on its hinges by a handle outside. A jet of steam is preferably employed to accelerate the current of air between the plate and the bars. In cases where the furnace is contained in an internal flue of the boiler, the fire grate is brought down lower so as to leave very little space between it and the flue; the same object is attained by this arrangement. The inventor makes four claims.—No. 4601. March 28th, 1887. 8*d.*

Water Meters.—*M. P. Freeman, Somerville, Massachusetts.*—A longitudinal section of the meter, constructed according to this invention, is shown in the accompanying figure. The shell of the meter is divided into three portions—A A^1 A^2. The first of these is in connection with the water supply through the opening H^2, and the latter two are the measuring cylinders. The two pistons B^1 B^2 are connected by the rod B, on which are fitted the collars J^1 J^2. The yielding bunters J are sunk into the pistons, in order to minimise the force of the collision between piston and cylinder at the end of each stroke. The valve mechanism consists of the ports K K^1, and of the exhaust port L, which communicates with the delivery pipe D^1. The cover G, with its projecting lips G^1 G^2, is supported by standards



not shown; and between G and the valve surface is the slide valve F, which is caused to reciprocate by a rack gearing with the toothed sector shown in the diagram. The valve F has the two passages O^1 O^2 in it, and pads are fitted at its ends similar to those on the pistons. The cover G has holes N^1 N^2 in it, which allow the passage of water through them. The motions of the pistons and the valve are connected by means of the weighted lever I, which is hinged at the bottom. The head of this lever leans against the collars on the piston rod B, and rocks in the plane of the figure. The action of the parts is as follows: When the position of the mechanism is as shown in the figure, the water is admitted into A, and passes through the opening N^1 in the cover G, and round the lip G^2, through the valve opening O^2, through K^1 C^2, to the rear of the piston B^2. The pistons then move to the right, and the liquid which was in A^1 is forced through C^1 K O^1 L, and through the delivery pipe D^1. As the pistons move on the collar, J^2 comes in contact with the periphery P^1 of the lever I, which is thus swung round its hinge. When the lever has gone a little beyond its central position, some pins which it carries come in contact with the toothed sector; the motion of this sector carries the valve F along with it, and causes it to assume a similar position with respect to the passage K as it did before with the passage K^1. The weight of the lever is then sufficient to cause the collar J^1 to travel on to the right. In order to deaden the blow of the lever I against the cover G, the elastic projections P^2 are placed on I, and dash pots N^2 are hollowed out in the cover G to receive them. The action of the meter is then reversed, and the same train of operations re-commences. The inventor makes six claims for this arrangement of weighted lever and the slide valve.—No. 16433. November 29th, 1887. 8*d.*

Pulverising Machinery.—*J. R. Alsing, London.*—The cylinders are constructed of blocks or plates, and the object is to provide a simple means of joining these parts together. The circumferential plates are grooved along one edge and ribbed along the opposite edge, so that the grooves and ridges of adjacent plates shall fit into each other. The sectorial plates at the ends of the cylinders are fitted in the same way. The whole cylinder is held together in a frame, and is employed for the usual purposes. The plates may be of iron or steel, and are adapted to either wet or dry grinding. The inventor makes three claims for these improvements.—No. 5379. April 13th, 1887. 6*d.*

Valve Gear for Steam Hammers.—*A. Davy & W. J. Benton, Sheffield.*—The object of this invention is to cause the hammer to fall dead on the anvil instead of giving the usual elastic blow. The descent of the hammer is actuated by steam, but the distributing valve is disconnected from the hammer head during its fall, and is moved by an independent means, such as a spring. A cataract cylinder is placed between the spindle of the distributing valve and the gear on the hammer head which controls the motion of the distributing valve. The effect is that the downward stroke does not terminate in an elastic spring, but the hammer slackens speed and pauses slightly. The inventors make one claim for the combination of the cataract with the distributing valve, for the purpose described.—No. 4066. March 17th, 1887. 8*d.*

Paper Making.—*L. McFarlane, St. Mary Cray, Kent.*—The inventor has designed a machine for taking the glazed paper from the set of glazing plates, and for filling the set with paper ready to be placed in the calenders. These processes have hitherto been effected by hand. A tubular standard passes upwards, above and between a series of platforms which are adjustable to be raised or lowered. The standard carries three tubular arms, which are provided with india-rubber suckers, and is connected with an exhaust fan, which produces the vacuum utilised for sucking up the paper and plates. A rotary motion is communicated to the standard and the arms. Valves are provided in the arms in order to introduce the vacuum into them intermittently, thereby enabling the arm to pick up or release the paper according to the arrangement of the working of the machine. A mechanism is also designed for lowering the platforms as the height of the pile of paper decreases. The inventor makes five claims for this new machine, and for the application of the tubular arms, and the vacuum, for the purpose described.—No. 910. January 6th, 1887. 8*d.*

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ELECTRICITY.

SECONDARY BATTERY FOR MINER'S LAMP.—*M. Bailey & J. Warner, London.*—Narrow glass or ebonite cells are placed side by side in the enclosing wooden box, and the elements are folded over the sides of the contiguous cells, and placed so that the same plate is an anode in one cell and a cathode in the other. The plates are made of lead, and are constructed in the form of a mesh of finely woven strips of metal, and with a selvage or bound edge. After the cells have been filled with sulphuric acid, they may be charged from a dynamo. The terminals are formed in the substance of the enclosing box, in order to facilitate the re-charging of the battery. The inventors claim: (1) A battery formed as described connected with a mining incandescent lamp; (2) the application of the wire mesh elements to the battery; (3) the method of suspending the elements so as to avoid all joints and connections.—No. 16669. December 3rd, 1887. 6*d*.

DYNAMO-ELECTRIC MACHINE.—*J. Y. Johnson, London. (W. C. Rechniewski, Paris.)*—This invention relates to an improved construction and combination of the cores of electromagnets and their armatures. The plates of the inducing electromagnets are stamped out from the same sheets as are employed to make the discs or rings which constitute the core of the armature. The elements of the electromagnets are arranged side by side in the same way as the discs or rings forming the armature. The plates can thus be insulated from one another, and the magnets can be combined with toothed armatures which have parts projecting radially from their periphery. The powerful field which can be obtained by the toothed armature can be produced by this invention without the disadvantageous Foucault currents which usually result from the passage of the teeth before the pole pieces. The inventor makes two claims for these improvements.—No. 15588. November 14th, 1887. 6*d*.

SAFETY DEVICE FOR ELECTRIC CIRCUITS.—*A. C. Cockburn, London.*—This invention is intended to remove the unreliability of fusible cut-outs and safety catches in electric circuits. A wire or strip of metal of one or more pieces, capable of being fused when the current passing through it is above the normal strength, is weighted at its middle, in order to assist its rupture when melted. The inventor makes three claims for the loading of the fusible safety device for the purpose described.—No. 4138. March 19th, 1887. 8*d*.

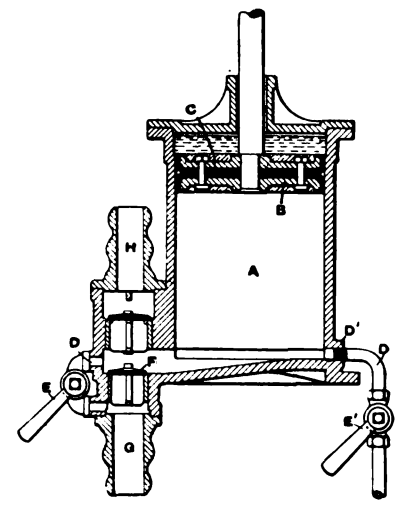
DYNAMOS.—*H. H. Leigh, London. (J. L. Clerc, Paris.)*—The armature consists of pairs of cylindrical coils, forming a set of electromagnets, and fixed radially to the axis of rotation in such a position that their poles rotate past the poles of the field magnets. The coils are wound so as to produce alternating polarities for two adjacent magnets, and are excited by a current taken from a field magnet coil by a commutator on the armature axle. The commutator consists of three copper rings embracing an insulated sleeve, and insulated from each other. The projections on these rings are irregular, and the number of them on each ring is half the number of the field magnets. Two of them have equal projections, while the projection of the third is equal to one-fifth of that of the others. The three rings are fixed relatively to each other, and in such a manner that at a given moment the current is interrupted for the purpose of avoiding short circuiting or sparking. The rings having the larger projections are connected to the armature wires, while the ring with the smaller projection is unconnected, and, if required, may be replaced by some other insulator. The coils of the armature are wound either singly or in series, their connection with the exciting coil of the field magnet being effected by a pair of brushes which are mounted in such a way that as one is leaving one projection on the commutator to contact with the next, the other of them is upon the unconnected projection. The coils of the field magnets are made by winding copper wire upon a core of iron wire, and the core is made by winding an insulated iron wire upon a U shaped mandrel. The mandrel is then inverted upon a wood sole plate, by means of which the coils are fixed to the side plates of the machine; the ends of the mandrel constitute the pole pieces. The coils of the field magnets may be coupled either singly or in series. The inventor makes three claims for the method of making the field magnets and the commutator, as described.—No. 563. January 13th, 1887. 8*d*.

CHEMISTRY.

ALUMINIUM ALLOYS.—*A. Mann, Twickenham.*—The inventor mixes sulphate of alumina with the chloride of some metal, such as sodium, which will undergo decomposition when exposed to heat. This mixture is subjected to heat in a retort, and the resulting mixture of chloride of aluminium and sulphate of soda is treated with hydrate of lime, and the whole mass laid aside for some weeks to mature. A mixture of aluminium sulphate and some de-oxidising agent, such as charcoal, is then added to the other mass, together with some scraps of metals with which the alloy is to be made. The exposure of this mixture to the heat of a furnace produces the desired alloy. In practice the alloy of aluminium and copper obtained by this process is too hard and brittle for working, and in order to overcome this defect a small proportion of brass or zinc is added, with the result of increasing the malleability and ductility of the metal. The inventor makes four claims.—No. 9313. June 30th, 1887. 6*d*.

DYEING WITH ANILINE BLACK.—*J. Grunhut, South Shields.*—This invention consists of a new process of dyeing fibrous materials in the raw or woven states. The materials are first subjected to the action of a mordant which is composed of a solution of soda or carbonate of soda and an azo dye. After being boiled in this mordanting solution the materials are washed, and are subsequently oxidised, and dyed in aniline black by being placed in a vessel containing a mixture of aniline oil, hydrochloric acid, and bichromate of potash. Instead of the latter dyeing mixture, suitable proportions of aniline oil, aniline salt, hydrochloric acid, and bichromate of potash may be employed. Such products of aniline as naphthylamine, rosaniline, or xylidine may also be used as the base of the oxidising and dyeing solutions. The inventor makes one claim for the above improved process in dyeing.—No. 15432. November 11th, 1887. 6*d*.

FILTERING METALLIC SALTS.—*C. T. J. Vautin, London.*—This invention consists of improved apparatus for separating the metallic salts from powdered ore, or from other granular material. The filtering process is hastened by means of a suction pump, and the filter is kept free and clean by the reflux of a portion of the pump charge through the filtering medium. A section of one form of apparatus designed with this object is shown in the accompanying figure. The pump barrel A is formed of some material which will not be attacked by the salts. When solutions of chlorides and bromides are treated, the most convenient material is an alloy of lead and antimony, and the piston B is packed with the cup leathers C for the same reason. At the left hand side of the figure a branch communication D is made between the upper side of the suction valve F and the lower suction pipe, and is fitted with a regulating cock E. If this branch is left partially open, the piston, on its lower suction stroke, draws the liquid through the suction valve F, and also through D, which is of small relative area to the suction and delivery pipes. Upon the



return stroke of B, a portion of the charge will return by the passage D, through the suction pipe G, back to the filtering medium, while the remainder of the charge passes through the delivery pipe H in the usual way. This effect may be produced by placing D at D¹, that is, in communication with the bottom of the barrel A; this pipe should also be fitted with a hand cock E¹. The inventor also specifies two other modifications for attaining the desired object, and makes four claims for the design of the vessel and for the three forms of the apparatus described.—No. 15575. November 14th, 1887. 8*d*.

MISCELLANEOUS.

PURIFYING CRUDE SPIRIT.—*J. A. F. Bany & M. C. A. Ruffin, Paris.*—This invention is for the purpose of introducing improvements in the process described in the specifications of patents No. 10870 of 1884, and 783 of 1886. The spirit to be treated is first rendered alkaline in order to remove the aldehyde. It is then charged into a vessel, into which pure petroleum oil is pumped through a perforated pipe near the bottom. The oil rises in streams through the spirit, and flows over the top into the first of a series of vessels to be regenerated. This series comprises a filter for entrapping solid matter, a washer for retaining any spirit which has been carried away, several vessels where it is subjected to the action of sulphuric acid, and finally a vessel containing alkali for the neutralising of any acid contained in the oil. Each of these vessels is arranged with a perforated floor, on which are placed fragments of substances not attacked by acid. The oil enters under the perforated floor, rises in sub-divided streams, and flows over the top of the vessel into the next. The regenerated oil passes from the last of the vessels into a pump which forces it back into the vessel containing the spirit. The time required to effect the complete purification of the spirit is between twenty and thirty hours. By the use of petroleum of considerable specific gravity, not flashing under 140°C., the risk of fire is avoided, and as this oil is not volatile all the vessels may be open. The inventor makes two claims for the method and apparatus respectively.—No. 5337. April 12th, 1887. 8*d*.

PITCH CHAINS AND CHAIN WHEELS.—*A. Spencer, London.*—Each link of these pitch chains is composed of two longitudinal members, of the shape of flattened rings or loops, connected by a transverse piece at one end, from which projects a neck provided with trunnions of a T form. The general arrangement of the parts is such that the trunnions of one link can be inserted within the loops of the other. According to a modification, the loops and links are made on the same principle, but of rectangular shape. The object of these two arrangements is to obtain a chain which is not extensible when subjected to long continued strains. There is one claim.—No. 4119. March 18th, 1887. 8*d*.

CENTRIFUGAL SEPARATOR.—*J. Gray, Stranraer.*—The apparatus constituting this invention consists of a receiver which is secured to and carried on a vertical spindle. The bottom of this receiver or separator is truncated, and at the top of the truncated part a vessel is secured concentrically with the spindle. The milk is conducted to this vessel by a supply pipe, and from the bottom of this vessel the milk flows out through apertures in tubes which extend from the bottom of the vessel to the lower part of the separator. The upper edge of the receiver has a rim upon it which projects concentrically inwards and outwards, and from the inwardly projecting part there rises a concentric bevelled or inclined collar. In the rim, between its inner edge and the side of the collar, are a series of holes through which, as the receiver is rotated, the cream rises into the collar and over its upper edge. Thence the cream passes into a dish which has a downwardly inclined bottom secured to an outer casing. At one part the rim round the receiver is duplicated, that is, it is composed of two plates with a space between them; and an opening is formed between the outer edge of the under plate and the vertical side of the receiver, through which the skimmed milk rises into the space between the two plates. From this space the milk flows through an opening made in the rim at the outer side of the collar, and it thence flows into a vessel secured to the outer casing. Into the annular space between the outer casing and the inner rotating receiver, a pipe and jets are introduced, and through the jets a stream of water issues and plays on the receiver. The effect of this action is the better separation of the liquid. The inventor makes three claims.—No. 2747. February 22nd, 1887. 8*d*.

TREATMENT OF FIBROUS PLANTS.—*J. Longmore & W. L Watson, London.*—This invention is designed for the extraction of the fibre from exogenous plants, such as Boehmeria nivea. The stems of the plant are made into bundles and boiled for a few minutes in an open vessel containing a solution of caustic soda. This process dissolves the gum contained in the plant, and the outside black bark can then be removed by hand. The fibres are left clear by the removal of the tissue, and are ready for use after having been washed and dried. Instead of removing the bark in the foregoing manner, another method may be employed. The dried stems are dipped in cold concentrated sulphuric acid for a short time; this treatment decomposes the bark, but allows the gum to remain. The stems are then placed in cold water, which causes the bark to swell up and leave the stem. In some manufactures the gum is required in the fibres, and in these cases the latter process is carried out. Both of these methods of treatment have been found by the inventors to be comparatively harmless to the fibre. Three claims are made.—No. 3715. March 11th, 1887. 6*d*.

GRINDING AND POLISHING MACHINES.—*W. Barraclough, Stanningley, Yorkshire.*—The object of this invention is to provide means of confining the resulting dust and grit, and also to render the spindles more adjustable than those in ordinary

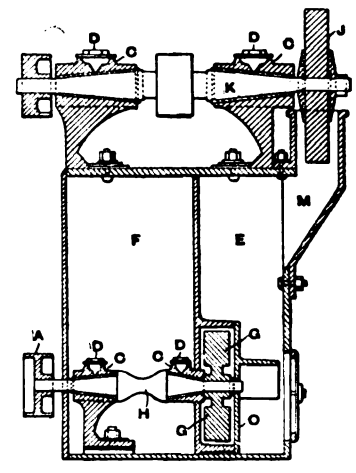


FIG. 1.

machines. Figures 1 and 2 represent respectively an end elevation and a vertical section of the improved apparatus. The pedestal is divided into two compartments E and F, and the spindle K rests in conical bearings on the top of the pedestal. The grinding wheel J is mounted on K, and is partly enclosed in the hopper M, and a hinged cover N fits over the wheel, in

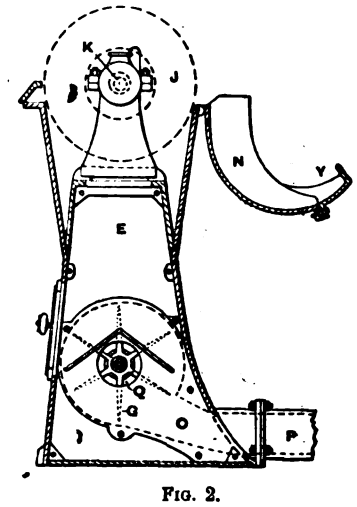


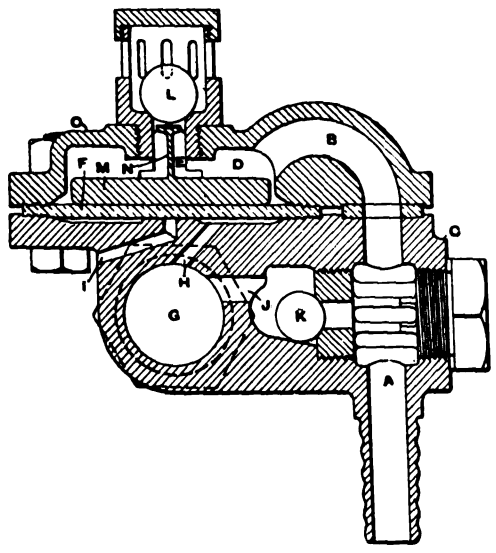
FIG. 2.

order to keep the dust and powder from flying about. The cover has an adjustable end Y, so that it may be made to suit the different sized grinding wheels. The lower part of the hopper opens into the chamber E, in which the fan G revolves; a chamber O surrounds the fan, except where the hole Q is left. The light particles of dust are drawn from the chamber E by the suction arising from the fan, and the blast from the fan expels them through the exhaust pipe P. The fan may be driven by a belt which passes round the pulley A and the corresponding one on the shaft K, or by a belt passing round H. The adjustment of the spindle bearings in case of wear is provided for by the conical shaped bearings of H K; and the oil cups C are provided with covers D in order to keep out the dust. The inventor claims the combination of parts for exhausting the dust and for adjusting the spindles.—No. 4971. April 4th. 1887. 8*d*.

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Lubricating Spindles.—*J. Gamble, Belfast.*—This arrangement is for retaining the lubricant on the vertical spindles, which have sliding bearings, and is specially designed for the roving, spinning, and twisting frames used in the preparation of flax and jute. This invention provides a means for preventing the waste of oil which escapes out of the collar bearing. A cup is attached to the bottom of the collar of the spindle, and annular layers of flannel, sponge, or other absorbent material are placed within it, so as to fit the spindle. On the bottom of the collar are projections which prevent the absorbing material from rotating with the spindle, and the spaces within the projections form openings for admitting the surplus lubricant into the annular space between the cup and the spindle. The absorbent material prevents the lubricant running down the spindle; and as the collar and its cup descend, the spindle is cleared and exposed afresh to the lubricant. There is one claim for this method of retaining the oil.—No. 4561. March 28th, 1887. 6*d.*

Valve for Vacuum Brakes.—*F. A. Brüggemann, Altona, Hamburg.*—This apparatus is shown in vertical section in the accompanying figure. The casing C is fitted to the train pipe G and contains two valves K and L, the former closing the communication between the train pipe and the passage A, which leads to the brake cylinder, and the latter closing the communication between the valve box open to the atmosphere and the passage B. A flexible diaphragm F divides the space D into two parts; and the tube H leads to the train pipe, and the weight M rests on the upper side of the diaphragm and is connected to the stem N which projects into the passage E. The



check valve K allows air to pass from the brake cylinder into the train pipe and prevents its return, and the valve L closes communication between the outer air and the brake cylinder. When the train pipe is exhausted the space under the diaphragm F is also exhausted through H. The diaphragm is thus pressed down and the pipe I is closed. If air be now admitted into the train pipe, F will be subjected to pressure on its under side through H, and will be therefore raised. Atmospheric air will thus be admitted through I into the bottom of the chamber D, and will pass directly into the train pipe through H. The stem N will raise L from its seat, and thus admit full atmospheric pressure through the top of the chamber D and the passages A B into the brake cylinder. The diaphragm F and valve L will remain in their raised position until the air pressure on both sides of the diaphragm is equalised, whereupon the diaphragm will be pressed down by its own weight, and will close the air passage H and the valve L. The inventor makes two claims for this combination of valves K L, passages I H, and diaphragm F with the train pipe, for the purpose described.—No. 16246. November 25th, 1887. 6*d.*

Lithographing Process.—*C. Salcher & H. Schwertschlag, Harland, Austria.*—The object of this invention is to provide a metal plate which will efficiently replace the costly lithographic stone. A zinc plate is generally used. The plate is first etched with an aqueous solution of nitric acid, in order to roughen its surface slightly; it is then coated with slaked lime and allowed to dry. Owing to the action of the air the lime is partially changed into carbonate, which firmly adheres to the surface when it is brushed. This process may be repeated several times, in order to insure a perfect coat of carbonate of lime. Before the transference of the design to the plate the latter is washed with a strong solution of alum, whereby a small quantity of alumina is added to the coating, so as to render the surface more capable of absorbing fatty substances. The plate is then rinsed with water and is ready for the transfer, which is accomplished in the usual manner. The inventors make one claim for the process, as described.—No. 17162. December 13th, 1887. 4*d.*

Treating Leather.—*H. Golding, London.*—In order to render leather water proof, and at the same time to increase its durability and improve its appearance, the inventor applies a solution of resinous gums, linseed oil, and turpentine. The leather is to be impregnated by this mixture, and not merely coated, and the process is to be conducted while the solution and the leather are warm. The inventor makes one claim.—No. 3860. March 14th, 1887. 6*d.*

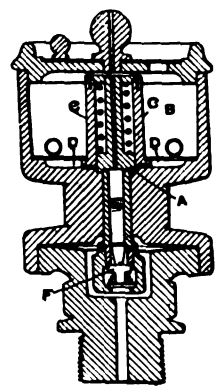
Consumption of Smoke.—*A. M. Clark, London.* (*P. Oriolle, Nantes.*)—This invention applies more particularly to consumption of smoke given off by the engines which drive a torpedo boat, but it is also applicable to any boiler which has a forced draught. The chimney stack is not very high, and is surrounded by an iron vessel of rather greater height, and of five times its sectional area. The gaseous products of combustion, together with the unconsumed carbon, pass up the funnel and down this exterior vessel, and their velocity of descent is retarded in consequence of the greater area of the surrounding casing. In the top of the casing is a perforated iron plate, through which water is pumped. A shower of very finely divided spray enters the smoke space through the perforations, and condenses the gases and carries the soot along with it to the bottom of the casing. The resulting solution passes out into the sea. The inventor makes two claims for this construction of parts for the purpose described.—No. 4749. March 30th, 1887. 8*d.*

Ventilation of Mines.—*J. Taylor, Sunderland, and W. Whitfield, Gateshead.*—The inventors lay branch pipes all through the mine which are connected to a main pipe descending the shaft. Air is pumped down this pipe by means of a fan, and is conducted along the branch pipes to the face of the workings. The air returning along the headings and shafts carries along with it all the gases which it is desirable to clear away. The remote parts of the mine can be reached by this system, as the draught can circulate without there being two openings to a heading. The inventors make one claim for the above method.—No. 17069. December 12th, 1887. 4*d.*

Straightening Steel Wire.—*J. Thornton, Cleckheaton, and W. Walker, Scholes, Yorkshire.*—A metal roller is mounted on bearings, and is either conical or cylindrical in shape. Along its curved surface are spiral grooves, and runners are placed in slots at various points in the lengths of the grooves. The wire to be straightened is led through the tubular bearing of the roller and passes along the spiral grooves; and on arrival at the other end of the roller it is led off through the corresponding hollow bearing. The roller may either be stationary or revolve, and the wire is drawn off the cylinder by suitable drawing rollers. By this process it is found that the wire is effectually straightened and that its properties are not damaged by the action; thus no tempering is required. The inventors make two claims for this improved method.—No. 2484. February 17th, 1887. 8*d.*

GERMAN PATENT ABSTRACTS.

Lubricators.—*B. Heinrich & A. Schoschnig, Posen.*—The lubrication is effected in two periods. In the first period the perforated piston A closes the two oil passages D, and also the cylinder C, thereby preventing the oil from escaping out of B. Air is admitted into E by the perforation of A. In the second



period the valve casing, and with it the oil reservoir E, is lifted by the pressure of the steam, thereby forcing the piston A upwards, opening the oil passages D, and allowing the oil to pass through D into E. As soon as the steam is cut off and a partial vacuum formed, the valve F is opened, and the oil sucked into the cylinder.—No. 41769. February 19th, 1887.

UNITED STATES PATENT ABSTRACTS.

Governor for Steam Engines.—*J. A. Horton, Reading, Massachusetts.*—The four arms supporting the governor balls are arranged as usual in the form of a parallelogram; but the two lower arms support the apparatus in the fixed bearings. The spindle slides vertically in a bearing at the upper angle, where the two higher rods are jointed, and the upward and downward movement of this joint, consequent on the fall or rise of the weights, transmits motion to the valve by means of a rack on the vertical spindle and a pinion on the valve shaft. The inventor makes one claim for this arrangement of the governor.—No. 377028, dated 31st January, 1888.

Journal Bearing.—*M. Randolph, New York.*—The inventor employs a journal and bearing composed of vulcanised fibre, and in order to reduce the friction as much as possible, circular transverse grooves are made in the friction surface. A lubricating material, composed of plumbago and some adhesive cement, is placed in these grooves. The inventor makes one claim for this combination of the journal with the plumbago placed in the grooves.—No. 377049, dated 31st January, 1888.

Compound for Coating Iron.—*J. F. Martin, Chicago.*—In order to protect the surface of wood, iron, and canvas, a compound is made by mixing common glue, paris white, sulphur, and shellac together with any colouring matter which it is desired to cover the material with. The application of colour in this way preserves the surface of the material, and also makes the coat of colour last longer. The inventor makes nine claims for this compound coating.—No. 377081, dated 31st January, 1888.

Traction Cable.—*P. J. Fransze, Chicago.*—A strip of metal with bevelled edges is wound in a coil so as to form a continuous spiral covering for the hemp, or other rope, used in drawing railway cars. This method of construction enables the rope to be easily bent, without any disadvantage to its own construction; and the metallic covering serves to strengthen the rope, and to protect the hempen core. Two claims are made.—No. 377023, dated 31st January, 1888.

Polishing Powder.—*V. Seib, Albany, New York.*—The inventor proposes to manufacture a cleaning and polishing powder from coal ashes. The ashes are re-heated and re-burned, and afterwards boiled in water. On the conclusion of this process the ashes are allowed to settle, and when dried are ready to be used for the purpose stated.—No. 376211, dated 10th January, 1888.

Adding Machine.—*W. F. Gatewood, Harvard, Nebraska.*—In the accompanying diagrams Fig. 1 represents a central horizontal section, and Fig. 2 a vertical section of the improved machine. The apparatus is contained in a box A. The finger pieces C^1 and levers C are connected with the rocking shaft E. The index wheel F is mounted on the horizontal shaft F^2, which is supported

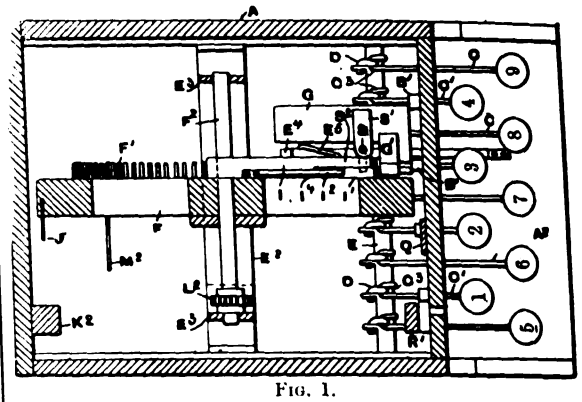


Fig. 1.

on the standards E^3; and round the rim of the wheel are 99 projections F^1. The lever I is pivoted loosely on the shaft F^2, and at its other end is a movable pawl I^1; and the rod E^5 connects I with the lever E^4 and rock shaft E. When one of the number plates C^1 is depressed one of the levers E^4 is raised against the action of the spring E^1, and the arm I is consequently raised. The pawl I^1 travels upwards past as many of the projections F^1 as correspond to the number on the depressed plate C^1, and when the pressure on C^1 is released the pawl I carries the wheel F round with it. The gravity tooth H prevents any

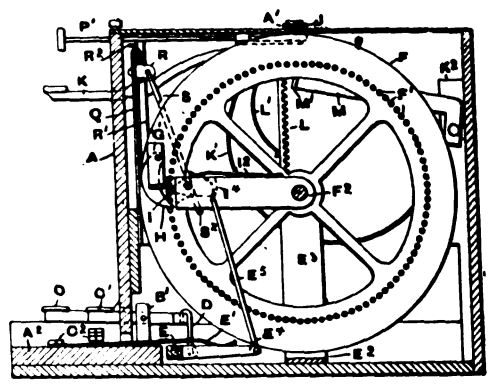


Fig. 2.

accidental backward motion of F. The consecutive numbers from 1 to 99 are placed in series round the periphery of F, and an opening A^1 in the top of the case enables the operator to observe the sum total. A spur and pinion gear registers the hundreds and thousands, which are read off on a dial placed beside the opening A^1. The mechanism above described is for the purpose of adding; there is also some parts of the machine which are used for returning the index wheel to its original position, where it registers zero at the opening A^1 in order to commence a fresh series of additions. The lever K is pivoted to the support K^2, and is held in an elevated position as in the figure by the spring K^1. A rack L is pivoted to the middle part of the lever K, and is held vertically by the spring L^1. In order to bring the wheel back to zero the lever K is depressed so as to bring the rack L into gear with the pinion L^2. The same movement of K lifts the arm 1 and pawl I^1, and the repeated depression of K rotates the wheel F until the stop M^2 on the wheel comes in contact with the projection M, which places the zero mark opposite the hole A^1. The lever P^1 serves to restore the pointer J to zero. The inventor makes eleven claims for this apparatus.—No. 370777, dated 4th October, 1887.

Uniting Pipe Sections.—*A. L. Murphy, Philadelphia.*—The ends of the metal pipes which are to be joined together are made of a slightly greater diameter for a short distance, and a small length of pipe is introduced into the two contiguous enlarged ends. The whole is then placed together and welded into one piece. The inventor makes four claims for this process.—No. 376750, dated 24th January, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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TRIPLE EXPANSION LAUNCH ENGINES.

CONSTRUCTED BY MESSRS. WILSON & CO., VAUXHALL IRON WORKS, LONDON.

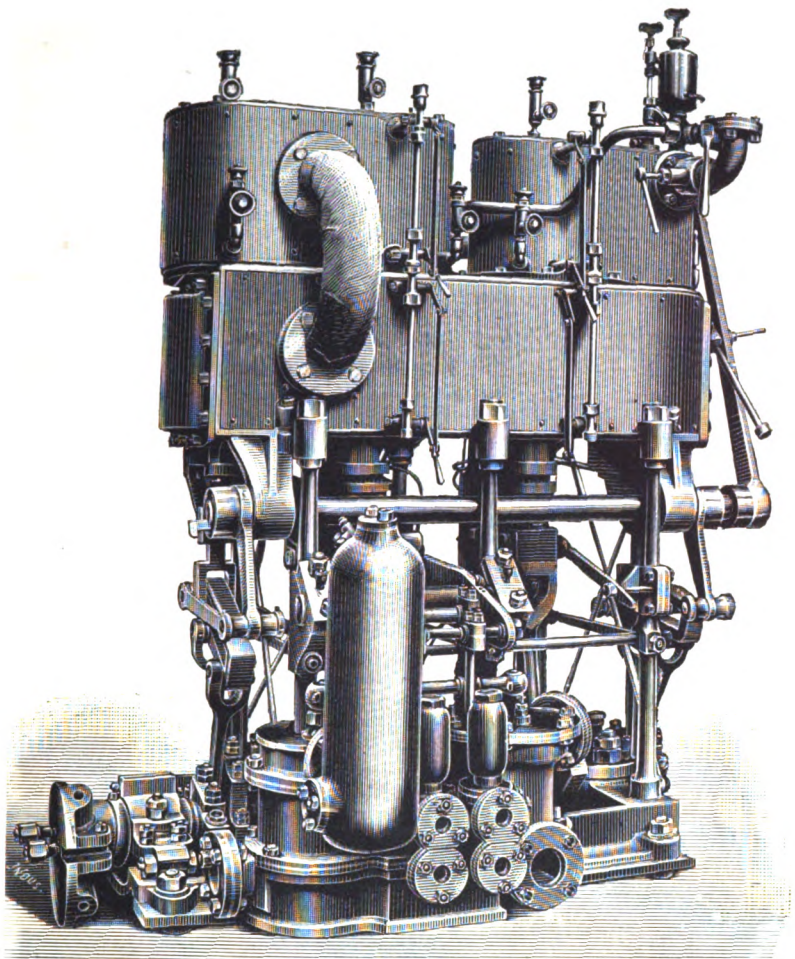


FIG. 1.

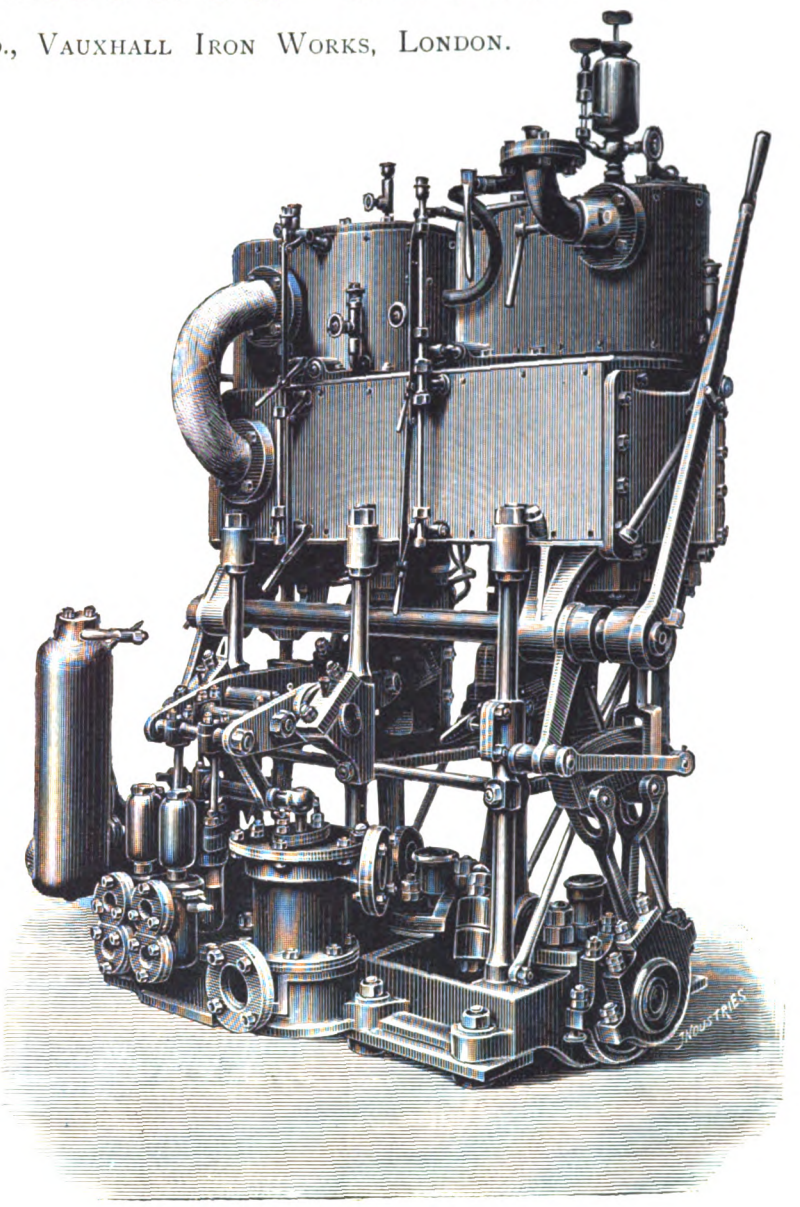


FIG. 2.

A JAPANESE ART COMMISSION.

FOR the past dozen years or so Japanese art has influenced almost all our domestic ornamentation and many of our art industries, and it may interest our readers to hear some Japanese opinions about Western art, as given by a member of a commission of artists and students which was dispatched by the Japanese Government to report on the subject. The official report has not yet been issued; but one of the members of the Commission on his return to Tokio delivered a lecture to the leading native artists of the Japanese capital, and from it we can gather some of the opinions which are likely to be found in the report.

We are pleased to learn that the lecturer believed that it was a duty Japan owed to herself to develop her own methods and ideals, for there has been too great a tendency during recent years for all the truly valuable features in Japanese art to be vulgarised to suit the demands of ignorant foreign visitors. The lecturer before his tour defended Japanese art on national grounds, but his observations during his travels confirmed him in his opinions. While admitting that European art was very fine in itself, he was strongly of opinion that the tendency to copy it in Japan would crush out the peculiar Japanese spirit and individuality; and after a lengthened study of Western fine arts, the social conditions which led to their characteristics, the state of art education, and the relations of modern art to industry, supplemented by conversations with leading art teachers, critics, painters, sculptors, architects, and manufacturers, the members of the Commission expressed the following rather startling opinion: "The new evidence which we have found conclusively proves that good Eastern art is better than the present style of Western, not only for Japan, but also for the whole world; that if Japan will improve her own art from within, it will become not merely a national movement, but one which will spread over America and Europe also. In short, Japanese art, with all its faults, is the only living art in the world to-day; and if she be true to her own best inspiration, in comparatively few years Japan will become the acknowledged centre and leader of the fine arts in all civilised countries." We may discount the rather lofty language used here, and which was recently made the subject of a clever cartoon in *Punch*; but anyone who knows anything about Japan will know that there is a great amount of truth in it. It is no exaggeration to say that the Japanese are the most artistic nation on the face of the globe, and if they cultivated their own style of art productions, and maintained a high artistic standard, they would have little difficulty in practically keeping a monopoly of their own specialties. The lecturer dwelt on the advantage to Japan, on the economic side of the art problem. He stated that in his opinion there is almost no such thing to-day as good European design; that the capacity for designing died out several centuries ago, and that the divorce between "painting" and the "decorative art" wrought by the sixteenth century paralyses the power of both. No such divorce has ever taken place in Japan, and because "she can design to-day, she can become, if she will develop her own powers, the great manufacturer of fine art products for the world. For Japanese, then, to introduce European methods of art education, would be to kill out their own power of design, and destroy their own economic future. But if Japan develops her own methods, and follows her own ideals, Europe and America will be forced to come to learn of and buy from her."

The lecturer entered into an interesting comparison of Japanese and Western methods; but into this we cannot enter, our chief object being to direct attention to the industrial aspect of the question, and to show our art manufacturers that if the spirit indicated by the Commissioners develops in Japan, they will have in that country one of their most powerful competitors.

TRIPLE EXPANSION LAUNCH ENGINES.

THE accompanying illustrations show a set of triple expansion surface condensing engines for a 50ft. steam launch, built for the use of the Admiralty officers at the Keyham and Devonport dockyards. The engines have been supplied by Messrs. Alex. Wilson & Co., Vauxhall Iron Works, London. The two perspective views (Figs. 1 and 2) are from photographs supplied by the makers, whilst the sectional elevation has been reproduced from the Proceedings of the Institution of Naval Architects. There are four cylinders—two low pressure, one high pressure, and one intermediate cylinder, the last two being placed directly over the low pressure cylinders. These are both 12in. diam., the intermediate cylinder is 10in. diam., and the high pressure cylinder 6in. diam. The stroke is 8in. The piston and valve rods pass through internal metallic glands. There are only two cranks, and this arrangement was adopted to secure economy of room, the length available in the launch not permitting the use of a three-crank engine. Piston valves are used for the high and intermediate cylinders, and ordinary slide valves for the low pressure, as shown in Fig. 3. There is no steam reservoir between the cylinders beyond the ordinary passages and connections. The pumps are worked from the piston rod cross heads. There are two feed pumps, each capable of supplying the requisite quantity of water; the air pump is 7½in. diam., and the circulating pump is 5⅜in. diam.; the crank shaft is 3in. diam., of wrought steel, and the piston and connecting rods are also of steel.

The surface condenser supplied with the engines has 225 solid drawn tubes ⅝in. in diameter, and presents a total cooling surface of 120 sq. ft. The boiler supplied for the engines is of the ordinary cylindrical return tube type, with one circular furnace. It is worked at 140lb. pressure, and is constructed entirely of Siemens-Martin

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TRIPLE EXPANSION LAUNCH ENGINES.

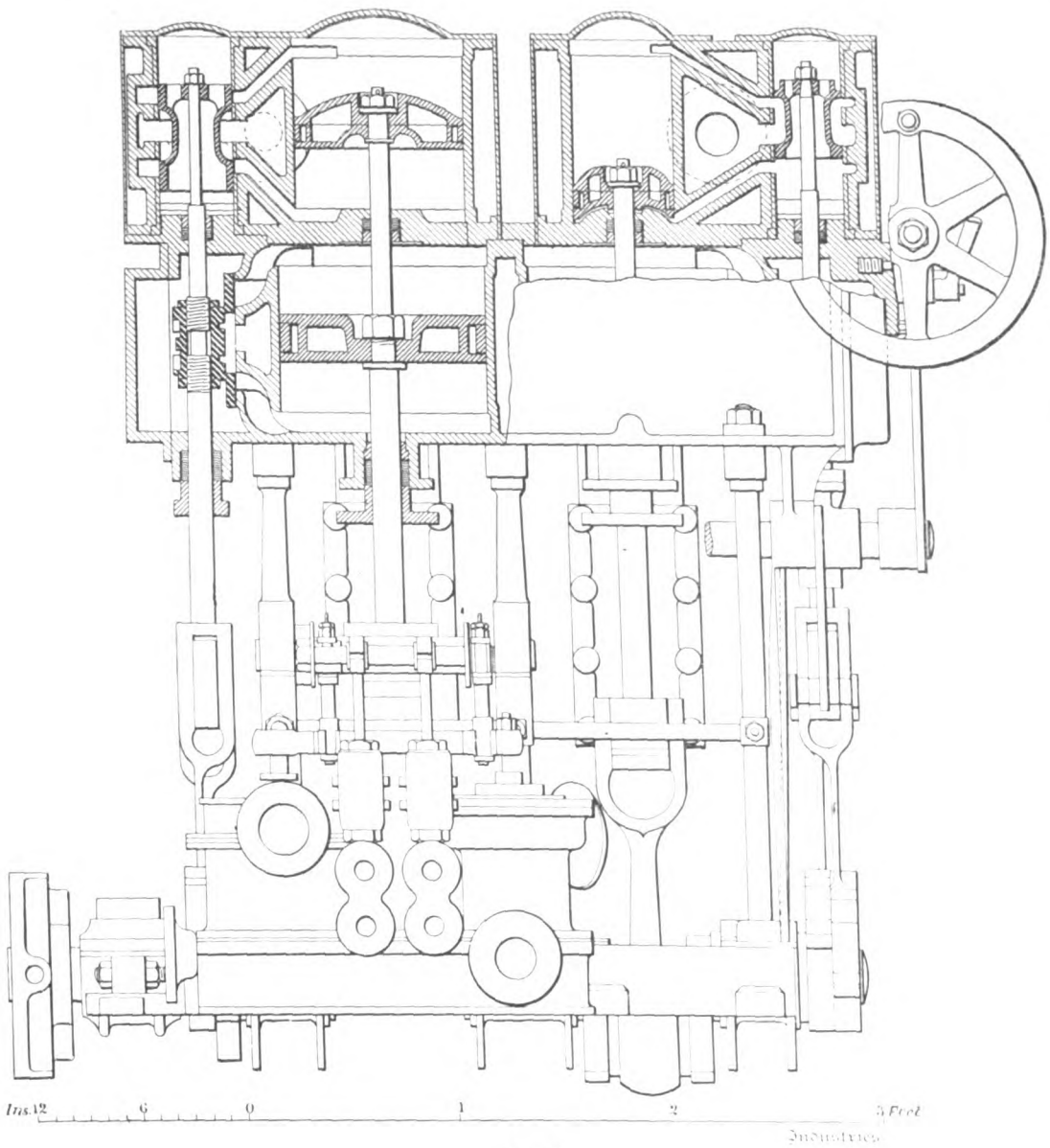


FIG. 3.

steel, the transverse seams are double riveted, and the longitudinal seams treble riveted. The shell plates are $\frac{9}{16}$in., the end plates $\frac{5}{8}$in., and the furnaces $\frac{7}{16}$in. The grate surface is 10 sq. ft., and the tube surface 180ft. At a trial trip of three hours' duration, the consumption of coal was found to be 2·54lb. per i.h.p. per hour. The mean pressure in the cylinders was 51·1lb. for the high, 36·9lb. for the intermediate, and 10·5lb for the low pressure cylinders, the boiler pressure being 139·1lb. per square inch. The total i.h.p. was 70·8, giving 7·08 i.h.p. per square foot of grate surface, and about 1 i.h.p. for every $2\frac{1}{2}$ sq. ft. of tube surface in the boiler. The speed of the launch was 9·26 knots per hour, the crank shaft and screw making 283·4 revolutions per minute. The screw is 3ft. 6in. diam., 4ft. $1\frac{3}{8}$in. pitch, and made of gun metal. The engines are supported on cast iron bed plates by a wrought iron frame work, with diagonal stays. The valves are worked by double eccentrics and link motion at each end of the crank shaft. The engines have been designed to suit a launch already built, and as these small craft are frequently employed on detached duty, the quantity of coal to be carried is of importance, and it was for this reason that triple expansion was adopted. The result of the trial shows that the economy resulting from triple expansion is not confined to large engines; and the fact that 70 h.p. has, at a moderate speed, been obtained from steam passed through a 6in. high pressure cylinder, is significant of the degree of perfection which the triple expansion principle has now attained.

ITALIAN RAILWAYS.

MR. J. G. KENNEDY, Her Majesty's chargé d'affaires at Rome, is informed that the Italian Minister of Public Works has undertaken to formulate proposals for the future construction of railways in Italy. Three plans are to be adopted, the first being the construction by the State at an expense of £18,960,000, spread over four years, of lines already commenced, and of other lines which could not conveniently be conceded to private enterprise. The second is for the concession of construction and working of a certain group of railways to the Southern Railway Company, which is to construct and work the system at yearly payments of £822 per kilometre, to be paid from the date of the completion of the works up to the year 1996. By the third plan concessions will be given to the highest bidder for the Rome-Naples, Eboli-Reggio, and Messina-Cerda lines. The object of the scheme, which has to be passed by Parliament, is to promote railway construction without imposing immediate heavy expenses on the Government.

THE COTTON INDUSTRY AND TECHNICAL EDUCATION.

THE cotton trade of this country, holding, as it does, an important position amongst our manufacturing industries, suffers perhaps more from the keenness of competition than that of flax, woollen, or silk. English and Scotch manufacturers are not only handicapped in the race for existence by the immense production of home concerns, but are now feeling the serious effects of being undersold in foreign as well as in their own markets at home by the cheaper, although less substantial, products of foreign manufacture. With the low wages paid, and long hours worked by foreign artisans, the position of our producers is no doubt a precarious one, and as each year competition from abroad must necessarily increase by the establishment of manufactures where they do not now exist, and by their extension where they have already found a seat, we can only hope to retain our supremacy for some years longer by the production of a better article in appearance and quality, and in the working of our machinery with more economy and advantage. Technical education has of late contributed, to some extent, towards improving the capabilities of many of the young men connected with our manufactures; but considering the number employed in mills and factories, the percentage of technical students is yet extremely small. Every year, however, will, we hope, see some development of this system of instruction, for technical schools are now recognised as not only useful but essential institutions.

Some years ago it was the general opinion among manufacturers that their employés should only be allowed to obtain a knowledge of some one particular department, any attempt to gain an insight into the others being strictly forbidden; but this narrow minded system is now happily dying out, and many manufacturers are now found among the chief promoters of industrial education. Without instruction of this kind, we may easily realise that the heads of the various departments in our mills and factories must, to a great extent, be merely experimentalists. Suppose, for instance, we take the case of a young man brought up in a cotton mill through the successive stages of lap carrier, stripper, grinder, and under carder; and that after mastering the various details and work attached to these positions, he finally obtains an appointment as head of a department. He may attend well to his duties, and devote his time and energy to producing increased work, either by alteration in the existing arrangement of weights, speeds, or system; but having only his own practical experience to guide him, he is forced to try one plan after another to achieve success, whereas, had he been properly taught, he would, in addition to his own knowledge, have possessed the combined experience of others who had passed through these various experimental stages before him.

From a proper course of technical education numerous other advantages are to be derived. For example: a knowledge of the mechanical structure and other properties of the material used, and of the various uses to which it is to be applied, also the best methods to adopt in order to work it with full advantage at any particular process, and so that it may be best adapted for those which succeed it. Not long ago, the majority of those who held responsible positions in cotton mills were entirely unacquainted with the different divisions of the cotton plant product, and the characteristics which distinguish the various fibres. To be able to discriminate between long and short, dirty and clean, and strong and weak cotton, was—and is in some cases even yet—looked upon as all that is necessary to constitute an accomplished buyer, and one in whom the greatest confidence might be placed. At the present time even, when education in almost every other department of industry is so far advanced, we may safely assert that not one per cent. of the operatives employed in cotton mills know anything whatever of the cotton fibre beyond its delicate, silky, outward appearance. Twenty years ago, education on such a subject was, even on the part of the managers and overlookers of spinning factories, not necessary or essential, and in fact practical knowledge of the business could have been dispensed with on the part of the manager, if he possessed tact, commercial ability, and sufficient general experience of the work in the various departments to enable him to pass through the ordeal of an ordinary conversation. Little else at that time was required, as competition like that felt at the present was almost unknown, and therefore quality, quantity, and economy in production beyond a very moderate standard was never expected. The demand from consumers was always in excess of the supply of both cotton yarns and cloth; consequently, instead of having accumulated stocks, companies could then dispose readily of their produce at rates which left ample margin for the payment of large profits to the shareholders. Now, however, the position of affairs is altered; and managers and overlookers should therefore be men of recognised ability, and be practically acquainted with every detail of the processes employed in converting the raw cotton into finished yarn, and finished yarn into cloth.

In short, if we are to retain our manufacturing supremacy, it must be by rendering our spindles and looms capable of rapidly producing cheaper and better articles than our foreign competitors. This object we can only hope to accomplish by business energy, and by imparting to our workpeople a more intimate knowledge of the raw material, and the distinctive features of each variety. In this way any part of a process which might be liable to injure its natural qualities could be avoided, and probably something else substituted with equal, if not better, effect. The treatment of all classes of textile fibres in manufacture may be compared to that pertaining to the human body; for, in the latter case, unless the physician understands the nature and root of any disorder, it is not to be expected that he will be able to successfully prescribe. Similarly, therefore, in the working of cotton, it is obvious that unless those who may have the arrangement and working of the machinery under their charge thoroughly understand the characteristics and structure of the various fibres, they cannot properly determine the treatment to which it is best adapted, or which may be conducive to the protection of its qualities and properties.

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The position of mill manager is, as one would naturally suppose, the chief and most important in connection with a cotton factory. On him the responsibility for the success of the concern directly rests, and, although other matters, over which he may have no control, such as dull trade and low prices, may bring about unprofitable results, incompetency on his part is usually considered the cause of them by suffering shareholders. A manager's position, especially in limited companies, is not at the present time an easy one, requiring, as it does, constant and unremitting care, study, and attention. Even under favourable circumstances he is always subject to the responsibility arising from incompetency or neglect on the part of some of his numerous employés. In some mills the manager is also yarn and cloth salesman, though the custom generally adopted is to have a special salesman for this part of the business; but here, again, he is often placed under a false responsibility, as any losses occasioned by the salesman does not appear separately on the balance sheet, but is included in the item termed "loss on the quarter's working." For everything that goes wrong in the mill, the manager is rightly held responsible; but in many cases where the working has been unprofitable, an impartial investigation might reveal the fact that he was in a great measure free from blame. The manager of a spinning mill should be a man of tact, energy, and general ability; he should possess a thorough practical knowledge of the working of all classes of cotton, the blending of different varieties together, and the details of each machine in the mill and its principle of operation—from the scutching to the warping department. He should be able to work out all calculations in connection with the entire industry, and have a good knowledge of engines, gearing, and shafting. While doing his duty to his employers, he should cultivate an agreeable feeling amongst his workpeople, and endeavour to induce and sustain a friendly rivalry between the operatives in each department. He should daily inspect the working of each machine, and personally test what percentage of waste is being made at each operation. At different periods he should have the covers of the carding engines removed, and not only examine the condition of the wire, but gauge the working parts. Where combing machines are used, he should frequently inspect the top combs and cylinders. Generally speaking he should supervise everything in connection with the mill, even to the minutest detail, and leave nothing entirely to the care and discretion of those under him.

The salaries attached to the position of manager vary in modern mills from about £180 to £800 per annum. The following are average salaries for English managers at the places named:—

	£		£	Approximate average per annum. £
Bolton	180	to	800	400
Oldham	180	to	400	280
Germany	250	to	600	450
Russia	400	to	1,500	1,000
India	400	to	1,000	600
America	400	to	1,000	600

Coming now to the weaving manager, anyone holding this position should have general qualifications similar to those already stated. Unless he is competent to produce every variety of fabric, and to judge all varieties of yarn, the advantages obtained from his services will not be of much worth. He should, in addition, be a good designer and practical weaver, and be able to superintend his workpeople with care and kindly firmness. The salaries attached to this position are in England only about one-half those already given for general manager.

The secretary of a cotton mill should of course be a man of trust and integrity. He should have a good commercial education, and although a practical knowledge of the manufacture is not essential in his case, general information on the various details of manufacture is an advantage. He should be a good book-keeper and correspondent, and energetic and methodical in all his transactions. Cotton mills have now become so much like large banking concerns, that the secretary should be a good financier in order to discharge his duties efficiently. He has the loan business and the issue of deposit books to look after; he has the interest on the loans to make up and pay by cheque or warrant; he has the share capital to attend to, and he must ascertain each quarter the liabilities and assets of the company. He has also to prepare and publish the balance sheets, and to carry out the payment of dividends, while all work common to business offices comes under his charge. It will thus be seen that the secretary's position is not a sinecure, and that neglect and carelessness in the discharge of his duties must result in great loss and confusion. The salaries attached to the secretarial office are not very large, ranging from £70 to £250 per annum, the average salary in modern mills being about £150 per annum.

Referring now to the carding master, the man holding this position should be brought up in each department, and have had experience in the working of several forms of carding engines. He should be a competent grinder, stripper, and setter, and able to undertake, if required, any alterations or repairs which may be necessary in his department. He should be a good judge of cotton, and be able to attend to the mixing, or to the setting of the rollers or machines for the working of any or every kind of cotton. He should act carefully as regards the consumption of various materials, such as belting, oil, filleting, &c.; and he should be strict in the management of the workpeople placed under him. The average wages of English carders are as follow:—

	£	s.		£	s.	Approximate average per week. £	s.
England	1	10	to	3	0	2	0
Germany	2	10	to	4	0	3	0
Russia	3	0	to	6	0	4	10
India	3	0	to	9	0	5	10
America	3	0	to	5	0	4	0

The position of combing master is generally only required in fine spinning mills, and competent applicants for vacant positions are consequently never very numerous. In the working of combing machines, more study, carefulness, and attention are required than for any other class of machines. Upon this process the quality and value of the yarns produced materially depend, so that no one should be entrusted with this responsibility except he has had a large experience in the work. The wages paid are about 5 per cent. or 10 per cent. less than to carders. During recent years, the position of the spinning master has improved considerably both in responsibility and remuneration, although the applicants for vacant appointments are more numerous than for any other department. To be a competent spinning overlooker, a man must not only be a practical spinner, and have a thorough knowledge of the various kinds of machinery in use, but he requires to be able to make any change required, either in hank or twist. He should also be a good judge of yarns, and the characteristics they should possess to adapt them to the manufacture of various fabrics, laces, or threads. The wages paid to spinning masters are about the same as paid to carders.

RAILWAY CARRIAGE AND WAGGON WORKS.

By M. Powis Bale, M.Inst.M.E., Assoc.M.Inst.C.E.

III.

(Concluded from page 185.)

Passing next to the various planing machines, No. 13 on the plan represents a combined roller feed, planing, jointing, tongueing, grooving, and moulding machine, especially adapted for planing carriage floor boards, chamfered waggon sides, soles, &c. Perhaps the most useful size for railway work is a machine to plane wood up to 16in. by 6in. Angling side cutters will be found an advantage for beading and chamfering, as well as tongueing and grooving. No. 14 is a trying-up and planing machine with travelling table, useful in planing to dimensions, and taking out of "winding" waggon and carriage soles, cross bearers, stretchers, buffer beams, and such like heavy work. It will also be found advantageous for edging to gauge, as several waggon soles, or a number of boards, can be cramped together on edge and passed beneath the cutters at one time. No. 15 is a machine specially adapted for planing carriage panels and such like work. It should be fitted with vertical side cutters, so that panels, &c., can be planed and tongued to fit into the uprights and door frames without hand finishing. For working thin and valuable woods, spiral cutters may be used, as they are less liable to split thin pieces. The machine planes up to 30in., and is driven by two belts, one at either end of the spindle. A variety of hand feed surface planing machines have been introduced recently, and one or two of these would be found extremely useful in a railway carriage works for the interior joinery, surfacing, jointing, chamfering, and mitreing. The tenoning machine (No. 16) should be specially adapted for cutting single or double tenons on the sides, bearers, and diagonals of the under frames of carriages and waggons. Owing to the weight the table should be arranged with a self acting traverse motion, and to swivel. The table should be wide enough to take four waggon sole plates at once, and double tenons can be cut on them at one passage of the table past the cutters. The table is then swivelled round, and during its passage backwards tenons are cut on the opposite ends. Tenons on the diagonal can also be readily cut by this arrangement. The middle of the three cutter heads should be made movable, and the machine can then be used for rebating the ends of the sole plates for the iron rings. An extra slide carrying a cross-cut saw is useful, so that all the pieces of timber can be brought to one exact length at the same time that the tenons are being cut. One great advantage of the swivelling table here referred to is that when once the wood is fixed all the tenons are cut without its being moved, and they are all exactly parallel to each other. The table should also be arranged to cant for cutting diagonals. For cutting tenons with shoulders of unequal length, the sliding brackets carrying the cutter block spindles should be arranged with lateral as well as vertical adjustments. This may be effected by mounting the brackets in dovetail slides, and adjusting them laterally by a hand wheel and screw. These slides should be marked so that shoulders of unequal length can be cut to any desired gauge. The spindles for cutting double tenons should also have both lateral and vertical adjustments. To cut shoulders of unequal length, cutter blocks are sometimes shifted on their spindles; but this plan is both dangerous and uncertain, and should not be used.

Another form of tenoning machine is sometimes used for railway carriage work. In this the wood to be worked is cramped on a table. The cutter blocks, of which there are three, begin cutting upwards, and stop automatically when at the top. One end of the timber being thus completed, it is pushed through the machine on to another table, and being held in a similar manner, is operated upon by the cutters moving downwards. A small tenoning machine (No. 17) is also needed for light work, such as railway carriage window frames. Tenoning machine cutters should be arranged to work diagonally to the grain of the wood, and it is found in practice that the nearer the cutters act with the fibre of the wood the smoother the work. For heavy railway work, the cutting edge of the irons should have a speed of from 3000ft. to 3500ft. per minute; but in light machines this speed may be increased to 4000ft. per minute. The illustration (Fig. 15) represents a double tenoning machine, newly designed by Messrs. Thomas Robinson & Son, Limited, Rochdale, for cutting tenons on railway carriage and waggon soles, and heavy work of that class. The timber is placed on the table, which is arranged with a self acting feed, and traversed past the circular saw, which cuts it to the required length. It then passes through the tenon cutters, which cut tenons on the one end. The table is then swivelled, and tenons on the other end of the timber are cut in a like manner. The table is also made to swivel for cutting tenons on the diagonal. The cutter spindles are mounted in sliding brackets, adjustable vertically and horizontally, and the saw can also be adjusted laterally to cut timber of different lengths. Another form of tenoning machine especially adapted for cutting single or double tenons on the ends of sole bars, and diagonals, of railway carriages and waggons is illustrated by Fig. 9. It is from the designs of Messrs. A. Ransome & Co., Chelsea, London. As will be seen from the engraving, the cutters are bolted to blocks, mounted on a vertical spindle. The timber to be tenoned is carried within cast iron brackets, bolted to the main frame of the machine on either side. The timber is held in position by screw cramps, and when once fixed does not require moving, as after one end is cut it is traversed to the opposite table till the other end is in a position to be operated on. This is a distinct advantage in heavy tenoning machines, where the labour of moving the timber is considerable; and at the same time much greater accuracy is secured. The cutters are traversed past the end of the timber by means of self acting gearing, and cut one tenon when travelling forward and the other when returning.

A very important operation in the construction of railway carriages and waggons is mortising. Some of the mortises—especially those in the under frames—are of considerable width, and difficult to make in hard wood. Two types of machines are in general use—the reciprocating and the rotary—but these two types have also been combined in one machine with success. For many years vertical reciprocating machines with a positive stroke have been chiefly used, but latterly some works have adopted a graduated stroke machine. This latter—which is of American origin—possesses some distinct advantages. It can be worked gradually into the mortise from a point above the extreme upper throw at the will of the operator, and with much less jar and vibration than the positive stroke machine. This arrangement, however, has the disadvantage of increasing the number of wearing parts in the machine. By combining a rotary or routing mortise tool with a reciprocating chisel, the former may be used for roughing out the mortise, and the latter for squaring the ends; and in establishments where head stocks and soles are recessed as well as mortised, the routing tool can be used for this purpose also. In heavy mortising machines, if the chisel is arranged to drive from the base of the machine, increased steadiness in working is secured. In mortising hard wood a clearance hole for the chisel should always be bored. The best form of chisel for general purposes is a double-lipped one, with a portion of its groove parallel, and then tapered off. With this arrangement the core of the mortise is withdrawn as the parallel lips grip, and retain the chips, which are afterwards discharged through the taper clearance. In sharpening this chisel the side lips

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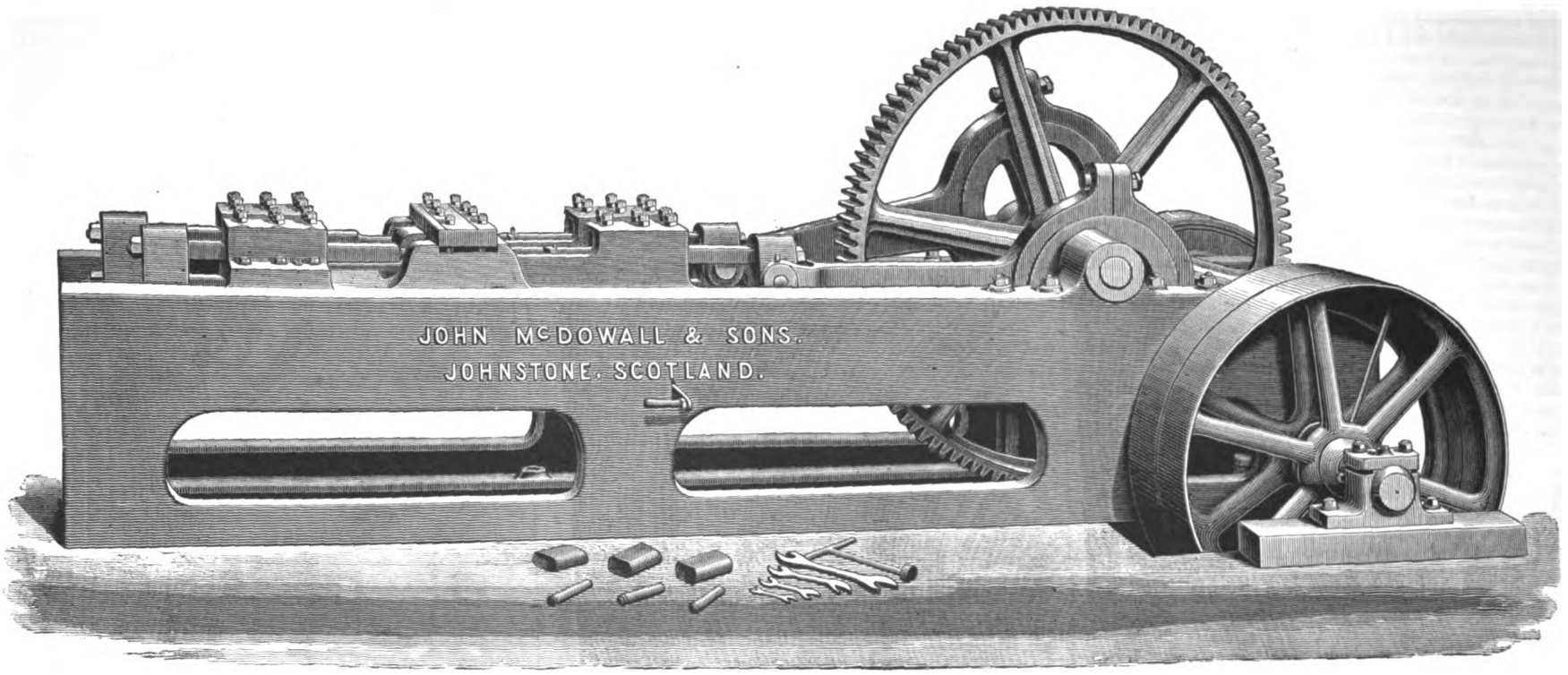


FIG. 8.

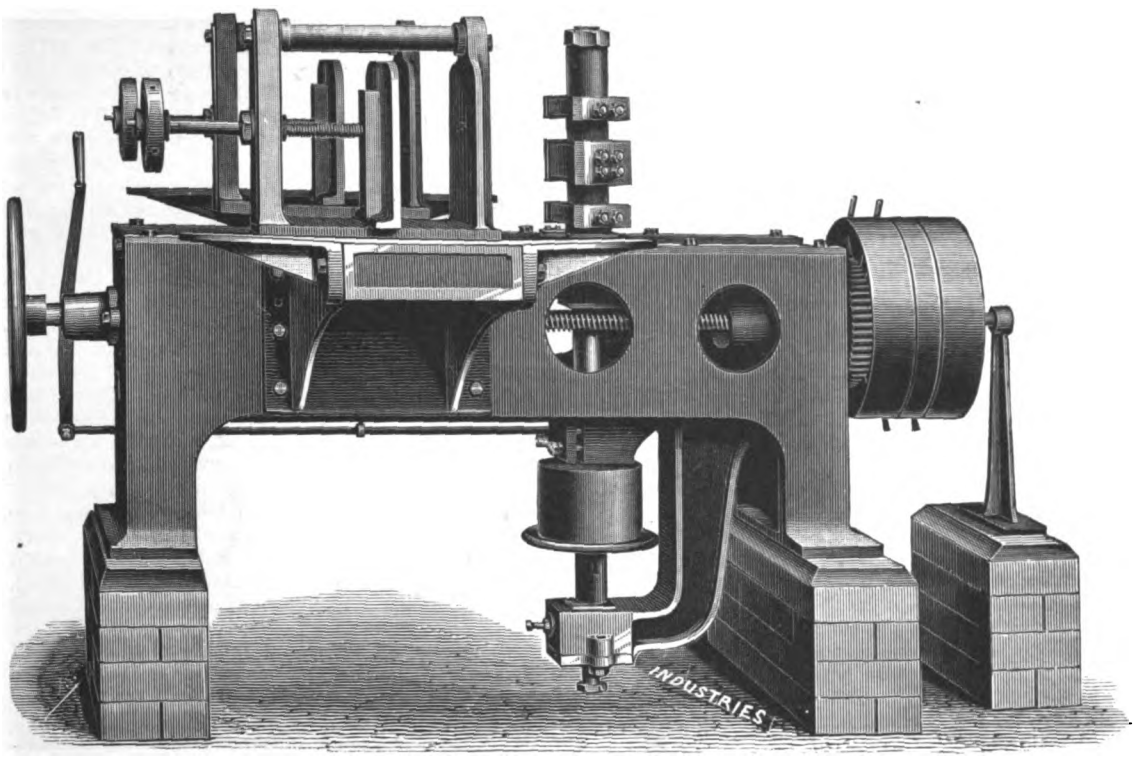


FIG. 9.

should not be touched, but kept at the same angle, and the points at the same projection. In working heavy machines making mortises up to say 3in. wide, a speed of from 175 to 275 strokes per minute will usually be found suitable. For light mortising, with a movable table, a speed of from 275 to 400 strokes per minute may be attained. The spindles of rotary machines are usually speeded to make about 2000 revolutions per minute for working soft wood, and 1200 revolutions for hard wood. Fig. 11 represents a combined routing and squaring out machine, especially adapted for railway carriage framing, &c., from the designs of Messrs. George Richards & Co., Limited, Broadheath, near Manchester. The general arrangement of this machine can be readily gathered from the illustration. The table upon which the wood is placed has horizontal and vertical adjustments, and is fitted with a series of rollers, all geared together, which enables the wood to be traversed through the machine rapidly. Suitable stop pieces are fitted to the table, to regulate the position and width of the mortises. Passing to the boring machine (No. 20), this should be preferably a vertical multiple spindle machine carrying three or four spindles. The object of having multiple spindles is to avoid the loss of time in constantly changing the bits, through the holes in carriage work, soles, &c., varying considerably in size. The boring spindles should be mounted in a sliding bracket, having a transverse movement across the face of the main column, as this obviates the frequent shifting of the timber. For boring head stocks, sole bars, &c., the table is best mounted on rollers, and an additional standard with rollers should be placed about a yard from either end of the table for supporting long pieces. The rollers supporting the table may be driven by toothed gearing, and the table traversed, as may be desired. This plan of driving the table and the transverse movement of the boring bits will effect a very considerable saving over the ordinary plan, as the bits may be brought into action at any desired point on the face of the timber. The bits should make about 1500 revolutions per minute, and for rapidity of work a slightly modified form of the American screw auger will be found useful. The illustration (Fig. 14) shows a four spindle boring machine, specially designed for railway carriage and waggon work, by Messrs. Thomas Robinson & Son, Limited, of Rochdale. The head stock carrying the boring spindles is adjustable transversely, so as to allow of the position of the augers being quickly varied. The timber to be bored is fixed on the travelling carriage, which is traversed longitudinally by means of a rack and pinion gear. The double vertical spindle shaping and moulding machine, indicated on the general plan by No. 29, will be found extremely useful for interior carriage work, window sashes, &c., also for narrow planing and rebating. The spindles are arranged to rise and fall and revolve in opposite directions, so that the wood being worked can be passed from one spindle to another to suit the grain of the timber. Ordinary flat cutters shaped to the desired profile are usually employed, the wood to be shaped being mounted on a template to the desired form. The cutters are either mounted on blocks or secured between collars by means of end pressure. The latter arrangement is generally to be preferred, as sharper curves can be worked than with blocks. Where a large quantity of work of the same profile is required in lieu of blocks, solid steel saucer-shaped cutters may be used with advantage. In these the profile of the desired moulding is turned on the periphery of the cutter, which is sharpened inwards, certain openings being provided for that purpose. This form of cutter is much more costly than the ordinary flat cutters, but possesses the advantage that it never alters the shape of its profile, even if the sharpening is badly done. In using flat cutters, if any difficulty is found in keeping them all to the same profile, one cutter on each block may be dispensed with, its place being filled by a steel blank. Care must be taken, however, that the blanks and the cutters balance each other, or the work will be marked and irregular, owing to the centrifugal force set up. The cutters should travel about 5000ft. per minute. A considerable saving over hand labour in preparing panelling and similar smooth surfaces for varnishing can be effected by using a scraping machine, such as illustrated in Fig. 12, from the designs of Messrs. George Richards & Co. The wood is smoothed by means of a blade having a burred or turned edge, after the fashion of a hand scraper. The blade is held in a clamp, and the wood passed over it by feed rollers; the stock is pressed against the wood by an adjustable spring, and a light shaving is taken from its surface. It is necessary to the successful working of this machine that the scraping blade be ground perfectly straight on the face and bevel, and the scraper edge turned properly. This is accomplished by a machine illustrated in Fig. 13, the grinding being done by an emery wheel, the dust from which is removed by an exhaust fan. In establishments where large numbers of carriages are turned out, a self feeding sand papering machine for panels, &c., may be used with advantage. This consists of a modified form of roller feed panel planing machine—the rollers being covered with sand paper instead of cutter blocks. A cylindrical dusting brush for cleaning the wood is also fitted, and any desired pressure may be put on the sand papering rollers by means of hand wheels and springs; and the speed of the feed may be altered as desired. A very useful form of machine for sand papering work after it is put together is what is known as the flexible arm disc machine. This is usually hung from a wall bracket or separate column, and consists of a disc covered with sand

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RAILWAY CARRIAGE AND WAGGON WORKS.

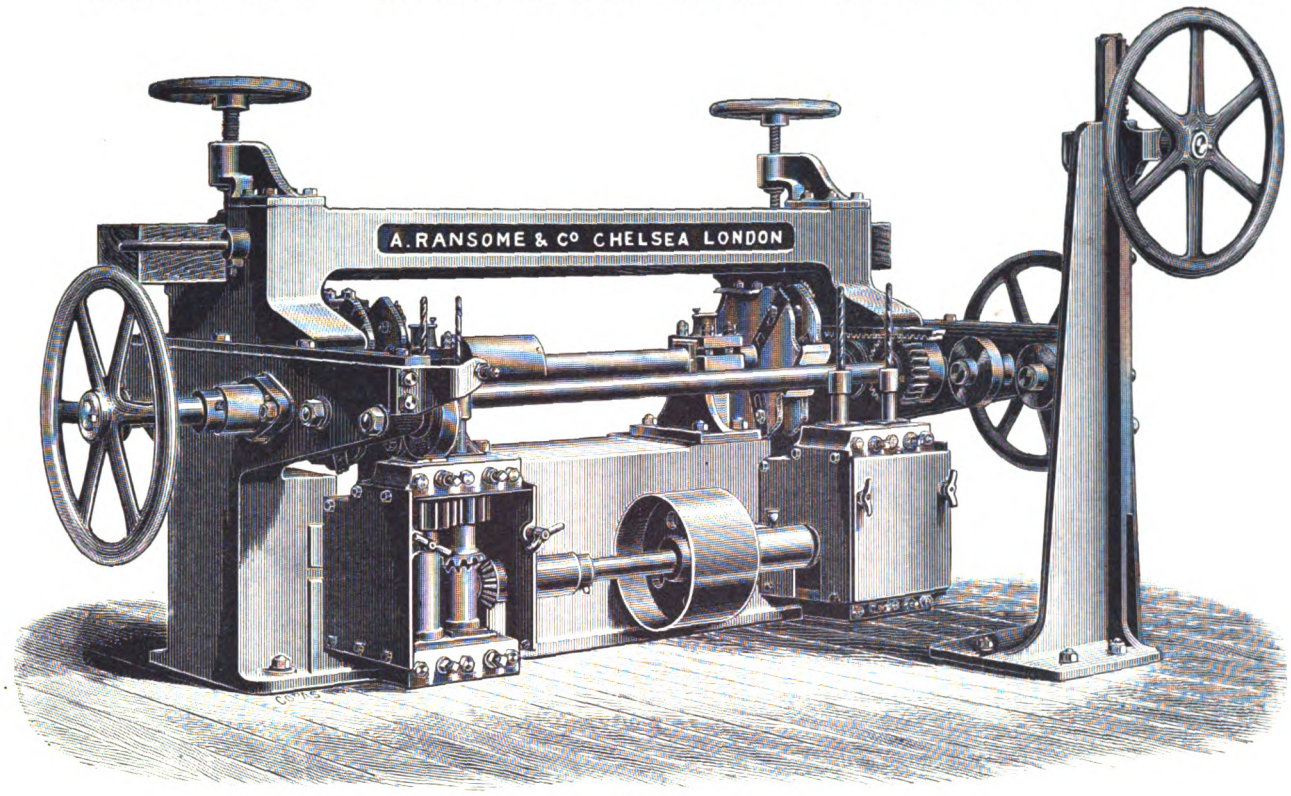


Fig. 10.

paper, which is made to revolve at a suitable speed. By means of several flexible arms or elbow joints the disc may be moved in any desired direction by the workman; the wood being placed on a table beneath it. The disc is made adjustable to different thicknesses of wood by means of a hand wheel and screw. A small exhaust fan is usually attached to the block which carries the sand paper disc, and rapidly removes all dust from the face of the work, and the operator is thus able to see at a glance when the right amount of finish is obtained. For short pieces or irregular work a plain revolving drum covered with sand paper, or an endless band covered with a composition, can be used.

All wood converting establishments should have a tool sharpening room, with a complete equipment of sharpening machines for circular, straight, and band saws, plane irons, &c. These should be placed under a man of the highest skill, who should be held answerable for the complete equipment and condition of all the cutting tools in the works, as it goes without saying that unless they are kept in what may be justly termed scientific order, the result is loss of power and wood, and a reduced output of inferior quality. The sawyers should not be allowed to sharpen their own saws, as it is generally found that each one of them has different ideas as to the proper method of performing that operation. Any judicious outlay in the tool and sharpening room is money well invested, as on it depends to a very considerable extent the successful working of the whole establishment.

Although not strictly within the scope of this paper, an important matter in railway economy is the manufacture of keys and treenails. Fig. 8 represents a powerful machine for compressing keys or treenails, designed by Messrs. John McDowall & Sons, of Johnstone, near Glasgow. In this machine the main spindle gives motion, by means of eccentrics, to two bars or rams which drive the keys or treenails into dies, and two bars which drive them out again when compressed. It can also be used for compressing parallel keys, which are driven through the dies one after the other at each stroke of the machine. When used for this purpose, the two return bars are removed. A slight modification allows the machine to deal with keys steamed under compression. In this case it is fitted with two bars for driving in and two bars for driving out the keys or treenails. The makers claim for this machine an output —when dealing with parallel keys—of some twenty per minute, and with keys steamed under compression about twelve per minute.

Fig. 10 represents a combined sleeper adzing and boring machine specially adapted for sleepers of very hard woods, designed by Messrs. Ransome & Co., of Chelsea. The sleeper to be cut is cramped by square threaded screw cramps to a cast iron carriage, running on large turned rollers, and capable of being fed over the cutter blocks by means of a rack and pinion motion, actuated by large

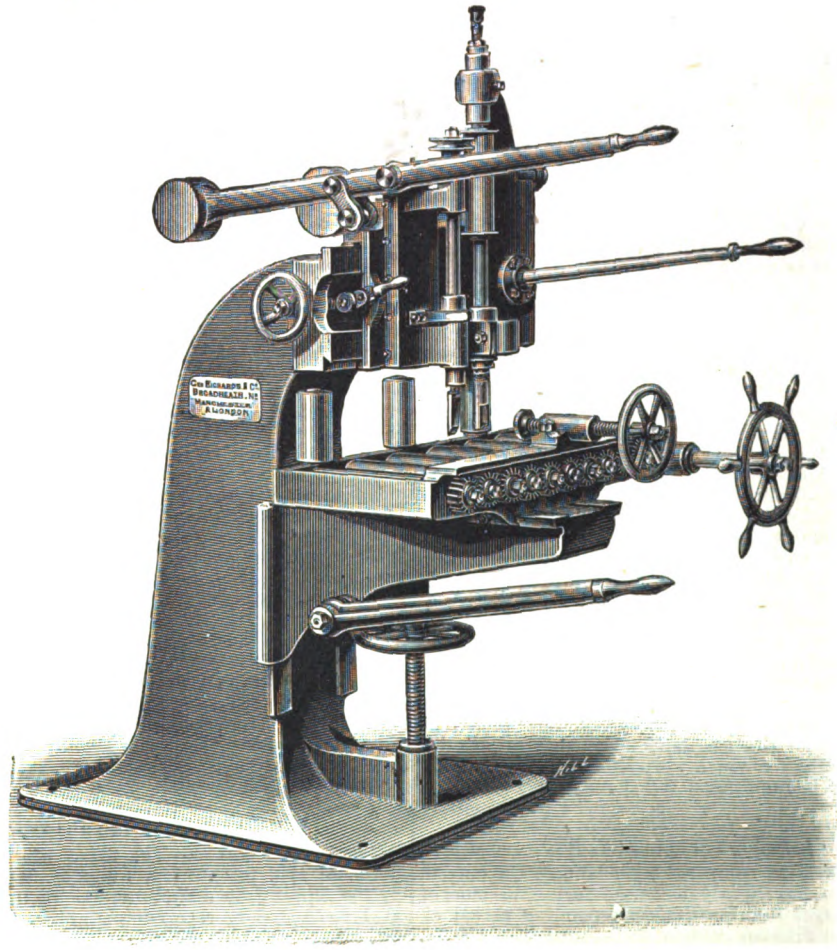


Fig. 11.

hand wheels, one on each side of the machine. The cutter blocks are of comparatively large diameter, and provided with three adzing cutters and six shoulder cutters. The main frame of the machine consists of a hollow box bed or standard of cast iron, carrying two side brackets for the rollers of the travelling carriage, and the saddles for the boring spindles. The boring spindles are of steel sliding in cast iron sleeves, and all four spindles are capable of being fed up simultaneously towards the sleeper by means of a rack and pinion motion, actuated by the hand wheel on the standard shown to the right of the illustration. The boring spindles are geared together in pairs, and driven by mitre wheels from a horizontal counter shaft attached to the machine. The whole of the gearing for driving the boring apparatus is cased in from dust and chips by cast iron covers. A transverse adjustment is provided for the cutter blocks and boring spindles, to permit a slight variation if required in sleepers used for curves. The reason the boring apparatus is fed through the wood by a hand wheel instead of having an automatic action is that with very hard wood any other system tends to break the augers.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 28TH FEBRUARY, 1888.

THE IRON MARKET.—The iron market still exhibits a tendency towards greater activity, and the recent rise in prices is easily maintained. In most cases the current rates are willingly paid, and in some great eagerness to buy is manifested. The events of the day also tend to strengthen the situation. The Belgian trade in finished iron and steel, which showed symptoms of declining vigour a few weeks ago, is again reviving. The negotiations in progress between the Northern group of iron masters and those of the Centre, relative to the establishment of a common scale of prices, appear to be on the point of arriving at a successful issue. The Paris market is fairly animated and buoyant. In the provinces business is still more animated. Plates are in strong demand in the Nord, wire and wire nails in the Haute-Marne, and crude iron, steel blooms and billets, and plates in the Meurthe-et-Moselle. The pig iron trade of the Longwy districts is very animated. The latest "Comptoir" prices are as follow: White forge pig, 38s. 5d.; grey forge, 40s. 10d.; basic steel pig, containing from 1·50 to 1·75 per cent. of manganese, 45s. 7d.; foundry pig, No. 1, 54s. 5d. The Société des Aciéries has blown in another blast furnace for basic steel pig this week.

A WAR OF TARIFFS WITH ITALY.—French industries seem about to suffer from a violent disturbance of the commercial relations hitherto existing between France and Italy. The refusal of the Government of the latter country to renew the treaty of commerce has provoked a spirit of retaliation, which is likely to lead to a serious issue. The Commission of Customs, under the presidency of M. Méline, has completed its inquiry into the proposals of the Government concerning a new tariff designed to meet the increased duties imposed by Italy on French goods. This Commission has raised the Government figures considerably on a large number of articles. The matter is of great importance to the trade of Europe.

EXHIBITION OF LIFE SAVING APPARATUS.—The international exhibition of apparatus for the saving of life, to be held this year in the Palais de l'Industrie, is likely, judging from the numerous and varied applications for space, to be one of very great interest. The scope is wide, including land, sea, and air. Not the least important section will be that which deals with the saving of life in mines. This exhibition, and that which is to follow it in 1889 at Berlin, of apparatus for the prevention of accidents, should do something towards lessening the risks of those who are engaged in hazardous occupations. Anyhow, the occasion is one not to be lost sight of by inventors who have designed a new device in this line.

FALL OF AN IRON BRIDGE.—The fall of the iron bridge, known as the Pont d'Arcole, at Paris, is a matter of interest to engineers. It was one of the first iron bridges built in France, and consisted of a single arch of 90 metres span, its breadth being 20 metres. At the time of its erection, in 1851, the science of iron bridge building was in its infancy: but even at that period doubts were entertained of the stability of the structure.

THE PARIS OPERA COMIQUE.—The plans for re-building the Opera Comique, which was burnt down nearly a year ago, have been elaborated by the French Government, and copies have been distributed among the deputies. According to this project, the theatre is to be re-built on the same site; but a piece of adjoining land has been acquired which will allow of large exits being made at the four corners of the theatre. The total cost is estimated at £139,200, which, after deducting the amount paid by the insurance companies as indemnity for the burning of the previous theatre, and the amount realised on excavated material, will be reduced to £96,552. The stage will be provided with independent staircases, while the actors' dressing rooms and store rooms on either side of the stage will be so constructed as to form an incombustible barrier between them and the auditorium. The staircases for the use of the *personnel* of the theatre will be easy of access, and in direct communication with the two adjoining streets. The building will be heated by low pressure steam, the boilers being placed under the vestibule. The theatre will be lighted electrically, for which purpose from 1800 to 2000 glow lamps will be required.

BERLIN, 27TH FEBRUARY, 1888.

COAL MARKET.—As compared with January the output of most collieries has slightly decreased during this month, but it is still larger than at the corresponding period of last year. The Silesian colliery owners recently met at Breslau to discuss the question of transport facilities, which at the present moment are sadly inadequate. There is a great lack of waggons, and orders cannot be executed with sufficient speed. At the conference in Breslau the general opinion was that the coal trade would remain brisk during the whole of the year, and that an increase of from 5 to 10 per cent. in the rolling stock would be required to meet the demand. Coking coal and coke are in strong demand at hardening prices. Various collieries have made contracts with railway companies and private firms for the supply of coal throughout the year, and in some cases at prices somewhat higher than ruled in January. A slight reduction in the tariff for coal will come into force on the State railways on the 1st of April next.

THE IRON MARKET.—The Upper Silesian iron market continues unchanged. Crude iron, both for puddling and foundry purposes, continues in good demand, and the blast furnaces are hardly able to keep pace with present requirements. A few weeks more of this condition of affairs will necessitate the blowing in of several new furnaces. Steel works are also well employed, and the spring season for boiler works, engineering shops, and pipe makers is likely to prove good. The falling off in the quantity of rolled iron sold during January has been more than counterbalanced by increased sales in the present month, and all rolling mills are now working full time. In joists and other building iron the demand is exceptionally brisk. Generally speaking, little is done in building iron during the winter; but this year orders have come in so abundantly that stocks have been cleared out, and manufacturers of that class of iron are hardly able to supply the demand. Forge pig is quoted at from 50s. to 54s., and foundry pig from 56s. to 58s., whilst scrap iron has slightly declined in price. A rise of 2s. has taken place in the price of sheets, which are now quoted for local consumption at 160s. to 165s. Bar iron is firm at 140s., and profile iron at 155s.

ELECTRIC TRAIN LIGHTING.—Experiments have been in progress on the Alsatian State railways since the beginning of the year with electrically lighted trains, the current being supplied by small storage batteries carried under each coach in lieu of the gas reservoir. Each battery consists of 36 cells, carried in a tray for facility of handling. These batteries are charged at some of the stations which already have electric lighting plant, the intention being to utilise this plant during the daytime. The capacity of the battery is 40 ampère-hours, and the cells are small ebonite boxes containing plates of novel construction. Instead of the usual perforated grid, each plate consists of a rectangular lead frame, containing a number of vertical lead pencils about ¼in. diam., which at every half inch are widened out into thin discs about ⅜in. in diameter, and the grid of pencils and discs thus formed serves to support the active material. The plates are necessarily much thicker and heavier than equivalent plates of the usual construction. Each coach is lighted by five 10-candle 60-volt Seel lamps, requiring from 5 to 6 ampère. A small rheostat is added in front of the battery tray, by which the conductor can regulate the light. The illumination is much better than was previously the case when the train was lighted by 5 c.p. gas lamps. The trains were fitted by the Alsatian Electric Works, of Strasburg.

ELECTRIC LIGHTING.—Messrs. Siemens & Halske have been experimenting for a year and a half with the secondary battery of Herr Epstein, and under the inventor's supervision considerable improvements have been made, not only in the mechanical construction of the plates, but also in the process of forming them, which now requires four hours instead of several days as formerly. The forming is facilitated by the treatment of the plates in certain baths. It is evident that the makers must now have considerable confidence in these plates, since they are fitting up a set of accumulators in the Central Hotel in this town, which is at present supplied with current from the mains. This will be the second instance in Berlin where accumulators are used in connection with central station distribution.—The town of Bremen is also on the point of receiving a central station; the contractors are the Allgemeine Elektricitats Gesellschaft, but the work will be done by Messrs. Siemens and Halske. A very curious contract has been made between the company and the Town Council of Bremen. Upon payment of a toll or fee to the Town Council of 1s. per annum per lamp attached to the central station, the company have the right of carrying their mains over the houses or under the streets, and in any manner they may think proper. Practically the company have for this small toll secured the sole and undisturbed right of way for running their circuits. Consumers pay ·57d. per 16 c.p. lamp-hour. The supply will be on the parallel direct system at 100 volts, and the capacity of the station is to suffice for 10,000 lamps. The districts to be lighted are not extensive. Consumers find their own lamps and pay for the installation, but the company will refuse to supply current to any consumer who has not employed Messrs. Siemens & Halkse for the wiring and fitting up of his premises. In Hamburg the company have also a small central station supplying 1500 glow lamps and some arc lamps. A second and much larger station is projected.

VIENNA, 27TH FEBRUARY, 1888.

THE IRON MARKET.—The event of the week is the purchase of a private iron works in St. Michael, Styria, by the Alpine Iron and Mining Company. The company, as I have already reported on previous occasions, have hitherto always been more or less in financial difficulties, owing to their being burdened with large tracts of forest land, which, although valuable to their industry in previous years, are now, owing to improved methods of smelting iron, almost useless. The directors have therefore resolved to pursue a policy of reform, and the first step has been the sale of some of the mining and forest land. The proceeds of the sale will be expended in re-modelling their plant in accordance with modern requirements, and the purchase of private works forms a part of the programme. No change of any importance has taken place in the iron market. The rise of 7s. in the price of bar iron, which I reported last week, has had the effect of stimulating rather than checking consumption, and dealers, apprehending a further rise, have come into the market and placed considerable orders. There is as yet no sign of any improvement in crude iron; but sheets are in fair demand, and a considerable business is also being done in furniture. In Bohemia, there is a good demand for agricultural implements, such as spades, picks, hoes, &c. Engineering works are fairly well supplied with orders. Rolling mills are said to be contemplating a rise in the price of girders and profile iron for building purposes. In Hungary, there has also been a slight revival, consequent upon the increase in the price of bar iron. A fair demand exists for boiler plates, but sheets are neglected. A rise in the price of wire nails was confidently expected, but has not yet taken place.

TEXTILES.—The firm tone of the linen and yarn market in Trautenau, which I reported in my last letter, has been fully maintained during the past week. The improvement is not so marked in wool, cotton, silk, and jute. There is a slight tendency to better prices; but this cannot assert itself, owing to the want of confidence in the political situation on the part of spinners and weavers.

RAILWAYS IN AUSTRIA.—The total mileage of steam worked railways throughout Austria (exclusive of Hungary) is about 8500 miles, being at the rate of 1 mile per 2000 inhabitants. These lines are owned by fifty-six separate owners, of which forty-six are private companies, five are joint administrations with foreign railways, and five are under State administration. The network of Austrian railways has forty-four junctions with foreign countries, and eleven junctions with the Hungarian system.

THE MERCANTILE FLEET OF AUSTRIA.—The present position of Austrian shipping is by no means cheering, showing a diminution not only as compared with last year, but even with ten years ago. This decrease falls exclusively to sailing tonnage. At the end of 1887 there were trading 9235 Austrian vessels, giving employment to 27,209 persons. The steam power of this fleet amounted to 24,163 h.p. At the end of the previous year the figures were 9252 vessels, 27,586 persons, and 23,598 h.p. The decrease in the number of vessels and the increase in horse power show the present tendency to supplant sailing vessels by steamers. There were 219 vessels engaged in trading over long distances, representing an aggregate of 17,555 h.p.; eighty-seven vessels, with 5405 hp, were engaged in long distance coasting trade; and 155 vessels, representing 1203 h.p., were engaged in short coasting voyages. Ten years ago 409 vessels traded over long distances, sixty-one were long distance coasting traders, and 1658 were short distance coasting traders. A glance at these figures will show the reason why Austrian shipbuilding is in its present depressed condition. In the sixteen shipbuilding yards, having an aggregate of twenty-nine stocks, the total tonnage built during 1887 was less than 2000 tons. There were built and launched during the year twenty-one sailing vessels, 180 barges, and three steamers. The average price obtained for the last was about £31 per ton.

BRUSSELS, 28TH FEBRUARY, 1888.

THE COAL MARKET.—Prices are firm, but the stoppage of canal navigation, and scarcity of railway rolling stock, make it a matter of difficulty to forward consignments of coal. Orders are being given by the Government railways for 335,000 tons of coal, and blast furnaces are desirous of renewing their contracts, which expire on the 31st March. In the Mons district there has been a rise both in household and industrial coal. Contracts for future delivery in the Liège district also show an advance, and the Charleroi market is very satisfactory. Owing to the high Belgian railway rates, a Hainault colliery is finding it impossible to compete in the Grammont market with French coal; but the request for an abatement of 10d. per ton has been refused by the Belgian State railway management. The production of coal during the second six months of 1887 amounted to 9,480,853 tons, as compared with 8,810,677 tons in the corresponding period of 1886. The total production of 1887 amounted to 19,216,031 tons, as compared with 17,235,144 tons, an increase of 1,980,887 tons.

THE METAL MARKET.—The price of forge pig shows no tendency to weaken, and the disproportion between these rates and those for finished iron continues. The market generally is unchanged. The contracts for five hundred 10-ton coal trucks for the Belgian State railways have resulted as follows: Trucks with spindle brakes—The Société Franco-Belge, La Croyère, fifty trucks, £4,450; Dyle & Barcalau, fifty trucks, £4,494; Germain & Co., fifty trucks, £4,508. Trucks with Stilman brakes—Lambert and Co., fifty trucks, £3,748; Halot, of Louvain, fifty trucks, £3,758; Vanderpepen, of Mons, fifty trucks, £3,768; Société Haine, of St. Pierre, fifty trucks, £3,774; Noulet & Co., fifty trucks, £3,796; Baume & Marpeut, fifty trucks, £3,784, and fifty trucks, £3,846. A vote of credit will be asked shortly for the Meuse fortifications, and the specifications for the steel armour required will shortly be issued.

GLASS WORKS.—A meeting of glass manufacturers has been held to consider the present crisis in the trade. This is due to the fact that fuel is dear, consequently the margin of profit at the present low price of glass is becoming daily less. A special brand of coal raised in the Mons district is, it appears, indispensable to the glass makers with their present plant, and as the prices for this coal continue to advance, some of the less prosperous glass works will probably have to cease work, unless all the makers can come to an understanding by which the prices of glass ware can be forced up. There is no change in the prices of glass, the rates for England being 19s. for coarse, 21s. for

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fourth, and 23s. for third quality. The *four-à-bassin* of M. C. Lambert has been installed at the La Planche works, and has given excellent results. The length of the furnace has been diminished and the width increased, in order to reduce the first cost of the plant. The furnace is also 6ft. high, against 3ft. 6in. or 4ft., as customary in the old construction. Gas and air are not mixed before ignition in a special chamber, but are carried separately up to the edge of the basin by parallel conduits, terminating in a special burner, giving a long and regular flame. The saving in fuel over the old furnaces is about 25 per cent.

Electric Lighting.—A committee has been formed to take the initial steps in connection with the electrical syndicate to which I recently referred, and consists of M. Van Rysselberghe representing Mourlon, M. Julien for the Société l'Electrique, M. Gérard for the Anspach-Gérard-Mignot combination, M. Goffin for the Société Industrielle, and M. Bonnevil for Bouckaert & Co. This committee has drawn up two proposals to be submitted to towns desirous of obtaining tenders for electric lighting: (1) The erection of central stations on the alternating current system with transformers, and (2) the erection of stations for the supply of high tension continuous currents and secondary batteries. In the first case the dynamos of the Bouckaert and Industrielle Companies and Goffin-Hohe transformers would be used, and, in the second, Gérard dynamos and Julien accumulators.

DÜSSELDORF, 27th February, 1888.

The Iron Market.—The home business in iron is still characterised by animation and advancing prices; but it cannot be expected to preserve these features much longer in the face of a steadily decreasing foreign trade. For the present manufacturers revel in the prosperity born of trade combinations, and leave to the future the unpleasant reckoning which the loss of foreign markets must inevitably bring. There is not much that is new to report concerning the crude iron market. Nearly the whole of the make in the first half of the current year is placed, and contracts are being made for delivery in the third quarter. The prices paid are in all cases above the syndicate minimum. Despite the present high rate of production, and the falling off in the exports of pig iron, the January trade resulted in a further diminution of the stocks. Forge pig is less sought after, but spiegel is in strong demand. Both forge and spiegel is being largely bought on French account, in anticipation of the abolition of the traffic in *acquits-à-caution*. To meet this demand for immediate delivery prior contracts have had to be deferred. Luxemburg forge is now quoted at 40s. Foundry pig is in better demand; other sorts remain unaltered. There is no change to note in the finished iron and steel trade. A rise of 2s. 6d. a ton in bars is expected. Business in common plates is less active. The production of plates by the works of the West of Germany Union in January amounted to 9121 tons, against 8339 tons in December. The following are Cologne prices: Spiegel pig, of 10 to 12 per cent., 58s. to 60s.; German Bessemer, 54s.; white forge pig, 54s.; Luxemburg forge, 38s.; German foundry pig, No. 1, 57s.; merchant bars, £6. 2s. 6d. to £6. 5s.; angles, £6. 12s. 6d. to £6. 15s.; joists, £5. 18s. to £6; best boiler plates, £8. 5s., and Siegen H K plates, £7. 10s. to £7. 15s. per ton. The production of pig iron in January amounted to 346,962 tons, against 293,879 tons in the same month of 1887.

The Linen Yarn Market.—The linen yarn market is this week characterised by more activity. Spinners show a disposition to buy. The demand is brisk for tow yarns, and prices have become very firm.

The Flax Spinning Industry.—The flax spinning mills in and around Bielefeld are now running full time. The demand for yarns has been steadily reviving for some time past, the coarser numbers being most sought after. The stocks in hand are being heavily drawn upon, and orders rapidly booked for future delivery. The business of the year 1887 was on the whole satisfactory, and 1888 promises to be better.

Railway Receipts.—The expanding tendency of trade is seen in the railway receipts for last year. The report of the Budget Commission states that the receipts for the passenger traffic amounted to £9,397,000, an increase of £512,500 on those of the previous year, while the goods traffic yielded £25,026,050, an increase of £1,420,500.

LILLE, 28th February, 1888.

Textile Manufactures.—Business in textile goods is still wanting in life. The heavy snows of the last two weeks have no doubt contributed something towards the quiet which prevails, so that we may expect a revival with the return of more genial weather. There are already signs of approaching activity in the linen goods trade of Armentières. The situation of the woollen goods trade has not improved, but rather grown worse. Some of the Roubaix weavers have put their mills on short time. Spinners complain of a lack of orders, having scarcely sufficient in hand to keep their works going. Raw wool, in sympathy with the London market, has receded a little in price. Australian combed is fairly firm at 5·65fr. to 6fr. per kilo. South American wools are lower by 0·15fr. There is some animation in the market for "noils." South American sells at 3·10fr. to 3·30fr., and Australian at 3·50fr. to 3·80fr. per kilo.

Flax and Yarn Markets.—Home grown flax continues to find ready purchasers at prices that tend steadily to advance. The decline in the rate of exchange having enabled sellers to offer some concession in prices, more business is being done in Russian produce. The dealings have been mostly for future delivery. Tows are less inquired after. Business in yarns has become less animated; but as spinners have heavy contracts on hand, they trouble themselves but little concerning the present state of the market. Jute yarns are still in good demand, and prices are in favour of sellers. At Ghent there are indications of weakness in the market for flax. The values of the yarns exported in 1887, compared with those of the preceding year, are as follow: Woollen yarns, £1,540,320 (£1,755,840); flax and hemp yarns, £412,360 (£242,400); cotton yarns, £100,200 (£76,120); jute yarns, £53,920 (£70,040).

The Import Trade in Wool.—The imports of wool from La Plata through Dunkirk shrank to a relatively small total in the latter months of last year. The falling off, however, is of only temporary significance, being due to the fact that the abolition of the duties levied on all goods exported from the Argentine Republic came into force on the 1st January of the current year, a circumstance that occasioned the delaying of as much business as could be conveniently postponed. Large quantities of Algerian wool have lately arrived. Besides the steamers of the three regular lines between the French colony in Africa and Dunkirk, several foreign vessels, accepting lower freights, have brought cargoes shipped at Algiers and Philippeville.

The Iron Market.—Though the business in iron has been marked this week by somewhat less animation, the market has lost none of its firmness. The demand for bars and joists has somewhat decreased, but buying goes on briskly in common plates. An advance in the prices of this latter class of goods is expected, and may be announced any day. Manufacturers are very firm in their demands from customers who buy for home consumption; but concessions are made to foreign purchasers. In anticipation of the date when the traffic in *acquits-à-caution* is to cease, manufacturers of the Centre and South are buying largely, chiefly from the German producers. The consequence to this district is that considerable quantities of pig iron of foreign origin find their way into the hands of consumers.

AMSTERDAM, 28th February, 1888.

The Mail Service in the Dutch East Indies.—The Second Chamber of the States General has passed the Government Bill, authorising the Governor General of the Dutch possessions at Batavia to sign a contract with a national syndicate, providing for the establishment of a new and subsidised mail service between Java, Borneo, Sumatra, New Guinea, and all other important islands of the Indian Archipelago. The syndicate will transfer its rights and privileges to a new company, still to be formed. The contract is for fifteen years, commencing in 1890. The Bill has a very important bearing upon British shipping, which will be virtually excluded from the steamship navigation between the Dutch-Indian islands. Hitherto the monopoly has been in English hands, as the Netherland-India Steamboat Company, which holds the existing contract for the mail service in those seas, was only nominally a Dutch, and in reality an English undertaking, with English directors, English shareholders, and registered offices in London. Political reasons have induced the Dutch Government to abolish the system of public tenders for their Indian mail service, as they were determined to give the contract to a Dutch company. All the directors, and the captains and crews of the mail vessels, must be Dutch subjects. Moreover, the concessionaires are to have these vessels constructed in Holland, as far as possible. There have been protests against the strong protectionist character of the contract; but the Government have carried the day, and there is no doubt that the First Chamber of the States General will likewise sanction the Bill.

NEW YORK, 18th February, 1888.

The Coal Market.—The coal market is practically unchanged, and the statement that the miners' strike has received the approval of the Executive Committee of the Knights of Labour, and that 15 per cent. advance would be demanded in the Wyoming region, has so far had no effect on the market. The shipments of coal show an increase. The supply is now ample.

The Iron and Steel Market.—The pig iron market is still unsatisfactory, and there is a decided falling off in the demand. Prices are unchanged. This year's output will probably not exceed 6¼ million tons, while the productive capacity is about a million tons in excess of this. Higher prices are unlikely, and a 5 per cent. decline would probably reduce the production of iron and steel by from 10 to 15 per cent. The bar iron market is moderately active, but with no improvement in prices. Orders are for small lots, and most of the work in hand can be finished in a week or ten days. Prices are two cents per lb. for refined bars, but large orders can be placed at 1·9 to 1·95 cents. The steel rail market retains its firm tone, but has not shown the activity expected. Sales in small quantities are made at $32 per ton, and larger orders are placed at $31·50. Domestic steel makers will not increase the allotment of 800,000 tons until the market shows an improvement. The total contracts for the year amount to about 500,000 tons. The miners' strike and the small amount of business in steel rails have had a prejudicial effect on the blast furnaces, of which there were on the 1st inst. only 313 in blast with a weekly capacity of 127,166 tons, a reduction of 10 per cent. of the number in blast a year ago. There are 274 out of blast, of a weekly capacity of 75,085 tons.

The Metal Market.—The copper market has changed but little; sales somewhat below the average have been made, with prices varying from 16·35c. to 16·55c. per pound for present delivery. In lead, sales, partly speculative, have been made to the extent of 1400 tons, at 4·90c. to 4·95c. per pound. Stocks of tin are small, and there is only little business transacted.

Railway Car Building.—This branch of engineering is brisk, and one leading car builder has already made contracts for the entire capacity of his works during the present year, and has been compelled to decline an order for 1200 cars.

Ship Building.—Messrs. William P. Clyde & Co. have given an order to Cramp's shipbuilding yard for a new steel steamship, which will be 300ft. long, 46ft. beam, and over 3000 tons burden. She will be fitted with triple expansion engines and steel boilers, and will run between New York, Charleston, and Jacksonville.

Salt Supply.—A report has been published by the superintendent of the salt reservation at Syracuse, from which it appears that the total number of bushels inspected during the year 1887 was 5,695,797, of which 2,576,823 were of fine salt. The production has during the last forty years sometimes been as high as 9,000,000 bushels, with an average of 7,000,000. The report states that the sinking of two wells for the purpose of discovering beds of rock salt was a failure. One of the wells reached a depth of 1600ft., and the other 2000ft. This is not of itself discouraging, as at Ithaca 2270ft. had to be bored before the 50ft. bed of rock salt was reached. The salt bed of Western New York extends about 120 miles from east to west, and about forty to fifty miles from north to south. The area of the salt bed territory is nearly 5000 square miles, and the average thickness is 40ft. This means that the supply is practically inexhaustible.

PHILADELPHIA, 18th February, 1888.

Railways.—The revival of the South Penn Railroad project is the most interesting event that has taken place in Eastern railroads for some time. The road is to run from Harrisburg to Pittsburg, and is intended to compete with that portion of the Pennsylvania road. Considerable work in tunnelling and preparing the road bed had been done when the original owners sold the property to the Northern Central, the negotiations being conducted and payments made by the Pennsylvania. As it is contrary to law in this State for one road to buy up a competitor, the Attorney-General brought an action to have the contract declared illegal, and this suit is still pending. Last July it was proposed by the Vanderbilt interests and others to go on and build the road. The Pennsylvania road have filed a bill in equity praying for an injunction against the construction of the line until the ownership of the property is settled. It is expected that active work on the road will begin as soon as the weather is open enough. The line has been examined by engineers, and found to be in good shape, very little damage having resulted from its abandonment. The contracts with the Reading road and other connecting roads are still in force.

The Baldwin Locomotive Works.—These works have recently completed their nine thousandth engine. The works were not originally laid out for building modern locomotives, and they labour under some disadvantage in consequence. The different shops are separated by public streets, and many of them are at a considerable distance from the main office. From a small beginning the Baldwin works have built up by far the largest business of the kind in the world.

Wrought Iron Pipes.—This industry is beginning to feel the bad effects of over production. Within the last eighteen months production has increased over 100 per cent., and now amounts to over £4,000,000. The prosperous condition of the business a year and a half ago induced new parties to enter the business, and new mills were started at Boston, Oil City, Wheeling, and Pittsburg, while the old mills increased their production enormously. The result is that there is not market enough to take up the output of both old and new mills.

Locomotive Check Valves.—The Pennsylvania Railroad are fitting an inside valve on their boilers, so that if by an accident the check valve chambers are broken off, the valve will close and prevent the escape of the water and steam. The utility of this arrangement has already been shown in the case of a slight accident lately, where the locomotive ran into the side of a passenger car and the check valve chamber was broken off; but no injury by scalding took place.

Natural Gas for Glass Furnaces.—Wherever it is available, natural gas is being used in glass furnaces with excellent results. It is an improvement in every way, and not only lessens the cost of fuel, but does away with the labour of attending to the furnaces. It also improves the quality of the glass produced, as the intensity of the heat, which can be regulated at will, allows a perfectly uniform temperature to be maintained, and thereby lessens the time required to do the work. In the case of flint glass the time is reduced from thirty-six hours to twenty-four hours, and in all kinds the saving of time is never less than four hours.

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TELEGRAPHS IN JAPAN.

		Telegraph department's lines. miles. fur. yds.	Other government department's lines. miles. fur. yds.	Railway department and railway companies' lines. miles. fur. yds.	Private lines.	Totals. miles. fur. yds.
On telegraph lines.	Length of lines	5,542 6 22⅔	... 16 1 110⅔	... 19 3 205⅓	... ——	... 5,578 3 118⅔
	Length of wires	14,634 3 100⅓	... 84 0 31⅓	... 411 3 21⅓	... ——	... 15,129 6 153⅔
	Offices: 1st class	11				
	Offices: 2nd class	40				
	Offices: 3rd class	147				
	Offices: non-classified	21				
	Offices: Totals	219	... 35	... 25	... ——	... 280
	Offices: Fusan office	1				
	Instruments	463	... 46	... 28	... ——	... 537
On telephone lines.		miles. fur. yds.	miles. fur. yds.	miles. fur. yds.	miles. fur. yds.	miles. fur. yds.
	Length of lines	——	... 185 1 89⅔	... 36 4 50½	... 12 2 19	... 233 7 159
	Length of wires	——	... 231 5 10½	... 165 5 57	... 12 2 19	... 409 4 86½
	Instruments	——	... 163	... 22	... 4	... 189
Totals of telegraph and telephone lines.		miles. fur. yds.	miles. fur. yds.	miles. fur. yds.	miles. fur. yds.	miles. fur. yds.
	Length of lines	5,542 6 22⅔	... 201 2 200½	... 56 0 35⅔	... 12 2 19	... 5,812 3 57⅔
	Length of wires	14,634 3 100⅓	... 315 5 42	... 577 0 78⅔	... 12 2 19	... 15,539 3 20
	Offices	220	... 35	... 25	... ——	... 280
	Instruments	463	... 209	... 50	... 4	... 726

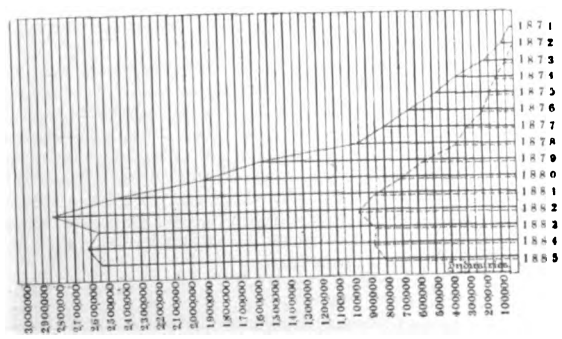
TELEGRAPHS IN JAPAN.

The rapid progress which has been made in Japan during the past few years is not realised by those who have not been to that country, at least to the extent that it should be. The Japanese are ambitious of making their country the Britain of the East, and it seems to be in a fair way of fulfilling their wish, at least if we may judge from the rapid extension of their telegraph system, which is shown in the following table:—

Year.	Population.	Number of telegrams.	Average number of telegrams per thousand of population.	Total receipts.	Average receipts per thousand of population.
				Yen.	*Yen.*
1872	33,110,825	80,639	2	10,255·55	0·31
1873	33,300,675	186,448	6	50,777·77	1·53
1874	33,625,678	356,539	11	114,560·08	3·41
1875	33,997,449	486,853	14	155,190·34	4·57
1876	34,438,404	648,619	19	187,821·98	5·47
1877	.....*	802,236	...*	312,353·74	.....*
1878	.....*	977,151	...*	361,728·22	.....*
1879	35,768,584	1,593,190	45	564,001·00	15·77
1880	35,929,060	1,924,083	54	716,227·84	19·94
1881	36,358,994	2,448,548	67	871,704·47	23·98
1882	36,700,118	2,826,952	77	974,344·11	26·55
1883	37,017,302	2,555,894	69	863,098·67	23·32
1884	37,451,764	2,613,811	70	878,033·36	23·44
1885	37,868,987	2,542,156	67	806,910·07	21·31

* No census having been published in 1877 and 1878, the figures for those years are incomplete.

Also graphically in the accompanying diagram, while the general arrangement of the telegraphic system of Japan was shown in the map we published in Vol. I., page 112. The following particulars have been extracted from the twelfth report of the Director-General of the Imperial Government Telegraphs which has just reached us, and



Number of Telegrams.

which contains a considerable amount of interesting information regarding the development of the system, and statistics regarding the different localities, which, however, are of no special value to readers in this country. We will, therefore, only note a few of the items of more general interest. During the year 1885-86 the total length of new lines—telegraphic and telephonic—which were constructed was 166 miles 1264 yards, involving a length of wire of 397 miles 1728 yards, which is a very fair rate of progress indeed. The total length of telegraph and telephone lines at the close of the fiscal year 1885-86 is given in the table at the head of this page.

An account is given in the report of the International Telegraph Conference, at Berlin, in August, 1885, at which the Director-General was present as delegate from Japan, and during the proceedings he made several good suggestions for the improvement of international telegrams. For instance, under the London revised regulations, a telegram consisting of only an address, without any text, was admissible. Such telegrams could, of course, be made the subject of pre-arrangement between the sender and the receiver, and would consequently have a meaning to them, although no actual "message" was transmitted. Much inconvenience arose from such messages, as the receiving office did not know when the message had been omitted, and when it had not been intended to be sent, and the resulting inquiries caused both trouble and expense. It was therefore suggested by the Japanese delegate that no telegram should be omitted which did not contain at least one word of text. This suggestion was seconded by several delegates, and after long debate it was determined that the question of allowing or disallowing telegrams without text should be left to the option of each administration, with the proviso that although each administration might refuse to accept no text telegrams from the public, it should nevertheless accept them from other administrations either for transmission or delivery. Another arrangement suggested by the Japanese delegate was the relaxation of the regulation that words containing more than ten letters were to be reckoned as two words, in so far as names of places of destination were concerned, and this was adopted by the Conference. The most important suggestion, however, made by him was that referring to the rule whereby an ordinary telegram when delivered, with no matter how many errors or omissions of words, was considered "delivered," and no question of refund on account of such errors or omissions was entertained. This was the old rule when there was a fixed charge for messages of twenty words. Since the regulations as to a single word rate have come into force, however, it appeared to the Japanese delegate to be only fair that when one or more words were omitted from a telegram, the charges paid for these words should be refunded, and he made a proposition to alter the regulations in accordance with these views, and it was accepted by the Conference. Lastly, although Japan's necessities require more expense to train her operators in foreign languages, and to obtain instruments, apparatus, &c., from abroad, and she is, therefore, comparatively not in a position to sustain loss, yet she proposed to decrease the rate for telegraphic traffic between Europe and Japan by 25 per cent. To this proposition, in its full extent, many companies objected; but, they being willing to accede to a reduction of 15 per cent., this compromise was adopted by the Conference, Japan also determining to lower her own rates in the same proportion. We mention those matters to show that the sending of a delegate from Japan to a European conference is no mere formality; and further, that that delegate looks after not only the interests of his own country, but also of the whole trading community.

The following table shows the number of foreign residents in Japan, including Chinese:—

Tokio	285
Osaka	271
Kanagawa	3762
Nagasaki	866
Niigata	31
Hakodate	84
Hiogo	844
Total	6143

It ought to be mentioned that Kanagawa is in reality the official name for the district usually called Yokohama.

THE PHYSICAL SOCIETY.

At the meeting of this Society held on the 25th inst., the first communication was a note by Professors Ayrton and Perry on "The Efficiency of Incandescent Lamps with Direct and Alternate Currents." The communication was made by Professor Ayrton, who prefaced it by pointing out that for economical distribution it was necessary to send the current through the mains at high e.m.f., and to adopt some system of transformation. The earliest attempt to effect this was by means of motor dynamos; then followed Sir William Thomson's method of charging accumulators in series, and afterwards dividing up the accumulator into groups and using them separately for the lamp circuits. After this came the Jablochkoff alternate current transformer, and finally Edison's system of direct current transformation.

The problem treated was to determine whether more light would be obtained for a given expenditure of power by the use of direct or alternate currents. In carrying out the experiments the light given out by the lamp was compared with a standard candle by means of a divided paraffin disc photometer. In order to eliminate the effect of irregularity in the amount of light from the candle, readings, with direct and alternating currents, were taken alternately in quick succession. The potential difference between the lamp terminals was measured by means of a voltmeter of the improved Cardew type, recently described by the authors at a meeting of the Society of Telegraph Engineers. The product of the readings of the voltmeter and the dynamometer would give the "measured watts," and the time watts were obtained by multiplying with $r\tau / \sqrt{L^2\pi^2 + r^2\tau^2}$, where r is the resistance and L the co-efficient of self induction of the dynamometer, and τ is the period of alternation.

The first experiments were made with Edison-Swan lamps, in which the filament is in the form of a loop, and this might introduce an error through self induction. Another error also occurred in these experiments from a metal box used for the damper of the dynamometer causing induction. These experiments were therefore rejected, the metal box was replaced by a wooden one, and Maxim-Weston lamps, having **M** shaped filaments, and lamps with simple horseshoe filament, were used. In either case there would be no appreciable self induction. The experiments were made both with ruby red glass and with green glass, and the result of seventy-five observations gave for the light from a lamp—with direct currents, 3·3989 watts per candle; with alternate currents, 3·3955 watts per candle. The difference between these is within the limit of errors of observation, so that as far as these experiments go the conclusion is that the same power (properly measured) will give the same amount of light, whether the currents are direct or alternating. The speed of alternation in the experiments varied from $\frac{1}{40}$th to $\frac{1}{150}$th of a second, but no difference was observed in the light.

Mr. Swinburne did not think that there would be appreciable self induction in an Edison-Swan lamp with any current less than 400 or 500 ampères. He found different dynamometer indications for the same amount of light with direct and alternate currents, and thought that the capacity of the filament for heat would have some effect.

Professor S. Thompson had, by moving a mirror backwards and forwards in front of a lamp, observed periodic variations in the intensity of the light obtained from alternate currents; but the period was much longer than that of alternation, and was, no doubt, due to a want of symmetry in the armature or the field magnets, either of which, as he had formerly pointed out, would give rise to a variation in the e.m.f. of a period equal to that of rotation of the dynamo. He thought it was of great importance that attention should be directed to the improvement of photometers, none of which were satisfactory. For example, in the one used the curvature of the waves falling on the disc would change when the position of the disc was altered, so that when the illumination was balanced at the centre it would not be so at the edges. He pointed out that a great objection to standard candles is that the light varies with the length of the wick. This, however, does not apply to the present results, as they can be made in such a way as to eliminate the effect of any irregularity. Supposing the light of a lamp supplied with alternate currents to vary periodically, we should have to consider how the eye integrates the impression received. Fechner's Law, though in general giving approximately true results, may not apply to rapid changes.

Professor Ayrton considered that the different dynamometer indications for the same light observed by Mr. Swinburne for direct and alternate currents were probably due to errors in the dynamometer. Captain Cardew had observed the same thing and mentioned it to him, and he pointed out that whereas the dynamometers usually made are constructed of thick wire to minimise the loss of energy, the one which they had

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used in these experiments had been constructed with very thin wire, as in this case what was required was great accuracy, the waste of power being of no importance. Professor Perry, in reply to Professor Thompson's remark as to the slope of temperature from the inside to the outside of the filament, stated that in 1874, in consequence of a letter to *Nature* calling in question Dr. Macfarlane's results on the radiation of copper spheres, on the ground that the internal conductivity of the copper had not been allowed for, he investigated the question with great care, and found that it would have no effect, and he believed it would be the same in the case of the filament.

The Hon. Ralph Abercromby then read a paper entitled "Observations on the Height and Length of Ocean Waves." He pointed out that much better results could now be obtained than formerly, owing to the improvements in aneroid barometers, which will now measure height within one or two feet, whereas it was necessary formerly to climb the rigging until you could see two crests in line, and the time can now be observed by means of a chronograph without looking at the instrument when making an observation. The observations described in the paper were made two years ago in a steamer between New Zealand and Cape Horn. The length and velocity were determined by standing in the stern of the vessel with a chronograph and taking the interval between the passage of two successive crests, and also the times of passage past the stern and the bow. The table below gives the results of the author's observations, compared with those noted by other observers:—

Observer.	Maximum height.	Maximum length.	Maximum velocity.
Abercromby	35	507	39·5
"	46	765	47·5
Ross	23	1902	90
Scoresby	42	—	—
"Challenger" observations	23	—	—

The distances are in feet, and the velocities in feet per second.

The discrepancies in the results the author attributed to the difficulties introduced by the superposition of smaller undulations on the larger ones. The author always made his observations only when he could see two or three waves of about the same size coming in succession. If the distance between only two maxima are taken as the length of a wave, such enormous lengths as those given by Ross are often obtained. The velocity given by Ross is also much greater than any observed by the author.

THE LISTOWEL AND BALLYBUNION RAILWAY.

The opening ceremony of this railway took place on Wednesday last, in the presence of a number of distinguished visitors and well known engineers. The railway is the first constructed in Great Britain on the Lartigue single rail system, which was described in *Industries* (Vol. I., page 316). Some of our readers may remember that a model of this system was on view at Westminster eighteen months ago. The success of this company is due to the energetic spirit of Mr. T. B. Behr, the managing director of the Lartigue Railway Construction Company. The distance between the terminal stations of this railway is ten miles, and the average time of transit is half an hour. The construction has only occupied five months; and this fact, together with its unprecedentedly small cost in proportion to its carrying capacity, makes its erection an event of some importance in connection with Irish railways.

Erratum.—In the reference we made on page 201 of our last week's issue to Mr. J. W. Wells' recent address before the London Chamber of Commerce, the word "Venice" should read "Valparaiso."

The Photographic Exhibition at the Crystal Palace.—In deference to a widely expressed desire, the Directors of the Crystal Palace have arranged for the Exhibition to remain open until the 17th of March, a fortnight later than was at first intended.

The British Association.—A meeting of the members of the Manchester local committee and of the guarantors of the late meeting of the British Association will be held at the Town Hall, Manchester, on the 6th inst., to receive the final report of the local executive committee and the statement of accounts. It will be remembered that the numbers attending the meeting, and the amount received by the Association, were largely in excess of former records. The local expenditure, which will be borne by the guarantors, is considerably below that of the previous year. A call of 35 per cent. was made on the guarantee fund, and the £3,500 from this source, together with the proceeds of minor sources of income, brought the total receipts to £4,369. 10s. The principal items of expenditure included erection of luncheon and retiring rooms, £700; fittings for reception and section rooms, £770; advertising, £240; printing, £470; lodging of secretaries, gratuities, and wages, £570. The receipts from excursions amounted to £716, and the expenditure £711, thus showing a profit where there has formerly been a large deficit.

Notices of Meetings.

THIS WEEK.

Geologists' Association.—Friday, 2nd March, 8 p.m. Papers to be read on "The Pleistocene Land and Freshwater Mollusca from the Barnwell Gravels," by Mr. B. B. Woodward, F.G.S., and on "The Evolution of the Cephalopoda," by Mr. F. A. Bather, B.A., F.G.S.

Royal Institution of Great Britain.—Saturday, 3rd March, 3 p.m. Lecture on "Experimental Optics," by Lord Rayleigh.

NEXT WEEK.

Society of Arts.—Monday, 5th March, 8 p.m. Cantor lecture on "The Modern Microscope," by Mr. John Mayall, jun.—Tuesday, 6th March, 8 p.m. Foreign and Colonial Section. Paper to be read on "South African Gold Fields," by Mr. W. H. Penning, F.G.S.—Wednesday, 7th March, 8 p.m. Ordinary meeting. Paper to be read on "Framework Knitting," by Mr. W. T. Rowlett.

Royal Institution of Great Britain.—Monday, 5th March, 5 p.m. General monthly meeting.—Thursday, 8th March, 3 p.m. Lecture on "Microscopical Work on the Least and Simplest Forms of Life," by the Rev. W. H. Dollinger.

Society of Chemical Industry.—Monday, 5th March, 8 p.m Paper to be read on "The Recovery of Sulphur from Alkali Waste by means of Lime Kiln Gases," by Mr. A. M. Chance.

Royal Institute of British Architects.—Monday, 5th March. Special general meeting. Election of Royal Gold Medallist.

Society of Engineers.—Monday, 5th March, 7-30 p.m. Paper to be read on "The Effect of Sea Water on Portland Cement," by Mr. Henry Faija, M.Inst.C.E.

Institution of Civil Engineers.—Tuesday, 6th March, 8 p.m. Ordinary meeting. Papers to be further discussed: "Manganese in its Application to Metallurgy," "Some Novel Properties of Iron and Manganese," by Mr. R. A. Hadfield, Assoc.M.Inst.C.E. At this meeting the monthly ballot for new members will take place.—Students' meeting. Friday, 9th March, 7-30 p.m. Paper to be read on "The Prevention and Extinction of Fires," by Mr. Alfred Chatterton, B.Sc., Stud.Inst.C.E.

Royal United Service Institution.—Wednesday, 7th March, 3 p.m. Paper to be read on "The Condition of the Mercantile Marine Personelle and Matérial, with a view to its complete utilisation as a Reserve for the Royal Navy," by Captain W. Crutchley.—Friday, 9th March, 3 p.m. Paper to be read on "The Native Army of Madras: its Constitution, Organisation, Equipment, and Interior Economy," by Major-General J. Michael.

Liverpool Engineering Society.—Wednesday, 7th March, 8 p.m. Ordinary meeting. Paper to be read on "Filtration of Sewage," by Mr. J. H. T. Turner, Assoc.M.Inst.C.E.

Society of Telegraph Engineers and Electricians.—Thursday, 8th March, 8 p.m. Paper to be read on "The Present State of Fire Telegraphy," by R. von Fischer Treuenfeld.

PRICES CURRENT, 1st March.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/2	Cash
Scotch Warrants, m/n		39/1	"
Hematite Warrants, m/n		41/9½	"
Stocks in Stores. Scotch	951,290—Inc. for week,	2292	Tons
Middlesbro'	334,366—Dec. "	2873	"
Hematite	211,332—Dec. "	587	"

Exclusive of stocks in makers' yards.
Market rather steadier.
Scotch shipments 5007 tons, against 6038 tons for same week last year.

	No. 1.	No. 3.	
Coltness	48/6	42/3	f.o.b. Glasgow.
Gartsherrie	45/3	41/9	" "
Dalmellington	41/-	39/-	" Ardrossan
Eglinton	39/6	37/9	" "
Glengarnock	44/3	40/3	" "
*Derbyshire	—	37/-	f.o.t. Works.
*Lincolnshire	—	32/6	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.	Best.	
Middlesbro' Bars	£ 4 17 6	£ 5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 2 6	5 12 6	Manch'r.
" Angles	5 12 6	6 2 6	"
Crown Sheets	6 12 6	7 2 6	"
" Hoops	5 10 0	6 0 0	"
"Siemens-Martin" Steel Boiler Plates		7 17 6	"
" Ship and Girder		7 12 6	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	10	0	to	£19	15	0
Copper: British Cakes and Ingots	80	0	0	"			
" Chili Bars	78	17	6	"	79	0	0
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	5	0	"	15	10	0
" English Sheet	16	5	0	"	16	10	0
Tin: Straits	166	0	0	"	166	10	0
" Australian	167	0	0	"	167	10	0
" English Ingots	161	0	0	"	163	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Chili bars have been notably firm during the past week at £78. 10s. to £79 per ton, and a fair business has been done thereat; this is practically an advance of 10s. since our last. The position of manufactured is without alteration.

Tin.—Straits steady at last week's quotations for sharp cash parcels forward delivery according to date, full three months quoted £143 per ton.

Lead is again firmer; Spanish quoted £14. 10s. to £15 per ton. English seems likely to advance still further.

Spelter is very steady at last quotations.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	28	0	0
" Ceylon	"	24	15	0
Cottonseed	"	20	0	0
Cod	"	18	0	0
Lard	"	42	10	0
Linseed	"	18	12	6
Palm, Lagos	"	21	10	0
Rapeseed: English	"	24	0	0
Seal: Pale	"	23	0	0
" Brown	"	17	0	0
Sperm	"	41	10	0
Whale	"	14	0	0
Turpentine	per cwt.	1	10	3
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6 5/8
" Spirit	"	0	0	7 1/2

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	4	—	0	0	4¼
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6½	—	0	1	6¾
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3¾	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	12	5	0	—	12	10	0
" Liquor	lb.	0	0	3¼	—		.....	
Bleaching Powder	ton	7	10	0	—	7	15	0
Bisulphide of Carbon	"	13	0	0	—		.....	
Borax	"	28	0	0	—		.....	
Benzole (90%)	gal.	0	3	7	—	0	3	9
" (50/90%)	"	0	2	7	—	0	2	9
Copper Sulphate	ton	21	5	0	—	22	0	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	22	15	0	—	23	0	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	10	0	—	25	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	6⅛	—		.....	
" Prussiate (Yellow)	"	0	0	7⅜	—		.....	
" Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	17	6	—	7	0	0
" " " 60%)	"	5	17	6	—	6	0	0
" " (Cream, 60%)	"	5	15	0	—	5	17	6
" Crystals	"	2	10	0	—	2	12	6
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	12	6	—	6	15	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

Lancashire and Cheshire Telephone Exchange Company.—The yearly directory, which has just been published, shows that this company is extending its sphere of usefulness. Up to the present time connections have been established between sixty towns in Lancashire, Cheshire, and North Wales, while several towns in Yorkshire may be communicated with by arrangement with the National Telephone Company. The total number of subscribers approaches 5000, and new names are being continually added to the list. Under the system pursued by this company, not only are any two members enabled to converse together, but it is also arranged that outsiders shall be able to communicate with each other by means of public call offices at various parts of each district. The co-operation of the Post Office has been secured in Manchester, Liverpool, and Blackburn, in order that telegrams may be sent to and received from the Telegraph Office through the telephone without the loss of time necessarily occupied by a messenger.

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HOME INDUSTRIES.

MANCHESTER, 1st March, 1888.

The Cotton Trade.—The condition of business in cotton yarns is practically unchanged. Spinners have still the advantage of a price which leaves them a margin between cotton and yarn, and are in most cases making a fair profit. This state of things appears likely to last, because, although large quantities of yarn are difficult to sell at present rates, an equal bulk is being sold in smaller lots. The demand for the Eastern markets is undoubtedly very dull, and in almost every case the offers which are made are lower than spinners are disposed to accept. It is now generally admitted that the American cotton crop will be more than 6¾ millions of bales. It is interesting to note that the estimate of Mr. Henry Neill has again proved to be correct, and judging from past experience, this gentleman may be taken as a tolerably safe guide. Manufacturers are finding the competition in cloth much more severe, and there are many well grounded complaints of a scarcity of orders and lower prices in all new contracts. The production of the looms about to be started will exercise a great influence on the future course of the market.

The Bundling of Yarns.—An inquiry is being carried on by the Manchester Chamber of Commerce with the object of ascertaining the legality of certain methods of reeling yarns. Four leading questions have been formulated, and evidence is being taken on the subject. It has been a common practice amongst spinners to reel the yarn into hanks which did not contain the standard 840 yards. In this way yarns have been made into bundles, and sold as being of finer counts than they really were. It is, therefore, a question whether such a practice is not an infringement of the Merchandise Marks Act. It has come out in evidence that the Austrian spinners, who have been reeling in the same way, are now compelled by the Government to mark each bundle the correct count, whatever may be the actual length of the hanks enclosed.

A New Pulley Lubricator.—The trouble experienced by users of loose pulleys, owing to inefficient lubrication, is well known to all engineers. Mr. J. J. Royle, of Manchester, has just begun to manufacture a patented appliance which will be of some service in this direction. Screwed into the boss of the pulley is an oil cup, containing an inner tube, through which the lower end of a brass spindle passes. The upper end of the spindle projects slightly beyond the rim of the pulley, so that every time the belt passes over it, it is depressed. A spring is arranged so as constantly to press the spindle upwards. The tube inside the oil cup is shorter than the internal length of the cup, so that every time the pulley revolves a little oil finds its way into the tube, but is prevented passing out of it by means of a swell at the end of the spindle, which with the lip of the tube forms a valve. When the spindle is depressed the lower orifice is opened, and the upper one closed, the oil thus finding its way into the interior of the pulley boss. The oiling is positively accomplished, and the contrivance is neat and at the same time cheap, and can be easily applied to any pulley.

LONDON, 1st March, 1888.

The Money Market.—The rates for the loan of money have now returned to their normal state, the settlement on the Stock Exchange which began on Monday having hardened the market. The rate of discount still remains low, and shows little sign of strengthening; but for short loans for Stock Exchange purposes the rate was much firmer this week than was the case in the last few settlements. The supply of unemployed capital available for short loan purposes has shrunk so considerably that applications were made to the Bank of England for accommodation. The settlement was a very light one, because the depressed and lifeless condition of the stock markets for a fortnight past has stopped new business altogether. The sensitiveness of the foreign market, due to the unfortunate turn of the Crown Prince's malady, and aided by the effect which the extreme depreciation of the Russian currency has upon Berlin, still adversely affects Stock Exchange business. Substantial investment stocks stand steady; but speculative shares are very flat, though they occasionally experience a fitful revival. The making up prices show a heavy fall during the fortnight in copper shares, and in spite of ever recurring efforts to give them an upward turn, the "bull" movement in copper mines seems almost to be exhausted. So long as the French syndicate is in the field, the shares of the larger copper mines will be the sport of gambling speculators. Investors do well to avoid everything where artificial and abnormal influences are at work to disturb natural market values.

Companies.—The following new companies have been registered since our last report: The Dom Pedro Segundo Gold Exploration Company, Limited (Brazil), with a capital of £100,000; Notting Hill Electric Lighting Company, Limited, with a capital of £100,000; House-to-House Electric Light Supply Company, Limited, with a capital of £35,000; the Halfpenny Letter Post Company, Limited, with a capital of £100,000; the London Produce Clearing House Company, Limited, with a capital of £1,000,000; Clark's Transandine Railway Company, Limited (Chili), with a capital of £1,500,000; the Union Manufacturing Company, Limited, with a capital of £30,000, to carry on a spinning, bleaching, dyeing, printing, and furnishing manufacturing business; the Newfoundland Fish Drying Company, Limited, with a capital of £10,000, to work patents for an improved apparatus for drying codfish, and glutinous, fibrous, and other substances; the Glogan Gold Mines Company, Limited, with a capital of £50,000; the European Pneumatic Tool Company, Limited, with a capital of £60,000, to acquire the patent rights of the pneumatic tool described in *Industries* (Vol. IV., page 157); and the Cornholme Mills Company, Limited, with a capital of £25,000, to manufacture handkerchiefs and other fabrics, in Manchester.

Textiles.—The favourable opening of the colonial wool sales, which commenced on 31st January, and terminated on 25th February, gave promise of good business; but the attendance gradually fell off, and prices, which had advanced from ½d. to 1d., again receded. At the lower rates ruling at the close of the sales, however, there was considerable animation in the market. The next colonial wool sales will commence on April 5th. There is no change in the price of Baltic hemp. In Italian hemp some transactions have taken place, but at lower figures. In Manilla, the tendency of the market is decidedly favourable, and a large amount of business has been done.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 19th February amounted to £1,084,375 on 15,831¼ miles, as compared with £1,090,443 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 122¾ miles, or 0·7 per cent.; and a decrease in the receipts of 0·5 per cent. In order to minimise the number of accidents which occur to porters when engaged in coupling railway carriages, the Great Western Railway Company are introducing the use of a shunting pole.

Compound Locomotives.—Experiments are being made by the London and South-Western Railway Company with compound locomotives. Engine No. 446 has been converted into a compound engine, with cylinders 18in. and 26in. diam., the stroke being 24in. The engine is fitted with one of Mr. Worsdell's starting valves for the admission of high pressure steam to the low pressure cylinder. The valve closes automatically by the action of the exhaust steam from the high pressure cylinder after one revolution of the crank. The steam pressure used is 160lb. per square inch in the boiler.

The Navy.—After the complaints which have been heard from time to time as to the dismissal of workmen from the Government dockyards, it is satisfactory to learn that a number of workmen have been taken on at Chatham dockyard to expedite work in hand. The addition is, however, of a temporary nature, the special work being estimated to last for two months. There have been completed for sea at Chatham, the "Benbow," 10,000 tons, 7500 h.p.; the "Rodney," 9700 tons, 7500 h.p.; the "Warspite," 7390 tons, 5000 h.p.; and the "Hero," 6200 tons, 4500 h.p. The new torpedo depôt ship of 12,000 h.p. which is to be laid down at Portsmouth, is to be called the "Vulcan," and will be considerably larger than the "Hecla."

Our Big Guns.—With reference to Mr. Carbutt's remarks on the bursting of a 10-inch gun at Woolwich, which will be found in our last issue, the Secretary of State for War has stated, in reply to Sir B. Samuelson, that twenty-six 9·2in. breech loading guns, having their liners inside, have been sent to proof, of which twenty-five are being made in the Royal Gun Factory. Of these none of the A tubes have split, as stated, but five have split their liners. He states that this accident is not one of any danger, and many rounds can be fired subsequently without injury to the gun. But the question of these liners is a new one, and is offering to all makers of these guns some unexpected difficulty. No gun ready to be shipped to the Colonies was found to be cracked, still less from end to end; but a crack was found in the hoop over the breech of one gun before the completion of proof.

The Electric Lighting Act, 1882.—Sir Michael Hicks-Beach has stated in the House of Commons that since the passing of the Electric Lighting Act fifty-nine provisional orders and five licenses have been granted to companies, and fifteen provisional orders and two licenses to local authorities. The Board of Trade are not aware of any cases in which the powers obtained are now being exercised.

Progress of New Works.—The extension of the London, Chatham, and Dover Railway from the present terminus at Blackheath Hill to Greenwich, is proceeding vigorously. The contractors, Messrs. Lucas & Aird, have a large force of men employed; most of the cutting is completed, and the masonry is well advanced. Messrs. Appleby Brothers, Limited, the contractors for the landing stages of the Greenwich Ferry Company, Limited, have one of the cylinders on the Greenwich side sunk almost to the full depth, and the excavation ready for pitching the second cylinder.

GLASGOW, 1st March, 1888.

Glasgow International Exhibition.—Notices were issued on Friday last to some of those whose applications for space had been entertained, informing them that their exhibits would be received. It is difficult to estimate the number of exhibitors, since in some of the sections, *e.g.*, the women's industries section, the number is very large. Exclusive of this section, and of the Indian and fine art sections, the number may be roughly estimated at twelve hundred. Upwards of four hundred of these are local exhibitors, while forty come from Edinburgh, eighty-three from London, thirty-two from Manchester, fifteen from Liverpool, and thirty-four from Ireland. The construction of the bishop's palace and of the other outbuildings is rapidly approaching completion, while the machinery section is practically ready for the reception of exhibits. The dynamo room is being fitted with its plant, which consists of twenty-three Brush machines, four of Messrs. King, Brown, & Co.'s machines, and three Thomson-Houston machines.

Ship Owning in Glasgow.—A meeting of the Ship Owners' Association was held last week. Mr. Alexander Allan, chairman, delivered an address upon ship owning, with special reference to the report of the Royal Commission on Loss of Life at Sea. Other speakers complained that freights as a rule were depressed, and attributed this depression to a superabundance of tonnage. The subject of light dues was also discussed. Mr. Browne mentioned that the Clyde ship owners paid a sum of £60,000 a year in light dues, equal to one-fifth of the total sum paid in the country.

Freights.—In spite of the somewhat gloomy tones of the speakers at the ship owners' meeting, the general impression is that freights, especially to the East, are considerably advanced. Quantities of heavy goods which are shipped to the East on speculation are at present being held back, in the hope that freights will fall ere long.

Pig Iron.—The pig iron market continues to be entirely without animation. Stocks are increasing, and though special brands are finding a ready sale, the great accumulation at Connal's stores is sufficient to prevent any but the most temporary advance in price. However, if the American tariff alterations effect a reduction of the duty on iron, the immediate result will not improbably be an upward movement of prices. According to the *Boston Herald*, labour troubles in America are having an influence upon the Scotch iron market there. The coal strike has resulted in shortness of fuel, and consequent scarcity of American iron. The same newspaper alleges that the Scotch-American iron trade is in the hands of a clique, who have temporarily depressed prices in order that they might buy. Should this manœuvre not be unduly prolonged, there may be an impetus given to the Scotch market consequent upon the American double contingency—the probable diverted demand from American to Scotch iron, and the probable tariff alteration. The Tariff Bill is expected to be introduced into the House of Representatives within a few weeks. It is stated that Messrs. Connal & Co., who have had for many years the monopoly of the storage of pig iron, are about to convert their business into a limited liability company. The capital is stated to be £400,000, none of which at present will be offered for public subscription.

Electric Light in City Hall and Bazaar.—The installation of electric light in the City Hall and the Bazaar, which adjoin each other, has been completed. The Thomson-Houston system has been adopted, the work having been carried out by Mr. Richard Miller, Mr. W. A. Bryson superintending on behalf of the Corporation. The plant consists of a Robey horizontal compound non-condensing engine of 50 h.p., two dynamos, twenty-three double arc lamps in the Bazaar, and ten double arc lamps with eight incandescent lamps in the City Hall. The lights underwent preliminary trial on Friday last.

(From our own Correspondents.)

LIVERPOOL, 29th February, 1888.

The Isle of Man Steamship Companies.—The three competing companies for the traffic to the Isle of Man have now issued their financial report of last year's working. While the general public has reaped such enormous benefits from the splendid service of boats, it has been at the expense of the shareholders of the different companies, for each company has been worked at a serious loss. If the three companies are to compete in the coming season, it is to be hoped that terms may be arranged which may be more satisfactory to the shareholders.

The National Steamship Company.—An ordinary general meeting of the shareholders was held last week, to receive and consider the directors' annual report. This stated that there was improvement in the earnings of the steamers, and a reduction in the expense and liabilities of the company. The working account showed a profit of £32,797; the balance of the previous year's insurance account, £94,226, had been written off the capital account for steamers, and an underwriting fund opened. The balance at credit, £16,000, had been invested in British Railway preference securities; the amount of loans on debentures was £52,334, and the depreciation credited with £25,864. The capital had been reduced by paying 25,000 preference shares the sum of £2 per share, which with dividend thereon amounted to £61,314; preferential shares of £10 with £8 paid had been reduced to £8 shares with £5 paid, no other dividend being paid.

The Water Famine.—Notwithstanding the slight recent increase in the amount stored at Rivington, the supply is such as to cause the greatest anxiety, and the Water Committee recently decided to further curtail the already short supply, and during the twenty-four hours there will only be three hours in the morning and three hours in the evening when water can be obtained from the mains. Arrangements have been made with the St. Helens Corporation for an auxiliary supply, on the condition that 4d. per thousand gallons be charged; a new bore hole is to be sunk in the Kirkby well, and new pumping machinery is to be obtained capable of lifting 1,500,000 gallons per day; reports upon the available supply at

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Abram, Prenton, and Whiston are also to be made. The water at Vyrnwy will commence to be impounded about October. The expenditure on these works for the last three months was, for land and easements, £1,230. 6s. 8d.; Llanwddyn embankment, £17,997; quarry, £5,740; aqueduct, £35,294; making the total net expenditure up to date, £1,697,598.

Liverpool Exhibition Buildings.—The strenuous efforts which have been made from time to time to convert the old exhibition buildings and grounds into a winter garden or other kind of permanent pleasure resort, have proved to be useless, and the council have now placed the whole affair into the hands of a well known firm of Manchester auctioneers for sale, most of the structures, including the Eddystone Lighthouse model, being offered for sale by tender.

SHEFFIELD, 29th February, 1888.

The Heavy Trades.—The competition in all the local heavy trades is very keen; but Sheffield cannot complain of a lack of orders, and its output at the present time is much in excess of that during the prosperous period of 1874. Profits are narrower, and much more work has to be done for less money; nevertheless, with shrewd purchases of raw material, and the adaptability of labour saving machinery to many branches of manufacture, Sheffield firms have not so far been distanced in the industrial race. That some of them are paying less dividends need excite little surprise, for they are the inevitable results of smaller profits. With every probability of the firm prices of iron and steel being maintained, and an undoubted improvement in inquiry for all sorts of heavy material, the current half year should prove a satisfactory one to shareholders in such works. Even the holders of shares in Messrs. Vickers, Son, & Co. (some of whom have been grumbling for days past that the dividend has run down from 14 to 9 per cent.) may find less cause of complaint at the next meeting. The company has recently obtained some capital orders for heavy castings and shipbuilding material, and is busy in nearly all departments. Not much is doing just now in heavy armour plates; but ordinary ship plates, steel sheets, and similar material are in extensive request. A constantly developing trade is also being done in steel for small springs. The engineers are well employed on heavy machinery for various purposes, both on home and foreign account; and work is plentiful at the rolling mills. All descriptions of railway material are inquired for more eagerly, and steel rails have somewhat stiffened in price for best sections. The edge tool manufacturers find trade improving, and some of the old established houses are doing business very largely just now both with the Continent and the Colonies.

Knives.—Most of the cutlery houses are busy, though they find that they have a very narrow margin of profit. Messrs. Joseph Rodgers & Sons (who declared a dividend of 12 per cent. a few days ago) are an exception, for they can practically fix their own price, and scarcely trouble themselves about the competition. The silver and electro-plating trades are doing well.

Coal.—All kinds of coal are in active demand, and the prolonged winter has made prices of household sorts firmer.

NORTH STAFFORDSHIRE, 29th February, 1888.

The Iron Trade.—The outlook is anything but encouraging to makers, and little advance can be obtained over last year's lowest prices, either for pig or finished iron. Forges and mills are with difficulty kept going from four to five turns per week.

Coal and Ironstone.—The severe weather continues, and those collieries producing fuel suitable for domestic consumption are hard pushed to supply the demand. The output is somewhat lessened by reason of the refusal of many men to comply with the provisions of the new Mines Act with regard to the use of safety cartridges for blasting in fiery mines. The demand for ironstone is dull, and prices are low, averaging from 8s. to 8s. 6d. for furnace mine, and 10s. to 10s. 6d. for puddle mine, delivered to local works.

North Staffordshire Mining Institute.—The annual meeting of the members of this Institute was held at Stoke-on-Trent on Monday last. Mr. W. Woodall, M.P., was re-elected president, and Mr. J. Richard Haines secretary. There was an interesting exhibit of mining and mechanical appliances. In his address, the President dealt with the provisions of the Coal Mines' Regulation Act, 1887, having special regard to mining accidents. He pointed with satisfaction to the continually decreasing number of accidents in North Staffordshire mines. Mr. A. R. Sawyer, Government Inspector, mentioned some statistics illustrative of the comparative death rate in England and Germany from mining accidents, which were distinctly favourable to the former country.

North Staffordshire Tramways Company.—The fourteenth ordinary general meeting of the shareholders of this company was held last week, in London. As compared with 1886, the traffic receipts for last year increased by £308, the expenditure amounting only to 58 per cent. of the gross receipts. The Chairman moved that a dividend of 6 per cent. be paid on the preference and 3¾ per cent. on the ordinary shares. A special resolution for the conversion of fully paid up shares into stock was also carried. Since the company started their cars have carried 13,000,000 passengers, and they are now being run with regularity and speed. Having regard to the situation of the Pottery towns, there can be no doubt that this company has supplied a distinct want for some time felt in this district, and the main result of their formation has been to secure an intermediate class of traffic for which the railways were unable to provide.

BARROW-IN-FURNESS, 29th February, 1888.

Iron and Steel.—There is less activity in the hematite pig iron trade, and business has declined even in hematite warrants, although prices are lower; but makers who are tolerably well sold forward have not brought down their prices, and are firm at 43s. 6d. to 44s. per ton net f.o.b. for mixed numbers of Bessemer iron. There is some hope of a revival, because the consumption of iron is increasing, and makers are aware that for many months to come some very large parcels will have to be delivered. There is, however, no doubt of the fact that the production of hematite pig iron throughout the country is too great, even in face of a growing demand; but it is impossible to secure any reduction, except by means of a general understanding amongst makers. There is, however, very great activity in all departments of the steel trade. The inquiry for rails is larger than for some months past, but lower prices are ruling, good heavy sections being obtainable at £3. 18s. 6d. per ton net f.o.b. Plates are quoted at £7 per ton, and angles at £6. 10s., and if makers could deal with orders they would be able to increase their production very considerably. Active efforts are being made to increase the production of all classes of Siemens-Martin steel. There is a satisfactory inquiry for blooms on general American account, and the prices quoted are about £3. 15s. per ton. Billets are also asked for at £3. 18s. 6d. per ton net f.o.b.

Shipbuilding and Engineering.—There is a prospect of some very large orders in shipbuilding coming to Barrow. The order for a large floating dock for Buenos Ayres, to lift a 5000-ton steamer, is all but settled with the Pacific Steam Navigation Company, and orders are expected for some large ocean steamers, as well as for Nordenfelt submarine torpedo boats. In engineering and boiler making there is a better feeling, and there is a more cheerful tone throughout the town and district than has been experienced for some months past.

MIDDLESBROUGH, 29th February, 1888.

Pig Iron.—There is every reason for an improvement in the pig iron market, but there is none. This is caused mainly by the market being in the hands of merchants and speculators, whose interest it is to keep it down. There are sellers at 31s. 6d., but buyers offer 3d. less. There is really very little business being done at all. In the meantime stocks are declining, and many makers are waiting to see what the monthly returns will be.

Exports of Pig Iron.—This month's exports are highly favourable, having, up to the 27th, amounted to 60,175 tons, as against 55,830 tons to the 27th of last month, and 50,070 tons to the 27th of February last year. The latter part of the month has been very stormy, else more would have been exported. It is satisfactory to know that the exports are increasing in every direction, with the exception of America. Germany and Holland have taken nearly twice as much as during the same period last year. The coastwise shipments also have materially increased.

Finished Iron and Steel.—Both of these are much as they were last week. Finished iron is firmer perhaps, but it does not take so much to make this trade busy now-a-days. Steel rails are quiet, but ship plates are in very strong demand. The rising price in ship plates is likely to be checked by the unexpected appearance of German plates. These, however, can only be temporary rivals. The increasing plant in preparation to overtake the increasing demand should make competition of that sort impossible.

Engineering.—The boiler yards are fairly busy on going orders, chiefly for foreign destination. Marine engineering is exceptionally busy, on account of the rapid improvement in shipbuilding. In the manufacture of railway plant there is as great a turnout as ever.

SUNDERLAND, 29th February, 1888.

Shipbuilding.—Owing to the difficulty of obtaining delivery of steel plates and angles, several shipbuilders are, with the consent of their customers, fitting iron in place of steel for floors, engine and boiler seatings, bulkheads, &c. A few days ago the Chief Surveyor visited Sunderland and held a conference with the local shipbuilders. He submitted draft copies of the proposed new rules for steel vessels.

Shipping.—The monthly trade return for January, laid before to-day's meeting of the River Wear Commissioners, shows that 552 vessels of 206,287 tons register, paying dues to the amount of £1,798. 16s. 5d., cleared from the port, being an increase of twelve vessels, 2660 register tons, and £35. 0s. 4d. dues, as compared with January, 1887. The total quantity of coal shipped was 336,331 tons, an increase of 3269 tons over the corresponding period of last year. The entire revenue of the Commission for the last month was £10,167. 6s. 2d., as compared with £9,227. 0s. 3d. in January, 1887, an increase of £940. 5s. 11d.

The Coal Trade.—There is no steady rising tendency in the price of coals. Merchants affirm that if the shipments are to be maintained, lower rates will have to be accepted. This statement appears to be borne out by recent statistics. The coal shipments at this port amount to 73,974 tons, of which 23,849 were sent abroad, and 50,125 to ports in the United Kingdom. In the previous week the total only reached 67,487 tons; in the corresponding week in 1887 the shipments were 82,867 tons.

Boat Building.—Wearside boat builders are on the whole well employed. Messrs. M. Robson & Son have just received an order from Palmers' Shipbuilding and Iron Company, Limited, for an outfit of boats for an unusually large passenger steamer. All the boats are to be built of teak, and six of them are also lifeboats.

Boat Lowering Apparatus.—Mr. Wm. Mills, of Southwick, to whom was awarded a silver medal at the Royal Jubilee Exhibition, Newcastle-on-Tyne, for his boat lowering and disengaging apparatus, has just obtained a large number of orders for the gear, and his works are kept busily employed.

Cement Works.—The cement manufacturers have their works actively employed. Orders appear to have been equally divided between the Sunderland Cement Company, Limited; the Wreath Quay Cement Works Company, Limited; the Hylton Cement Company; and the Deptford Cement Works.

NEWCASTLE, 29th February, 1888.

Iron.—The improved condition of the finished iron trade, which was noted in previous reports, is still maintained, the works being generally busier than they were at this time last year. The output of Messrs. Raine and Co.'s works, Winlaton, since the opening of the year, has exceeded, by many hundred tons, the production for the corresponding period in any former year. Other manufactories, though not showing such extremely satisfactory results, have in every instance turned out a much larger quantity of material than they have been in the habit of doing for some years past. Manufacturers still hold firmly to the advanced prices obtained in December last, though with reference to some descriptions of the commodity considerable pressure is being brought to bear upon them for easier terms. A very strong reason for refusing concession in this direction is that before the advances referred to were obtained, the margin of profit was so small as to be often almost non-existent, and it will go hard with manufacturers before they again consent to do business on so unsatisfactory a basis.

Steel.—The output of product at the Consett steel works steadily increases each week, as the newly added productive resources are being brought into requisition. The other extensions of works in the district are being actively proceeded with, and it is expected that in a short time the supply of steel plates, angles, &c., will equal the demand. All departments of the Newburn steel works are now extremely busy, and the steel factory in connection with Sir W. G. Armstrong, Mitchell, & Co.'s Works, Elswick, is among the most briskly employed departments in that great establishment. Iron and steel sheets have been exported this year in large quantities by the Redheugh Iron and Steel Sheet Company, among other shipments being one of 600 tons to Kurrachee.

Chain and Anchor Works.—Both the chain and anchor departments at Messrs. Abbot's establishment, Gateshead, are now tolerably busy, some orders for large anchors having recently been received. At Messrs. Hawks, Crawshay, & Co.'s works there are also some very heavy anchors of a special type in course of manufacture.

Re-opening of a Shipyard.—Arrangements are now being made for the immediate re-opening of Messrs. Palmer & Co.'s Howdon yard, which has been closed since 1884. This step is understood to have been made necessary by the fact that this firm have contracted for a very large amount of work, a considerable portion of which has to be turned out by the end of the year.

DUNDEE, 29th February, 1888.

Flax and Jute Trades.—There has been a lack of animation in the staple industries of the town during the past fortnight. Notices have been put up in most of the jute works, that for three months machinery will be stopped on Saturdays. The flax market has been somewhat irregular. The sudden fall in the Russian exchange has made sellers more anxious to offer, and considerable sales are reported at low rates. Flax and tow yarns meet with a slow sale, which is partly accounted for by the fall in the price of flax. Manufacturers are willing to operate on easier terms; but prices are difficult to arrange, as spinners still hold out fairly well. There is no improvement in the demand for linen goods; but for fine fabrics, more especially those produced in the Fife district, the orders on hand are sufficient to keep the factories well employed. Jute has been selling freely, and prices are firmly maintained. Jute yarns continue in fair request, but the advanced rates asked act as a check upon business. In jute goods Hessians are in moderate demand and prices fully maintained, but there is an absence of forward buying. The probability of an alteration in the American tariff is a good deal canvassed by the trade. It is feared that should Congress take off the duty on raw jute, and retain the heavy duties on manufactured goods, Dundee would be exposed to serious competition from American producers. Sacking and bagging continue in active request at late rates.

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RAILWAY CARRIAGE AND WAGGON WORKS.

(For description see page 209.)

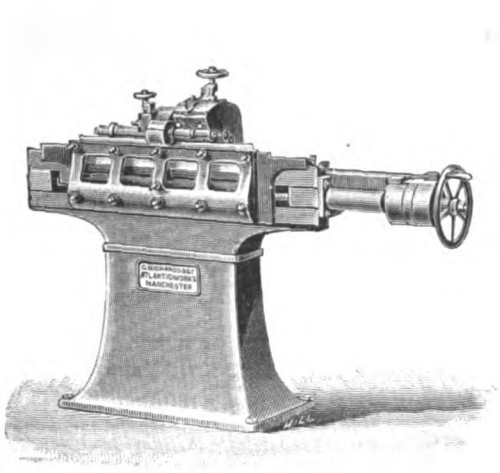


Fig. 12.



Fig. 13.

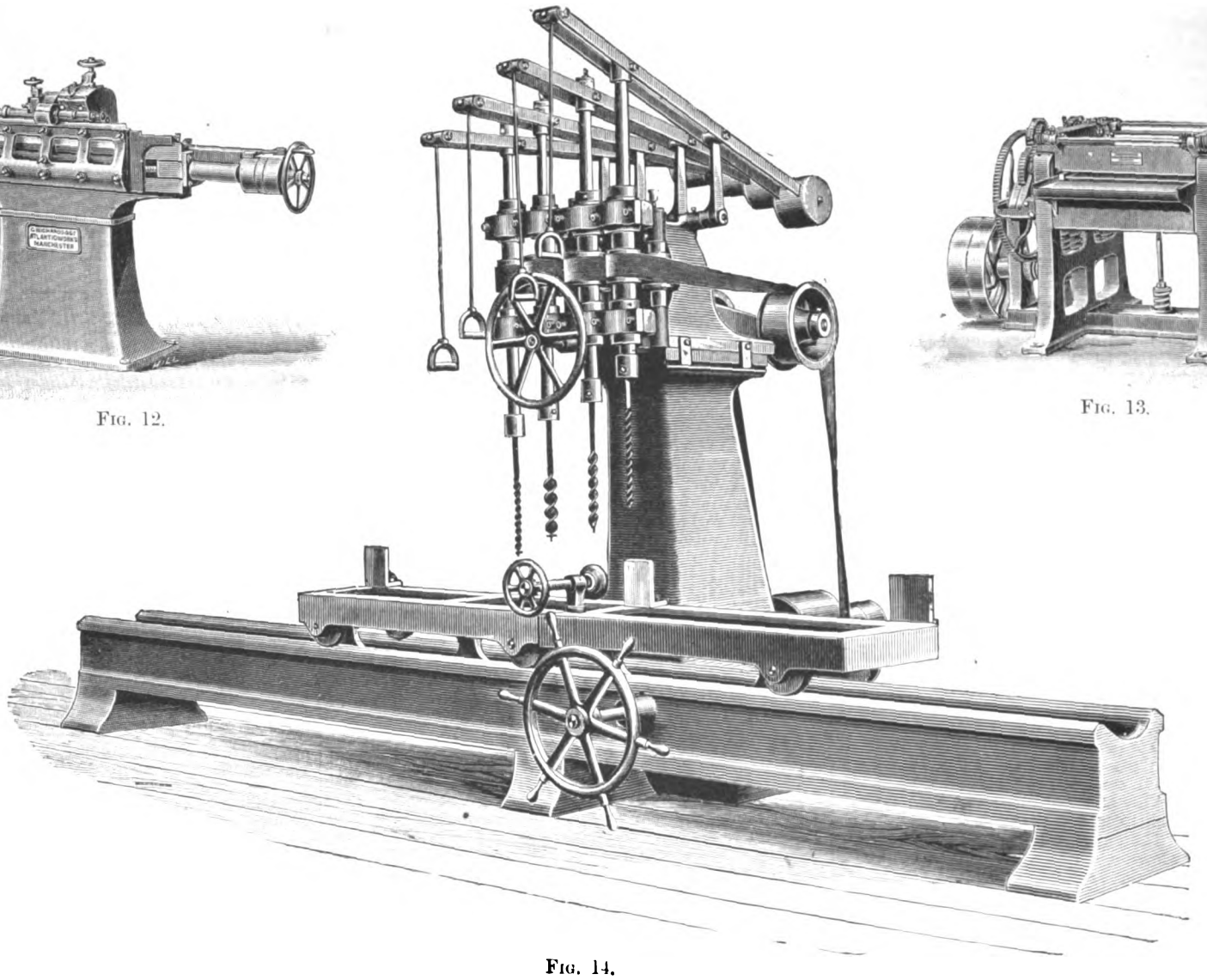


Fig. 14.

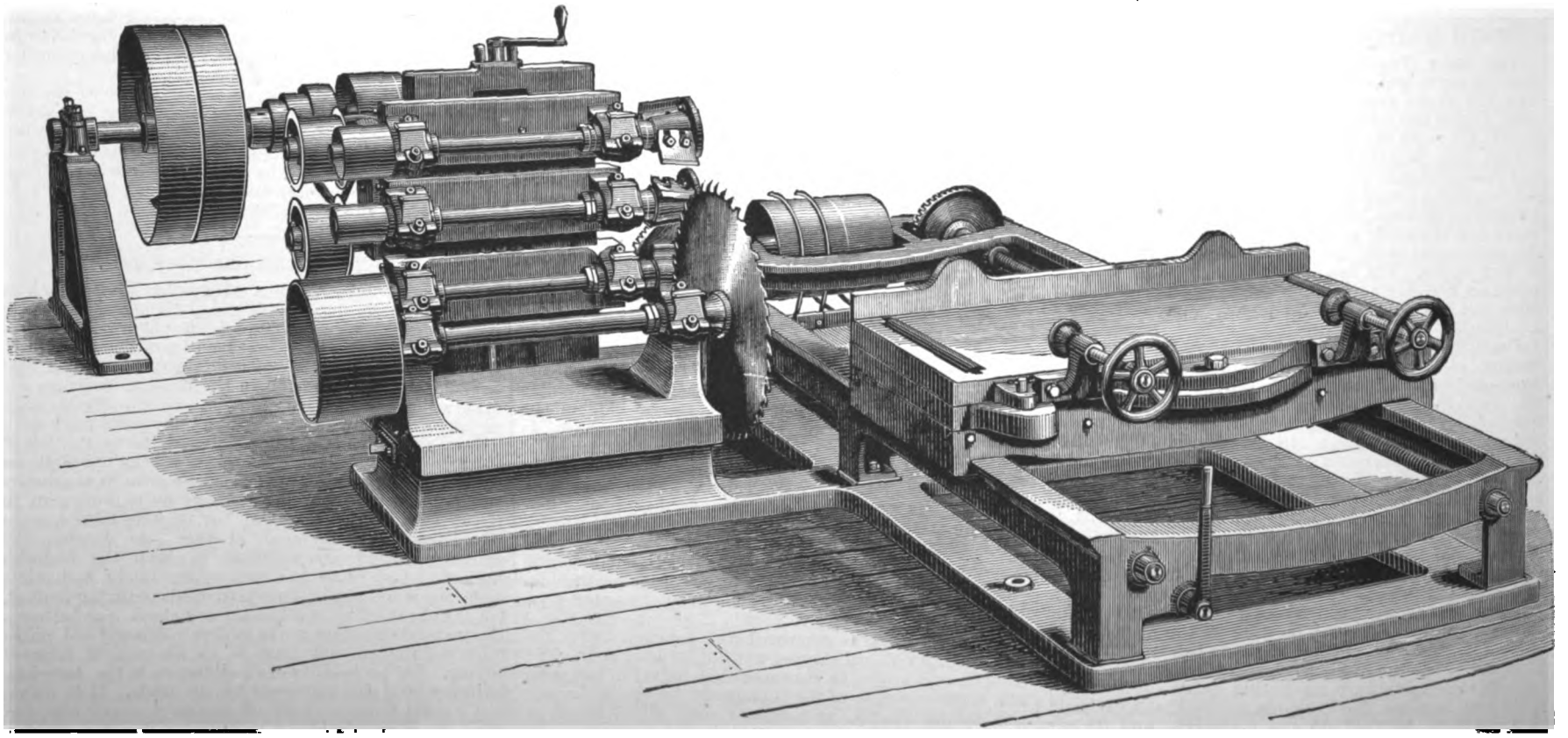


Fig. 15.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London. 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
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Telephone number: 684, MANCHESTER.
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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," *either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.*

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 2ND MARCH, 1888.

THE ASSOCIATED CHAMBERS OF COMMERCE.

THE annual meeting of the Associated Chambers of Commerce was held last week, in London, when delegates from the provincial Chambers met to discuss matters of current commercial interest. Though a good deal of solid information and a considerable mass of statistics were contained in the speeches of the President, Sir Bernhard Samuelson, M.P., of Sir Jacob Behrens, Sir John Lubbock, and the other commercial and financial magnates who took part in the discussions, there was an absence of matter for exciting discussion. The old stories of the desirability of arbitration between nations—not between business firms—instead of war, fair trade, and the need of national harbours of refuge, were debated and resolved upon, and more strictly commercial questions, such as commercial education, railway rates, and the amendment of the Joint Stock Acts, were discussed at some length. In all there were sixty resolutions on the agenda paper. The report of the Executive Council, reviewing the commercial history of the last Parliamentary session, concluded with certain recommendations. These were that the system of devolution of public business to Committees of the House of Commons be extended, and that to these Committees—which should be fairly representative—all Bills not involving questions of Imperial policy should be relegated. The report also recommended the carrying forward of measures not completed in one session to the next session, and it also suggested that the power of blocking Bills should be restrained. While all these measures are obviously sensible, a preliminary question might be raised. Why should Parliament have so much to do? Why should our legislative machine be worked so hard that the old means of lubrication are no longer sufficient? Last session seventy-four Bills were passed through Parliament, many of them measures that will have to be amended in the course of a year or two, and a few of them measures that nobody wanted except it be the few crotcheteers who manœuvred them through the Houses of Parliament. If, however, so great and important additions must annually be made to the statute book, it is essential that they should be made with as full knowledge of the needs of each special case as is possible. Committees to whom non-partisan measures might be referred form a useful invention of which much more extended application might be made. There is another mode of securing the passing of Bills efficient for the purpose intended, which seems likely to be adopted to a considerable extent in the future. That is the appointment of a board or committee of skilled persons in special departments to act along with the Government departments in preparing legislation and in administering the law. The Board of Agriculture and the proposed Committee in the Boiler Registry and Inspection Bill are instances of this kind. The members of such Committees are not necessarily members of Parliament; they are selected from among men who have distinguished themselves in special departments, and who are, therefore, looked upon with certain confidence by the public. This might well form the text of a future resolution at a meeting of the Associated Chambers. The suggestion that the "massacre of the innocents" should be abolished, and that Bills which have passed through the preliminary stages should, on the reassembling of Parliament, be taken up at the stage at which they were dropped, is an eminently reasonable suggestion. There is really no valid constitutional reason for the waste of time involved by thus summarily disposing of measures upon which time has not been found for complete discussion. That change of conditions involved in a dissolution does not occur when Parliament is simply prorogued. It is to be hoped that some Government will ere long have the courage to propose such obvious improvement in the conduct of public business as the Associated Chambers have suggested. The power of blocking Bills would be deprived of a large part of its efficacy if Bills were carried over, since part of the delightful experience of "blocking" is the knowledge that, if successfully postponed till the end of the session, the Bill is almost sure to be found among the "innocents." The address of the President, Sir Bernhard Samuelson, referred mainly to the improvement of trade which he said had taken place during the last six months of 1887 and the early weeks of 1888. He quoted the figures of our total cargo trade for 1887, showing that our foreign trade amounted to 56,000,000 tons, an increase of 2,370,000 tons over 1886. Adding the coasting trade of 27,500,000 tons to our foreign trade, made a total of 83,500,000 tons shipped from our ports. And adding to this the 270,000,000 tons carried on our railways, an estimate is possible, though necessarily not very exact, which would place our aggregate of transported goods at 353,500,000 tons. This, of course, is not the total of our production, for a great quantity of raw material is productively consumed almost or altogether *in situ*, or is transported by more primitive means than the railway or the steamboat. Sir Bernhard also drew attention to the circumstance that recent increases in foreign tariffs in the United States and in Italy had increased the cost of living everywhere abroad. Against this bare statement may, however, be placed the arguments that the remuneration of labour, in the United States at any rate, is rather higher than it is in this country, and that wages in proportion to the standard of comfort are probably rather higher and more uniform in protected countries than in free trade countries. This, however, must be taken with due reservation, for absolute statements are to be avoided on both sides. It is extremely difficult to compare the wages and prices of two different nations working under different climatic conditions, and with different standards of comfort. Statements as to the increase of the cost of living in protected countries can therefore only be accepted in very general terms, and as operating over comparatively small areas. Sir Bernhard also referred to the Paris Exhibition, and to the subject of commercial education. This topic formed the basis of a resolution moved by Sir John Lubbock, to the effect that it is desirable to obtain an alteration in the School, Civil Service, and University Examinations, to substitute modern languages and elementary science for the classical subjects in these examinations, and also suggesting the appointment of a Minister of Education, and the insertion of clauses in the Technical Instruction Bill, which will doubtless be revived this session, to provide for teaching commercial subjects and modern languages in technical or board schools. A resolution presented by a number of provincial Chambers also dealt with technical education, and urged that evening as well as day schools should be

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provided, and that proper provision should be made for the systematic training of teachers. This resolution also suggested that grants should be given for proficiency in technical and commercal education, and that the clause in the Bill of last year, which made its adoption permissive, should be cancelled so far as the ratepayers are concerned, and that powers should be given to the local authorities to adopt the Bill without appeal to the ratepayers. These are all important suggestions; but the main point upon which none of them indicated any opinion is, what do they mean by technical education. Commercial education is not quite so ambiguous, but many persons seem to have a very hazy opinion as to what they really want when they demand technical education. We have from time to time in these columns pointed out some of the lines upon which we think technical education ought to be administered; but it would be well if public bodies, instead of passing general and vague resolutions like those quoted, condescended somewhat more to detail, and described to us whether they want handicrafts taught in schools, or whether they mean by technical education that training in principles which every man who works with his hands ought to have in his head. The question as to whether the ratepayers ought to be disregarded, except when called upon to pay the rates, is too important for slight treatment. The experience of the Libraries Act is perhaps the moving cause for such a proposal. It has been extremely difficult to persuade the ratepayers of the large towns to adopt the Act and pay the tax; and the presumption is that technical education might be similarly delayed. It is, however, an unsafe method. The practice of directly appealing wherever possible to the persons who are to defray the cost, is too sound to be disturbed without substantial reason. The system of payment by results or grant-earning must clearly undergo considerable modification before it is extended. While there is some sound reason why the nation as a whole should share in the cost of what is a benefit to the nation as a whole, it is by no means to be assumed that a pecuniary grant per student passed is the best method of securing this. The system has been discredited in elementary education, and it has unquestionably worked some mischief in science education. To make it otherwise than injurious to efficient teaching, and absolutely fatal to cramming, it would be necessary to re-construct the system root and branch.

ELECTRIC STREET LIGHTING.

The recent action, or, rather, want of action, on the part of the City authorities, to which we drew attention in our last issue, is calculated to bring the subject of street lighting more prominently before electrical engineers and contractors. The lighting of our streets is a question which has been rather neglected during the last few years, and improvement in lighting plant has mainly been made with a view to its use in private establishments. This, we cannot help thinking, is a mistake, as engendering on the part of those responsible for civic improvements a feeling of hesitation. If the problem be to light a large hall, a factory, a schoolroom, or offices, the opinion of experts and outsiders would scarcely differ about the best method to be adopted in each case; but as soon as the question arises of how to light a public thoroughfare, opinions become divided. We do not mean to say that the opinion of electric light engineers, who thoroughly know their business and mean to do good work, would differ; but their opinion is easily over-ruled by that of outsiders, who cannot possibly discriminate between one system and another in its adaptability for a special purpose. This was strikingly shown at the meeting of the City Commissioners of Sewers, on the 22nd ultimo, when a substantial and workable scheme brought forward by the Brush Corporation, and which had obtained the approval of the Streets Committee, was shelved because of two rival schemes, which we cannot characterise otherwise than as absurd, but which, notwithstanding their defects, palpable to engineers, at once obtained the support of a large number among the Commissioners. One of these schemes was to replace the gas jets in each street lamp by three glow lamps. We should be very sorry to see such a proposal carried out, because it could only discredit electric lighting. Many years ago, Pentonville Road was lighted by glow lamps, and the result was a complete failure, as was also the lighting of Holborn Viaduct, which was carried out in the same manner. The light given by a glow lamp is more or less of the same character and power as a good gas jet, and it is inferior to the Siemens, Wenham, or other regenerative burners now in the market. The reason that glow lamps are adopted indoors is not on account of giving more light than gas, but because of the greater convenience, cleanliness, and the absence of any products of combustion. These advantages are sufficiently great to counterbalance the larger cost as compared with gas, but in the streets these advantages become illusory. Where the products of combustion escape directly into the atmosphere, non-pollution of air and cleanliness become immaterial, whilst the question of convenience is reduced to the small matter of dispensing with the lighting and extinguishing of each lamp; but even this could in the case of gas be done automatically by a pilot light and regulating apparatus which is called into play by a sudden rise or drop in the gas pressure. The glow lamp (Parson's high candle power glow lamp perhaps excepted), therefore, possesses no advantage whatever over the gas jet, whilst the cost of lighting must always be greater. Electricity is now sold by one large company in London at the rate of 7½d. per Board of Trade unit. This is a very low figure; but assuming even that the supply could be obtained at 6½d. for municipal purposes, the cost of incandescent lighting would still be about twice that of gas. We may therefore dismiss the proposal to light the streets by glow lamps as too absurd for further consideration.

The other rival scheme which helped to shelve the report of the committee, was that put forward by the Maxim-Weston Company, and on close inspection it will be seen that this is hardly less absurd than the other. This company offered to erect a central station generating plant, and eight hundred small arcs throughout the city, for the modest sum of £15,000, and to work the plant for an annual charge of £3,875. The lamps were to be 450 n.c.p., and to be kept alight from sunset to sunrise, that is, roughly speaking, for 4300 hours per annum. The lamps are presumably the Watt lamps, about which a great deal has been written in the daily press, and nothing at all has transpired in the scientific journals. To judge by the reticence observed both in the matter of the dynamo and the lamp, the inventor seems to prefer the verdict of the non-scientific newspaper reporter to that of a skilled electrician when he submits his invention for inspection. We have, therefore, no means of knowing anything about the merits or otherwise of the Watt lamp: but assuming this small lamp to be as efficient as an ordinary 10 ampère lamp—an assumption which is by far too favourable—each lamp would require 225 volt-ampères; and allowing a loss of 25 volt-ampères for the leads and regulating devices, we find that each kilo.-watt generated at the station would maintain four of these lamps alight. For the eight hundred lamps, the total capacity of the generating station would have to be about 200 kilo.-watts, and the yearly output 860,000 Board of Trade units, which, calculated at the low figure of 6½d., represents a charge for current alone of £2,325, to say nothing of the cost of carbons, which will probably amount to one-fifth of a penny per hour per lamp, representing an additional outlay of £2,800 per annum. This does not include the cost for trimming lamps nor outdoor supervision, which must necessarily be high where a large number of small lamps is employed. From our figures it is obvious that the Maxim-Weston Company must have made some mistake or other in estimating the annual working expenses, which they will find out to their cost, and perhaps to that of the City also, if they obtain the contract on these lines. It is obviously not to the advantage of any community to get contractors to work for them at a loss, for in such cases the public is certain to be badly served. We may therefore also dismiss the Maxim-Weston proposal as impracticable on account of economic reasons, and the question remains whether arc lighting in any shape or form would be an improvement upon the present system of gas lighting.

When a part of the City was lighted by arc lamps for the first time, the service was not altogether satisfactory: the light flickered a good deal, and the lamps were fixed on posts so low as to inconvenience the drivers of omnibuses and vans. Since then great improvements have been made in dynamos and lamps, and those of our readers who saw the Manchester Exhibition must have noticed how exceedingly steady was the light of the Brush arc lamps—the number of lamps which were there in nightly use being far in excess of that now proposed for the City. It is therefore reasonable to expect that the company would find no difficulty in supplying an equally good light in the City, and as the lamps would be fixed on posts 18ft. high, no inconvenience to drivers of high vehicles would ensue. The annual cost of running a 10 ampère arc lamp from sunset to sunrise is variously computed in this country at from £25 to £35. The Thomson-Houston Company, in the United States, supply a lamp according to its position and the competition encountered from other electric lighting companies, at a charge varying from £20 to £10. Now, the Brush Company offer to run their lamps at a charge of £26 each, and it will thus be seen that their offer is not so low as to make a loss inevitable; at the same time it is sufficiently low to be advantageous to the City, which would thus have to pay only twice the price of gas, and obtain about thirty times the light. The reason why, under the Brush scheme, the City can be efficiently lighted at a moderate outlay, must solely be sought in the employment of lamps of fairly large candle power. It is well known that large arc lamps give more light per unit of energy expended than small ones, whereas the cost of carbons and attendance is not materially affected by the size of the lamp between the limits of say 500 to 2000 c.p. It is thus obviously of advantage to employ a smaller number of high candle power lamps in preference to a large number of small candle power lamps, and to place them on posts considerably higher than gas lamps are fixed. The system elaborated by the Brush Corporation appears to us the proper solution of the problem how to light our streets electrically, and if carried out it will probably form the pattern for similar work in other parts of the Metropolis.

CENTRAL STATION LIGHTING BY STORAGE BATTERIES.

At the last meeting of the Society of Telegraph Engineers and Electricians, this system of distributing electricity was warmly advocated by Mr. Gordon and Mr. Crompton, the latter gentleman speaking from personal experience in the use of storage batteries for this purpose. As this is a question of great importance to electrical engineers and contractors, it will be of interest to our readers if we give a short account of a visit we recently paid to Mr. Crompton's central station at Kensington Court, to inspect the machinery and distributing plant. Since we published an illustrated description of this station in our issue of the 18th February, 1887, the plant has been duplicated. There are now installed two boilers and two direct acting steam dynamos of the Willans-Crompton type. One of the dynamos is a double horseshoe horizontal machine, and the other is of the inverted single horseshoe type. Each machine is able to supply current equal to from 40 to 45 h.p., but only one machine is at present required at a time. At one end of the machine room there are stages for several batteries of storage cells; but only one battery is at present in use, and is connected by means of an ingenious switch board with three lighting circuits, all of which have a very low resistance, so that the loss of pressure in the mains is only trifling. At present the routine of the installation is as follows: One of the engines is started about three o'clock in the afternoon, and begins charging the battery. At the same time the current is sent out from the battery to the various lighting circuits, and these connections are never interrupted during the whole twenty-four hours, so that consumers can have the light at any moment of the day or night. The consumption reaches a maximum towards seven o'clock in the evening, and by about eleven o'clock it has again sufficiently declined to allow of the engine being stopped. Meanwhile the batteries have received a sufficient charge to last till the next afternoon. After stopping the engine at eleven o'clock, the station is locked up and left to itself. The charging current and the discharging current are both measured by Aaron's coulomb meters, and in the consumers' houses there are installed either Ferranti or Cauderay meters. The mains in the streets are of a novel construction, and consist of bare copper strips supported on porcelain insulators within a brick culvert set in cement. At certain intervals a flag of the footpath is provided with lifting rings, so that it may be lifted to give access to the mains. The house connections are simply soldered on to the copper strips, the switch and fuse being placed, not in the culvert, but at the entrance to the consumer's premises. Each main is protected by fuses at the station, and potential wires are carried back from the far end of the main to the station, to indicate the pressure at the lamps. The attendant is therefore enabled to regulate, by means of the switch board already mentioned, the number of cells working on any particular circuit, so as to maintain the pressure constant within one or two volts.

PATENT LAW.

In concluding our review of patent litigation for the year 1887, in our issue of the 20th January last, we ventured to state a proposition, which we thought would appeal to common sense, viz., that commercial success was a fair test of novelty and of patentability. We scarcely anticipated having judicial decision to support this, but the proposition has since been made good in two cases. The first case was the decision of the

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Court of Appeal in an action brought by the American Braided Wire Company against Thompson. The American company were the owners of Letters Patent, dated 25th July, 1885, for "Improvements in bustles or dress improvers." The bustles were made of tubular braided wire, and very large quantities of them had been sold. The action came on before Mr. Justice Kekewich in July last, and he declared the patent invalid. He held that the "plaintiff's invention was merely the application of material of a previous patentee to purposes *analogous* to those pointed out in the specification." On appeal, the case came before the Lord Chief Justice and Lord Justices Cotton and Bowen. The Court of Appeal upheld the validity of the patent, and the following will show what influenced them in arriving at this result. Lord Justice Cotton remarked, "There was the circumstance that a large sale at once followed the introduction to the public of bustles made according to the specification." Lord Justice Bowen, in giving judgment, asks this question, "Unless there is some ingenuity in the person who brought out this article, why was it never brought out before?"

The second case to which we have referred was Ehrlich *v.* Ihlee and Sankey, in which judgment was delivered on the 21st ult. The plaintiff was the inventor of a musical wind instrument known as the "ariston." The valves are opened by levers which were operated by means of slots in a circular disc. Since the date of his patent, in 1882, the patentee had sold over 150,000 of these instruments, and over 2,000,000 of the discs, or musical sheets. Mr. Justice Kekewich decided in favour of the patentee. In giving judgment he referred to the case of the American Braided Wire Company *v.* Thompson in these words: "I conceive the following proposition to be established by that case. If, within a short time of the first manufacture and sale, an article of commerce commands a ready and extensive sale, that fact, which is proof of utility, must also be accepted as evidence, not conclusive, but cogent, of novelty. The words are mine, but the substance underlies the judgment of certainly two of the members of the Court in the particular case, and particularly that of Lord Justice Bowen, who asked the very question which I asked myself in Siddell *v.* Vickers: 'Unless there is some ingenuity in the person who brought out this article, why was it never brought out before?' The proposition commends itself to one's common sense, if I may venture to say so; and it is the more applicable here because the introduction of the ariston displaced other instruments which, until then, had been largely sold by the plaintiff, and which, according to the evidence, not only have not been sold, but cannot be sold now."

Letters to the Editor.

THE BOARD OF TRADE INSPECTORS AND VERTICAL FIRE BOX BOILERS.

To the Editor of "Industries."

Sir,—The thanks of the steam using public, as well as those of engineers and boiler makers, are undoubtedly due to your correspondent "Economiser" for drawing such pointed and timely attention to the question of the strength of short flues, furnaces, or fire boxes of vertical boilers, and it is to be hoped that boiler makers who make the manufacture of such boilers a specialty, will adopt "Economiser's" suggestion, and forward to you the result of their experience of the behaviour of fire boxes under hydraulic pressure. It would form interesting, instructive, and valuable data, and would also supply important evidence as to the reliability or otherwise of this type of boiler.

The boiler described by Mr. Peter Samson in his Report No. 145, is stated to be of the ordinary wrought iron vertical type, with two cross tubes in the fire box and a vertical uptake; the outer shell 4ft. diam. and 7ft. 4in. high, made of four plates arranged vertically, the seams lapped and double riveted with ¾in. rivets, 2in. pitch. The crown of shell was in one plate, dished, flanged, and single riveted to shell. The fire box was slightly conical, about 4ft. high, exclusive of the crown, 38¼in. at the top and 40¾in. at the bottom, internal diameter, with plates arranged vertically, lap jointed and single riveted. The crown was made in one plate, dished, flanged, and single riveted. There were two 8in. welded and flanged cross tubes in the fire box, fixed at right angles to each other. The uptake was 12¼in. at the top, and 10⅜in. at the bottom, secured by angle rings to shell and fire box. According to the Board of Trade instructions to surveyors, the collapsing pressure of the fire box of such a boiler would be, as shown by Mr. Samson, 141lb., and by the same instructions the proper safe working load upon the safety valve should not exceed 28·6lb. Now, by the usual formula adopted by engineers, the collapsing pressure would appear to be about 600lb. per square inch, consequently the fire box ought to prove stronger than the shell in this instance, the bursting pressure of which would be about 500lb. per square inch.

If a boiler were made to the sketch accompanying "Economiser's" letter and to the dimensions given above, and it was proposed to a boiler insurance company, it would be accepted without demur; for a daily working pressure of 141lb.—the load which, according to Messrs. Traill and Samson, or the Board of Trade instructions to surveyors, would at once collapse the fire box. Either Messrs. Samson and Traill are the authors of another ridiculous scare, and the finders of another mare's nest as huge as that discovered by Mr. W. Woodthorpe of the "so-called economisers," or the engineering practice of the United Kingdom is hopelessly blundering on in the dark. If boiler makers respond to "Economiser's" invitation, this question may be shortly decided, and in the interest of the public generally it is of the utmost importance that it should be. Should there be anything like 25,000 of such boilers in use in Great Britain, the urgency of the matter can scarcely be exaggerated, when such a vast disparity exists between the engineering opinion of the country and that of the Board of Trade inspectors, which might at any moment result disastrously both with regard to property and life. It is perhaps, however, unnecessary to take too serious a view of Messrs. Traill and Samson's Report (No. 145) and its conclusions, and we—speaking for steam users generally—shall possibly run into no danger by treating it with disrespect.

Some other of the Board of Trade inspectors do not attribute all cases of collapse to want of compliance with the Board of Trade instructions to surveyors, and they have theories and explanations which, though probably of no more real weight or value than the one just referred to, still have a merit of their own, certainly of ingenuous simplicity. To prove this assertion, let me take the evidence of Mr. G. Carlisle, another of the Board of Trade inspectors. On the 28th April, 1883 (see Report No. 29), he reported upon the explosion of a boiler at the Huyton Iron Works, Huyton Quarry, Lancashire. The boiler was of the Lancashire type. It had two furnaces, each running into a through flue of the same diameter, fitted with Galloway tubes, placed diagonally. The boiler was 30ft. long, 7ft. diam., made of $\frac{7}{16}$in. plates, lap jointed, double riveted longitudinally, and single riveted circularly. "The furnaces and flues were composed of ten lengths, the end lengths being conical. The furnaces comprise the first three lengths at the front end of the boiler, and were of $\frac{5}{8}$in. plates, lapped and single riveted, both circumferentially and longitudinally. The flues comprise the remaining seven lengths, and were of $\frac{7}{16}$in. plates, the longitudinal joints being butted and fitted with outside straps single riveted. The circumferential joints were made by single riveting the edges of the rings of plates to the flanges of T iron hoops, spaced about 3ft. apart. In each flue there were three diagonally placed Galloway tubes, about 10in. diam. at the upper end."

This explosion, says Mr. G. Carlisle, was due to the collapse and rupture of the crown of the right hand furnace. The water and steam escaping through the rupture bared the top of the left hand furnace, in which there was a good fire, and this caused the over-heating of the top of the left hand furnace; but it was not distorted or materially injured. Mr. G. Carlisle then goes on to state that, "*in my opinion, this explosion was due to the excessive strain thrown on the seams, and the flattening tendency of the top of the furnace caused by the sudden contraction of the top of the furnace and flue in consequence of the furnace door being open for a period of from five to ten minutes whilst the furnace was being cleaned, the dampers being open at the same time.* Similar contractions on previous occasions may possibly have caused cracks between the rivet holes, and the loosening of the rivets of the circumferential seams, which I observed existed, and which have been of frequent occurrence hitherto in this boiler."

In Mr. Carlisle's further remarks upon this case, he states that "during the clearing of the fire, a current of cold air would be impinging against the top of the furnace and passing along the flue to the chimney. A slight fizz at the circumferential seam immediately over the fire was observed at the time, but as it had been seen on previous occasions no particular notice was taken of it. . . . The engineman had just been round the boiler to see that all was right, and both he and the fireman swear that there was plenty of water in the boiler, and that the steam gauge showed 50lb. . . . From the foregoing particulars, and the attached sketch, it will be seen that the flues are very much stronger than the furnaces, both as regards plating and method of construction. It therefore seems to me that the variations of length of flue and furnace, due to the expansion and contraction of its 30ft. length, would tell very severely on the weakest ring or rings of plates, and would be quite sufficient to account for the trouble hitherto experienced with these furnaces. The impact of a volume of cold air with the heated plates of the top of the furnace would make them contract, and tend to flatten and otherwise distort them. The ultimate strength of this furnace, had it been perfectly cylindrical and cold, by Fairbairn's formula, is about 100lb. The collapse, therefore, of this lapped and single riveted furnace—distorted and, possibly, partially fractured—at 50lb., is only what might have been expected."

If Mr. Carlisle's calculation by "Fairbairn's formula" is correct, and the collapsing pressure of the furnace was only "about 100lb.," as he alleges it to have been, this boiler must have been working, according to the information given in Report No. 29, night and day (except when being cleaned) about two years, with a factor of safety of only 1·4. In Report No. 145 Mr. P. Samson and Mr. T. W. Traill, Engineer Surveyor-in-Chief, unite in deciding that a fire box with a factor of safety of 2·16 (by their own calculation) collapses and explodes because "the pressure at which the boiler was worked was too great for the thickness of plates in fire box." Yet Mr. Carlisle makes no remark upon this furnace with a factor of only 1·4, and attributes the collapse to "the sudden contraction" of the top of the furnace and flue, in consequence of the furnace door being open for a period of five to ten minutes, whilst the "furnace was being cleaned, the dampers being open at the same time."

It will be observed that no "observations" by the Surveyor-in-Chief (to borrow "Economiser's" humorous expression) are appended to Report No. 29, this, no doubt, being due to the very awkward conclusion to which his subordinate had led him, viz., that furnace doors should not be kept open while cleaning, otherwise furnaces would collapse from sudden contraction caused by the impact of a volume of cold air upon the heated plates. The Engineer Surveyor-in-Chief would no doubt fully appreciate the dilemma into which he was thrown, as he could scarcely "observe" that furnace doors should be kept closed during cleaning, there being some physical difficulty in carrying out such an instruction, apparent even to an official mind. Had the deductions of this Report, however, been carefully scanned, matter would have been found by an expert for some interesting "observations" of an *unofficial* character.

The simple precaution of checking Mr. Carlisle's calculation by "Fairbairn's formula" would have shown that the collapsing pressure of the furnace by that formula would be about 300lb., assuming it to be 3ft. diam., as it appears by proportion from the sketch. The calculation that Mr. Carlisle has made appears to have been by the Board of Trade formula for "surveyors," which (taking the furnace to be 3ft. diam.) would be, as he states, about 100lb. It might then have been prudent also to inquire what are the general habits of furnaces of the same character, and if it is customary for them to collapse during the time fires are being cleaned; and it would have been well to have found one case, even of a collapse of a furnace, that has ever taken place due to such a cause. Failing to obtain a satisfactory reply to these inquiries, some thought might have been given to the question: Do fire boxes or furnaces ever give way that are not weak in themselves, and at the same time amply supplied with water? It is the habit of the Board of Trade inspectors to take so much evidence and to collect so many opinions, that it might be thought after eighteen days' cogitation a less curious conclusion would have been arrived at in this case, than that keeping the fire door open from five to ten minutes during the cleansing of the fires, even with an open damper, should have caused the explosion.

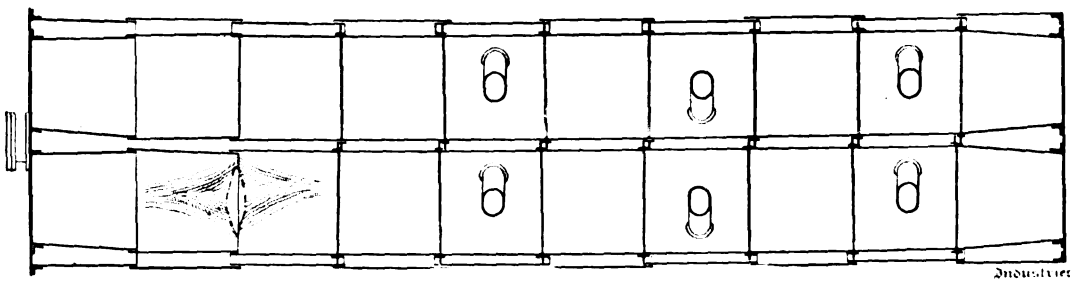
As no competent engineer will endorse this opinion, the question arises, did the furnace collapse from weakness? If, as Mr. Carlisle states, the collapsing pressure was only 100lb., with a factor of safety of 1·4, why did the second furnace not collapse, and why did the injured furnace work safely for more than two years night and day, at 70lb. pressure? If, again, the collapsing pressure of these furnaces was about 300lb., as they would be if really calculated by Fairbairn's formula, why did one of the furnaces collapse, providing that the boiler had a sufficient supply of water, which Mr. Carlisle does not appear to question? Such a report as the one now under consideration should never have been published, in the interests of the Board of Trade inspectors; but as evidence as to the value of their opinions and supervision, it appears conclusive. The great object of the official mind is to throw off and avoid responsibility. The engineering practice of this country says a factor of safety of 4 is sufficient, the whole of the boiler insurance companies and the Manchester Steam Users' Association are satisfied with a factor of 3, but the Board of Trade instructions to surveyors state that 5 must be the factor.

In other words, let there be no responsibility; make the factor sufficient; if 3 will do, and 4 is perfectly satisfactory, by making it 5 there can be no doubt, and consequently no responsibility. Let the steam using public be thankful that we do not make the factor of safety 6 or 7! Where would the great engineers, who have made the wealth and prosperity of this nation, have been had they been subjected to the cast iron rules of a Board of Trade? And let me ask, in conclusion, will engineering progress of the future keep pace with that of the past, or the present, if hampered by Board of Trade inspectors and their instructions to surveyors?

Yours, &c.,
Boiler.

Manchester, 25th February, 1888.

BOILER AT THE HUYTON IRON WORKS.



Sectional Plan.

COMPULSORY INSPECTION OF STEAM BOILERS.

To the Editor of "Industries."

Sir,—The first part of the letter of your correspondent "Economiser," dealing with the above question in your last issue, being chiefly personal to myself, and an ordinary sample of would-be smart writing, I will pass it over and come to what I take it are the real points under discussion. It may be as well, however, to say here that I have not any knowledge of, or connection with, the Board of Trade or its officials, or with any boiler insurance company, and so write from a perfectly independent and unprejudiced standpoint. In the first place, would it or would it not be advisable to have all the steam boilers in the kingdom inspected? I think the general consensus of opinion is that it would be advisable. The next question is, What is the best method of carrying this out without interfering with the liberty of the boiler owner? Two plans at present

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are suggested: (1) Inspection by Board of Trade officials; (2) inspection by boiler insurance companies, under Board of Trade direction. Of these two there is little doubt the latter is to be preferred. I think that no boiler owner who looks well after the condition of his plant, and employs a competent man to attend to it, would have any objection to an inspection, if arranged to suit his convenience. The chief objector would probably be the greedy or ignorant owner, who uses an old boiler, often worn or corroded to a dangerous extent, without troubling or caring about inspection, or the lives of the people in his employ. That there are many such boilers in use can be proved to demonstration, notwithstanding the denial of your correspondent; and if he will peruse the last issue of your contemporary *The Engineer*, he will find ample corroboration of this assertion, and also of my contention as to the advisability of granting certificates of competency to boiler attendants.

Supposing it is conceded—at any rate for argument's sake—that compulsory inspection is desirable, the point to be aimed at is the best system of inspection, at a moderate cost and with the least amount of friction between the boiler owner and the inspectors. Could not a Bill be drawn which would give a joint control to a committee elected by boiler owners and some of the Board of Trade officials? In cases where a great divergence of opinion exists as in this, *medio tutissimus ibis* has proved itself to be the best course to pursue over and over again. Some of your correspondents appear to discover the cloven foot in everything emanating from the Board of Trade; but I think it must be conceded that the Board in this case appears to be desirous to meet the wishes of engineers and steam users at large as far as may be, or they would hardly propose that a committee of sixteen experts be elected from the various Institutes, &c., to confer with a Select Committee of the House of Lords as to the best form in which to draft the proposed Bill. It must also not be forgotten that the introduction of a Bill of this kind comes within the province of the Board of Trade. If they should attempt, however, to pass a harsh measure to obtain and retain in their own hands undue power, that would press heavily on boiler owners, I should as a person affected—if on no other grounds—be one of the first to help to oppose it. They appear, however, on this occasion to be willing "to give and take." If I remember rightly, some of the Government Bills for the inspection of mines met with considerable resistance in certain quarters; but hardly anyone will deny that on the whole they have acted beneficially.

Yours, &c.,

M. Powis Bale.

Appold-street, London, E.C., 27th February, 1888.

TECHNICAL EDUCATION.

To the Editor of "Industries."

Sir,—There seems to be considerable difficulty in stating clearly what are the aims and what are to be the processes of Technical Education. The various meanings attached to the name, however, seem to point in one common direction, that, viz., of making the education of the people in all its grades bear upon their everyday life and work. This seems in every way desirable, for two reasons—first, as likely to increase the productive power, and therefore the material wellbeing of the country; and second, as likely to give that higher tone of intellectual interest to every, even the humblest, occupation which serves at present to differentiate what are called professions from what are called trades. The aim of technical education, thus broadly stated, may be regarded as that likely to be generally accepted as both desirable and attainable.

Greater diversities of opinion, however, exist as to the way along which we must travel to reach the desirable destination. The perusal of the articles by Mr. Henry Dyer, C.E., which appeared in *Industries* of the 27th January, and the 3rd and 10th ult., has prompted me to write this letter as a contribution to what I should hope would be a considerable correspondence upon a question that is likely to occupy public attention for a long time, and which involves issues so vast that a false start would be disastrous. The reception of the recently passed Act for Technical Education in Scotland shows, I think, that the Act has probably been a piece of premature legislation, not enacted in response to any clearly expressed public demand, nor formulated as the result of careful discussion by educational authorities. That example, if I am right in calling it premature in the sense above indicated, ought to stimulate free discussion on the subject, in order that the larger interests of technical education in England may be not rashly but speedily legislated for.

Now, in working out the problem of technical education for the country, it is necessary to remember that the education must address itself to probably three different classes. These are: (1) Actual operatives, who form the bulk of the community; (2) employers, actual or potential, and managers, actual or potential; (3) a class who would fall under neither of the above, but who, if the system were once in working order, and actually deserving of the name "education," would find it acceptable as a substitute for what may be called the philological education on which pupils and students spend so large a portion of their time. This class would naturally be small to begin with, but would increase in proportion to the recognition of the educational value of the studies inaugurated under the new system.

From this division it follows that technical education will fall into the two grades of primary and secondary, with, of course, a still higher grade, that may be said to already exist in present colleges and universities. The question that next arises is, What is the subject matter of this education?—from what portion of the wide fields of knowledge are we to gather? The answer, of course, is "Science," but in other than its usual academic sense. It is a commonplace remark that every art has its corresponding science, and while the arts are learned in workshops and factories, and the sciences in schools and colleges, they are usually learned by different persons, and the correspondence between the art and the science is learned by few. Indeed, this connection or correspondence may in a general way be said to constitute all the new matter with which technical education must deal. We certainly need more science teaching and more teaching of the arts also, but the connecting link is the matter which is most conspicuously wanting. It is fortunately a fact that working people take new interest in their work when they learn that the individual facts that daily come before them are examples of the great general laws of sciences of which they previously were ignorant, just as a student of science is delighted when he observes for the first time, in some homely process of trade, a concrete illustration whose existence he never dreamt of before, of one or other of the grand generalities with which he was familiar. To such persons the science and the art both have greater intellectual interest after the connection between them becomes clear.

To revert for a moment to the division I indicated of the classes to whom technical education addresses itself, I may now say that the educative processes to be carried on must differ according as we are dealing with the first class or with the second. The first will have an empirical knowledge of facts; they must be taught to scientifically correlate them. That is, they must be taught more science than art. The second class may be presumed to have had a scientific training, as well as a knowledge of their trade; they must be carried further in each. To young people of both classes the teaching of the trade and of its corresponding science must go on simultaneously.

The first step in organising a system of such teaching of applied science is to discover if nothing is made, or can be made, of existing educational organisation. We have, broadly speaking, four classes of institutions to which we must look. These are the Elementary Schools, whose function is all important as the basis of everything; the Secondary Schools, in which the education has hitherto been mainly philological, but which are being gradually adapted to more modern ideas; Intermediate Schools, as they may be called, such as colleges and other variously styled institutes, in which the bulk of the teaching is scientific and modern: and, lastly, the Universities, in which the sciences that are taught are either in the high regions of pure theory, or applied to the needs of the one profession of medicine and surgery. We must therefore adapt, as much as is necessary and possible, these existing institutions, and establish whatever new classes or schools are required. But it is perfectly appalling to think how much adaptation is necessary. In the highest region, university reform, long talked of in Scotland, may do a good deal. But even in the elementary schools there may be said to be absolutely nothing taught with even a remote reference to technical education. Mr. Dyer's scheme is based upon the elementary school; but the system of elementary education must be transformed before anything can be made of it. After reading, writing, and arithmetic get their due share in our Scottish schools, grammar, geography, and history are taught, and these, with sewing, fill up all the available day school time; for each of these subjects is systematically drafted in a four year's syllabus, and attention to them is secured by a system of grants graduated according to the quality of the teaching. Elementary optional science, which is the very thing we want, is prescribed as an alternative grant-earning subject—alternative to geography and history only—but that subject is all but ignored. The reason for this neglect of science is the nature of the teacher's own education, which is usually on the traditional philological lines. The first necessary step, in my opinion, would therefore be such alteration in the training of elementary teachers as would make them able and willing to give their oral lessons a tendency towards those parts of science which corresponded to the trade of the locality. The time for this might be easily found by giving less time to grammar, &c., which are taught with probably unnecessary thoroughness, considering the greater value of subjects which they exclude. The aim must be, of course, to awaken interest and inquiry, not to cram facts for an examination. Were this double adaptation effected—adaptation of teacher and of school curriculum—the primary schools might be, as they ought to be, an excellent foundation for more definite technical education.

So far the question of expense hardly arises. Neither need it arise to any great extent in connection with the adaptation of secondary schools, for the high fee chargeable would go a long way to pay expense. But most boys of fourteen who leave an elementary school go right off to trades, and cannot get the more definite education of the secondary school. At this point appear what must form the new feature of our educational system—continuation classes mainly in science for boys engaged in learning trades. A great difficulty in the way lies in the fact that division of labour and the use of machinery are now carried to such an extent that in many trades the workmen can hardly be said to be tradesmen at all. For example, a riveter can hardly be called an engineer or a shipbuilder; a man who can do nothing but bore holes in metal plates can hardly be called a skilled mechanic. So that apprenticeship does not mean what it used to mean. And this defective teaching of the practice must be made up to some extent simultaneously with the teaching of the theory. This, I understand, is systematically carried out in the works of some engineering firms. The apprentices have science classes bearing on their trades as part of their apprenticeship, the practice and the theory being taught side by side *in the works themselves*. This would seem the very perfection of technical education for that class at least, and they are, after all, the main element in the case. It is quite conceivable then that in many districts where there is one staple industry, model factories or workshops, with class rooms attached, might be found the best type of technical schools. In large centres of population with a variety of trades, a separate institution for each trade would be most advantageous. In smaller places one such institution might have more model workshops than one upon a smaller scale. The actual trade would be carried on and saleable articles produced. Indeed, a portion of the expense of the institution would be paid out of returns for the sale of products. A half-time system of attendance might be established for apprentices.

I cannot see, as Mr. Dyer sees, how university extension can do much for technical education. It is quite true that science lectures are a first rate foundation for technical education; but they can never do the work altogether. Besides, though we had a complete system of technical education, there would still be a blank that university extension alone is able to fill; for men and women are more than mere wage earners, and must have wider intellectual interests than in their trades only. There are, therefore, numerous branches of knowledge that will have high educative value for men and women of all occupations, but which are not in the least connected with any trade.

Neither is there much likelihood of the universities going in the direction of technical education. Much is hoped for from university reform bills; but such a great transformation as is implied in converting the universities into technical colleges is hardly among the changes that are to be hoped for. I can see no harm in some form of certification or license (or degree, as Mr. Dyer seems to desire) for the best technical students. Such certificates would soon have a very high value. When that stage is reached the existence of prospective certificates is as good for an institution as an endowment would be.

In all this the great danger is a hasty race after results, expecting to reap fruit off a newly planted tree. If the results of technical education are to be valuable they will be slowly attained.

Yours, &c.,

Perth, 25th February, 1888. J. W. Munro, B.A.

THE INDUCTOR DYNAMO.

To the Editor of "Industries."

Sir,—In the report of Mr. Mackenzie's paper read before the Society of Telegraph Engineers and Electricians given in your issue of the 17th ult., you apply the term "armature" both to the moving part of the machine and also to the fixed part. This, though technically correct, is rather confusing. The term "inductor" has already been applied by Prescott and Thompson to the moving armatures, and is a very convenient name for them. I propose, therefore, to call the moving part of the machine the inductor wheel, and to apply the terms primary and secondary magnets to the excited magnets and those in which the alternating current is generated, respectively. The term "armature," which is sure to give rise to confusion, is thus avoided altogether.

Yours, &c.,

London, 23rd February, 1888. J. A. Kingdon.

Books Received.

A Further Attempt for the Correlation of the Coal Seams of the Carboniferous Formation of the North of England. By M. Walton Brown. By permission of the Council, excerpt Minutes of Proceedings of the North of England Institute of Mining and Mechanical Engineers, Vol. XXXVII., 1887.

The Gold Fields of Victoria: Reports of the Mining Registrar for Quarter ended September 30th, 1887. Melbourne: Compiled and arranged by the Secretary for Mines.

Every Man's Own Lawyer: A Handy Book of the Principles of Law and Equity. By a Barrister. 25th Edition. London: Crosby Lockwood & Son.

Bradbury and Hirsch's Review of the Market for Sulphate Ammonia during 1887.

The "Shipping World" Year Book, 1888. London: *Shipping World* Office, Gresham Press Buildings, Little Bridge-street.

Formulaire Pratique de l'Electricien. Par E. Hospitalier. Sixième Année, 1888. Paris: G. Masson.

Turning Lathes. Edited by James Lukin, B.A. Illustrated. London: E. & F. N. Spon.

A Course of Lectures on Electricity. By George Forbes, M.A., F.R.S. (L. and E.), F.R.A.S., M.S.T.E. and E., Assoc.Inst.C.E. London and New York: Longmans, Green, & Co.

Sewage Treatment, Purification, and Utilisation. By J. W. Slater, F.E.S. London: Whittaker & Co.; George Bell & Sons.

Reviews.

Notes on the Lithology of Gas Coals. By James Paterson, C.E., F.G.S. London: Walter King. 1887.

This is the third edition of the author's "Notes" and "Analyses," and includes a large quantity of additional matter, which renders the book of greater usefulness to those interested in the chemistry and calorific values of the different varieties of coal and cannel. The first article on the lithology of gas coals was read some years ago, before the British Association of Gas Managers; but the tables of analyses of gas coals and cannels have been considerably augmented since the previous editions, and include upwards of two hundred complete analyses of British coals and two samples of Japanese coal analysed by Messrs. Newbigging & Paterson, for the Government of Japan. Nearly one hundred analyses of cannels are also tabulated with their respective yields of gas and coke, the quality of the former being given in illuminating power stated in candles and in grains of sperm per cubic foot. The per cent. of sulphur and of unsaturated hydrocarbons, as determined by the bromine condensation method, are also given in the tables. A useful table of the calorific value of English coals, as tested in Thompson's calorimeter by the so-called deflagrating process, forms an important part of the work, especially as these coals are compared in composition and calorific value with coals from other localities. The concluding pages deal with an inquiry into the chemico-physical relations between coal and cannel, in which the author brings forward geological and palæontological

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evidence in support of his view that cannel coal beds have a similar origin to common coal, viz., that the difference in their properties is due to the larger proportion of gummiferous trees present in the primeval forests of the former. The influence of fish remains and molluscan and other oils upon the streak and fracture of cannel is also pointed out by Mr. Paterson; and his own views on the origin of anthracite, the abnormal conditions of many coal seams, and the distribution of petroleum are placed in appendices at the end of the volume. Mr. Paterson has evidently devoted much thought to these complex problems which are of such great interest to the geologist, and undoubtedly interest the reader; but we think that more evidence is necessary before some of his theories can be accepted as final. These theoretical discussions do not, however, prevent the book from being at the same time a very valuable work of reference to all those who desire to know more of the composition and physical properties of our English coals and cannels.

ELECTRO-CHEMISTRY: INORGANIC. By G. Gore, F.R.S., LL.D. London: Published at the office of *The Electrician*.

This short treatise consists of a collection of the facts at present known concerning the electrolysis of inorganic compounds. The first portion is devoted to a historical sketch of the subject and a brief account of the laws which govern the electrolysis of solutions. The matter is not treated from a mathematical point of view, but frequent references to the more important original papers on the subject are given. It is unfortunate that this part of the work is not now up to date, as the greater portion appears to have been written some time prior to the year of publication. A new edition, embracing the recent discussions on this subject at the British Association meetings, and the reports which Professor Lodge has drawn up, would materially increase the value of the work as a book of reference. The electrolytic separation of the gases and non-metallic elements and their chief compounds has considerable space devoted to them, while the behaviour of metallic salts under eletrolysis and the isolation of the metals by electrical means concludes the volume. The references given in this part of the book are chiefly to English sources, so that for complete information on several of the points touched upon it is necessary to consult Watt's Dictionary, reference to which is usually made for information as to the journal in which the original may be found. The author's own work on the electrolysis of the metallic fluorides is naturally given somewhat more fully, and such subjects as the self-deposition of metals, and the work of Raolt and Gladstone, and Tubes' experiments with metallic couples are included in the book. The author in the preface states that the treatise is essentially a scientific one, and that information of a technical character has been purposely omitted. The book will, however, be found of use to electrical technologists, as the more important manufacturing operations in which electrolysis plays a part are shortly described. Messrs. Elkingtons' process for refining crude copper, Morris & Johnson's methods for depositing brass and German silver, and the gold and silver cyanide plating solutions, are given. In this part, as in the former, the recent additions to the applications of electrolysis in the manufacture of aluminium by the Cowles electrical furnace, and the separation of metals from the ores, would increase the value of a second edition. A second volume is promised on the electrolysis of organic substances, in which we presume the author intends to include the electrosynthesis of carbon compounds when pure water is electrolysed with carbon plates, which is not alluded to in the article devoted to the electrolysis of water in the present volume.

THE ORDNANCE SURVEY OF THE UNITED KINGDOM. By Lieut.-Colonel T. Pilkington White, R.E. Edinburgh: W. BLACKWOOD & SONS.

The aim of this book is to convey to the general reader an intelligible idea of the National Survey, and this it does very successfully by giving a short popular account of what might seem at first sight a dry scientific subject, suited only for experts. It begins by giving the early history of the survey, which had its origin shortly after the "forty-five" rebellion, and was doubtless the outcome of that unhappy rising, for it contemplated a general map of the Scottish Highlands. It was undertaken by Generals Watson and Roy, and it was carried on by fits and starts for some years. It was not, however, until 1783 that arrangements were made for the conducting of a huge and delicate trigonometrical operation, which was in reality to form the nucleus or starting-point of that elaborate system of triangulation we now possess over these islands. Colonel White's book traces its history down to the present time, and explains in simple language the chief operations involved in the survey, and the computations necessary for making them available for use. Descriptions are also given of the scales of the maps, as well as an account of the controversies which have raged round the subject, and an account of the organisation of the survey, including the most recent changes which were made in 1880, when, in order that the whole work should be completed in 1890 instead of 1900, as was previously contemplated, the staff was almost doubled. This change, notwithstanding the difficulty of suddenly increasing so largely the strength of trained employés, was smoothly and most successfully accomplished, and the result promises to more than justify the forecast made of the acceleration of the progress which would ensue; for the pledge given to Parliament and the nation as to the completion of the Cadastral Survey of the United Kingdom in 1890 is certain to be kept, provided, of course, that the necessary annual funds continue to be voted, and no unforeseen causes of delay arise.

Comparatively few people have a clear idea of the various uses and objects of the survey, and therefore we may briefly enumerate them as follows: (1) military, and especially for laying out the national defences; (2) geodetic; (3) geological; (4) hydrographic, as supplying accurate coast details to the nautical surveyor; (5) archæological; (6) topographic; (7) for engineering purposes of all kinds connected with the construction and maintenance of water works, gas works, drainage works, telegraphs, roads, railways, canals, harbours, and so forth; (8) mineral survey; (9) parliamentary, in reference to standing orders; (10) sanitation, as under the various Acts relating to the public health; (11) delineation of the civil and ecclesiastical divisions of the country, hundred, parochial, &c.; (12) to facilitate the adjustment of jurisdictional areas; (13) census and statistical information; (14) the enclosure and reclamation of waste lands; (15) registration of title; (16) simplifying and cheapening conveyances of land, deeds of sale, leases, and all transfers of landed property; (17) for miscellaneous uses of general public or private interest. This is a long but by no means exhaustive list, but it is sufficient to furnish an ample *raison d'être* for the prosecution and maintenance of a national Cadastral Survey, and the work has been done in such a way as to evoke from foreign experts the unique encomium, "L'Ordnance Survey, œuvre sans précédent et qui devrait servir de modèle à toutes les nations civilisées."

FORTSCHRITTE DER ELEKTROTECHNIK. By Dr. Karl Strecker. Berlin: JULIUS SPRINGER.

We have before us the first and second parts of a work which it is proposed to publish in future quarterly, and which is a kind of synopsis of publications in scientific journals and patent abstracts referring to electrical engineering, which have appeared during the previous quarter. The matters treated are divided into five main parts. The first embraces electricity in its mechanical application; the second, electro-chemistry; the third, telegraphy and telephony; the fourth, measurements and scientific investigations; and the fifth, earth currents and atmospheric electricity. Each of these divisions is again sub-divided, and the manner of this sub-division will, perhaps, best be shown if we give as an instance the headings under electricity mechanically applied. These are the following: General theories of dynamo machines, electromotors, descriptions of types of machines, details of machines, regulators and prime movers for dynamo machines. Under each of these headings is a long list of references to publications in European and American journals, classified under the author's name, and in many cases references are given to patent specifications under the names of the patentees. Considering the great difficulties which the editor of a periodical magazine of this kind must experience at the start, the information contained is fairly exhaustive. There are a few omissions, but these in future numbers of the magazine will grow less as the organisation for collecting information becomes more perfect and automatic. Referring to this point, the editor says in the preface that he experienced great difficulty in obtaining many of the journals from which abstracts are quoted, and he addresses a request to the publishers of journals and authors to furnish him with proofs of their articles. In the table of references, the titles of the articles are given in the language in which they originally appeared, together with the name of the journal, page or date, number of columns and illustrations. The references are entered under consecutive numbers, and in the short abstracts of articles which follow the reference table, corresponding numbers are placed in the margin so that the author's name may be identified where it is not mentioned in the text. The abstracts are succinct and clear expositions of the original articles, or of the patent specifications. No attempt is made at independent criticism, as the work is merely intended for reference, and not as a text book. In some few instances the text is illustrated by simple diagrams, but in this respect we think the magazine might be considerably improved, since diagrams are as essential in a work of reference as in a text book. It would also seem advisable to add an index of subject matter, and of the names of authors and patentees to every quarterly issue, and not only as proposed to the last number of each volume. With these improvements, this magazine will become one of great utility to practical electricians and engineers. The fact that the abstracts are in German will only to a certain extent reduce the value of the book to English readers, for, as already stated, the tables of reference contain the titles of articles in the language in which they originally appeared, and form, therefore, a complete record of the more important articles and patents published in English.

THE YEAR BOOK OF NEW SOUTH WALES FOR 1887. Special edition for the New South Wales Government.

This year book is evidently written to amuse and edify the colonial whose remoteness from civilised life deprives him of those comforts which he has sacrificed for present or prospective advantage. Round a camp fire, or in the dull and silent evenings in typical colonial cabins, even the reading of statistics, of cures for baldness, cures for corns, and the thousand odds and ends of information scattered through this little book, will be more valued than the most fascinating sensation novel on the shelves of a distant library. For intending emigrants, or for those who wish to inform themselves on the administration and institutions of the colony, the year book is invaluable. Colonial Acts of Parliament, *e.g.*, the Rabbit Nuisance Act, and the Crown Land Acts, information regarding the hiring of diamond drills and other boring machinery belonging to the Government, and notes on the Fishery Department, education, and colonial industries, afford the emigrant some notion at least of what he wants to know ere he makes up his mind to try colonial life. The manufactures which have been most successfully founded in New South Wales are, it appears, brass, lead, and iron work, machinery, woollen, leather, and leather manufactures (in this industry alone 4182 persons are employed), household furniture, paper, ornamental iron work, terra cotta, pottery, tiles, and bricks. This list shows no mean variety of industries, especially when one considers that with a territory almost as large as the combined areas of France and Italy, New South Wales has a population only slightly greater than that of any one of our three great cities, Manchester, Liverpool, or Glasgow. An interesting parallel is drawn in an essay printed in the volume between Victoria, whose fiscal policy is protective, and New South Wales, whose fiscal policy is that of free trade. The figures quoted to prove the relatively greater advance of the free trading colony are very striking, and are not to be lightly explained away by those who take an opposite view. The figures relating to shipbuilding, though diminutive from the point of view of shipbuilding statistics in this country, are relatively significant enough. The average annual amount of tonnage launched in New South Wales and in Victoria respectively in the years 1874-76 was 4439 tons and 1286 tons. In 1884 the figures were 7663 tons and 167 tons respectively. Doubtless other causes contributed to the expansion in the one case and the contraction in the other; but the difference in tariff is a striking coincidence. Among other interesting and important information in the year book is the fact that there is still unalienated land in the colony to the extent of 163,000,000 acres, and that nearly 150,000,000 acres of this is land suitable for either agricultural or pastoral purposes. The Board of Technical Education of New South Wales has among its departments agriculture, with four courses of lectures (one on wool sorting); applied mechanics; architecture, with courses on masonry and bricklaying; chemistry; commercial economy, with seven courses; domestic economy; geology, &c., &c.; and it organises besides free popular lectures on technical, scientific, and artistic subjects, in the Sydney Mechanics' School of Arts, four nights a week. Diplomas carrying the title Industrial Expert are given to those who pass prescribed examinations. There are some common sense ideas here that might well be applied to our educational system, partly fossilised as it is by tradition and convention. A list of wages ruling in the colony, with the cost of the chief items of a working man's expenditure, are given at the end of the year book, with advice to those about to emigrate.

BRITISH MINING. By Robert Hunt, F.R.S. London: CROSBY LOCKWOOD & Co.

This is a second edition, differing from the first issued some years ago in nothing but the price. It has, however, been revised, for the author tells us that though he has not thought it advisable to add to the original text, he has examined the latter with much care. In this statement we have his assurance that in the vast mass of facts which he has brought together in this volume of 882 pages, there is nothing which the experience of publication has shown to be inaccurate or of a doubtful character. The difference of price sufficiently distinguishes this new edition. So long as the work was within the reach only of the few who can afford to spend considerable sums of

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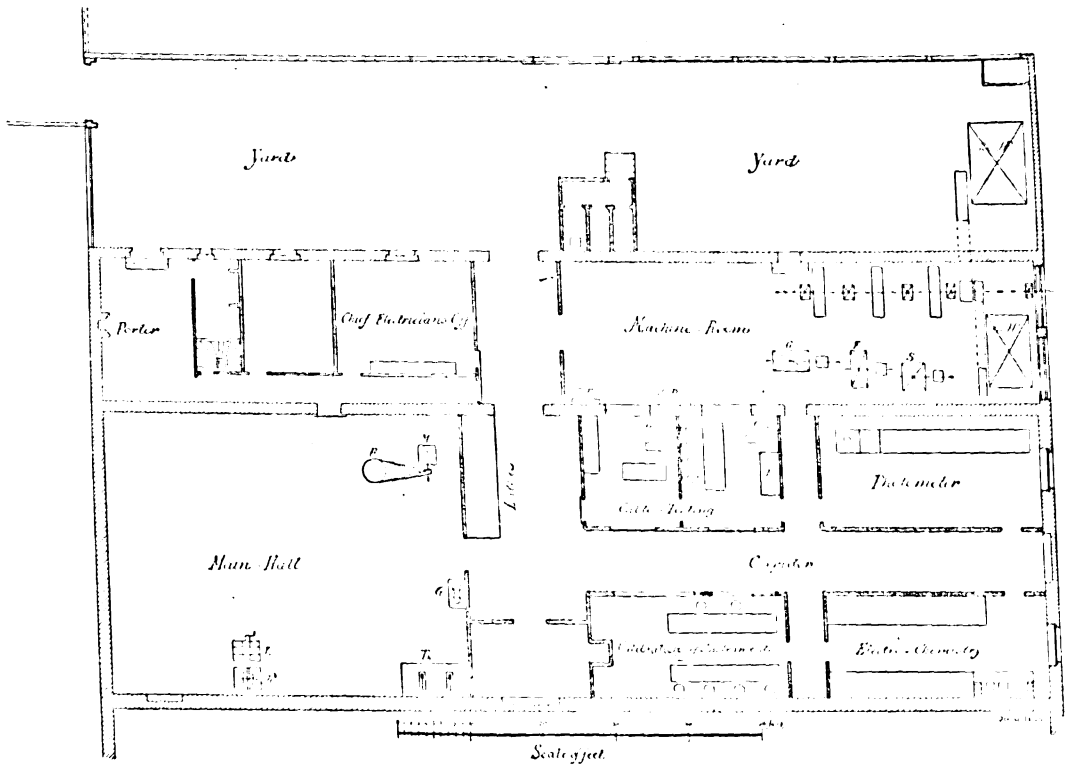
money on books, its use was restricted to a narrow circle. In the hands of the many it will better fulfil the intentions of the author in undertaking so laborious a task as its compilation involved. By issuing it at a popular price "young miners, on finishing their education, will," he says, "be in a position to possess the book, while the experienced metal miner may have it at hand for consultation when in search of information on some particular subject." Doubtless those for whose benefit the reduction has been made will be quick to appreciate the advantage thereby afforded them, and we may safely predict for the second edition a much wider distribution than was possible for the first.

Mr. Hunt has used his unequalled opportunities well, and has drawn from every source known to him. He has selected wisely and condensed intelligently. Everything is arranged with a due regard to logical sequence, and, as the style is lucid, all is clear and forcible. These are merits not always to be found in writings on technical subjects. It is a book for the leisure hours of the student and the busy moments of the practical man. Even the general reader will find in its early pages matter to while away profitably a weary hour. That it is a trustworthy compilation goes without saying. No man, probably, was better qualified than the Keeper of the Mining Records to perform a task of this character and magnitude. He has done his best, and the result is necessarily worthy of our confidence. It is, however, to be regretted that the opportunity afforded by a new edition was not used to bring this important work down to the present date. Within the last five years considerable progress has been made in the science and practice of mining, and none could have known better than Mr. Hunt the true value of the improvements effected. New processes have been devised, more efficient machinery has been designed, more powerful or more suitable explosive agents have been discovered, more economical or safer methods of working have been adopted or proposed, and additional legislation has imposed fresh duties and difficulties on the miner,—all of which matters might with advantage have found a place in the second and popular issue of "British Mining." We also look in vain for examples of the best American practice, which, outside England, is acknowledged to be well ahead of our own. If these things do not yet come within the category of British mining, none could have done so much as Mr. Hunt to remove from us the reproach of lagging behind the times. The publishers will do well to bear this shortcoming in mind in view of a third edition. If it be deemed inadvisable to add to the dimensions of a book which is already bulky, a remedy may perhaps be found in greater brevity in the first two divisions.

The work is mainly divided into four books. In the first we have an instructive historical sketch in six chapters, occupying 180 pages, of British mining, from the period when Celtic Britain passed under the Roman rule down to the close of the eighteenth century. The second book, which consists of four chapters and fills a space of 316 pages, treats of the formation of mineral deposits. In these pages the author has "examined the characteristics of the metal-bearing rocks and elucidated the hypotheses which have been promulgated to explain the phenomena of the formation of metalliferous veins." This statement does not, however, comprehend the full scope of these four chapters, which form the principal feature of Mr. Hunt's treatise. In the compilation of this book, the author spent his best efforts, and it is here that the extensive knowledge and scrupulous care of the Keeper of the Mining Records becomes most strikingly visible. He has given us a minute description and, from some points of view, a detailed history of all the principal known metalliferous veins in the United Kingdom, and from this wide induction of facts he has endeavoured incidentally to build up a consistent theory of the formation of these ore deposits, introducing, as he says, "a few of the certainties of science into an arena of debate in which uncertainty prevails," in the hope of "convincing the miner that nature works according to fixed laws in regulating her subterranean operations." The third book will be regarded by many as the most valuable, or, at least, as the most generally useful. It treats of "Practical Mining," and deals with the subject in five chapters, occupying 314 pages. This division may, as we have already pointed out, be advantageously extended in the next edition. Book IV. represents the purpose for which the work was originally taken in hand by Mr. Hunt. He tells us in the preface that, as a member of the Royal Commission, appointed in 1866, to inquire as to the quantity of coal annually consumed in this country with a view to determine the probable duration of our fossil fuel, he was brought constantly into contact with our great metallurgists, who pressed upon him the necessity of obtaining, if possible, a solution of the same problem in relation to metal mines. This question is learnedly examined in the fourth book, divided into five chapters, to which is allotted the space of 72 pages. The work, which contains upwards of 230 illustrations, ends with an appendix of useful statistics and a glossary of mining terms.

It is interesting, now, when the competition of German workmen, both abroad and in this country, has become one of the burning questions of the day, to learn from Mr. Hunt that Queen Elizabeth first introduced our new formidable Teutonic rivals to these shores. We are told that about the year 1562, acting on the advice of her Council, she sent to Germany and obtained the services of a large body of practical miners, whom she distributed over the various mining districts of the kingdom, "for the purpose of improving the British workman." During the next twenty years, there appears to have been a constant influx of German miners, to whom was granted a monopoly of all the mines in Wales, and in eight English counties besides; so that, practically, the whole mining industry was at that period in the hands of these foreigners. They introduced a better system of working and more perfect processes of dressing the ores. But the Cornish miners were proof against the "improving" influences of their foreign teachers. "With true Celtic obstinacy," says our author, "they remained satisfied with the methods used by their forefathers."

THE PARIS ELECTRICAL LABORATORY.



THE PARIS ELECTRICAL LABORATORY.

By the courtesy of M. de Nerville, the general director of the laboratory established by the International Society of Electricians at Paris, we are enabled to lay before our readers a plan of the building, and some information regarding the machinery and apparatus installed. The building is one storey high, and contains a machine room, a room for cable testing, where resistance, capacity, and insulation of conductors will be measured; a photometric room, an electro-chemical laboratory, a room for the calibration of measuring instruments, and a main hall for experiments with dynamo machines, transformers, and other appliances. The disposition of the various rooms will be seen from our plan. In the yard adjoining is placed a 20 h.p. portable engine lent by Messrs. Weyher and Richmond for the modest rental of one franc per annum. Power is transmitted from this engine by a belt to the countershaft in the machine room from which the different dynamos are driven. Within this room there is also a 12 h.p. Otto gas engine, so arranged as to work on to the same countershaft. In our illustration S is a Gramme dynamo made by Messrs. Sautter-Lemonnier and Co., and having an output of 300 ampères at 70 volts; E is a 100-light Edison dynamo, and G an alternating current Gramme machine, whilst S B are two switch boards, one serving for the continuous and the other for the alternating currents. In the photometric room is fixed a large Bunsen photometer, with 13ft. scale, and with the necessary standard lamps and a Dumas and Reynault balance for weighing the consumption of oil. In the electro-chemical laboratory is a large number of instruments for making current measurements by the deposition of silver and other metals, a branch of the subject which has already received special attention from M. de Nerville during his work in connection with the determination of the legal ohm. In the calibrating room are standard mercurial resistances, three Duprez-d'Arsonval galvanometers, and one Mascart electrometer. This room will serve for standardising commercial voltmeters and ammeters. In the cable testing room is a very complete collection of instruments, comprising Wheatstone bridges, Thomson's mirror galvanometers, and Deprez galvanometers, marked G on our plan; and one of the new Carpentier dead beat electrometers. There is also a battery L of 100 Leclanché cells for capacity and insulation tests. The main hall is as yet sparsely furnished with apparatus. There are two Thomson graded galvanometers, Th.; a small hand gramme dynamo, L; a Wimshurst induction machine, W; a Gaulard & Gibbs' transformer, G; and a 1 h.p. Gramme motor, driving a Romilly pump. The large hall is to be used for conferences and special experiments, such as the photometric measurement of lighthouse arc lamps, for which the Bunsen photometer is not large enough. The lamp will, in this case, be placed at the extreme end of the corridor, and the photometer at the opposite end of the hall, the available distance being about 120ft. As has already been reported by our Paris correspondent, the laboratory was opened on the 10th of February.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

The adjourned discussion on transformers and the distribution of electricity by their means was resumed on Thursday, the 23rd ult., by Mr. Lamb, one of the gentlemen who had made calorimetric experiments with the transformer to which Professor Ayrton referred at the previous meeting. Mr. Lamb described the apparatus used, and exhibited some interesting efficiency curves, showing that the true efficiency of a transformer, as determined by the calorimeter, is throughout greater than the apparent efficiency determined by a wattmeter, or by the indications of a dynamometer and voltmeter.

Mr. Gordon regretted that so much labour and ingenuity should be wasted on problems connected with alternating currents, because there was no future for them. He himself was one of the first to use alternating currents at the large installation put up by him at the Paddington railway station, and this system is still at work, with satisfactory results; but notwithstanding this success, he had come to the conclusion that the employment of alternating currents is beset with so many difficulties as to make the system unfit for general adoption. One of the objections is the large size of dynamo. He himself has constructed alternating current machines which were larger than any other machine produced up to that time, and although it may be very satisfactory for an engineer to see these huge armatures revolving, it was less satisfactory to the shareholders of the company. A 200 kilo.-watt machine would require an armature 10ft diam., whereas a 100 kilo.-watt low tension continuous current machine could be made with an armature only 16in. diam. Another objection to the system was that the whole of the power must be developed in one machine. He did not think it was possible to couple

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several alternate current machines together without producing considerable jumping in the lamps, which would of course shorten their life. Mr. Gordon exhibited an interesting diagram, showing that in a residential district the maximum number of lamps is only on for an hour and a half each day, viz., from 6 to 7-30 p.m., whilst from one-half to two-thirds of this number is on from 5 or 6 o'clock in the afternoon till 10 p.m. From 10 o'clock to about 3 a.m. the number of lamps alight steadily declines, and from 3 a.m. to 3 p.m. in winter it is only a small fraction of the total number fixed. The uneven rate of consumption is a great difficulty, because machinery must be provided equal to the large consumption, and the plant is therefore in excess of the requirements for twenty-two hours out of the twenty-four. He preferred to supply the lights from storage batteries, which could be charged steadily during twelve hours, or even during twenty-four hours daily, by which means small engines and dynamos only are required; but being kept at full work for a longer period, the total output is the same as with a larger plant spasmodically worked, whilst the efficiency is of course much higher. Engineers knew perfectly well that it was uneconomical to work engines much below their power. So convinced was he of the superiority of lighting by batteries, as compared with the direct system, that he was now engaged in putting up a central station at Whitehall Place, where it will be possible to do what gas companies are doing, viz., to utilise the waste products. In this case the waste product is exhaust steam, which will be used for supplying hot water to the baths and heating apparatus of the residential chambers for which the central station is being erected. Mr. Gordon, after collecting statistics on the amount of gas lighting done in London, has found that there are about 125,000 gas jets to the square mile.

Mr. Crompton, who followed, spoke in the same strain. He thought Mr. Kapp's paper was rather dry, and he would therefore try to infuse a little life into the discussion by treating it from the commercial side. He did not deny that the transformer system had developed to a certain extent in America, but this was merely due to the fact that Americans would put up with any lighting, no matter how bad. It had also been developed to a considerable extent in London by the Grosvenor Gallery Company, and in this connection he thanked Sir Coutts Lindsay very cordially for being engaged in educating Londoners in the use of the electric light, and teaching them to put up with scintillations instead of good steady lighting. He thought that the clients of the Grosvenor Gallery could not be very fastidious, and it would be very easy for him or any other electrical engineer to satisfy their demands in the future. He did not believe that it was possible to work alternate current machines in parallel, and therefore it was necessary to do the whole of the lighting from one huge machine. This entailed a considerable waste of power when the demand for light was small, and therefore he thought that the average efficiency of the system must be exceedingly low. They were told by Professor Ayrton that the transformer he tested had a very high efficiency. That may be so, but what he wanted to know was the efficiency taken commercially, viz., from the coal bill to the money received for the sale of the current. This he ventured to say would be very unsatisfactory to the supplier of the electric light on the alternate current system. He drew attention to the last paragraph in Mr. Kapp's paper, where the author said that his network of mains would be available for use with batteries if at a future time the change of system could be effected. He thought this showed that the author himself did not believe very firmly in transformers. The speaker had already adopted the battery system in several installations, and found it exceedingly economical. There was no need of employing currents of 2000 volts, as it was quite feasible to light a district a mile away from the generating station by currents of 500 volts, and yet to have comparatively small mains.

Mr. Esson did not think that the author's assumption regarding the curves of electromotive force and current were consistent with actual facts. He doubted that a dynamo which contained iron in its armature could give a true sine curve. This was shown on a wall diagram on which was drawn a true sine curve, and a curve calculated by Mr. Esson for a particular dynamo. If then the curve be not a sine curve, the graphic method of the author he thought became useless.

Professor Perry dealt with the same subject, but came to a totally different conclusion. He thought the current given by any dynamo might with very little error be considered to follow the true sine curve. It was well known that a curve of any shape could be considered to consist of a true sine curve with other sine curves of the second, third, or fourth order superposed. Now the action of the transformer was to smooth down the ripples thus formed, and this action was the stronger, the more marked were the ripples. From this it followed that whatever may be the shape of the pole pieces or the disposition of the iron in the armature, the current passing through the transformer would follow very nearly a true sine curve. The difficulty of employing alternating current machines in parallel he did not think was insurmountable. It would be perfectly easy to contrive an instrument which would permit of the coupling up to be done only when the two machines have come into synchronism, and the same instrument might be used to regulate the power and speed of the engines, so as to maintain the synchronism.

Mr. Mordey could not agree with the author that it would be well to keep the transformers out of the houses, and to employ a proper low tension distributing network. He thought that by doing this one of the great advantages, viz., cheapness in distributing plant, would be lost. He would prefer to give each consumer his own transformer, or at the most to employ one transformer in common for two houses. Referring to the question of lag, he described an interesting experiment which apparently showed that there was no appreciable lag. In the first experiment he had two transformers. The thick wire terminals of the first connected with the dynamo, the fine wire terminals of the same transformer were connected with the fine wire terminals of the second transformer, and between the thick wire terminals of the second transformer would therefore be produced the same potential difference as that given by the dynamo. If now one of the thick wire terminals on each transformer were connected by a short wire, and a voltmeter was inserted between the remaining two thick wire terminals, this would indicate either the sum or the difference of the potential difference existing between each pair of terminals. If there were an appreciable lag the sum would be somewhat smaller than twice the potential difference of the dynamo, and the difference would be somewhat greater than zero. If there were no lag the sum would be exactly twice the potential difference of the dynamo, and the difference would be exactly zero. To his surprise he found that this was actually the case, and even when he had coupled six transformers in the manner here described, the total potential difference over the whole series of six was exactly six times that existing between the terminals of the dynamo. This experiment seemed to show that there was no appreciable lag.

Mr. Wright could not agree with the author that the shell transformer was inferior to the core transformer. He himself had adopted the shell type because most of the heat was produced in the iron, and for this reason he thought it wise to place the iron outside.

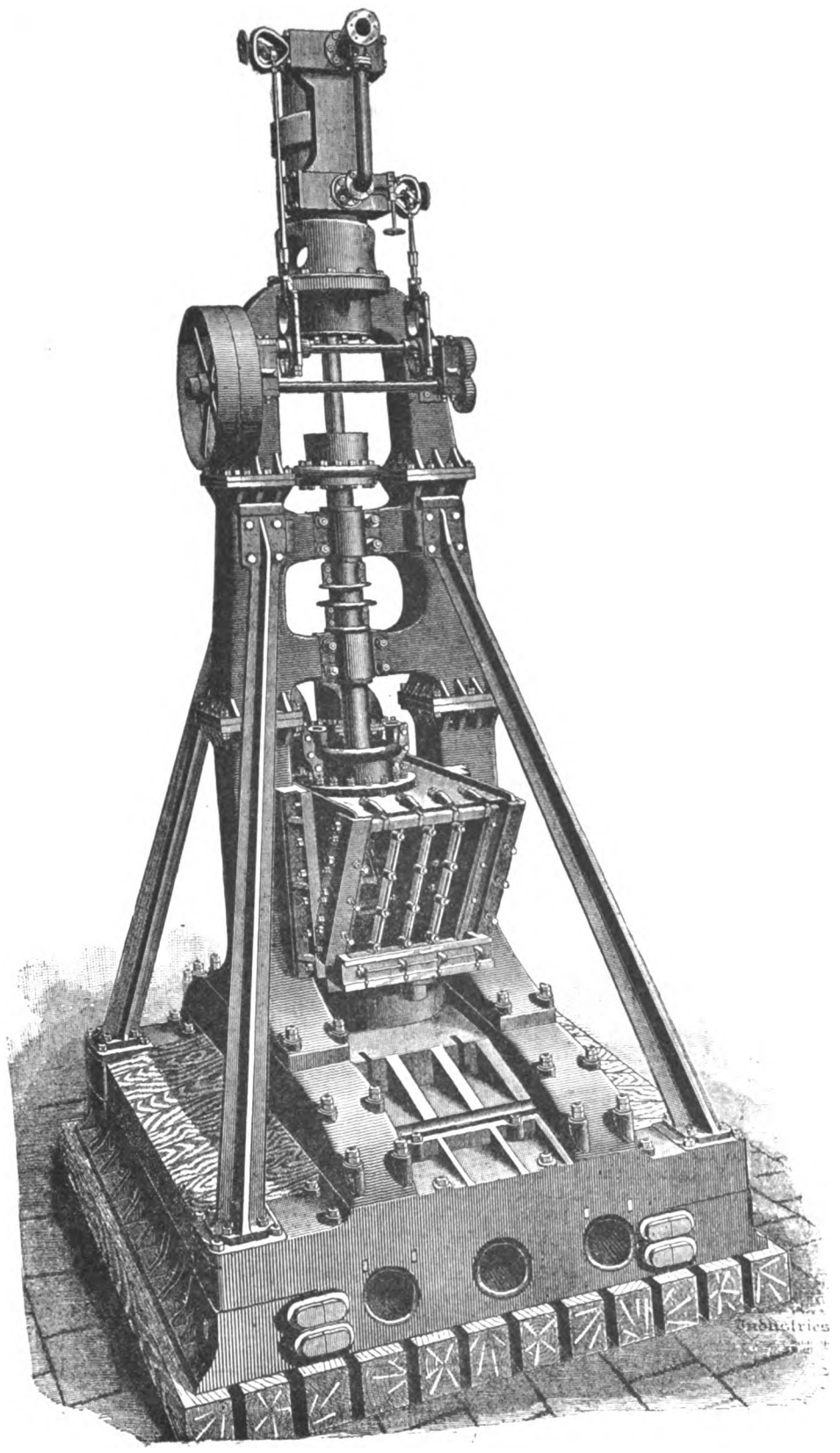
Professor Sylvanus Thompson thought the distinction of transformers into shell and core transformers was not a very definite one, as it was impossible to say, in some cases, whether a particular transformer belonged to one or the other class. The graphic method of the author was certainly very simple and of practical use, because it enabled engineers who had no special mathematical training to solve problems connected with transformers. Mr. Esson's objection that the curve was not a true sine curve, he could not share. He had already, on previous occasions, expressed his opinion that the transformer is the very best possible apparatus for toning down the ripples in the curve, and altering its shape to that which corresponds to a true harmonic function. He thought that before high pressure service by means of continuous currents could be obtained, it would be absolutely necessary to improve the commutator of the dynamo. Mr. Crompton mentioned 500 volts as the highest pressure he intended to apply. This he thought an insufficient pressure if economy in mains was the object. The reason why Mr. Crompton adopted this low limit was simply that he could not get an ordinary commutator to work satisfactorily with a pressure of 2000 or 3000 volts. All the successful high tension machines had special commutators, but in the alternating system this difficulty was entirely overcome.

After a few remarks from Mr. Evershed and Mr. Kent, the President called upon Mr. Kapp to reply. The space at our disposal does not permit of our mentioning the various points touched upon in the reply, and we must, therefore, limit ourselves to that portion of it which had the greatest practical importance, because dealing with the comparative merits of the rival systems of supply brought forward at the meeting. Referring to the remarks made by Mr. Gordon and Mr. Crompton, the author did not dispute that distribution of electricity by means of secondary batteries was preferable to distribution by transformers; but before they could adopt the more perfect method it was absolutely necessary to have a reliable secondary battery. He himself had not met with such a battery, and if Mr. Crompton could bring one forward, he should hail its advent with delight. All the arguments which were used by these two speakers on that evening might with equal reason have been used three or four years ago; but they were not used, simply because the speakers had at that time no confidence in batteries. If a battery could be put on the market which would be as reliable and as efficient as a transformer, and the cost of which would not be excessive, the author himself would be amongst the first to recommend its adoption for central station lighting, and that he did not doubt the ultimate discovery of such a battery might be seen from the concluding paragraph of his paper, where he advised that a secondary network should be laid down in the streets in such a manner as to be available for use with batteries at any future time. Mr. Crompton's objection regarding the inefficiency of transformers when these are worked at low output, was met by the diagram which Professor Ayrton had exhibited on the wall. They would see that even with an output as low as a third of the normal the efficiency was still 85 per cent. It would never be necessary to work transformers below this output, because if the consumption decreased sufficiently they would simply switch off certain transformers on the network, leaving the work to be done by a smaller number, which would then be worked to half or three-quarters their capacity. Great stress had been laid by Mr. Gordon on the fact that the maximum number of lamps was only on for a very short time during the day, and that the plant must, therefore, be very much too large for the supply required during the rest of the time, and also be worked uneconomically. The latter objection, he thought, had been met by some of the speakers, who showed that machines could be worked in parallel, and that it was therefore not necessary to do all the lighting with one huge machine. As regards the other objection, this applied equally to batteries, and where it was even of greater weight, because for equal output batteries were more expensive than engines and dynamos. The author's programme was to adopt transformers and alternating currents for the present, and to retain them only as long as they could not get a reliable battery. If they could get such a battery, he would advocate to discard the alternating current machines and the transformers. This would entail a loss of only 10s. per lamp fixed, which might be taken as the cost of dynamos and transformers; and when they considered that the central station, boilers and engines, the network, the house wiring, and the lamps would remain equally useful after the change, they would see that the loss entailed by the change was really very trifling.

The President then called upon Mr. Mackenzie to reply to the discussion. Owing to the lateness of the hour the reply was necessarily brief; but we have been favoured by Mr. Mackenzie with some notes of his written reply, which he is sending to the Secretary of the Society, and the following is a short abstract: In reply to Professor Ayrton, who had asked whether compound winding of transformers had ever been tried at the Grosvenor Gallery, Mr. Mackenzie said that some experiments had been made with an apparatus consisting of a single coil of fine wire, placed in shunt to the primary of the series transformer. The coil surrounded a core consisting of a bundle of iron wires, which could be more or less inserted to suit the requirements of the secondary circuit. The results were, however, unsatisfactory, the coils always being burned up after some time, and the idea was finally abandoned. Mr. Bernstein's suggestion of using a fusible contact plug as a safety device the author considered quite feasible. It would not only be cheaper than the apparatus devised by Captain Cardew, but it was also free from the objections which are justly urged against the proposal of putting any point of the secondary circuit to earth. In reply to Mr. Atkinson, the author said that fluctuations in the strength of the exciting current had been observed with the Kingdon dynamo, though these fluctuations were not very great. They were probably due to the cause mentioned by Mr. Atkinson. The author did not intend to convey the impression that the fly wheels of existing engines should be altered to suit the Kingdon dynamo, but that in designing new plant for a central station, the fly wheel of the engine, which is necessary to insure steady running, could be made to form part of the dynamo, and thus combine two functions in one. The object of arranging the machine into various circuits was with a view to cut out certain of these circuits as the consumption diminished, so that the remaining circuits would be worked at maximum efficiency. With reference to Mr. Crompton's question regarding the actual cost of working the Grosvenor Gallery installation, the author thought Mr. Crompton had asked rather too much. Many of his objections against the alternating current system had already been answered by other speakers. There could be no gainsaying the fact that the transformer system had made great headway, and this would never have been the case had it not possessed sufficient merits to place it before all others for the general distribution of electricity. The author himself expected to see Mr. Crompton before long become as warm an advocate of the transformer system as he had many years ago been an opponent of electric distribution by secondary batteries. Professor Sylvanus Thompson and other speakers had taken exception to a statement in the beginning of his paper as regards the Faradaic theory. He wished to point out that neither he nor Mr. Gaulard had ever denied the Faradaic theory of induction; but Mr. Gaulard had from the first believed that this theory, as exemplified by Ruhmkorff, was not a proper basis for the construction of transformers.

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AN IMPROVED STEAM STAMP.



AN IMPROVED STEAM STAMP.

We are indebted to our American contemporary the *Engineering and Mining Journal* for the accompanying illustration, showing a steam stamp of the latest pattern, as constructed for the Tamarack Mining Company, by Messrs. E. P. Allis & Co., at the Reliance Works, Milwaukee, Wisconsin. The frame and bed plate of this powerful machine are made entirely of cast iron, and are securely bolted and braced together, thereby avoiding the excessive wear experienced in some forms of steam stamps. The bed plate consists of a massive casting, connected to the timber foundation by anchor bolts. There are nine spring timbers resting on the side sill of the bed plate, and arranged in such a manner that the worn out timbers may be easily replaced by new ones. The mortar rests on a solid cast iron bed plate 18in. thick, and weighing 18 tons, and is secured thereto by an angle iron frame bolted to the stamp frame, and forming a guide. This arrangement allows the mortar a slight vertical movement at each blow of the stamp head. The guides for the stamp shaft consist of loose shells, lined with Babbit metal, and may be easily removed when worn and re-filled. The stamp has fitted to it a vertical cylinder, 20in. diam. and 24in. stroke. The valves are actuated by two shafts, shown in our illustration. The lower one of these shafts is driven by a belt and pulley, and the motion is communicated to the upper shaft by means of elliptical spur wheels. In our illustration both valves are actuated by the upper shaft; but it has been found that better results may be obtained by connecting the upper valve to the upper shaft, which has an irregular motion, produced by the elliptical gear, while the lower one is connected to the lower shaft, having a regular motion. It is claimed that in this arrangement the valves are moved in such a manner as to leave both steam ports fully open during the down stroke, thereby admitting the steam at full pressure through the top port, and insuring a free exhaust through the bottom port. The amount of steam admitted during the up stroke is regulated by a separate valve placed in the steam pipe outside the lower main valve. This regulating valve may be adjusted to give any required pressure for lifting the stamp, while it does not interfere with the free opening of the exhaust. This arrangement has been patented by Mr. E. Reynolds, and we understand that it admits the perfect adjustment of the valves to suit any class of work. A scale is marked on the eccentric and shaft collars for giving the stamp any desired speed. The piston rod is connected to the stamp shaft by a circular disc encased in an iron cover bolted to the stamp shaft, and arranged in such a manner that it may be taken out without removing the piston. The space between the disc of the piston rod and the cover of the stamp shaft is filled with pure india-rubber packing. The piston and piston rod are made of steel, and all the bolts of the best Swedish iron. The water used in stamping is admitted round the stamp shaft, so as to protect it from sand. The stamps are estimated to last six years, whereas the shoes want renewing every two or three months. The capacity of this machine is 225 tons in twenty-four hours, on a consumption of 1 ton of coal for every 34 to 36 tons of ore, and with a speed of ninety to ninety-two strokes per minute. Messrs. Allis & Co. have now in course of construction a stamp in which the spring timbers will be left out entirely, and their place will be taken by a cast iron bed weighing 40 tons, and it is expected that greater efficiency will be attained with this arrangement.

THE SOCIETY OF CHEMICAL INDUSTRY.

The Oxidation of Camphor Oil.—At a meeting of the above Society, at Burlington House, on the 20th ult., Mr. C. T. Kingzett in the course of a paper set forth that of late camphor oil has to some extent come into the market as a substitute for turpentine in the manufacture of varnishes. If camphor oil be freed from camphor by freezing, and then be moderately heated, more camphor is formed; in fact, by oxidising camphor oil, camphor is yielded, and peroxide of hydrogen is formed. The chemical reaction of water upon some partly oxidised substances seems to be the formation of peroxide of hydrogen. The presence of such substances in the leaves of trees has an influence upon natural sanitation; the wind blowing over the leaves of certain trees in New South Wales and South Australia, gives rise by oxidation to an aggregate of millions of tons of peroxide of hydrogen, which must exert a beneficial influence upon the health. He had found that from sunflower oil treated by his method for the oxidation of camphor oil, no peroxide of hydrogen is formed, hence he concluded that sunflower oil does not contain any terpene.

The Chairman, Mr. Thomas Tyrer, said that some time ago a rather too oily camphor, with an aromatic smell, was in the English market. It was very cheap, and was undoubtedly produced from camphor oil; and that lately it had increased in value.

The New Dye "Primuline."—Mr. A. G. Green read a paper on "Primuline," a new dye manufactured by Messrs. Brooke, Simpson, & Spiller, who exhibited upon the lecture table a large collection of coloured fabrics illustrating the results obtained. Mr. Green said that all the cotton dyeing colours hitherto known might be classified as follows: (1) Hydroxy compounds capable of forming stable lakes with oxides; (2) insoluble colours formed in the fibre; (3) strongly basic nitrogenous colours; (4) non-nitrogenous natural dyestuffs; (5) azo cotton colours. Alizarine is a type of the first group. In group (2) soluble constituents are brought together in the fibre, in which they then produce the colour safranine; a pink colour is a type of the third group. In group (4) only three colours are known—anatto, turmeric, and saffron; no colours at all resembling them have been produced artificially. The colours of the fifth group have only been known since 1884, and the most important of them are those obtained from benzoline. Groups (1) and (2) form the fastest colours of all, because they are in the fibre; but if in addition one of the constituents had a natural affinity for the fibre, it ought to give the fastest colour of all, or at least a colour as fast as any of them; and the "primuline" colours discovered by him had the desired characteristic. A skein of cotton dyed with it alone was fairly fast, but not so fast as the colours produced from it by subsequent treatment of the skein. The method was to first treat the primuline with nitrous acid, and next with a phenol. A colour is then formed in the fibre. The primuline itself produces a pure primrose colour, and is applied to the cotton in boiling solution, containing a little soda, to "diazotise" it. It is then treated with a mixture of nitrite of soda and hydrochloric acid, and takes an orange colour, upon which any colour can be built up by the aid of phenols, especially varieties of reds, oranges, and yellows, and the colours are quite unaffected by acids. He then boiled some pieces of cotton dyed primuline red, also some other pieces dyed Congo red, in dilute hydrochloric acid. The Congo red went dark purple, practically black; the other dye was unaltered. Stuffs dyed by the aid of primuline may be re-diazotised, and again treated

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with the particular phenol, with the result of greatly deepening the colour. The discharge for primuline colours is a strong reducing agent. He used true sodium hydrosulphite, made by boiling sodium sulphite with zinc. This, applied hot, restored the cotton to its original primuline colour. By using primuline as a basis or mordant, cotton took methyline blue much better than would otherwise have been the case.

Mr. Nettlefold said that cotton treated with naphthol, and afterwards dipped into phenols, gave beautiful scarlets and violets, which would resist the action of reducing agents. He supposed that primuline must be a new base, and wished Mr. Green to tell the meeting its composition. In law courts it was often a matter of dispute whether colours were inside or outside the fibre. Mr. John Spiller remarked that an infinite number of colours could be built up by using primuline as a mordant.

Dr. Messel wished to know if the said colours were fixed to light and soap.

Mr. Green replied that the peculiarity of his process was that primuline itself was a real dye, so that the fabric could be thoroughly washed before beginning to impart to it another colour by means of a phenol. Other processes would not stand this washing. The colours were fast to soap, and would resist the action of light as well as any ordinary colours in the market, even if they were not quite so fast as alizarine.

Notes.

PUBLIC WORKS IN GREECE.

The original contractors for the cutting of the Corinth Canal have, according to the British Consul at Patras, ceded to the Comptoir d' Escompte, of Paris, their contract. The new company were to commence operations in January last. The difficulty in completing the work arose from the discovery of a bed of rock which will cause a long delay. The railway between Athens and Patras has been completed, and another line is to be commenced between Patras and Pirgos.

THE NICARAGUAN CANAL.

The delays in the construction of the Panama Canal, and the enormous sums of money which have already been expended on the work which has so far been carried out, have caused most people out of France to arrive at the conclusion that M. de Lesseps' scheme will ultimately break down. For years past, occasional paragraphs have also been seen in connection with the Nicaraguan Canal; but, according to Mr. M. Vaughan, the British Consul at Granada, Nicaragua, the general opinion there is that no serious work will be done. However, the contract between the Nicaraguan Government and Mr. A. G. Menocal, the representative of the Nicaraguan Canal Association in New York, which was signed last April, stipulates for the forfeiture of £20,000 if work is not begun within a certain time, and this money was duly deposited with the Government.

NATIVE INDUSTRIES IN ROUMANIA.

In order to stimulate native industries in Roumania, the Government of that country has decided to afford special privileges to persons possessed of a capital of £2,000 who are willing to establish factories to employ not fewer than twenty-five hands. Land will be given free for a period of ninety years, there will be freedom from taxation for fifteen years, free admission of machinery and of raw materials used in the manufacture of the latter which cannot be obtained in sufficient quantities in the country. All articles imported, which are re-exported after being worked up in the country, will be entitled to a drawback equal to the duties paid on their importation. Manufacturers working under this law must employ technical processes and improved machinery, under the charge of experienced foremen. The Government will give the preference in its contracts to articles of home manufacture.

ROYAL METEOROLOGICAL SOCIETY.

At the monthly meeting of this Society, held on the 15th ult., a paper was read on "Electrical and Meteorological Observations on the Peak of Teneriffe," by the Hon. Ralph Abercromby, F.R.Met.Soc. The author made a trip to the Island of Teneriffe, in October, 1887, for the purpose of making some electrical and meteorological observations, and found the electrical condition of the Peak of Teneriffe to be the same as that in other parts of the world. The potential was, even at considerable altitudes, moderately positive, from 100 volts to 150 volts, at 5ft. 5in. from the ground; but it rose to 549 volts on the summit of the Peak (12,200ft.) and to 247 volts on the top of the rock of Gayga (7100ft.). A large number of halos were seen associated with local showers and cloud masses. The necessary ice dust appeared to be formed by rising currents. The shadow of the Peak was seen projected against the sky at sunset. The idea of a south-west current flowing directly over the north-east trade was found to be erroneous. There was always a regular vertical succession of air currents, in intermediate directions at different levels, from the surface upwards, so that the air was always circulating on a complicated screw system. Papers were also read on the "Rainfall of South Africa, 1842-1886," by Mr. W. B. Tripp, M.Inst.C.E., F.R.Met.Soc., and on "Some Methods of Cloud Measurements," by Mr. Nils Ekholm.

CANADIAN RAILWAYS.

A favourable report of the progress which is being made by Canada in railway construction has been given by Mr. J. G. Colmer, in the course of a paper delivered before the Royal Statistical Society. Since the confederation in 1867, the railway mileage of Canada has extended from 2258 to nearly 12,000 miles; the population in the same time increasing from 3,400,000 to nearly 5,000,000. Although many hundreds of miles of railway constructed since 1880 run through districts which are very thinly inhabited, and which have not much effect on the traffic returns at present, yet since 1877 the passenger traffic has increased 50 per cent., the goods traffic 130 per cent., and the earnings 83 per cent., while the working expenses are 60 per cent. higher. Out of a capital of about £135,000,000 expended on Canadian railways, £32,000,000 has been contributed by the Dominion and Provincial Governments and by local municipalities.

INTERNATIONAL GEOLOGICAL CONGRESS.

The triennial meeting of the geologists of the world is to be held this year in London, during the third week in September. This Association was founded in America in 1876, at the Buffalo meeting of the American Association for the Achievement of Science, with the object of providing an opportunity for matters of geological interest and importance to be discussed by geologists of all nationalities. The succeeding meetings were held at Paris, Bologna, and Paris, and have been well attended. On the Continent, the several Governments have rendered great assistance to the Executive Committees by giving additional facilities to members visiting the meeting on the different State railways and in other official ways which are not possible in England. The funds necessary to insure the success of the meeting are being raised by private contributions, and the committee, which is a large and representative one, are confident that the present meeting will be a successful one. Many matters of general interest and problems related to the economic applications of geological science, mining, and metallurgy will be brought before the meeting, and the discussions which are likely to take place will afford a valuable contribution to our knowledge of these subjects. Professor J. Prestwich has been elected the president for the meeting, and the presidents of several of the London and local societies of allied sciences and mining associations are rendering their assistance to the committee. Mr. Topley and Mr. Hulke are acting as the general secretaries of the Congress; and the geologists of this country intend to offer their *confrères* from the Continent and America a hearty welcome to this country. A series of excursions are being planned to take place in the week preceding the meeting, which should prove an additional attraction to those visiting London and the neighbourhood for the first time and interested in its geology.

COLONIAL CONTRACTS.

Strong expressions of dissatisfaction have recently been given by some of the leading Chambers of Commerce on the subject of contracts for Colonial Governments, and has been brought prominently to the front through the action of the Government of New South Wales in connection with a contract for locomotives. It seems that forty-four of these were wanted, and tenders were asked for in the spring of last year from some of the leading makers in the Colonies, Europe, and America. A large number of quotations were furnished, and considerable expense was incurred by the makers in the preparation of specifications, in the belief that the work would be adjudicated on fair business principles. It was found that the lowest estimate had been sent in by Messrs. Nielson & Co., of Glasgow, and that the Colonial tenderers had quoted much higher figures, in some cases over 50 per cent. more than the British makers. But the Colonial Government has thrown all the offers aside, and practically told the Colonial firms that they desired to give them the orders, but that their prices were too high, and asked them to re-tender. This they have done, but the prices named are still very much higher than those of the British firms. Nothing has yet been settled about the order, but manufacturers ought to protest vigorously against such treatment as that to which the locomotive makers have been subjected. It is quite evident, from a heated controversy which the transaction has provoked in Sydney, that the only object in asking British makers to send in tenders was to check the prices of the Colonial competitors, as the Minister of Public Works has indicated that rather than allow the work to go out of the country, he will have the engines built at a Government repairing shop, in which it would be quite impossible to turn them out in a satisfactory manner, either as regards price or quality. If the Colonies are determined to protect their industries, of course we cannot prevent them; but our manufacturers should at least take steps to show them that they object to be used as mere conveniences.

OUR TRADE WITH JAPAN.

In the *Handelsmuseum*, which is issued from the Oriental Museum in Vienna, there lately appeared an article on the foreign trade of Japan, which contains a considerable amount of interesting matter. Great Britain still takes the first place in that trade; but since 1880 her share has steadily declined, especially as regards the import of goods. In millions of yen, the imports of British goods amounted, in 1877, to 15·7, in 1878 to 19·2, in 1879 to 16·8, in 1880 to 19·6, in 1881 to 16·4, in 1882 to 14, in 1883 to 12·7, in 1884 to 12·7, in 1885 to 12·4, and in 1886 to 12·7 million yen. Britain's participation amounted in 1878 to 58·6 per cent., in 1885 to 42·3 per cent., and in 1886 to 39·5 per cent. of the total imports of these years, and has thus since 1878 decreased by 19·1 per cent. Germany takes the second place on the list with 7·2 per cent. of the imports, and has since 1883 outrun France. The reasons given for this by the *Handelsmuseum* are very similar to those which we have indicated on various occasions. The British merchants ignored, up till lately, the existence of their competitors. They sat in their offices and expected their customers to call upon them, and they seemed to pay little attention to the demands or wishes of those who bought their goods. The German merchants go very differently to work. They generally begin by learning the Japanese language, and thus they are able to bring themselves more into direct contact with the people, or with Japanese agents. They do not neglect the smallest order, and they do all in their power to satisfy the wishes of the buyers; and lastly, they generally offer more advantageous terms than the British merchants. Moreover, the quality of certain British goods has deteriorated during recent years, and the Japanese Chamber of Commerce at Tokio, some time ago, did not hesitate to state that the quality of English cotton goods is deteriorating from year to year. Our contemporary concludes its article by saying that better, or at least equal quality at cheaper prices, prompt delivery exactly according to sample, perseverance, and tenacity are the advantages which Germans offer to the Japanese merchants, and to which their success is due. We commend its remarks to the attention of British merchants.

TRAIN LIGHTING IN GERMANY.

At a recent meeting of the Frankfort branch of the Society of German Engineers, Herr Voigt gave some interesting figures regarding the cost of train lighting on various German railways. On the Würtemberg lines electric lighting has now been in use for some time, and the cost per hour for a $12\frac{1}{2}$ c.p. lamp, based on the use of the light for 2100 hours per annum, varies from ·31d. to ·44d., the average being considerably below the cost of lighting by oil gas. The cost of oil gas is least on the State railway in Saxony, the lamp-hour costing there ·376d., and most on the Halberstadt and Blankenburg line, where the cost per lamp-hour amounts to ·69d. The cost of gas plant, including compressing machinery and piping, amounts to £2,500 for an output sufficient to supply 150 carriages with gas. The advantages of electric train lighting are summarised as follow: (1) Complete independence of the charging station, so that the electrically lighted trains may be run over any lines. With oil gas the whole service is disorganised if through an accident at the gas works or through fire the supply of gas is interrupted; (2) the light is better than gas, and there is no danger of explosion and fire in case of collision; (3) the expenses for labour are lower, because no preparations are required before the light is actually wanted; (4) the working expenses are lower, as found by experience; (5) the cost of plant is only slightly greater than that for gas lighting; (6) the weight of lighting plant to be carried on the train is less than with gas. It is interesting to note that an engineering works in Esslingen have already fitted several trains not only in Germany, but also abroad, with electric lighting plant. Amongst these are six trains on the Novara-Seregno line in Italy, and some on the Russian South-Western Railway. On the Italian lines the plant works almost automatically, an attendant only accompanying the train over a few stations to oil and look after the machinery, and then returns by the next train in the opposite direction, so that during most of the time the machinery is left to itself. Notwithstanding this want of supervision no hitch has as yet occurred in the lighting.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

17th February, 1888.

2381. Hall, J. H. ..... Boiler furnaces.
2384. Mills, J. ..... Steam boilers.
2387. Pinnington, G. ..... Rotary engines.
2389. Hamilton, T. B. ..... Pickers for looms.
2393. Pickles, G. ..... Machinery for planing wood.
2395. Appleyard, J. ..... Ironing machines.
2396. Whitby, J. ..... Manufacture of gloves.
2398. Huck, G. ..... Looms.
2399. Edwards, S. ..... Lawn mowing machines.
2400. Stacey & Wilkinson ... Apparatus for pumping.
2401. Crowther, J. ..... Pistons.
2402. Simpson, W. F. ..... Furnace for steam boilers.
2403. Norman & Norman ..... Grinding mill.
2409. Kendall & Cooper ..... Railway signalling.
2413. Miles, A. ..... Broughams.
2418. Williams, H. A. ..... Shaping metal rods.
2419. Fournier, G. ..... Manufacture of hats.
2423. Morgan, C. H. ..... Manufacture of rolled wire.
2424. Morgan, C. H. ..... Wire rod reeling machines.

18th February, 1888.

2430. Dudgeon & Thompson.. Shuttles for looms.
2432. Stoney, F. G. M. ..... Grabs for excavating.
2441. Midgley, J. W. ..... Tension device for spinning machines.
2442. Begg, W. ..... Furnace for the prevention of smoke.
2443. Hawke, J. ..... Harrows.
2444. Rariden & Heath ..... Car couplings.
2446. Elcoate, T. ..... Valves for steam engines.
2453. Henderson, A. C. ..... Boot making (*Robert*).
2462. Williams, T. H. ..... Manufacture of bottles.
2466. Quack, E. ..... Gas engines.
2467. Cole, T. W. ..... Steam engines.
2468. Stevens & Stevens. ... Harrows.
2472. Clark, A. M. ..... An improved motor (*Honigmann*).
2473. Schotte, A. ..... Looms.

20th February, 1888.

2478. Wilding, R. ..... Spinning machines.
2489. Walker, J. ..... Lathes.
2498. Michaelis & Smethurst ..... Gig mills.
2500. Brigg, T. H. ..... Looms.
2504. Goodwin, G. ..... Machinery for grading grain.
2518. Lansell, G. ..... Boiler flues.
2528. Wallace, J. ..... Machinery for preparing flax.
2532. Singer & Judell ..... Cleansing wool.

21st February, 1888.

2535. Marchington, W. E. ... Spinning machines.
2536. Alley, S. ..... Screw propellers.
2537. Gass & Gass ..... Revolving cloth stretchers.
2542. Ross, J. H. ..... Compressed air motor.
2545. Taylor, J. A. ..... Scutching machines.
2550. Christie, W. ..... Stopping the progress of vessels.
2555. Annand, R. C. ..... Printing machines.
2560. Grout & Bowers ..... Sewing machines.
2561. Tilton, H. W. ..... Sewing machinery (*Angell*).
2565. Harris, E. J. ..... Puddling furnaces.
2569. Sauvee, A. ..... Armoured turret (*Canet*).
2571. Boult, A. J. ..... Car couplings (*Brown*).
2572. Thompson, W. P. ..... Air compressors (*Reynolds*).
2573. Boult, A. J. ..... Knitting machines (*Clay*).
2579. Lake, H. H. ..... Button hole machines (*Wheeler*).
2580. Lake, H. H. ..... Gun carriages (*Hill*).
2583. Lindley, L. ..... Sewing machines.
2585. McInnes, A. ..... Boiler furnaces.
2589. Harriss-Gastrell, J. P. ..... Compound engines.
2590. Sterry & Sterry ..... Gas engines.
2598. Hodgson, A. ..... Car couplings.
2604. Nordenfelt, T. ..... Breech mechanism for guns.
2607. Dobbs, C. J. ..... Annealing kilns for slag blocks.
2610. Lejeune, A. ..... Carding machines.

22nd February, 1888.

2616. Fairburn & Casson ... Shuttles of looms.
2617. Donkin & Nichol ..... Water tight doors for bulkheads of ships.
2622. Ford, W. ..... Breech loading fire arms.
2633. McGhie, J. ..... Manufacture of metal tubes.
2640. Miller, J. N. ..... Rotary engines.
2642. Walker, J. C. ..... Washing machines.
2643. Walker, J. C. ..... Combing machines.
2644. Rhodes, S. G. ..... Weighing machine.
2652. Thorneycroft, T. ..... Carriages.
2658. Hudson & Hudson ... Looms.
2659. Stott, J. ..... Boring vertical holes for mining purposes.
2668. Jones, J. G. ..... Governing steam engines.
2669. Gerdes, H. ..... Manufacture of carding teeth and cloth.
2671. Holmes, C. D. ..... Corrugated tubes.
2672. Hornsby & Ogle ..... Pulverising minerals.
2677. Lang & Jeffries ..... Drop-down small arms.

23rd February, 1888.

2680. Williamson, T. ..... Hot bloom shears.
2683. Douglas & Douglas ... Manufacture of boots.
2688. Rankine, J. ..... Cast plates for boilers.
2693. Halliwell, J. ..... Connecting together sheets of metal.
2696. Brown, A. B. ..... Steam engines.
2699. Barstow & Saaw ..... Combing machines.
2707. Coupe, G. E. ..... Friction dynamometers.
2708. Stevens, A. C. ..... Scaffolding.
2714. Pierce, A. ..... Hoisting apparatus.
2716. Hipkins, H. ..... Sleepers.
2718. Strang & Pinder ..... Couplings for permanent ways.
2727. Taylor, W. H. ..... Loom temples.
2733. Foulds & Woodward... Circular knitting machines.

ELECTRICITY.

17th February, 1888.

2420. Scott & Paris ..... Regulation of electrical currents.

18th February, 1888.

2488. Langhans, R. ..... Incandescent lamps.
2449. Allen, O. ..... Electric railways.
2450. Hibbert, W. ..... Electrical measuring instruments
2454. Moseley, W. ..... Electrical conductors.

20th February, 1888.

2515. Feaveryear, J. ..... Dynamo-electric generators.
2525. Richardson, C. ..... Arc electric lamps.

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2586. Kennedy, R. ..... Incandescent electric lamps.

22nd February, 1888.

2654. Kingdon, J. A. ..... Dynamo-electric machines.
2666. Sherrin, J. V. ..... Dynamo machines and electro-motors.
2667. Sherrin, J. V. ..... Primary batteries.

23rd February, 1888.

2689. St. George & Bonne ... Electrical incandescent lamps.
2694. Ward, W. F. C. ..... Batteries.
2695. Miller, S. ..... Electric lighting.
2703. Hargrave, F. ..... Sounding at sea by electricity.
2726. Kinninmont & Gastrell Laying electric light conductors.

CHEMISTRY.

17th February, 1888.

2401. Ewer, A., & others ..... Production of naphthylendiamines.

20th February, 1888.

2495. Chance & Chance ..... Sulphuretted hydrogen.

21st February, 1888.

2563. Holliday, T. ..... Bisulpho acids of beta-naphthol.
2584. Baldwin, W. A. ..... Extracting aluminium.

22nd February, 1888.

2664. Lake, H. H. ..... Colouring matters (*Leonhardt and Co.*).

MISCELLANEOUS.

17th February, 1888.

2380. Williamson and Williamson ..... Ventilating.
2382. Phipps, E. ..... Photographic cameras.
2385. Johnson, H. T. ..... Ventilators.
2386. Johnson, H. J. ..... Ventilator for infectious hospitals.
2391. Fessey, D. W. ..... Making sewing threads from coated yarns.
2405. Walton, C. ..... Stove.
2407. Bradshaw, J. B. ..... Rolls.
2412. Scott-Moncrieff, W. D. Manhole chambers.
2421. Hargrave, F. ..... Life buoys.
2422. Hargrave, F. ..... Signalling at sea.

18th February, 1888.

2434. Peebles, D. B. ..... Regulating the flow of gas.
2437. Burton, W. C. ..... Velocipedes.
2448. Hadlow, F. V. ..... Artificial coal.
2452. Mowll, C. H. ..... Screening coal.
2455. Crane, F. ..... Varnishes and lacquers (*Field*).
2456. Franke, F. O. ..... Packing for stuffing boxes.
2458. Bradford, T. ..... Butter workers.
2460. Grivotet, C. ..... Raising beer by compressed air.
2461. Redgrave, J. ..... Drying malt.
2465. Mefford, D. M. ..... Projectiles.
2470. Bulpitt, W. H. ..... Lamps.
2471. Perkins, L. ..... Refrigerating apparatus.

20th February, 1888.

2476. Thompson & Sharman.. Shot lighting in mines.
2477. Byers, H. ..... Cop packing.
2481. Aver, E. ..... Drawing pens for producing dotted or broken lines.
2483. Parkinson, J. ..... Lithographic machines.
2484. Lear, W., & others..... Railway couplings.
2494. Ashworth, J. S. L. ..... Bench vices.
2496. Johnson, H. T. ..... Ventilators.
2497. Thomas, G. ..... Temperature regulating apparatus (*Fischer*).
2503. Norris, A. ..... Smoothing iron.
2508. Boley & Vitzius ..... A fatty compound to be used in drawing wire.
2509-12-14. Hand-Smith, G... Manufacture of varnishes.
2511. Chapman, A. ..... Manufacture of sugar.
2513. Harding, E. W. ..... Coal gas.
2519. Lansell, G. ..... Equalising the strain on winding gears.
2523. Redfern, G. F. ..... Lubricating apparatus (*Sörensen*)
2524. Redfern, G. F. ..... Metallic packing (*Hulburd*).
2533. Hoyde, A. G. ..... Lamp extinguisher.

21st February, 1888.

2539. Baker, F. R. ..... Oil lamp burners.
2541. Williamson, T. ..... Railway chairs.
2544. Greenwood & Greenwood ..... Ventilating rooms.
2546. Roberts, C. ..... An improved cement.
2548-9. Windhausen, F. ..... Refrigerating apparatus.
2568. Thomas, F. S. ..... Refrigerating machines.
2570. Shedden, L. W. ..... Laying floors.
2575. Thompson, W. P ..... Heat regulating apparatus.
2578. Cooper, V. B. D. ..... Securing railway rails to chairs.
2596. Woodhouse, A. ..... Ventilation of sewers.
2597. Lake, H. H. ..... Manufacture of gas (*Humphreys*).
2599. Thomson, W. ..... Stoppering bottles.
2601. Holman, G. ..... Gas burners.
2602. Rubin, E. ..... Percussion fuses.
2611. Hackmann, H. ..... Filtering of wort.

22nd February, 1888.

2619. Hughes, O. ..... Cement and porcelain.
2620. Washington, S. ..... Preparation of black lead.
2623. Deverill, J. ..... Gully trap for drains.
2627. Hubert, P. ..... Grease injector apparatus.
2628. Bowen, O. ..... Artificial fuel.
2630. Law, D., & others..... Cast iron shoes for water pipes.
2632. Roberton & Patrick... Portland cement.
2634. McPherson, D. ..... Distribution of manure.
2636. Evans & Sanday ..... Decorative effects on china.
2638. Birnbaum, T. ..... Vessels for containing naphtha.
2641. Constable & Joseph ... Artificial stone.
2645. Myall, A. ..... Millstone dress (*Lancaster*).
2646. Russell, R. J. ..... Bicycles.
2661. Johnson, J. Y. ..... Drying yarn (*Lebailly*).
2662. Foerster & Wolff ... Shells.
2663. Herisse, E. ..... Apparatus for aerating liquids.
2670. Candy, F. ..... Cleansing filters.
2674. Slatter, G. F. ..... Ventilating closed carriages.
2675. Chandler & Chandler Washing or purifying gas.

23rd February, 1888.

2679. Molison & Young ..... Lamps.
2681. Thorpe, C. ..... Apparatus for cleaning carpets.
2684. Fox, C. J. ..... Lamps.
2690. Berry, L. ..... Indicating the depth of water in reservoirs.
2692. Henderson, N. M. ..... Miners' safety lamps.
2697. Sellman & Hill ..... Lamps.
2700. Thompson, G. F. ..... Collecting dust.
2701. Taylor, F. E. V. ..... Gas lamp.
2702. Fletcher & Clare ..... Gas fires.
2704. Hargrave, F. ..... Disengaging ships' boats.
2705. Fane, S. J. ..... Stoppers and bottles.
2706. Hamand, A. S. ..... Relief designs in wood.
2711. Gowland, J. ..... Ventilating shafts.
2715. Rea, W. H. ..... Lamps.
2717. Wright & Burt ..... Lamps.
2721. Heenan, R. H. ..... Cartridges for blasting.
2722. Banks & Storey .. .. Preventing collisions at sea.
2723. Pain, J. ..... Ships' signal lights.
2724. Griffeith, S. ..... Fastening of coal plates.
2731. Graham, W. ..... Wood cutting bow saw.
2732. Birch, W. ..... Safety tap.
2735. Squire, W. S. ..... Purifying crude spirit.
2736. Mefford, D. M. ..... Projectiles.
2738. Wylde, A. ..... Fire escapes.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

25th February, 1888.

2475. Guy, J. B. ..... Railway signals.
2506. Stoner, J. B. ..... Conveying grain.
2558. Edwards & Edwards... Grinding and polishing tubes.
2599. Jäger, W. ..... Centrifugal machine filters.
2954. Immisch, M. ..... Gearing for traction purposes.
3136. Bassett, E. ..... Permanent way of railways.
3729. Mayhew, A. ..... Steam boilers.
4003. Fleetwood, D. J. ..... Iron and steel hinges.
4227. Poore & Storey ..... Torpedo boats.
4260. Sutherland, W. S. ..... Welding furnaces.
4573. Beard, R. R. ..... Cutting the eyes of needles.
5198. Marquand & Williams Tube cutters.
5207. Moncrieff & Anderson Mounting and working disappearing guns.
5224. Cox, J. ..... Breech loading small arms.
5233. Browning, W. ..... Ironing machines.
5451. Nordenfelt, T. ..... Quick-firing guns.
5593. Coleby, T. ..... Compressing yarns.
5622. Rickard & Rickard.... Coating plates with metal.
5666. Cunningham, W. ..... Carding machines.
5711. Kerr & Wilson ..... Calico printing.
5734. Buckley & Allen..... Apparatus for lifting.
5747. Burrell, F. J. ..... Traction and tramway engines.
5767. Anderson, A. ..... Sewing machines (*Singer Manufacturing Co.*).
5775. Soulerin, L. ..... Steam engines.
5786. Morris, R. ..... Magazines for fire arms.
5790. Marshall, H. J. ..... Permanent way.
5811. Elias, G. ..... Terne and tin plates
5821. Whittaker, J., & others Washing machines.
5833. Crossley, F. W. ..... Combined gas engine & dynamo-electric machine.
5834. Holland & Robertson Extractor mechanism for drop-down small arms.
5844. Low, R. H. ..... Steam traps.
5855. Allan, J. ..... Loom.

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5857. JOHNSON, J. H..... Carding engines (*La Société Alsacienne de Constructions Mécaniques*).
5913. CUMMING & CRAWFORD. Screw propellers.
5927. BROADBENT & BUDENBERG ..... Apparatus for preventing smoke and regulating the supply of air to furnaces.
5951. PRIESTMAN & PRIESTMAN Hydrocarbon engines.
5961. KEMPE, E..... Fulling and washing machines.
6020. LANCASTER & THORMANN Spinning and doubling machines.
6030. REDFERN, G. F. ..... An improved sleeper (*Coblyn*).
6046. ALLISON, H. J. ..... Harvester reels (*Stout & Underwood*).
6113. FENDT, A. ..... Starting of tramway vehicles.
6224. DEVIEN, H..... Metal wheels.
6512. GERISCHER & SCHRÖDER Treadle mechanism.
6914. HOOPER, J. S. ..... Treating hides (*Darrow*).
7247. CLARKE, A. A. ..... Obtaining motive power from the waves.
7563. SEAMAN, F. W. ..... Self hardening steel.
9322. SMITH, J. J. C. ..... Casting metals under pressure.
10817. JOHNSON, J. Y..... Tempering armour plates (*La Compagnie Anonyme des Forges de Châtillon et Commentry*).
14803. HAWDON, W..... Removing molten slag from furnaces.
16367. AMBLER & WHITE ..... Spinning machinery.
17323. HANFORD, J..... Hydrants.
17954. WORTH, J. S..... Cranes and hoists.
686. LAKE, H. H. ..... Casting of metal ingots (*Illingworth*).
839. ROBERTSON, A. W. ..... Furnace doors.
846. GROTH, L. A. ..... Knitting machines (*Grosser*).
856. HERBERTZ, F. A..... Furnaces.
958. ARMSTRONG, R..... Railway chairs.
1074. MILLS, B. J. B..... Warp machines (*Beer & Co.*).
1075. MORGAN, W..... Manufacture of felt hats.
1080. LAKE, H. H. ..... Spinning machines (*Sanford*).

ELECTRICITY.

25th February, 1888.

2819. NERLINGER, H..... Electric lamps.
2825. STATTER, J. G..... Dynamo-electric machines.
4549. FEATHERSTONHAUGH, A. Electric incandescent lamps.
5199. LOWRIE & HALL ..... Distribution of electrical energy for purposes of locomotion.
5303-5505. RAVENSHAW, H. W., & others..... Dynamo-electric machines.
5637. SIEMENS & LAUCKERT... Electrical controlling apparatus.
5835. SELBY-BIGGE, D. L..... Contact makers.
6177. MARCILHACY, A. ..... Electric lamps for divers.
9731. THOMPSON, W. P..... Ammeters (*Westinghouse*).
1078. BERGMANN & DEMPSTER Switches for electrical circuits.

CHEMISTRY.

25th February, 1888.

4434. WOODS, J. E. T..... Treating refuse metals.
5627. WOODHOUSE, A..... Amalgamation of gold.
5757. MATHIESON & HAWLICZEK ..... Caustic ash.
5853. PARNELL & SIMPSON ... Sulphuretted hydrogen.
43. PFEIFFER, J..... Calcium hydroxide.

MISCELLANEOUS.

25th February, 1888.

3222. DYER, H..... Extinguishing lamps.
4907. SHERRING, E..... Oil lamps.
5159. PARR, J..... Tricycles.
5226. MCMENEMY J. ..... Metal barrows.
5420. HOGG & JACKSON..... Printing upon glass.
5519. ELLIOTT, J..... Continuous carbonisation of coal.
5530. HARRIS, A..... Gas producers.
5586. CRANE, F. ..... Varnishes (*Hale*).
5661. DAVIS & AITKEN ..... Purifying sewage.
5741. HOUSE, H..... Manufacture of artificial leather.
5759. LAST, C..... Malt houses and kilns.
5776. DEAN, H. S. ..... Stoppers for bottles.
5791. CRANE, F. ..... Varnish (*Hale.*)
5805. MOIR-CRANE & WILKINSON ..... Corrugated paper.
5860. SMITH, J. ..... Securing leather on to the surfaces of rollers.
5873. EVANS, N. ..... Ventilating railway carriages.
5901. DOULTON, J. D..... Earthenware tiles.
5904. KING, W. F. ..... Ball valves.
5942. COATES & THOMPSON ... Chain cables.
5967. FAIRFAX, J. S. ..... Aerating liquids.
5992. RYLANDS & BEDFORD ... Stoppering bottles.
6002. MARTIN & TURNBULL... Damping dust in collieries.
6007. WEIR & WEIR ..... Evaporating by means of steam.
6216. HASKELL & WILLIAMS... Decoration for metals.
7236. WARWICK, J..... Water pipes.
7491. DAVIS, M. ..... Lamps.
9588. BYRNE, C. P..... Velocipedes.
11256. NEWTON, H. E..... Danger indicators for use on shipboard (*Allman*).
12188. DEATH & TOMKINS ..... Gelatinised grain.
16065. LOMBARD, L. W. ..... Cartridges.
17736. HORN & ROBSON ..... Jointing building blocks.
99. LAKE, H. H. ..... Manure distributors (*Peabody*).
533. PHILLIPS, H. L..... Stoppers for bottles.
542. SHAND, F. J. ..... Safety fuse for blasting.
560. BARTHEL & MÖLLER ... Projectiles.
919. JOHNSON, S. M..... Tents.
954. HART, D. R. ..... Screw drivers.
967. WOOD, A. M..... Rubber composition.
1083. DON, A. ..... Prevention of smoke.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 18th November, 1887, inclusive).

Year 1883.

5330. MCINTOSH, W. F., & ano. An anti-fouling composition for ships' bottoms.
5335. FENBY, J. B. ..... Cocks and valves.
5338. WETTER, J..... Electric copying and engraving machines (*Schmid*).
5350. CLARK, A. M..... A nut lock (*Schwarzwalder*).
5351. FOX, C. J..... Lowering, &c., ships' boats.
5353. LONES, J., & others ..... Generators for gaseous fuel.
5357. BOULT, A. J. ..... Hydrocarbon furnaces (*Orvis*).
5358. MATHEWS, J. L..... Wool oiling machines.
5359. READMAN, J. B..... Extracting cobalt nickel and manganese from their ores.
5360. DAY, C. A. ..... Steel ingots (*Billings*).
5361. LAKE, W. R. ..... Ammonia, &c. (*Fogarty*).
5362. LAKE, W. R. ..... Looms for weaving (*Brown and another*).
5363. LAKE, W. R. ..... Treating calcareous phosphorites (*Cox*).
5367. BEARDMORE, W., & ano. Steel.
5370. LETHERBY, R. ..... Boring taper holes.
5371. NOAD, J., & another ... Batteries for electric lighting.
5373. HADDAN, H. J. ..... An engraving instrument (*Bain Electric Co.*).
5375. LYTE, F. M. ..... Protecting submerged iron from corrosion, &c.
5379. JOHNSTONE, J. F..... Deodorising foul air.
5380. MURDOCH, W. M..... Bessemer converters.
5385. WALKER, W..... Exhaust ventilators.
5389. HARFIELD, W. H., & ano. Steering gear for ships.
5390. DEENE, T. J. ..... Sewing machines.
5394. IMRAY, J..... Sewing machines (*Love*).
5399. CLARK, A. M..... Steam engines (*Eberhart*).
5406. PICKING, G. G., & ano... Gas motor engines.
5407. PRICE, A. P. ..... Obtaining copper from cupreous solutions.
5409. HADDAN, H. J. ..... Wire netting (*Kretschmann*).
5415, CARR, G. W. ..... Lawn mowers (*Carr & another*).
5416. PRICE, A. P. ..... Zinc.
5422. BRIGHT, SIR C. T..... Dynamo-electric machine.
5425. MAYHEW, A. ..... Automatic feeding of boilers.
5428. URQUHART, D. ..... Sulphuretted hydrogen.
5431. THOMSON, W. P.. ..... Steam engines (*Cumnver*).
5433. OTTO, E. C. F..... Velocipedes
5436. EPSTEIN, G. ..... Treatment of refuse.

Year 1882.

5416. JUSTICE, P. M. ..... Lubricator attachments (*Hoffman*).
5464. DEWHURST, J. B., & others Spinning, &c., fibrous materials.
5485. CLARK, J. L. ..... Transit instruments.

Year 1881.

4982. ROEMMELE, J.' ..... Marking key grooves.
5056. ROBINSON, A. E., & ano. Hot air engines.

Year 1880.

4666. BECK, W. H. ..... Candles (*Royau*).
4669. RICHARDSON, W. H., and another ..... Paper.
4672. BENTLEY, G. ..... Twist lace fabrics.
4697. BECK, W. H. ..... Knitting machines.
4706. THACKER, S. ..... Cloth made in circular knitting machines.
4737. CROSSLEY, E..... Looms for weaving.
4756. ROWCLIFFE, J. B..... Wire spring mattresses.
4757. HALL, J..... Tram car engines.

Year 1879.

4624. BARBOUR, J. ..... Segment wheels.

Year 1878.

4595. HEINRICHS, C. F..... Generating electric currents.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

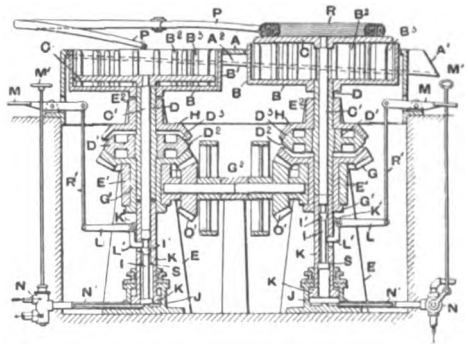
Compiled from the Published Specifications by W. E. HEYS, 70, *Market-street, Manchester.*

ENGINEERING.

TAKING UP MOTION FOR LOOMS.—*J. Cowburn & C. Peck, Eccles, Lancashire.*—This invention consists of arrangements by means of which the face of the cloth is prevented from being acted on by the taking up rollers. The axle of the taking up roller is mounted on arms, and rotation is imparted to it in a similar manner to that described in Patent No. 5896 of 1884, granted to the same inventors. The cloth is passed partially round a bar or guide, and then partially round the taking up roller, which is placed in front of the cloth roller. In another method described in the specification the invention is carried into effect by placing the taking up roller in front of or below the cloth roller, and the cloth is conducted from the breast beam of the loom to the taking up roller. The latter roller thus acts in both cases on the back of the cloth, and injury to the face is thereby avoided. There are two claims, one for each method.—No. 4117. March 18th, 1887. 8*d.*

PRODUCTION OF IRON.—*G. G. Mullins, St. Louis, U.S.A.*—Silica in the form of very pure quartz is added to the iron after having been ground to a fine powder. The fused silica has a strong affinity for sulphur and phosphorus, which it is so necessary to remove from iron. In carrying out the process embodied in this invention a puddling furnace is charged with ores or with pig iron. After this metal has been reduced to a molten state and brought to the highest white heat possible, a quantity of the powdered silica is added, amounting to from five to twenty-five per cent. of the weight of the iron, according to its quality. The mass is thoroughly puddled and allowed to boil for a few minutes, until certain blue and greenish flames are emitted from the boiling mass. The metal is then worked out in the usual manner. The sulphates and phosphates are removed with the scoria, and the silica remaining tends to strengthen the iron in the usual way. The inventor makes one claim for the above purifying process.—No. 12741. September 20th, 1887. 4*d.*

COILING MECHANISM FOR ROLLING MILLS.—*P. M. Justice, London.* (*F. H. Daniels, Worcester, Massachusetts, U.S.A.*)—The reeling apparatus, constructed according to this invention, is shown in vertical section in the accompanying diagram. Two reels B are supported on hollow shafts D, and are arranged so as to be level with the upper surface of the frame A. These reels are used alternately, and thus there is a continuous reeling action going on. A number of ribs B^3 project from the inner periphery B^1, and an equal number of vertical fingers B^3 rise up from the floor of the reels. The movable bottoms C consist of radial arms which fit between the ribs B^3. The floors C are supported on pillars C^1. The reels are rotated by means of the pulleys G^2, and the motion is transmitted through the gears O and the friction clutch D^1. The raising and lowering of the reels and movable bottoms is effected by the hydraulic mechanism I J K. The valve N is controlled at M^1 and supplies the water to the cylinder J. The plunger K is in contact with the shaft D, and the inner plunger I abuts against C^1. The lug I^1 and the



catch L^1 prevent the upward travel of I when necessary, and the shoulder S limits the height to which I can ascend. The action of the mechanism will now be described. If the pressure in the cylinder J is relieved, the plungers I and K descend and allow the friction clutch wheel D^1 to rest in contact with the rim of the gear G, as indicated on the left hand side of the figure. Rotary motion is thus imparted to B. The rod to be coiled is propelled by the finishing roll of the rolling mill, and is led to B through the guide pipe P and deposited upon the supporter C within the annular space between the ribs B^3 and the fingers B^3. It is there formed into coils by the rotation of the receptacle. Pressure is then admitted into J, and the plunger K is elevated together with the shaft D. The friction wheel D^1 is forced away from the gear G and into contact with the stationary rim H, as indicated at the right of the figure, and the rotation is thus stopped. The guide pipe P is in the meantime swung back into line with the trough A^1. The lever M is then operated so as to withdraw the catch L^1 from the lug I^1, and the pressure on I forces up the shaft C^1 and the supporter C. The coil of wire is thus lifted out of the receptacle. The inventor makes eleven claims, for the construction of the reel, for the combination of the mechanism for rotating and elevating it, for the application of the friction clutch, and for the locking lever L.—No. 2876. February 24th, 1887. 8*d.*

MACHINE FOR BRUSHING YARNS AND FABRICS.—*C. Binns, Manchester.*—A large central revolving brush is fixed in bearings in the frame of the machine, and round part of the brush are placed adjustable guiding rollers. The yarns or fabrics are carried over these rollers, and come in contact with the brushing sections of the large roller. Four small revolving brushes also move in bearings in the frame, and are parallel with the large brush. They rest in adjustable sockets in their bearings, so that they can be brought near to the fabric or lifted away from it at will. The material treated can thus be brushed on both sides at once. There is one claim for the improvement described.—No. 4799. March 31st, 1887. 8*d.*

GAS ENGINES.—*S. Griffin, Bath.*—In most gas engines the explosive compound, after having been ignited and expanded in the cylinder, is released at a pressure of 30lb. to 40lb. above the atmosphere, and consequently some available power is lost. In order to remedy this defect the inventor employs a cylinder and ports similar to those described in Patent No. 4080 of 1883, whereby the charge is introduced through a port close to the piston when at its full instroke, while the exhaust port is situated at the extreme end of the compression space furthest from the piston. According to the present invention, the compression space is made of a cubical content considerably less in proportion to the cubical contents of the sweep of the motor piston than has hitherto been usual. The cycle of operations employed may be similar to that described in the above mentioned patent, or may be the double cycle. In the former case, during one outstroke of the piston, air will be drawn into the cylinder, and gas may also be admitted during the first half of this stroke. At the next instroke the exhaust valve is open, and a portion of the air will pass through the exhaust valve, carrying with it the products of the previous combustion. During the whole of the next outstroke the air and gas is drawn into the cylinder. During the first portion of the next instroke the exhaust valve is again open for a sufficient time to allow the whole or any required portion of the air contained in the compression space in front of the explosive charge to be driven out. The exhaust valve is now closed, and the remaining part of the stroke compresses the charge. About the commencement of the next outstroke the charge is ignited, and it is expanded during the remainder of the stroke. During the next instroke a portion of the products of combustion equal to the sweep of

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the piston is expelled, leaving only that contained in the clearance. The cycle is now completed. The inventor makes three claims for this improved method of introducing the gas.—No. 3934. March 15th, 1887. 8*d*.

HYDRAULIC CRANES FOR SHIPS.—*A. B. Brown, Edinburgh.*—This invention relates to certain improvements in the arrangements for slewing the crane jib, described in the specification of Patent No. 16939 of 1884, granted to the same patentee. A hydraulic cylinder for working the hoisting chain is placed between the two girders of the jib, and on the outer side of each girder is placed a long hydraulic cylinder of small diameter. Round the pulleys at the ends of the rams are passed chains which have one end fixed to the jib. The other ends go round a pulley on a stud fixed to the jib, and then round a pulley on a

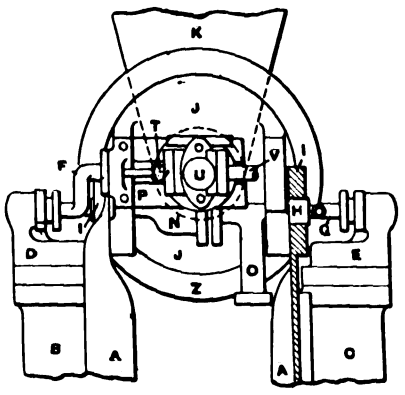


FIG. 1.

block which can be adjusted to any part of the jib. From the last mentioned pulley the chain is led to a fixed point at the side of the ship, and by making the hydraulic ram act on it the crane can be slewed. The two cylinders may be used for slewing in opposite directions; but with a raking mast only one cylinder is required for slewing, and the other is used for topping; the chain acted on by the latter is led to a pulley at the outer end of the jib, and thence up to a fixed point on the mast. The arrangement of pipes for leading the water to the slewing cylinders is shown in Figs. 1 and 2. Fig. 1 is a sectional plan of the inner end of the jib, and Fig. 2 is a vertical section of the same. The slewing cylinders B C are placed on the side of the girders A, and the blocks D E are fixed to their ends and communicate with them internally. The pipes F G have the same axis as the trunnions H, on which the joint eyes I of the girders A are jointed. The trunnions are fixed into the sides of the centre block J, which can turn about a vertical axis in the

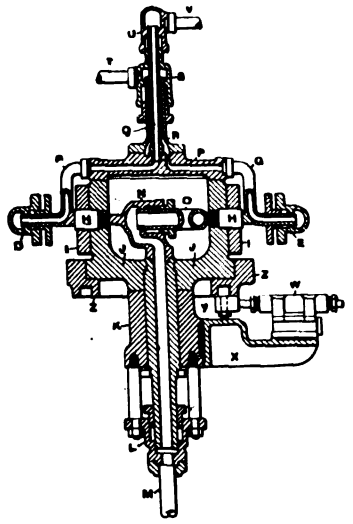
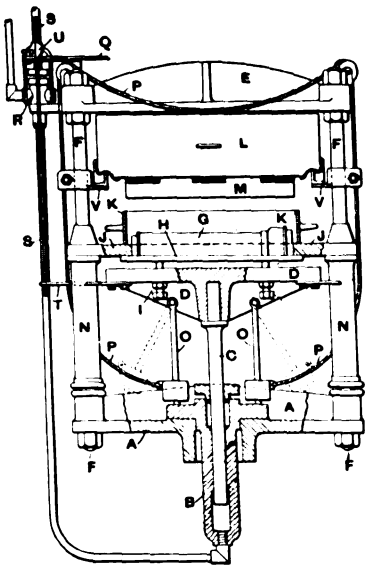


FIG. 2.

bracket K. The block J is also connected to a pipe M by which the water passes to and from the main jib cylinder. The stuffing box N is entered by a bent pipe O, which has its other end connected to the main cylinder. The pipes F G also communicate with passages in a piece P; one of these passages leads to a pipe Q and the other to a pipe R. The outer pipe R fits in a box S to which the pipe T is connected, and the inner pipe P passes up through S and leads to V. The box S is fixed to an upper bracket on the mast. If the cylinder B is arranged for slewing, the pipe T is led to a position near the hatchway where it is provided with a valve which controls the movements of the crane. If the cylinder C is arranged for topping, the pipe V is connected with a valve box W which is fixed to the bracket X; the valve rod Y is acted on by a grooved cam shown in section at Z fixed to the centre block J. When the jib is slewed inboard, the cam Z, acting on the valve rod Y, moves the valve in the box X so as to cause the jib to be raised. If found convenient the slewing action may be made automatic instead of the topping action. The inventor makes five claims, for the arrangement of the jib and pulleys, for the valve action of the slewing cylinders, and for the automatic motion provided by the cam.—No. 3112. March 1st, 1887. 8*d*.

WARP LACE MACHINES.—*J. Woolley, Nottingham.*—This invention introduces improvements in warp lace machines in which perforated steel bars and a guide bar carrying the pillar threads work in combination with a latch needle bar. Instead of the solid points working over or under the bars, and taking the threads from the steel bars and delivering them to the hooks, the inventor makes use of a double point or sheath formed out of thin sheet metal. Half its width is folded over on to its other half, so that the two sides lie parallel with each other, thus forming a double point or sheath. The doubled points enter the threads close under or close above the perforated steel bars, according to the construction of the machine, and convey the traversed fancy threads to the hooks. The hooks enter the double points, and in passing through them gather the whole of the threads from them, and place them on the reverse side of the needle to that on which the latch is turned. The hooks coming within the double points insure the delivery of the threads to the needles, and a greater number of top or bottom steel bars carrying the threads can be used. The combined movements of the hook bar and the bar carrying the double points are effected by links and truck bearing levers operated by cams on the cam shaft. The inventor makes one claim for the employment of double points working in conjunction with the hooks in warp lace machines, as described.—No. 5672. April 19th, 1887. 8*d*.

APPARATUS FOR MAKING MOULDS FOR CASTING.—*T. Alley and J. A. McLellan, Polmadie, Renfrew.*—In carrying out this invention a hydraulic press is used, with its cylinder at the base, and with a platen mounted upon the upper end of the plunger. The annexed diagram illustrates the arrangement and mode of operation, when applied to mould a pipe length. The flask or mould box for one half of the pipe is moulded at each operation of the machine. The hydraulic cylinder B is fixed to the base plate A, and the ram C carries the table D. The pattern G is placed on a plate H, which can be accurately adjusted and levelled by the screws I. When in position to receive the sand, the plate H is raised by the ram up to the parting plate J, through an opening in which the pattern



projects, so that one half of it is above the upper surface of the parting plate. The flask K is then placed on J, and the necessary quantity of sand is filled into it from the hopper L. The hopper is formed with a flat bottom, in two halves M hinged to its lower edges. After the sand has been run into the flask the ram is raised, carrying with it the platen, pattern, and parting plate up against the under side of the closed hopper bottom. The speed of lifting is such as to bring the sand, which projects up in a ridge along the middle of the flask, into contact with the hopper bottom, and the sand is thus made to apply itself compactly in contact with all parts of the pattern. The ram is then lowered, and the parting plate is guided by the columns F, on which it slides until the legs N reach some stops on the base plate. The descent of the platen D carrying the pattern is for a moment arrested when the parting plate is stopped, but immediately afterwards it descends to a distance sufficient to lower the pattern through the hole in the parting plate. The flask with the moulded sand in it is then removed, and an empty flask may be substituted for the next operation. For the purpose of temporarily arresting the descent of the platen, two weighted legs O are jointed to its under side. These legs encounter the top flange of the hydraulic cylinder, but are, a moment later, drawn away by ropes P. The movements of the apparatus are controlled by a hand lever Q, connected to the valve box R, through which the supply of water passes. The speeds of the various parts are controlled automatically by a rod S, which is adjustably fixed to a bracket T fixed to the platen. This rod is formed with a cam surface U at its upper end, which, when the hand lever Q is turned to put the cylinder in communication with the exhaust, at first prevents the exhaust being fully opened, but allows it to be so when the ram has descended a certain distance. The inventors make four claims, for the sand supplier, for the arrangement of the platen and parting plate, and for the speed controller described.—No. 3294. March 4th, 1887. 8*d*.

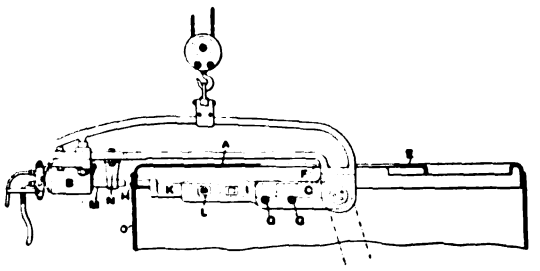
REAPING MACHINES.—*G. P. Cooper, Elton, Yorkshire.*—The inventor dispenses with the bevel gear and crank which usually supply the oscillating motion to the knives, and substitutes for them a drum which has an eccentric slot round its curved surface. A pin sliding in this slot is connected to a lever which is also connected at its other end with the cutter bar. The oscillating movement which the irregular slot gives to the pin causes the required reciprocation of the knives. The inventor makes one claim for this combination.—No. 11455. August 23rd, 1887. 6*d*.

SLATE WORKING MACHINERY.—*T. E. Morris, Carnarvon.*—The object of this invention is to construct the bearings and gear of a slate working machine in such a manner as to protect them from the dust which is formed in the operation of sawing. A worm is fixed to the saw spindle, and is enclosed in a metal box. A spindle at right angles to the saw spindle transmits motion to another shaft parallel to the saw spindle, by means of another worm gear. The whole of this mechanism is enclosed in a box containing a lubricant. On the shaft parallel to the saw spindle are clutch jaws and a pinion, which gears with a rack on the sawing table. The table is carried by means of two iron rollers, which are journalled in the casing of the machine. The inventor makes four claims.—No. 12900. September 23rd, 1887. 8*d*.

ROLLING THIN SHEETS OF IRON AND STEEL.—*J. Lysaght, Bristol, and W. R. Lysaght, Wolverhampton.*—This invention consists of rolling thin sheets between sheets of thicker gauge; the three sheets together are passed through rollers. The advantage of this method is that any inequality in rolling will be distributed equally among the sheets, and consequently the thin sheet will have a very small proportion of the irregularity. The inventors specify several methods of carrying out this idea, but do not limit themselves to any one; and they claim: rolling very thin gauges of iron and steel sheets between sheets of thicker gauge, for the purpose set forth.—No. 4191. March 21st, 1887. 6*d*.

PUNCHING HOLES IN METAL PLATES.—*H. T. Shaw & C. Chittick, London.*—The plate in which the holes are to be punched is supported on horizontal rollers. Along one side of the supports is a long table, which is also mounted on rollers, so that it may be moved endwise. At each end of the table is a saddle projecting from that side of the table at which the punch works. The saddles are capable of being moved along the table so that they may be brought against the ends of the plate and clamped to the table. The table and the plate then move together. The step by step movement of the table is brought about by having a number of pegs projecting from the side of the table. These pegs are acted on in succession by a revolving cam, the axis of which is parallel to the length of the table. The cam is formed of a cylindrical boss, with a fin projecting from it in the form of a screw round part of its circumference. The rotation of this cam moves the peg on, and with it the table. A second fin projects from the circumference, and holds the pegs between it and the first fin. There is provision made for varying the distance apart of the pegs, according to the number of holes to be punched in the plate. A longitudinal slot is made in the side of the table, and the pegs are screwed into the slot at the required distance apart. The inventors make three claims for the apparatus for giving the step by step motion, for the adjustable pegs, and for the general construction of the machine.—No. 2744. February 22nd, 1887. 8*d*.

PUNCHING AND RIVETING MACHINES.—*R. H. Tweddell, London; J. Platt & J. Fielding, Gloucester.*—This machine is arranged so that the hydraulic ram and the abutting tool shall be applicable for punching and riveting at the angles of boilers, and at similar parts of other structures where the ordinary machines are useless. The accompanying diagram shows the method of arrangement pursued by the inventors. The girder A carries at one end the hydraulic cylinder B, the plunger projecting from which carries the tool M. The abutment arm I is jointed to the other end of the girder between the two cheeks C. The abutting tool K can be adjusted longitudinally in the arm I, and is secured in its position by a cotter L. In the shell D E of the boiler to be riveted is a hole F, through which the arm I can be



passed when it is turned on its joint to a position such as is indicated by the dotted lines. After insertion, the arm I is secured in its position by the bolts G, and the tool K carried by it serves as an abutment when the tool M advances to punch a hole, or to head a rivet H. The inventors claim the construction of a hydraulic punching and riveting machine, wherein the cylinder with the tool is fixed at one end of a girder, and an abutment arm is jointed to the other end of the girder in such a manner that the arm, when turned in one position, can be introduced through a hole in the shell of the boiler, and can then be turned so as to present its abutment tool inside in a line with the punching or riveting tool.—No. 2828. February 23rd, 1887. 8*d*.

ROTARY ENGINE.—*T. Lambert, Plymouth.*—Two cylinders are mounted on the same axis, with a hollow dividing piece fixed between their ends. The dividing piece is bored to the same width as the crank disc, which works in contact with it. On the outer ends of the cylinders are cast covers, with central rings on them. The crank disc is formed with a cylindrical ring cast on each side, and working in contact with the faces of the cylinder covers. These rings are mounted eccentrically to the centre of the cylinders, and the disc divides the cylinders into two chambers, the inner chamber comprised within the eccentric ring and the discs on the cylinder covers, and the outer chamber constituted by the space between the outside of the eccentric rings and the bore of the cylinder. The pistons are common to both chambers, and are recessed for slides, which work loosely round the pins on the faces of the crank disc. The eccentric rings are slotted to correspond. The steam is admitted to the inner chambers through ports in the cylinder covers, and acts on one side of the pistons. These pistons consequently move round together with the crank disc and rings. The usual cut-off and expansion then takes place, and at a further point in the revolution the steam is allowed to pass to the outer chambers, where it again acts on the pistons. There are two main ports to each inner chamber, and two ports connecting the inner and outer chambers. Rotary valves are used to control the action of the ports. The inventor makes six claims, for the two cylinders and crank disc having eccentric rings, for the loose piston, for the rotary valves, and for the general construction of the machine.—No. 4343. March 23rd, 1887. 8*d*.

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MAGAZINE FOR FIRE ARMS.—*P. Mauser, Oberndorf, Württemberg.*—This invention relates to a cartridge box or magazine, which may be attached to and detached from the breech piece of breech loading fire arms. In Figs. 1 and 2 are shown elevations of the two sides of the magazine in conjunction with the Mauser gun. The magazine consists of a box A, in which the cartridges are confined by the spring J^1. The box is fixed to the chamber of the breech piece C by the frame work T, between which and the

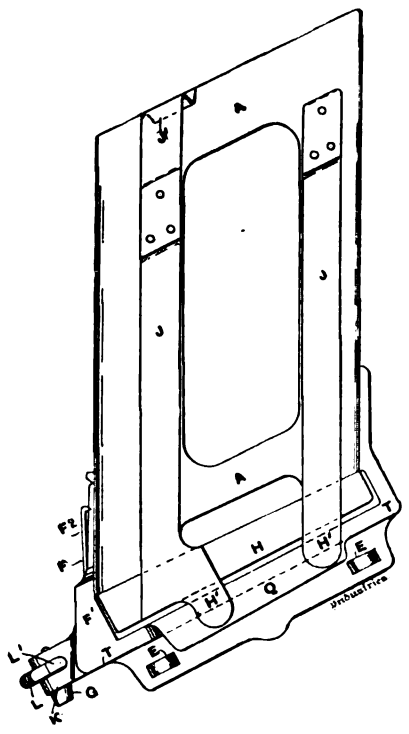


FIG. 1.

box is the carrier frame H. The carrier is attached to the springs J, and can be moved forwards in Fig. 1 to allow the cartridges to drop out one by one into the chamber C. The springs J extend downwards at H^1 in order to guide the cartridges in their journey to the chamber C, and the springs J tend to return the carrier to its normal position. Upon the outside of the rear wall of the box A is fastened a guide F^1 for the slide block F. The block F carries an angle lever L in such a manner that it swings horizontally round a pin secured to the foot K. In its normal position the longer arm of the lever touches

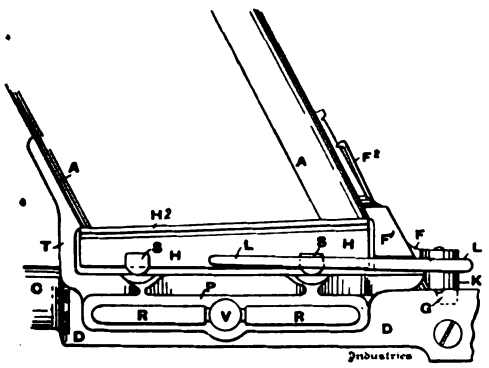


FIG. 2.

the wall of the carrier shown in Fig. 2. The shorter arm L^1 protrudes beyond the foot K to the front of Fig. 1, so far as to be acted on by a nose of the locking bolt. The attachment of the magazine to the breech piece is simple. The bottom of the frame T is formed with two ribs or flanges P and Q, by means of which it is set astride upon the left wall of the chamber C. Two spring studs E attached to the rib P enter the wall and secure the magazine in this position. These studs extend from the longer arms of the levers R, which turn round pins in the flange P. The shorter arms of these levers work in an annular groove in the push piece V. A coiled spring tends to press this piece outwards, therefore the studs E are constantly pressed on the wall of the chamber C. By pressing the piece B inwards, the studs E are withdrawn, and the magazine may be removed. There are modifications in the manner of attaching the magazine to the gun described in the specification. The inventor makes nine claims for the magazine and for its method of attachment.—No. 16274. November 26th, 1887. 8*d*.

PISTONS.—*G. W. McQuaker, Dalry, Ayr.*—The piston designed by the inventor has two L shaped outer packing rings, which are placed together so as to form a ring with an annular channel on its inside. The inner rim of the channel is turned at an angle with the plane of the ring, and on this slanting side of the rim another ring presses. The circumference of this pressing ring is made of three different segments, and the segments are made to press outwards on the packing rings by coiled springs. These springs form chords of the circle of the rings, and each of the springs causes a mutual reaction between two of the segments. The inventor makes two claims for this arrangement of rings.—No. 4693. March 29th, 1887. 8*d*.

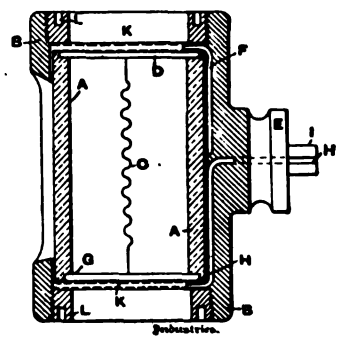
HEDDLES FOR LOOMS.—*W. R. Lake, London.* (*G. V. Morey, Boston, U.S.A.*)—In the construction of machine made heddles the inventor employs two continuous wire strands to connect the upper and lower heddle bars to all the eyes of a leaf of heddles. The continuous wire loops are prevented from slipping from their places on the top and bottom bars by means of a rubber or textile pad arranged in a groove on the bottom edge of the lower heddle bars. In addition, two metallic rods are arranged, one at each end of the heddle bars, and a thread and nut on each serves to tighten or loosen the wire loops by extending or contracting the distance between the heddle bars. The inventor makes two claims for the machine made heddle and for the method of constructing it.—No. 16132. November 23rd, 1887. 8*d*.

ELECTRICITY.

DYNAMOS.—*F. Bosshardt, Manchester.* (*A. L. H. Desbois, Angers, France.*)—The object of this invention is to regulate the strength of the currents automatically. To obtain the electric balance between the armature and the field magnets, the latter are to be rotated in a reverse direction to the former. Thus if one of them is accelerated, the other diminishes in velocity, and forms, therefore, an automatically governed balance. The electromagnets are turned at half the velocity of the armature. A differential movement is employed in the driving gear, consisting of two cones mounted side by side, one of them controlling the armature and the other the electromagnets. The cones are in contact with a friction pulley or a strap, the tendency of which is to move to the middle of the cones. The strap is brought into communication by means of a rod, either with a special regulator or with a galvanometer, and the swing imparted to the needle causes the strap to be displaced on the cones. The inventor makes one claim for the mode of revolution of the magnets and armature, and for the application of the cones in combination with the galvanometer.—No. 2419. February 16th, 1887. 8*d*.

ELECTRICAL TRANSFORMERS.—*J. G. Statter, West Drayton.*—In order to obtain the greatest possible inductive effect of the primary on the secondary coil in electrical transformers, the inventor makes use of ⊔ shaped pieces, stamped out of thin sheet iron. Two such pieces are insulated on one side of each, and the insulated parts are placed together and formed into a compound plate. Two coils, primary and secondary, rectangular in shape and in winding, are placed one on the top of the other, and bound together with insulating tape in such a way that the compound coil thus formed shall make a rectangle which will just fill up one of the spaces between the two upright projections of the plate. In order to construct the transformer, suppose that the workman holds the compound coil vertically upon its end. With his right hand he places a plate in position, inserting the central projection between the sides of the coil. With his left hand he forces in another plate in the opposite direction, and presses it upon the first plate. Then, with his right hand, he places another plate in the same direction as the first, and so on, alternately inserting plates from either side so that the projections of the plates overlap each other. The inventor makes three claims for this method of constructing the transformer.—No. 7530. May 25th, 1887. 8*d*.

DETECTION OF EXPLOSIVE GASES IN MINES.—*J. W. Swan, Bromley, Kent.*—The apparatus constructed according to this invention is intended for the detection of explosive gases in mines and other places. A chamber surrounds a platinum wire through which an electric current may be sent. The intensity of the glow of this wire affords a sufficient indication of the presence of combustible gases. One form of apparatus designed by the inventor is shown in sectional elevation in the accompanying figure. A is a glass tube, the open ends of which are covered



with discs of wire gauze K. The screwed rings L serve to keep the discs in position. In the tube A is a plantinum wire C attached at its opposite ends to the wires D G. The wires F H are in contact with D G, and are led through the vulcanite cover B to either side of the cylindrical boss I. The wire H is shown in the figure on the nearest side of I, while the wire F emerges from the cover on the side of I furthest away in the figure. Two parallel wires not shown in the figure press on either side of the boss I, and are connected at their other ends to the battery. By turning round the casing B, the emerging wires F H are brought into contact with the wires from the battery, and the platinum wire C is thus switched into the circuit. The current may thus be brought into the wire C, or cut off from it at will by simply turning the whole case. When the instrument is to be used, the tube is closed to the air by placing the finger and thumb against the openings at the ends. The brightness of the wire under these conditions is observed. Then the inside of the tube is left free to the air by the removal of the finger and thumb; the degree of luminosity of the wire indicates the presence of explosive gases, and to some extent the quantity of them. In another form of apparatus, two wires are placed side by side, one of them being permanently surrounded by a glass tube, so as to exclude the outside air, and the other exposed directly to the atmosphere, so that the comparison of their luminosities can be made in one observation. The inventor makes three claims.—No. 3362. March 4th, 1887. 8*d*.

ELECTRICAL PROPULSION OF VEHICLES.—*F. Wynne, London.*—This invention involves certain improvements and developments of former inventions by the same patentee. The carriage is propelled along the road by means of a motor in the vehicle itself. Plates or studs are employed in connection with a closed channel, in which is a main conductor of electricity. The connection of the main conductor with the road or positive contacts is by means of contact makers, each of which carries a suitable armature. The armature is attracted by the magnetic influence of the stud when polarised magnetically. When thus moved the armature makes and keeps electrical connection between the main conductor and the stud as long as the magnetisation of the stud continues. Each road contact is provided with its own contact maker, which works in a space between the lower end of the stud and the main conductor. These spaces may together form a continuous channel, in which the main conductor is carried; or they may be discontinuous spaces, the main conductor being left bare only in these spaces where the contact maker works. The contact maker is most conveniently a strip of copper, and is hinged on an extension of the lower end of the road contact; it is normally held out of contact with the said stud or main conductor respectively by its weight or by a spring, until forced into contact by the temporary magnetic influence. In one arrangement the lower part of the insulated positive contact of soft iron is wound with insulated wire, thus forming a solenoid of high resistance. One end of the insulated wire is connected to the metal of the stud, and the other with one of a second set of insulated earth contacts exposed in the roadway, and with which the vehicle in its passage makes contact. The electromagnet carried on the vehicle is in the form of a star, each ray of which is constituted an electromagnet by being wound with solenoids. The star revolves on an axis parallel to that of the axles of the vehicles. The inventor makes six claims for the combination of the two sets of contacts, and for the construction of the magnets and contacts.—No. 747. January 17th, 1887. 8*d*.

CHEMISTRY.

EXTRACTION OF ALUMINIUM.—*C. Netto, Dresden.*—The process of extraction of aluminium by means of the mutual action of cryolite and sodium is modified by some improvements embodied in this invention. The cryolite is first melted in a crucible together with a suitable proportion of decrepitated common salt. After a complete fusion has been effected, the sodium is introduced by a specially constructed instrument, and placed at the bottom of the crucible. The decomposition is rapid, and in the course of a few moments the whole molten mass must be cast into an iron mould. The aluminium sinks to the bottom in a single lump. The advantages of this method are that the short time allowed for decomposition precludes the possibility of injury to the crucible, that no sodium is burnt on the surface of the molten mass, and that the aluminium is precipitated to the bottom in a single piece instead of being scattered all through the mass. The instrument designed for placing the sodium under the surface of the fused cryolite consists of an iron rod, with a cap at one end, which has a number of perforations in it. Under the cap is a hook to which the piece of sodium is attached. The cap holds the sodium at the bottom of the crucible, but the perforations allow small pieces of it to ascend and combine with the cryolite. In order to prevent explosions, the sodium must be made free from oil by being cast *into* an iron mould, and protected from the air previously to its use in this process. The inventor makes four claims for the method of manufacture and for the instrument.—No. 4228. March 21st, 1887. 11*d*.

PYROSULPHATES OF THE ALKALI METALS.—*H. Baum, Mannheim, Germany.*—The inventor of the present process has discovered that when the hydrosulphates, or molecular mixtures of neutral sulphates and sulphuric acid, are subjected to a comparatively low temperature of 260°C. to 320°C., they break up into pyrosulphates, and liberate water without the formation of any anhydrous sulphuric acid. The mode of manufacture, according to this invention, is as follows: 240 parts of acid sulphate of sodium, or 142 parts of neutral sulphate, and 98 parts of hydrated sulphuric acid, at 66°Bé., are placed in a cast iron retort. The retort is connected with an air pump, and is heated during exhaustion to 260°C. After a fusion, lasting five to eight hours, the resulting mass is cast in plates. A stirring apparatus is introduced into the retort; and a condenser and receiver, connected by a glass tube, are placed between the retort and the air pump, in order that the time of completion of the process may be easily detected. This time is ascertained by the water disappearing from the glass tube. The inventor makes one claim for this process.—No. 4241. March 21st, 1887. 6*d*.

MONOHYDRATED SULPHURIC ACID.—*J. Brock, Widnes.* (*G. Lunge, Zurich.*)—According to this invention, commercial sulphuric acid is concentrated by evaporation in the usual way, until it assumes the form of rectified oil of vitriol. This acid, after having been cooled, is conveyed to a store tank, placed at a higher level than the charging box of the refrigerator. The charging box is made of iron, and is of such a shape that it stretches from side to side across the tank containing the freezing cells. It is divided by vertical partitions into as many divisions as there are freezing cells, and each division is of such a size that its contents, after being blown out, exactly fill one of the freezing cells to a suitable height. The partitions do not quite reach up to the top of the charging box, so that all the divisions may be filled by the supply pipe from the store tank, and their contents may be forced out at the same time by means of compressed air. The row of freezing cells is suspended in an iron frame, and is moved on a travelling crane. The space between two rows of cells is filled with a solution of chloride of calcium, kept at a low temperature. After having been exposed to the freezing tank, the row of cells is lifted out and dipped into warm water, in order to effect the removal of the frozen mass from the sides of the cells. The cells are then tilted out into a spout containing an Archimedean screw, which crushes the frozen mass, and conveys it to a centrifugal machine. In this machine the crystallised, monohydrated acid is separated out from the liquid. The solid mass is scooped out into another vessel, where it is melted and made ready for storage. The inventor makes three claims for this apparatus.—No. 4430. March 24th, 1887. 8*d*.

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MISCELLANEOUS.

COATING SHEETS OF METAL WITH TIN.—*H. Hall, London.*—The object of this invention is to improve the process of coating sheets of metal with tin, terne, or other metal, by preventing all air and moisture from coming in contact with the molten metal. After the plates have been swilled with water they are placed in a bath of hot oil, where the moisture is liberated from them. This bath of oil is placed just above a vessel containing the molten metal, and the oil therein contained is allowed to run over the surface of the metal, in order to protect it from the air. The plates are lifted directly from the bath of oil into the metal, and on their way they are not exposed to the action of the atmosphere. This process minimises the tendency of the plates to oxidise, and the scruff is not so likely to form on the surface of the molten metal. The inventor makes eight claims for the details of the apparatus employed in this process.—No. 704. January 17th, 1887. 8*d.*

CONVEYANCE OF SAND IN PIPES.—*A. C. Henderson, London.* (*P. Bony, Lyons.*)—In most apparatus for conveying sand to a distance by means of pipes, a certain quantity of water is added to the sand, and this mixture is forced by pumps through the pipes. The drawback of this method is that the sand and water wear away the parts of the pumps while passing through them. By the apparatus constructed according to this invention, the pump forces the pure water only, and thus the difficulty of wear is, to a large extent, obviated. The accompanying figure shows the method adopted. Fig. 1 is a transverse section, and Fig. 2 is a longitudinal elevation of the improved apparatus. C is the end of a discharge pipe from a dredging machine having a movable part D F, which can assume the position E F. The sand thus either falls into the receptacle A, or into B, according to the two positions of this movable part. The valves G G¹ are opened alternately to allow the dredgings to fall into A and B. The doors H I in the approach and discharge pipes direct the water under pressure into the vessels A and B according as they are turned on their hinges; and the openings R S T, at the bottom of A and B, are exits for the water. The cylinder K acts as a safety valve when the pressure of the water is too great. Suppose the

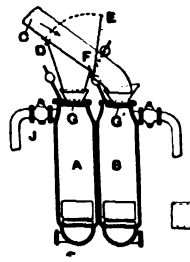


FIG. 1.

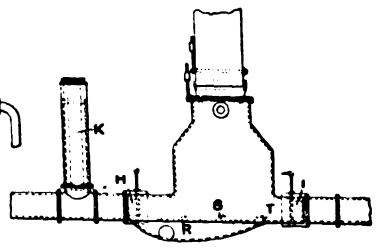


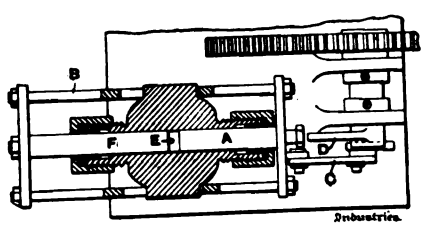
FIG. 2.

sand is directed into the compartment B; when full, the valve D F is changed in position, and the sand is allowed to fall on G¹. The water will be forced by a pump to enter the compartment B through H, and the sand will be discharged through I, while the bulk of the pure water will pass out through the openings R S T. The sand from the dredger will then enter A, and the water therein contained will be caused to overflow through J. The same process takes place with regard to A as happened before in B. These two compartments, and their alternate use, enable the action of the apparatus to be continuous. The same apparatus is applicable to the transport of grain, but in this case the fluid medium is compressed air. The inventor makes one claim. —No. 16596. December 2nd, 1887. 6*d.*

OILING RAGS.—*J. W. Vine, W. Fox, & B. Smith, Leeds.*—The object of this invention is to provide an apparatus for oiling and moistening rags before they are passed into the tearing machine. The apparatus consists of two metal reservoirs placed one within the other, the outer one containing water, and the inner one containing oil. The cover of the oil chamber is finely perforated, so that when the oil is primarily poured into this chamber through the perforated cover it loses most of its solid impurities. The water in the outer chamber is heated by means of a steam coil, in order to liquefy the oil more thoroughly. A series of pipes carry the oil to a long exterior tubular vessel, on the under side of which is a series of fine nozzles for ejecting the oil. A similar tubular vessel also serves as an exit for the hot water. These two series of nozzles side by side distribute the oil and water over the rags in their progress to the tearing machine. The inventors make two claims for this improved oil and water distributor employed for the purpose described.—No. 17653. December 23rd, 1887. 6*d.*

GERMAN PATENT ABSTRACTS.

LUBRICATORS.—*J. Bischoff, Hamburg.*—This lubricator is designed for working against high pressure. F and A are two pistons connected to a frame B, which receives a reciprocating



motion by means of a crank and a connecting rod G. As the frame B is drawn towards the crank shaft, a cam D presses the piston A against F, thereby forcing the oil through E into the cylinder.—No. 41683. April 16th, 1887.

CUT-OFF ARRANGEMENTS.—*C. Hambruch, Berlin.*—This patent relates to an arrangement for cutting off steam, water, or gas mains from a distance by means of a small pressure main. A in Fig. 1 represents a valve casing which is introduced into the respective main, the fluid or gas circulating through P and Q. The cut-off valve B carries on the upper end of its spindle a piston C, while the lower end passes through a stuffing box, and is connected to a weighted lever. The piston C is influenced from the top by the pressure in the pressure main H, and from

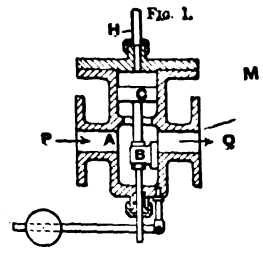


FIG. 1.

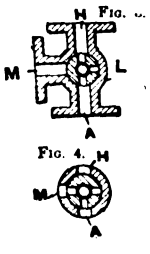


FIG. 3.

FIG. 4.

below by the pressure of the fluid or gas in the main, and these two pressures are balanced by the sliding weight on the lever in such a manner that by cutting off the pressure in H the piston C is forced upwards, thereby shutting Q. The cut-off in H is effected by a three-way cock L shown in Figs. 3 and 4. At M an outlet pipe is arranged through which the water escapes when

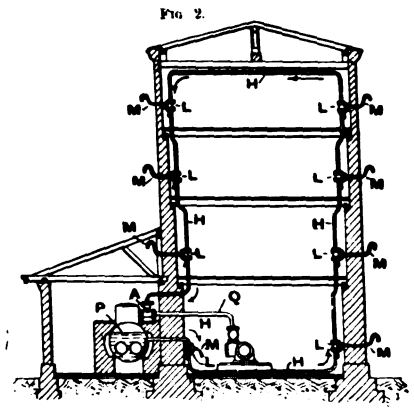


FIG. 2.

the connection between A and H is interrupted. In connection with this arrangement an automatic brake may be used, and L is in that case a four-way cock establishing a communication between A and the brake as soon as H is cut off. Fig. 2 represents the arrangement of this system in a factory for stopping the engine from any storey of the building. P is the boiler, Q the steam pipe leading to the engine, H a small pressure main supplied by the water in the boiler. L are the three-way cocks, M the outlet pipes, and A the valve casing shown in Fig. 1. The steam passes from the dome of the boiler through A into Q and on to the engine. As soon as one of the three-way cocks is turned into the position shown in Fig. 4, the water in H escapes through M, and the communication between P and Q is interrupted in the manner already described.—No. 41784. June 11th, 1887.

UNITED STATES PATENT ABSTRACTS.

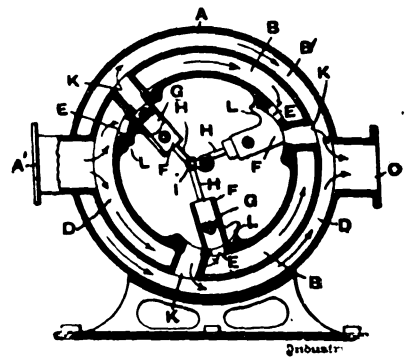
DYEING AND SCOURING MACHINE.—*C. L. Kalander, Philadelphia.*—The dyeing or scouring liquor is contained in a tank, and a shaft is supported in bearings on the opposite walls of the tank at the level of the surface of the liquor. A frame is fitted on the shaft, half of it being immersed in the liquid and half standing above its surface. The frame consists of two circular end pieces, with two concentric sets of rods forming a cylindrical surface between the two end pieces. The skeins of fibre to be treated are stretched between two rods, one in each set, and the whole frame is rotated with the shaft on its bearings. The inner series of rods are adjustable diametrically, so as to adapt the frame to any sized skeins. The outer set of bars are made of a polygonal cross section, and a motion of rotation is imparted to each, so as to gradually turn the yarn. A pin is fixed in the path of these outer bars, in order to give them the intermittent rotation. The inventor makes eight claims for these improvements.—No. 377393, dated 7th February, 1888.

ELECTRIC RAILWAY.—*W. I. Ludlow, Cleveland, Ohio.*—This invention involves an improved construction of the rails used in the electric railroad. A T rail is employed, and is composed of two equal vertical sections, joined at a certain distance apart by means of tie bolts and intervening washers. A space is left above the washers and between the two sections for two non-conducting and insulating strips of india-rubber; and in a cavity between these two rubbers are placed the flat conducting strips of copper. The inventor makes six claims for this arrangement.—No. 377397, dated 7th February, 1888.

EMBROIDERING MACHINE.—*R. T. Smith, Nashua, New Hampshire.* —In this improved machine, threaded vertical shafts and a threaded horizontal shaft engage in threaded recesses in the fabric frame supports, and have gearing mounted on them for their actuation. The movements of the fabric carrying frame are timed and controlled by a perforated sheet or stencil plate having a progressive motion, whereby an electric circuit is made and broken. The reversal of the needle carriages is automatic, and is effected by electromagnetic devices governed by the strain of the threads. The thread tension mechanism is variable, so as to produce designs differing in texture, or so as to produce threads of different sizes. Portions of the fabric may be removed by a punching apparatus automatically and positively actuated and intermittently fed. The distance apart of the cuttings may be varied. The threads are prevented from being withdrawn from the eyes of the needles by a locking device which acts while the threads are in tension. The gripping bars accommodate themselves to needles of any size, and a button hole stitch may be secured at any stage. Duplicate designs can be produced by varying the speed of the mechanism which adjusts the fabrics relatively to the feed of the main controlling element. Tension plates are placed near each surface of the web, whereby the swaying of the web, produced by the strain on the threads, effects through certain levers and electric devices the reversal of each needle carriage. The inventor makes forty-two claims.—No. 377408, dated 7th February, 1888.

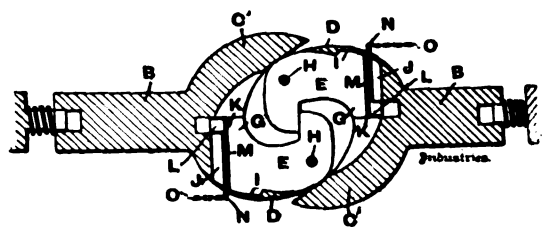
REFINING VEGETABLE OILS.—*G. W. Scollay, New York.*—This process consists of refining vegetable oils and of manufacturing paints in one operation. The oil is treated with any one of the ochres that are suitable as paints. The impurities of the oil are combined with the ochre, and the refined oil is easily separated. Thus a double product is obtained. One claim is made.—No. 377406, dated 7th February, 1888.

WATER MOTOR.—*E. F. Ranks, Lewiston, Minnesota.*—This invention involves a new arrangement of pistons, cylinders, and valves. The whole apparatus is contained in the outer casing A, and the water supply enters at A¹ and leaves at C. The annular spaces B B¹ allow the water to pass to and from the cylinders G. The crank shaft goes through the centre of the casing, and the three piston rods H of the three cylinders G are pivoted directly to the crank pin I. The three cylinders G are placed at an angle of 120° with each other, and are pivoted to the outer casing as shown. At the ends of the cylinders where they slide on the surface of the inner casing are guides L, which



serve to steady them in their oscillations, and to close the entrance ports E when the exhaust ports K are opened. Each cylinder in its movements comes in turn opposite the induction and eduction ports E and K which are provided in the inner casing, and thus the cylinders themselves act as their own slide valves. The course of the water is easily understood by reference to the accompanying diagram. The water enters through A¹ and passes into the annular space B. When the cylinders are in turn placed with their ends opposite the ports E, the water enters them and presses the pistons forwards. On exhaust the water passes back through K into the outer space B¹, from whence it escapes through the outlet C. The inventor makes three claims for this water motor.—No. 376610, dated 17th January, 1888.

CAR COUPLING.—*A. J. McGichee, Jackson, Tennessee.*—The accompanying figure illustrates the form of car coupling designed by the present inventor. The two engaging parts placed on each vehicle are similar in shape but reversed in position, so that any two cars may be joined together. The



drawheads B have two tongues C C¹, and a drawbar E is pivoted at H on the tongue C. The rear edge of the drawbar is bevelled, and the notch K is fixed at its hinder end. The notch K engages with a latch L hung on the drawhead. The tongue C is provided with a shoulder D corresponding and engaging with a vertical shoulder I on the drawbar E. Means are also provided for rotating the drawbar E, in order to couple and uncouple the gearing projections on E. The inventor makes two claims for this form of car coupling, for the combination of the tongues C C¹ with the drawbar E, and for the means of gearing the two parts together.—No. 376482, dated 17th January, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE THEORY OF HOT AIR AND GAS ENGINES.

By G. R. Bodmer.

In a series of articles already published under this head (see *Industries*, Vol. I., pages 630, 656, 681), it was stated that the indicator diagram does not give us all the information we require as to the practical efficiency of a heat engine. It is quite possible, as we shall show, that an engine may waste a large amount of heat for which the nature of the cycle, as given by the indicator diagram, would not account. This is the case, for instance, when heat is escaping by radiation and conduction through the walls of a cylinder, while at the same time it is being communicated to the expanding gas; and if both processes take place at the same rate, the result will be as though no heat had been communicated to the gas, the expansion curve being adiabatic. This is what actually occurs with some gas engines. If more heat is supplied during expansion than escapes by radiation and conduction, then only the difference between the quantity communicated and that abstracted will show itself in the diagram.

We have seen that in a perfect cycle, compression is an essential feature. In practice, no perfect cycle, nor even an approximation to one, occurs in hot air or gas engines. There are, however, advantages of a practical nature, apart from thermal economy, to be gained by compression. With a cylinder of given capacity, a greater quantity of work can be developed by compressing the gas before heat is communicated to it, than when this is not the case. This means that into a given space we get a greater weight of gas with compression than without it, and other things being equal, the work done is proportional to the weight of the working substance used. The thermal economy is not necessarily greater with more compression, the advantage being of an essentially practical character, viz., that to do the same work a

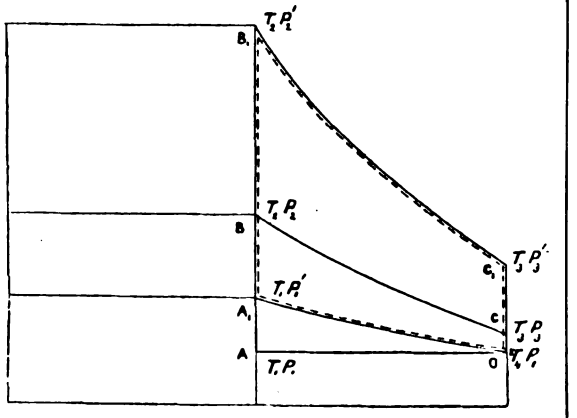


Fig. 1.

smaller cylinder can be used. As an illustration, let us take a practical example. In Fig. 1, ABCD represents an indicator diagram from a hot air engine, working with a permanent gas, having the following cycle: (1) Communication of heat at the constant initial volume V_1 until the pressure and temperature rise from P_1 and T_1 (atmospheric pressure and temperature) to P_2 and T_2 respectively. (2) Expansion adiabatically from the volume V_1 to V_2 the pressure and temperature falling to P_3 and T_3 respectively. (3) Rejection of heat at constant volume V_2 until the pressure and temperature fall from P_3 and T_3 to P_1 and T_1 respectively. (4) Compression from the volume V_2 to the original volume V_1 the pressure remaining constant while the temperature falls from T_1 to T_1. During this operation heat has to be rejected, and although the volume is reduced, as no increase of pressure takes place, compression, in the ordinary practical sense of the term, cannot be said to occur.

The numerical data are assumed to be as follow:—

$$\frac{V_2}{V_1} = 2.$$

$V_2 = 1$ cubic foot.
$V_1 = 0{\cdot}5$ „ „

$P_1 = 14{\cdot}7$ lb. per square inch.
$P_2 = 51{\cdot}45$ „ „ „
$\frac{P_2}{P_1} = 3{\cdot}5$
$T_1 = 460 + 60 = 520$.

If v_1 be the volume of 1lb. of air at atmospheric pressure (air being the permanent gas used), $v_1 = 13{\cdot}088$ cub. ft. at 60° F., then the weight of air used

$$w = \frac{0{\cdot}5}{13{\cdot}088} = 0{\cdot}038\text{lb.}$$

TABLE OF LAWS FOR PERMANENT GASES UNDER THE MOST IMPORTANT CONDITIONS.

J = Joule's equivalent = 772·8 foot-pounds.
T = Absolute temperature = 459·4 + temperature Fahrenheit.

General Formula $H = K_v(T_2 - T_1) + W$.

Nature of process.	Conditions under which it occurs.	Law of expansion.	Work done.	Heat communicated.
Isothermal expansion.	Constant temperature $T_1 = T_2 = T$	$p_1V_1 = p_2V_2$	$W = RT_1 \text{ hyp. log } \left(\frac{V_2}{V_1}\right)$ or $p_1V_1 \text{ hyp. log } \left(\frac{V_2}{V_1}\right)$	$H = W$
Adiabatic expansion.	No heat communicated or abstracted $H = 0$	$p_1V_1^{\gamma} = p_2V_2^{\gamma}$	$W = K_v(T_1 - T_2)$ or $\frac{K_v}{R}(p_1V_1 - p_2V_2)$	$H = 0$
Expansion at constant pressure.	Pressure constant $p_1 = p_2 = p$	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$	$W = p_1(V_2 - V_1)$ or $R(T_2 - T_1)$	$H = K_p(T_2 - T_1)$
Communication of heat at constant volume	Volume constant $V_1 = V_2 = V$	$\frac{p_1}{T_1} = \frac{p_2}{T_2}$	$W = 0$	$H = K_v(T_2 - T_1)$

H = Heat equivalent in foot-pounds communicated or abstracted during process.
T_1 = Absolute temperature at commencement of process.
T_2 = „ „ at end of process.
V_1 = Volume of one pound of gas at commencement of process.
V_2 = „ „ „ „ at end of process.
p_1 = Pressure „ „ „ at commencement of process.
p_2 = „ „ „ „ at end of process.
W = Work done in foot-pounds by one pound of gas during process.
K_p = Specific heat equivalent in foot-pounds at constant pressure = 183·5 } for dry air.
K_v = „ „ „ „ „ volume = 130·2 }
γ = Ratio of specific heat at constant pressure to specific heat at constant volume = 1·408.

By the formula given in the table, we can calculate the value of P_3 the pressure at the end of the expansion

$$\frac{P_1}{P_2} = \left(\frac{V_1}{V_2}\right)^{\gamma}$$

the ratio of the actual volumes is, of course, the same as that of the specific volumes where the same weight of gas is dealt with, hence

$$P_3 = \left(\frac{V_1}{V_2}\right)^{\gamma} P_2$$

$$P_3 = (0{\cdot}5)^{1{\cdot}408} P_2 = \frac{51{\cdot}45}{2{\cdot}653} = 19{\cdot}39\text{lb. per square inch.}$$

$\frac{T_2}{T_1} = \frac{P_2}{P_1}$ the volume being constant, hence

$$T_2 = 520 \times 3{\cdot}5 = 1820°$$

$\frac{T_3}{T_2} = \frac{P_3 \cdot V_2}{P_2 \cdot V_1}$ by the law of Boyle and Charles.

$$T_3 = 1820 \times \frac{19{\cdot}39 \times 2}{51{\cdot}45 \times 1} = 1371°$$

$\frac{T_1}{T_1} = \frac{V_2}{V_1}$ the pressure being constant, hence

$$T_1 = T_1 \frac{V_2}{V_1} = 520 \times 2 = 1040°.$$

The work done during expansion will be:

$$W_1 = wK_v(T_2 - T_3) = 0{\cdot}038 \times 130{\cdot}2(1820 - 1371)$$
$$W_1 = 2221{\cdot}472 \text{ foot-pounds}$$

the work expended on reduction of volume at constant pressure:

$W_2 = P_1(V_2 - V_1) = 14{\cdot}7 \times 144 \times 0{\cdot}5 = 1058{\cdot}400$ foot-pounds

The effective work done is:

$$W = W_1 - W_2 = 1163{\cdot}072 \text{ foot-pounds.}$$

Now, suppose that, instead of reducing the volume at a constant pressure P_1 from V_2 to V_1, we allow the pressure to increase, keeping the temperature constant at T_1; under these conditions, starting from the volume V_2, and compressing to that V_1, the pressure will increase from P_1 to P^1, P^1 being to P_1 in the ratio of V_2 to V_1, or 2 to 1. (*Vide* Fig. 1, ABCD.) If, then, we again communicate heat at constant volume, until the same temperature as before is attained, it is evident that the corresponding pressure will be twice as great, $P^1{}_2 = 102{\cdot}90$. Adiabatic expansion then takes place to the original volume V_1, the expansion ratio being as before. The ratio of initial to final pressure will also have the same value, and, therefore, the final pressure $P^1{}_3$ be double that previously obtained; the absolute temperature T_3 remains unchanged, $T_3 = 1371°$.

The pressure then falls again to P_1, and temperature to T_1, while heat is rejected. The work developed during expansion in this case is:

$$W^1{}_1 = w^1K_v(1820 - 1371).$$

It is evident that the work performed per pound of air has the same value as previously; but the weight of air working in the cylinder has been doubled.

In the first case, we had the volume V_1 at atmospheric pressure and temperature to start with; in the second case, the volume $V_2 = 2V_1$ under the same conditions of pressure and temperature. The work done during expansion, therefore, is, in the second case, twice as great as in the first, with double the weight of the working substance. It is also evident that the quantity of heat communicated at the constant volume V_1 is twice that required previously, the range of temperature being the same, but the amount of air to be heated double.

The work expended in compression at constant temperature T_1 is expressed by the formula—

$$W^1{}_2 = P^1V_1 \text{ hyp log } \left(\frac{V_2}{V_1}\right) \quad P^1 = 2P_1 = 29{\cdot}4 \times 144$$

The hyperbolic log of $\left(\frac{V_2}{V_1} = 2\right)$ is 0·6931

$$W^1{}_2 = 4233{\cdot}6 \times 0{\cdot}5 \times 0{\cdot}6931 = 1467{\cdot}154 \text{ foot-pounds.}$$

As we have shown,

$$W^1{}_1 = 2W_1 = 4442{\cdot}944$$

Hence $W^1 = W^1{}_1 - W^1{}_2 = 2975{\cdot}790$ foot-pounds

It will be noted that the net work done in this case is more than twice as great as in the former, with twice the quantity of heat, which means that a smaller proportion of heat has been rejected, so that in this instance we not only get more work with a given cylinder by compression, but also improve the efficiency of the cycle. The latter effect is due to the nature of the cycle having been altered. If, working between the same temperatures, greater compression be used with the same kind of cycle, then there will be no improvement in the thermal efficiency; but more work will be obtained from a given cylinder.

Generally speaking, the process taking place in a hot air engine is as follows: (1) compression of air, admitted to the cylinder at atmospheric pressure, to some higher pressure, with or without rejection of heat; (2) communication of heat either at approximately constant volume, or during expansion, or both; (3) expansion without further communication of heat; and (4) rejection of heat at constant volume, or during expansion, until the original pressure is reached.

In most so-called hot air engines, the heat to be converted into energy is generated in a furnace of some kind outside the working cylinder, and communicated through the walls of the latter; or the hot products of combustion are admitted into the cylinder, and there allowed to mingle with the working air or gases.

In gas engines, the heat to be converted into energy is produced by the combustion of gas, and in most cases this combustion is so rapid as to constitute an explosion; but this is by no means essential.

The combustion in gas engines, as a rule, takes place within the cylinder itself, and in consequence of this,

Note.—The pressures are given in pounds per square inch, but where they are used otherwise than in ratios, must be multiplied by 144, to express them in pounds per square foot, the unit of measure being the foot.

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a portion of the working gases undergoes a chemical change, which has to be taken into account in calculations regarding the operations of the engine. Generally speaking, however, gas engines can be treated essentially in the same manner as hot air engines.

So far, the cycles referred to have all been closed cycles; in practice, the great majority of heat engines have open cycles. In a closed cycle, the same working substance is used over and over again, and never leaves the cylinder. In an open cycle, at every repetition of the latter, for every working stroke, a fresh charge of the working substance is admitted to the cylinder, and expelled when the cycle is completed. For the purpose of thermo-dynamic

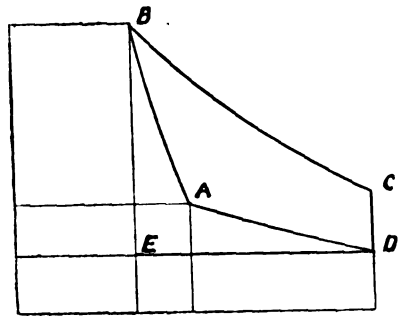


Fig. 2.

investigation, however, the diagrams obtained from open cycles may generally be treated as though they represented closed ones. Take, for instance, the diagram ABCDE, in Fig. 2, to represent an open cycle; the horizontal straight line DE records that part of the cycle during which air or gas is drawn in, and finally expelled at atmospheric pressure. No work (approximately) is required for this—that necessary for overcoming friction does not appear in this place—the pressure of the atmosphere on one side of the piston being balanced by that on the other, so that no further notice need be taken of this part of the diagram. After the air or gas is drawn in, it is compressed according to the curves DA and AB, and expanded according to BC; during all this period communication with the air outside the cylinder is cut off, so that this part of the cycle is a closed one. During the periods AB and BC heat is communicated, that is, during the closed portion of the cycle. When C is reached, communication with the atmosphere is established, and the air or gas in the cylinder blown off until the pressure is reduced to that of the atmosphere, and then the residue is expelled at that pressure, this latter operation being represented by DE.

The work done is measured by the area ABCD, irrespective of whether the cycle be closed or open. We have seen that Work done = (Heat communicated) − (Heat rejected) for a closed cycle; if the two first quantities are the same for an open as for a closed cycle, it follows that the third, the heat rejected, must also be the same. Although, therefore, the rejection of heat in the open cycle takes place practically in quite a different way to that occurring with a closed cycle represented by the same diagram, the net result is identical.

The foregoing table gives a tabular statement of the conditions and formulæ for the most important changes occurring in the state of a permanent gas, which will be useful for reference. All the quantities refer to one pound of gas, and the volumes given are the specific volumes occupied by one pound of gas at the corresponding pressure and temperature. Where the ratios only of the volumes occur, it is immaterial whether the specific or actual volumes are taken; it is often more convenient to make use of the latter.

NOTES ON SCREWING APPLIANCES.

III.

(Continued from page 106.)

In our last article the design and proportions of taps were commented upon, and in the present article an attempt will be made to fully discuss the design and manufacture of screw stocks, screwing machines, and chasers. Before commencing, however, we should remark that two of the illustrations in our last article were incorrectly numbered—Fig. 5 should have read Fig. 7, and inversely. There are three different types of screw stocks now in use, and they may be classed as "guide screw stocks" with three dies, "guide screw stocks" with two dies, and solid screw plates. Two methods of adjustment of the dies are adopted by makers, some preferring to adjust the dies by one of the handles, which serves the purpose of a screw; and others make both the handles and the body of the stock in one piece, and adjust the dies by a screw specially fitted for that purpose. The Whitworth "guide screw stock," the most useful and durable screw stock ever introduced, was designed by Sir J. Whitworth & Co., many years ago, and it is still the best kind of screw stock obtainable (see Fig. 1). The thread cut by this stock is only slightly inferior to that obtained in a slide lathe with a guide screw. The large die is fixed, and is not intended to do much of the cutting, but rather to act as a guide, whilst the thread is cut by one or other of the small dies, according to the direction in which the stock is being rotated; for only one of the

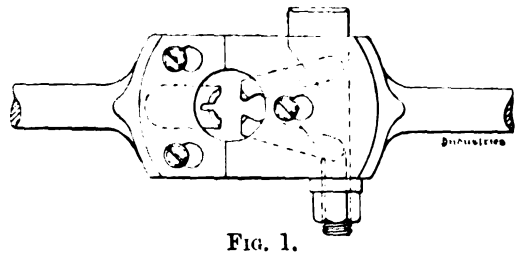


Fig. 1.

small dies can cut during rotation, as will be understood from the illustration. The small dies slide in grooves cut in such a manner that the cutting edge of each small die is always moved forward towards the centre in a radial direction, thereby acting in a manner similar to a chaser fixed on the slide rest of a lathe, so that the cutting edge is just level with the centres. Both inclines of the wedge must be so arranged that each die is moved forward by exactly the same amount, otherwise only one of the dies would cut properly, the other one having little or nothing to do. The stocks are drop-forged, and the handles drawn out under a Ryder forge or small steam hammer—whichever may be found convenient. The handles are then turned, the body shaped to gauge for thickness and breadth, and the slot for the wedge drilled to a case hardened gauge, and drifted out. Then the centre hole and the slots for the dies are drilled out to a case hardened iron template with ordinary drills and slot drilling machines respectively. In the same way, the cover plate and stock are drilled for the cover plate screws, and after the holes are tapped the stock is polished and case hardened. The dies are then fitted by hand, the thread cut by a "full master tap," for reasons given in the last article, and the dies are then finished off by hand, and hardened. This hardening requires no special care, as the pieces are so small that they are only liable to one change in hardening, viz., expansion. After hardening, the dies are ground on a copper wheel to fit their own stock, as the case hardening of the stock prevents the dies being made interchangeable, for the reason that very few stocks expand the same amount, even if made of the same material and hardened at the same time. The alteration in hardening is not

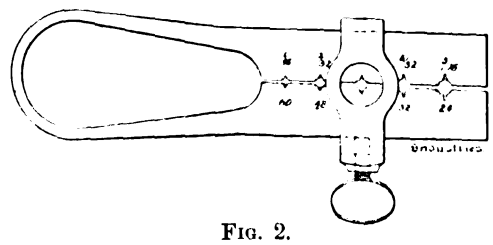


Fig. 2.

even uniform in the same stock, one of the small grooves being nearly always larger than the other after hardening, although shaped out by the same drill. Usually only eight sizes of stocks are made, to screw all sizes from $\frac{1}{8}$in. to 3in. diam.; (1) from $\frac{1}{8}$in. to $\frac{3}{16}$in.; (2) from $\frac{1}{4}$in. to $\frac{7}{16}$in.; (3) from $\frac{1}{4}$in. to $\frac{5}{8}$in.; (4) from $\frac{1}{2}$in. to 1in.; (5) from $\frac{3}{4}$in. to 1$\frac{1}{4}$in.; (6) from 1in. to 1$\frac{1}{2}$in.; (7) from 1$\frac{1}{4}$in. to 2in.; (8) from 2$\frac{1}{4}$in. to 3in. The smallest size is, however, very rarely used, as the thread on the screws it will cut is so small that it is preferable to have fewer loose pieces, and consequently the two-die stock is more frequently used for cutting screws of small sizes; but it is doubtful whether in this case even the two-die stock is equal to the small spring stock shown in Fig. 2.

Spring Stocks.—The action of the spring stock shown is precisely the same as the two-die stock; but it is much more convenient to handle. The threads are cut by a "full master tap," as already described.

Two-die Stocks.—This type of screw stock is the cheapest of all adjustable die stocks, on account of its simple construction; but it is inferior to the three-die stock in every way. A small notch is cut at the centre of each die, and the edges of these notches have to serve as cutting edges, and do all the cutting if the dies have been cut by a "full master tap." The slot is made so narrow to prevent weakening the die that there is not enough room for the cuttings, and the efficiency of the cutting edges is thereby reduced. Again, the notches are so shaped (see Fig. 4) that the cutting edge cannot be sharpened on a grindstone, like the dies of the three-die stock, but must be softened and filed up, and this method involves loss of time, and injures the thread. The cutting edges cannot be made so keen as those of the three-die stock, and, consequently, a longer time is taken to do equal amounts of work. The thread is sometimes cut by a "plug master" tap, and it is obvious that, in that case, as soon as the bolt is screwed down to the size of the "plug master tap," the whole thread surface of the dies hugs the thread of the bolt, and the cutting edges no longer act (see Fig. 3). This is rather an advantage while the dies are new, as it prevents the bolt being screwed too small; but after the dies have begun to wear it is impossible to cut a bolt as small as the plug master tap, and a good deal of trouble is experienced from tight bolts. This difficulty is avoided by some manufacturers by making the plug master taps $\frac{2}{1000}$in. or $\frac{3}{1000}$in. below the standard gauge. In this way the trouble from tight bolts is avoided; but it is an objectionable practice, as

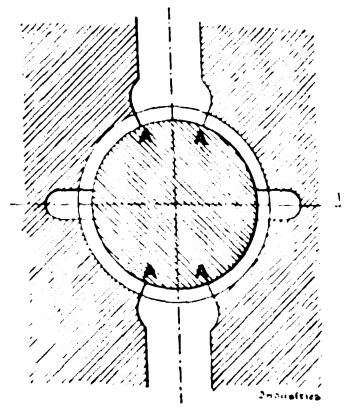


Fig. 3.

the thread traced on the bolt at the commencement of the operation is of a different pitch to that of the finished thread, and the thread is therefore defective at intervals along the bolt. The dies should have been cut with a full master tap; the thread first traced on the bolt would then be of the proper pitch, and the cutting edges would cut as well at the end as at the beginning of the operation (see Fig. 4). In this way it is possible to cut a bolt smaller than the gauge if necessary. The only objection to using a full sized master tap for cutting these dies is that when the thread is nearly finished, some care is required to keep the stock steady on the bolt, and prevent it from getting slightly jammed, for if this occurs —and it is not always easy to prevent it—the dies will cut deeper in that place, and the thread become uneven. The dies in Fig. 3, which were cut by a plug master tap, present a much better bearing surface on the bolt as the thread approaches completion, and on this account are not liable to get jammed, while the thread cut is generally smoother than if a "full master" had been used for cutting the dies. Therefore we have in making two-die

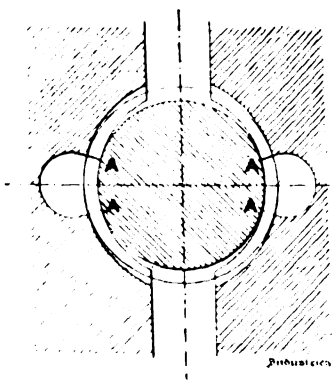


Fig. 4.

stocks to choose between the evils of each pattern, and, all things considered, the dies in Fig. 4 are to be preferred. The screw stock is an imperfect machine at the best, but is nevertheless a very useful one, and its defects appear to be more important than they really are.

The Solid Die Screw Stock.—This is obviously the cheapest stock made, and though it will do for rough work it is not so good a tool as those already described. If there be only one die for each size, the cut it takes in forming a thread is so deep that a smooth surface can hardly be looked for, unless a strong jet of soapy water is directed on the dies whilst cutting; but this defect is obviated by having two or three holes for each size. At the Patent Nut and Bolt Company's Works, Birmingham, solid dies, which cut a full thread at one operation, are largely used, and with very good results. Each die will cut about one hundred gross of bolts before requiring any repairs. The cutting edges cannot be sharpened when dull except by softening and filing the die, but the thread is thus injured by scaling. As there is no means of adjustment, the only way of rectifying the wear of the die is to close it in with the hammer when red hot, and tap the hole again with the

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plug master tap. The dies should never be thinner than the diameter of the bolt to be screwed, and the hole in the die must be tapped a little larger than the standard gauge, to allow for the contraction of the hole in hardening. The grooves should always be made as large as convenient. Three is the most usual number, and it should always be remembered that an odd number of cutting edges causes the die to cut steadier, and turn out better work than if it had an even number of grooves.

Screwing Machines.—These may be divided into three classes, viz.: Machines with revolving die boxes; machines with the die boxes fixed, in which case either the rod or the die box may be arranged to travel during the operation; and machines with solid dies, which may either have fixed or revolving dies, and either the die or rod may travel as the rod is screwed; but the motion of the machine has to be reversed to get the die off the rod when screwed. The first two machines have few faults, and equally good results as regards efficiency and convenience may be obtained with either. The solid die machine is less efficient than either of the others, for the reasons already given, and also because much time is expended and injury done to the dies by reversing the machine and running the dies the opposite way on the rod or bolt. With a well made case hardened die box for expanding dies no trouble is ever experienced from slackness of the die, which is the only argument urged against expanding dies.

Die Boxes.—Formerly four dies were used in the machines for screwing bolts at one operation, and these were moved in and out by right and left hand screws; but it is now the almost universal practice to have only three dies, and to move these forward by means of a cam. This is, however, by no means a new arrangement, as a screwing apparatus of this design is still in existence capable of screwing up to 2½in. diam. bolts, which was made by Whitworth so far back as 1835, and it differs in no way from the designs of other makers, who have since obtained patents for the very same arrangement. Why Sir J. Whitworth's design was abandoned to make way for the four-die apparatus it is difficult to say, but it is a fact

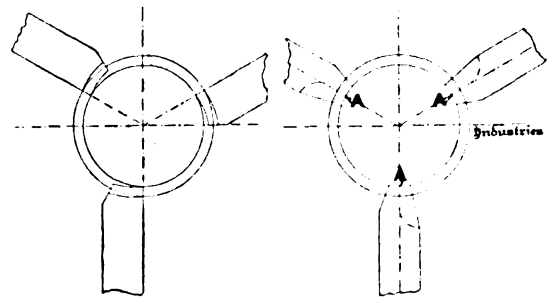


Fig. 5. Fig. 6.

that the idea was first put into practice at Whitworth's works over fifty years ago. Fig. 5 shows the best arrangement for a three-die screwing apparatus; the face of each die is a radial line, or even more acute, like a turning tool, to render the work easier, and the groove in which the die moves is arranged in such a manner that the cutting edge always moves along the same radial line, and thus is always in the proper position with regard to the rod, no matter what distance it is from the centre. This may appear a very trivial matter; and as all screwing machines are now made to "screw a full thread at one operation," it may seem unnecessary that the cutting edge of the die should move always along the same imaginary radial line. But such is not the case; for if the die box be constructed as shown in Fig. 6 (and one eminent firm has done this for years), with the cutting edge in advance of the radial, parallel to the motion of the die, it follows that no bolt can be screwed below the standard size, or even so small as the standard size, after the dies are a little worn. The reason is that if the dies were moved forward to screw a slightly smaller size, the bolt would rub on the centre of the thread at the point A, and the cutting edge would not be in contact with the work at all. It is thus impossible to screw a bolt below the gauge with this arrangement, in case the dies have been cut by a plug master tap; and if a full sized master tap were used for cutting the dies, the apparatus would scarcely work at all. In the construction, as shown in Fig. 5, either of these taps may be used for that purpose, although the plug master is the proper one to use. This defect has been remedied by using a tap smaller than the gauge for cutting the dies in Fig. 6; but by far the best plan would have been to grind away the die to the dotted line shown in Fig. 6, and when making new die boxes to move the slot a little further back, as this is the only difference in the two arrangements.

Depth of Dies.—The depth of dies, that is, the number of threads, is an arbitrary feature. In screw stocks the depth of die is generally a little less than the diameter of the bolt, and the thread is not tapered at either top or bottom of the die; but dies for screwing apparatus which have to cut a full thread at one operation, vary from 2½ diam. to less than 1 diam. in depth. For instance, the dies for cutting ¼in. screws are ⅝in. deep; for 1½in. screws, 1⅜in. deep; while for 3in. screws they are only 2¼in. deep, and the first five or six threads are tapered, the first thread being almost completely removed.

(To be continued.)

NOTES ON FOUNDRY WORK.

By the Author of "Pattern Making."

(Continued from page 133.)

XIII.

The Shrinkage of Castings.—For several years it has been my practice to note down for my own private instruction and guidance, sundry notes relative to the shrinkage and buckling of castings. Having had abundant facilities for doing this, as part of my ordinary duties, I have collected a large amount of data relating to iron castings moulded in dry and green sand, to cast steel, and to tough gun metal, as ordinarily used by engineers. From these I will select a number of typical examples.

It is, sometimes, not an easy task to satisfactorily decide the allowance for contraction, or the provisions against possible curvature in cooling, and the only way of doing either with a degree of accuracy is to profit by past experience. In proportioning similar, but not identical, parts, great judgment ought to be exercised, since it is surprising how a slight alteration in the disposition of metal, and the conditions of cooling, will sometimes affect the ultimate result. General rules may be safely deduced; but beyond these, the proportioning of each piece of work must be decided by its individual characteristics, and as a matter of judgment. Since appearances and deductions therefrom are often deceptive, owing to the swelling of the mould, and to rough and clumsy ramming, rapping, and mending up, I have observed special care in selecting these examples, giving only those furnished by the best, truest, and cleanest castings, made under the most favourable conditions of moulding, and preferring also horizontal to vertical measurements, since metal is more liable to "gather" or increase in thickness than in width, on account of the pressure of the molten metal, and the springing and lifting of the boxes. Since rules slightly differ occasionally, I have always used the same rule for measuring both patterns and castings. Figs. 86 to 97 represent useful types of castings in ordinary iron. The pattern maker's contraction rule gives an allowance for shrinkage of ⅛in. in 15in.; but this is only approximately correct, as will be shown further on. In the centre piece for a turntable of 50ft. diam. (Fig. 86), the shrinkage at A, 3ft. 9in. diam., was barely ⅛in., and that at B, 3ft. 11in. deep, the same. This is a very small amount; but it was a stiff, heavy casting, made in dry sand, and had to shrink around a hard, unyielding central core. Castings in dry sand and in loam usually contract rather less than those made in green sand. The latter yields more to the shrinking metal, and slightly chills the exterior of the casting, causing it to shrink suddenly, compressing the interior mass. Hot iron possesses the power of accommodating itself to some extent to the resistance of hard baked cores. Founders know this, but they also know that there is a limit to this power of accommodation; and that weak castings will fracture rather than yield—the poorer the quality of the metal is, the more readily they crack. Once I saw a 4ft. branch pipe, ¾in. thick, cast on end, fractured for a distance of 1ft. or more downwards from the top, because the dry, bricked up core was not removed on the night of casting, but left until the next morning. Hence in weak cylindrical castings, whether large or small, and in all cylinders of large diameter cast in dry sand or loam, it is quite necessary to dig out some portion at least of the core, while the metal is at a red heat. In loam moulds, loam bricks are commonly inserted for this purpose, four vertical layers of brick being inserted equi-distantly between the common bricks, and these loam bricks are broken up with the crowbar soon after the metal has set. In cases where the metal is of sufficient thickness and strength, the loam bricks will yield to the shrinkage. In casting light pipes, the core bars are drawn out as soon as the metal has solidified. In the particular casting shown in Fig. 86, the mould was made of dry sand, and the shrinkage was in a large degree stayed by the hard central core, which remained undisturbed until the casting was quite cool. As the core portion was large in relation to the bulk of the casting, and the latter was strong, the shrinkage was diminished without risk of fracture, especially as the metal used in casting consisted of a mixture of strong iron, which contracts less than the softer and more open metal. Lastly, metal which is cooled slowly shrinks somewhat less, forming larger crystals than that which is cooled rapidly, and in a dried mould the cooling and shrinkage are more equable than in a green sand mould permeated with moisture. To these causes collectively I attribute the exceptionally slight amount of shrinkage of the casting shown in Fig. 86.

The fact of the contraction in the vertical direction being slight or altogether absent in castings of which Fig. 86 may be taken as a type, and also in all shallow or plated work, if judged by comparative measurements of pattern and of casting, has induced a general belief that there is little or no vertical shrinkage. When unimpeded by the presence of cores, and when the mould is not "strained," that is, when the liquid pressure does not lift the cope, or press down the yielding sand, the shrinkage of metal is doubtless the same in the vertical as in the horizontal direction. Fig. 86 is an example of a rather shallow casting, which showed little shrinkage in the vertical direction. I may here also give as an example the case of a solid block of iron, used as a balance weight, and measuring 2ft. 11in. by 13in. by 22in. deep, in which the pattern and casting measured precisely alike. As there were no cores, and as the blocks—there were four of them—were cast in green sand, the absence of shrinkage must be due to the mould straining. But as a proof that castings do shrink the average amount in the vertical direction, I give my measurements of a hydraulic cylinder. It was 11ft. 2¾in. long by 18in. outside diameter; the thickness of metal was 2in., and it was cast on end. The total vertical shrinkage was 1 $\frac{3}{16}$in., or about ⅛in. in 14in., or scarcely different from the normal amount. But here everything favoured contraction, and the area at top and bottom was so small relatively to the length that little straining action could occur. Taking the casting (Fig. 87) as an illustration of conditions very different from those in Fig. 86, we have a confirmation of the inferences just deduced. This ring was cast in green sand, and cooled in the sand, without any part of the mould being removed. The green sand being loose and open, in comparison with the core in Fig 86, offered no resistance to the contraction of the massive ring, and the shrinkage at A was $\frac{7}{16}$in. in 3ft., or ⅛in. in 10in. The metal was not so tough as that in the previous case. Fig. 88 is an example of a similar type of casting. It is an internal toothed wheel, and moderately heavy, and there is only the body of green sand in the central space. Consequently, the contraction in this case was also large, being ⅝in. in 4ft. 5in. at A, or ⅛in. in 10⅝in. The ring of the section shown in Fig. 89 has a diameter of 12ft. 4in. at A, and shrunk 1¼in., or ⅛in. in 14¾in. The section of this ring is very light proportionately to the diameter.

The casting shown in Fig. 90 differs but slightly in proportion from Fig. 88, but the contraction at A was fully $\frac{5}{16}$in. in 3ft. 7½in., being about ⅛in. in 17in., or very much less than that in Fig. 88. Fig. 90 represents a cog wheel of 1⅝in. pitch, which was cast in green sand of good iron. The only marked difference between Fig. 90 and Fig. 88 is that the former has a central boss connected to the rim by six arms of T section. A wheel of identical section, but of slightly different dimensions, having 1⅞in. pitch instead of 1⅝in., as in the last example, shrunk a little less. The diameter at A was 4ft. 6 $\frac{7}{16}$in., and the total contraction amounted to $\frac{7}{16}$in., being about ⅛in. in 16in. These examples show that the presence of arms or ribs retards contraction. It is not very easily explained why this should be the case; but it is nevertheless certain that the presence of straight arms in any casting, whether wheel, bed plate, or frame, diminishes contraction. I venture to suggest the following explanation: There is more metal in a wheel with arms than in a ring, the bulk of the metal being in the boss. The comparatively light ring has a large area exposed to the chilling influence of the sand, and radiates heat outwards, thereby cooling rapidly. But while cooling it is prevented from shrinking to its full amount by the arms and boss, which have a higher temperature, and have consequently not shrunk so much as the rim. There is a certain tension in the arms and boss after they have ultimately shrunk to their full extent, because the rim has by that time set too firmly to yield to the inward pull. In this way contraction is retarded throughout. The shrinkage of engine cylinders depends upon their size. That shown in Fig. 91 was cast in dry sand, and shrank more than was anticipated. Length A shrunk $\frac{1}{16}$in. in 3ft.; B ⅛in. in 2ft. 3⅛in.; and C barely ⅛in. in 1ft. 11in., these figures giving a shrinkage of about ⅛in. in 12in. In small cylinders ranging from 7in. to 10in. in diam., the shrinkage is almost inappreciable, so that it is quite safe to allow for only one half of the contraction given by the ordinary rule. This slight shrinkage may be attributable to the fact that they are cast in dry sand, of strong metal, and that they enclose numerous cores. But the larger the cylinder, the larger becomes the shrinkage proportionally, since the metal is relatively less, and the enclosed cores offer less relative resistance to shrinkage. The contraction of pipes and columns lengthwise is quite that given by the pattern maker's rule, there being nothing to set up resistance. In the two examples illustrated in Figs. 92 and 93, the shrinkage was in the first case 1⅝in. in 12ft. 6in., or ⅛in. in about 13⅝in.; in the second, 1 $\frac{1}{16}$in.

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NOTES ON FOUNDRY WORK.

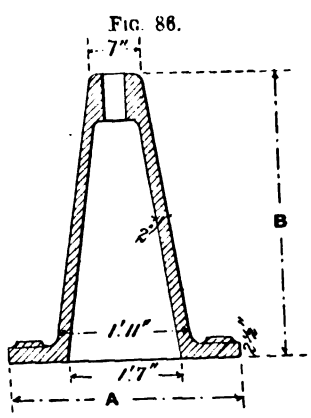


Fig. 86.

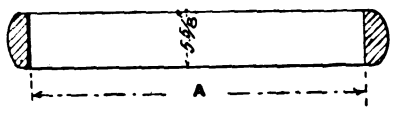


Fig. 87.

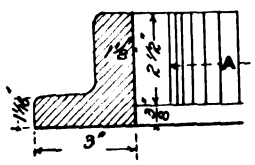


Fig. 88.

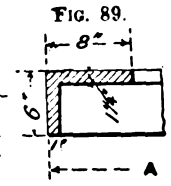


Fig. 89.

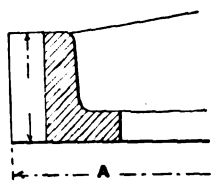


Fig. 90.

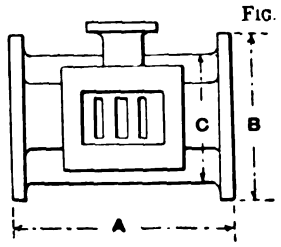
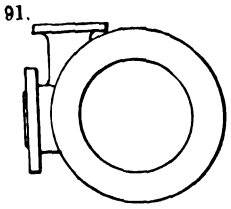


Fig. 91.



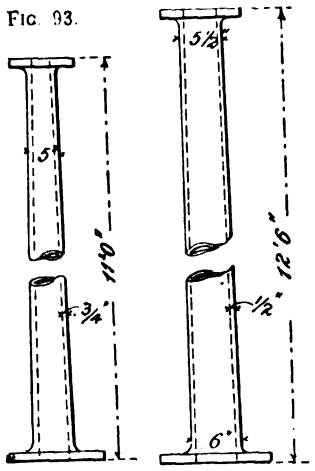


Fig. 92.

Fig. 93.

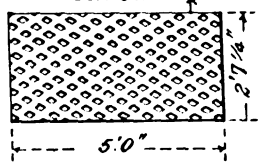


Fig. 94.

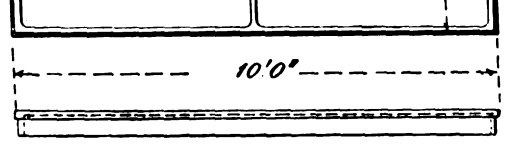


Fig. 96.

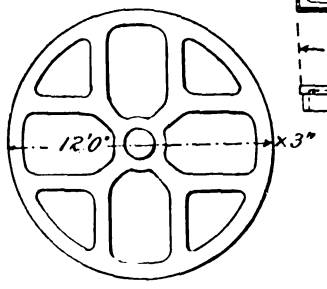


Fig. 95.



Fig. 97.

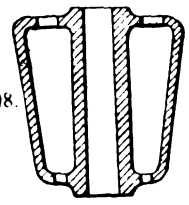


Fig. 98.

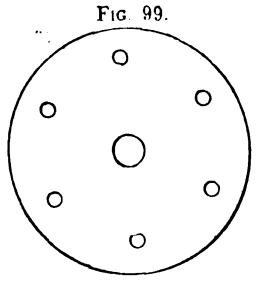


Fig. 99.

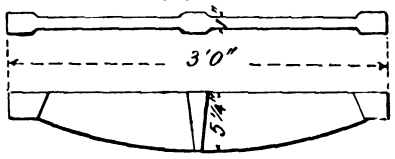


Fig. 100.

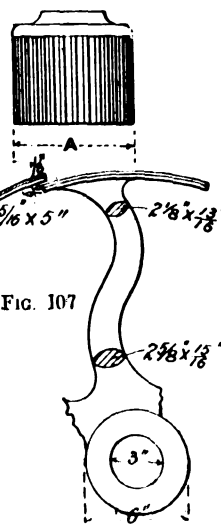


Fig. 101.

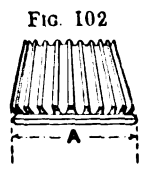


Fig. 102.

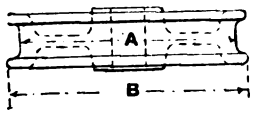


Fig. 103.



Fig. 104.

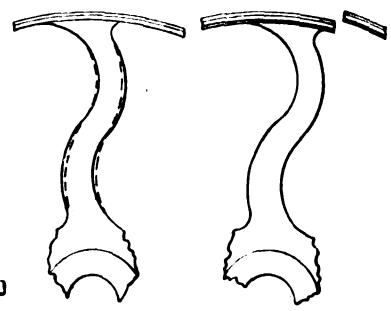


Fig. 105.

Fig. 106.

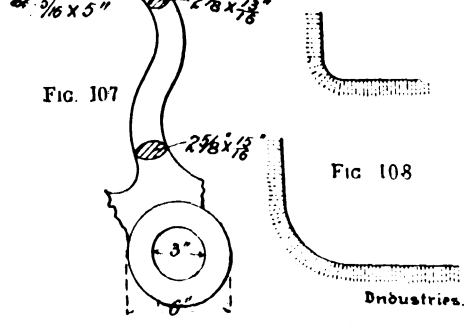


Fig. 107.

Fig. 108.

Industries.

in 11ft., or $\frac{1}{8}$in. in about 15$\frac{1}{2}$in. As bearing out the deduction that mass slightly reduces shrinkage, I noted that a column with $\frac{3}{4}$in. metal shrunk rather less than one with $\frac{1}{2}$in. metal. Taking similar examples: An 8in. pipe, 9ft. $\frac{1}{4}$in. long, with $\frac{1}{2}$in. metal, shrunk 1$\frac{1}{8}$in., or exactly $\frac{1}{8}$in. per foot. A fluted column, 11ft. 3$\frac{1}{2}$in. long, 8in. outside diameter, having $\frac{3}{4}$in. of metal under hollow of flutes, shrunk 1$\frac{5}{16}$in., or about $\frac{1}{4}$in. in 13in. A short pipe, 4ft. 8in. long, 4$\frac{3}{4}$in. core, $\frac{5}{8}$in. metal, shrunk $\frac{1}{8}$in., or $\frac{1}{8}$in. in 1ft. 2in. I have measured many pipes and columns, both large and small, and these are average examples of results which show general uniformity. The contraction of plain plates is about that given by the rule. Fig. 94 is a chequered foot plate $\frac{1}{2}$in. thick, and the contraction both in length and width was $\frac{1}{8}$in. in 15in. A packing block measuring 1ft. 11$\frac{5}{8}$in. by 14$\frac{1}{2}$in. by 1$\frac{3}{4}$in. thick, shrunk at the rate of $\frac{1}{4}$in. in 20in. Again a plain oblong plate, 4ft. by 2ft. by $\frac{5}{8}$in., almost identical in size with Fig. 94, shrunk $\frac{7}{16}$in. in length, and barely $\frac{1}{4}$in. in width, or about $\frac{1}{4}$in. in 1ft. 2in. A common tank plate, 4ft. square, $\frac{7}{16}$in. thick, shrunk $\frac{7}{16}$in. each way, or about $\frac{1}{8}$in. in 1ft. 2in. A plate 3ft. 6in. by 3ft. 8in. by 1in., shrunk $\frac{1}{8}$in. in 15in. A boiler maker's levelling block (Fig. 95), intended for putting together some turntable framings made of channel iron, contracted $\frac{1}{8}$in. in 18in. The casting in this case was 3in. thick. The block illustrated in page 368, Vol. III. (Fig. 41), which was 6ft. 1in. long by 4ft. 6in. wide by 3$\frac{1}{2}$in. thick in the plate itself, and having ribs 5in. deep, shrunk $\frac{1}{8}$in. in length and $\frac{3}{8}$in. in width, or about $\frac{1}{8}$in. in 18in. Though below the normal rate, this was rather more than I expected in this massive casting; but the numerous small round cores probably facilitated shrinkage. A marking off table (Fig. 96), 2in. thick in the plate, and having ribs 4$\frac{1}{4}$in. deep, shrunk $\frac{1}{16}$in. in a length of 10ft., and $\frac{5}{16}$in. in a width of 3ft. 6in., or about $\frac{1}{8}$in. in 16in. An angle piece of the section shown in Fig. 97, 8ft. 3$\frac{1}{2}$in. long, shrunk $\frac{3}{4}$in., or $\frac{1}{8}$in. in 16$\frac{1}{2}$in. Many similar instances might be given, but enough has been stated to indicate where maximum and minimum shrinkage is to be anticipated, and allowance should be made accordingly.

Chilled castings, and castings made of hard white iron, shrink very much, subject, however, to modifying influences. Fig. 98 is a coned roller, chilled on the conical surface. This shrank $\frac{7}{32}$in. in 11$\frac{3}{4}$in., or $\frac{1}{8}$in. in about 7in. Fig. 99 shows a thin plate 2ft. in diameter, chilled on face and edge, which contracted only $\frac{1}{4}$in., or $\frac{1}{8}$in. in 12in. But in Fig. 98 the chilled surface was large relatively to the size of the roller, and was so situated that the contractile influence of the cold chill acted at once throughout the thin wall of metal. Hard white iron is highly contractile. This must not be confounded with strong iron like that used in Fig. 86, and for engine cylinders, which shrinks least of all. The fire bar (Fig. 100) shrunk $\frac{1}{2}$in. in length, being $\frac{1}{8}$in. in 9in., or nearly twice the normal amount.

The contraction of steel is very different from that of iron, and I have made numerous notes of its behaviour, from which I select a few illustrations. My knowledge has been obtained by comparing the dimensions of castings with those of patterns which I have sent to various steel works, and I conclude that steel contraction is generally about three times that of iron. For crucible cast steel, from $\frac{3}{16}$in. to $\frac{5}{16}$in. per foot may be taken as a fair average allowance, varying with the nature of the casting. In a spur pinion (Fig. 101) of 12in. diam., the shrinkage at A was $\frac{3}{8}$in. In a pinion of a similar kind 2$\frac{1}{4}$in. pitch, measuring 10$\frac{3}{4}$in. at extreme diameter A, the shrinkage was $\frac{9}{32}$in. In another of 3$\frac{1}{2}$in. pitch, measuring 13$\frac{7}{8}$in. over all, the difference in pattern and casting was barely $\frac{3}{8}$in. In a bevel pinion (Fig. 102) the result was about the same, the shrinkage at A being $\frac{1}{4}$in. in 10in., and I found that the difference in diameter of this same pinion when cast in iron and in steel was $\frac{1}{4}$in., the iron showing really no contraction, which again corroborates my previous remarks as to mass diminishing shrinkage. Similar examples go to prove that while heavy iron castings contract less than light ones, heavy steel castings shrink to the maximum amount. In trolly wheels the metal is less in mass than in the pinions in Figs. 101 and 102, and they shrink proportionately less. Thus, taking several wheels of the outline shown in Fig. 103, the shrinkages were as follow: One 18in. in diameter at A contracted barely $\frac{3}{8}$in.; one, 21in., just $\frac{3}{8}$in.; another, 18$\frac{3}{4}$in., $\frac{3}{8}$in.; one, 2ft. 6$\frac{9}{16}$in., $\frac{5}{8}$in. Across the flanges B the shrinkages were in 19$\frac{3}{8}$in., $\frac{3}{8}$in.; in 22$\frac{1}{16}$in., $\frac{7}{16}$in.; in 20$\frac{7}{8}$in., $\frac{1}{2}$in.; and in 2ft. 8$\frac{1}{2}$in., $\frac{11}{16}$in. Two plated cog wheels of 2$\frac{1}{8}$in. pitch gave respectively $\frac{1}{2}$in. of shrinkage with 20$\frac{5}{8}$in. diam., and $\frac{7}{16}$in. with 19in. A turntable cap (Fig. 104) shrunk $\frac{9}{16}$in. in a diameter of 2ft. 2$\frac{1}{4}$in. A short casting of girder section, averaging about $\frac{1}{2}$in. thick, shrunk only $\frac{5}{32}$in. per foot—or about half that of Fig. 101.

The contraction of gun metal I have found to be so nearly uniform in castings of various shapes, that I may state that $\frac{1}{8}$in. in 10$\frac{1}{2}$in. will be an accurate average allowance in almost every instance. Sometimes, as in heavy castings, the shrinkage will be found rather less; but it is seldom, if ever, more. I will give a few examples without illustrations. A ring 16in. in diameter, having a cross section of 3in. deep by 1$\frac{1}{16}$in. thick, shrunk $\frac{3}{16}$in.; a hollow plunger, 13in. long by 3in. diam., shrunk fully $\frac{1}{8}$in. in length; a plated sheave pulley, 10$\frac{1}{2}$in. diam. over rim by 2in. wide, shrunk $\frac{1}{8}$in. in diameter; but a heavy worm wheel blank, 15$\frac{5}{8}$in. diam. on the central plane, shrunk only $\frac{1}{4}$in. in all; various facing pieces of different lengths, some straight and some curved, used for penstock doors, all shrunk uniformly $\frac{1}{8}$in in 10in.

Some experience of the changes of shape which castings undergo by reason of shrinkage strains is necessary, in order to proportion them correctly. I have seen numerous massive and very strong looking castings fracture during cooling, or a long time afterwards while lying in the yard untouched, or while being machined; the reason being that excessive contraction in one portion had put adjacent parts into a condition of great tension. By putting an excess of metal into some vulnerable point of a casting, is introduced an element of weakness and almost a certainty of its breaking by reason of the internal shrinkage strains. It is not the excess of metal in itself which gives rise to these strains, but the position in which it is placed relatively to other sections. Thus a lump of metal cast in juxtaposition to a thinner portion will not break the latter, so long as it is able to shrink freely upon itself. But if placed between two thinner portions, it may fracture them by its shrinkage. Hence the great aim is to so design castings that all portions thereof shall cool down with approximate uniformity. A founder learns much from the behaviour of cast iron pulleys and light wheels. As they are so light and weak, proportioning must be correctly observed, and when customers ask for a "good strong boss" or "strong arms," the request is one which, if complied with in the manner desired, that is, by unduly increasing the metal, will either fracture the pulley or wheel, or bring it near to the breaking limit. In all castings "strong" is a relative term, that form or size being strongest which harmonises as regards general proportions. In a light pulley three different conditions may exist: (1) All parts may cool down alike or nearly so; (2) the rim may cool long before the arms and boss; (3) the arms and boss may cool before the rim. In the first case, the pulley will be strong and safe. In the second, the rim in cooling will set rigidly, but the arms and boss will continue shrinking, each arm exerting an inward pull on the rim, and various results may follow. First, the strain may simply cause the arm to straighten, as shown by the dotted lines in Fig. 105. Or in less favourable conditions, and especially if straight arms, or arms but slightly curved, be used, the arms may fracture near the rim, but seldom near the boss. Or if the rim be weaker than the arms, fracture will take place as shown in Fig. 106. Or the pulley may be turned and then break, as shown in Fig. 107. In the third case, the arms and boss cool-

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ing before the rim, they are compressed by the shrinkage of the latter, and the arms may then become fractured if curved; or, if straight, may prevent the rim from coming inward, and so break it. In most cases fracture occurs from the mass of metal in the boss. As a single instructive example out of many, I may quote that of a pair of 2ft. 6in. pulleys, fast and loose, which had been running for several years. The fast pulley had a boss 6in. in diameter, the loose pulley one of 5in. only, and both were bored to 3in. By the accidental falling of a bar of iron both were broken. The rim of the fast pulley at once assumed the position shown in Fig. 107, being pulled in, while the loose pulley remained level at the point of fracture. This illustrates the presence of tension in the rim, due to the larger boss, and this tension had been present since the pulley was made. The pulley with the 5in. boss was probably much stronger than that with the 6in. boss. In fast pulleys and in wheels keyed on, the necessary strength around the keyway may be obtained by the use of keyway bosses, without increasing the entire diameter. Where large bosses are unavoidable, as in some deep double armed pulleys, or in spur wheels keyed on to large shafts, shrinkage is assisted by opening out the mould around the bosses, and removing the central core, thereby accelerating the radiation of heat, and further by cooling them with water from a swab brush when at a low red or black heat. Many a casting is saved in this way. Another method is to split the boss with plates, and bond or bolt it together afterwards. When casting fly wheels with wrought iron arms, the rim is first cast around the arms, and allowed to cool nearly down before the boss is poured. If the latter were cast at the same time as the rim it would set first, and, by preventing the arms from coming inwards, would put tension upon the rim.

Where aggregations of metal occur in castings, they may, if the castings be too strong to fracture, cause an evil of a secondary character, known as "drawing;" in other words, the metal is put into a condition of internal stress, and becomes open and spongy in consequence. "Feeding" tends to diminish this evil; but much can often be done by lightening the metal with cores, chambering out, or reducing the metal massed in certain places by other means. There is a difference in the behaviour of cast iron and of gun metal, of which advantage may be taken in small light castings. Designs which will not stand in cast iron or steel, will stand in gun metal, hence the latter may be useful in cases of difficulty.

Sharp angles very often lead to fracture. The difference in strength between the large and small hollows in Fig. 108 would be probably equivalent to five or six times the amount of metal in the larger hollow distributed over the surface area of a casting, for the actual amount of metal in a hollow is very small. When brackets, ribs, lugs, &c., are cast on work, the corners should never be left square or angular, for if there be much disproportion of metal, fracture will almost certainly commence in the angles. The use of hollows, though apparently so simple, is really of vital importance.

I have already alluded to the "straining" which large plated and heavy castings undergo, so that the sides and faces increase in dimensions, becoming also more or less rounded. The plate (Fig. 96), 3ft. 6in. wide, was, when cast, $\frac{3}{8}$in. wider in the middle than at the ends, and the face, crosswise, was $\frac{1}{4}$in. rounded, notwithstanding that the face was cast downwards. The same thing is always more or less noticeable in frames of the type illustrated on page 268, Vol. III. (Fig. 25). This may be due partly to the resistance of the cores enclosed by the sides; but the main reason is, I think, that the metal round the central portions does not cool so rapidly as that at the sides. The outsides radiate heat quickly, and shrink to their full extent; but the middle rib or ribs and the central portions of the plate retain their heat longer, and hold the sides in a condition of tension, thus forcing them to bulge or become round. When the central portions cool, the outsides are too rigid to yield to the inward pull. This refers to framed hollow work. When plates "gather" or increase in thickness, this is due mainly to the lifting of the cope, due to insufficient weighting. When a cubical mass of metal shows no shrinkage, this is due to the pressure of the entire mass compressing the sand on every side.

Briefly stated then, in deciding the proper contraction allowance for a pattern, I should take into consideration its mass, the manner in which it is moulded and cast, the presence or absence of cores, and the nature of the same, its general outline, and the character of the metal. For a heavy solid casting in iron, I should allow considerably less than the normal contraction for iron; for a similar casting in steel, more than the normal contraction for steel; for a heavy casting in gun metal, less than the normal contraction for gun metal. The precise allowance in any case must be regulated by circumstances. For the vertical depth of a shallow casting, very little shrinkage, if any, should be allowed; for a deep casting, the full amount. Then again, a mould with dry sand cores of moderate or large size will not allow the casting to shrink so much as if the cores were of green sand, or were altogether absent. For hard and chilled iron, the shrinkage will be at its maximum; for strong mottled iron, at its minimum; and for common grey metal, at about the average.

(To be continued.)

IMPROVED DISCS FOR HEATING AND COOLING PURPOSES.

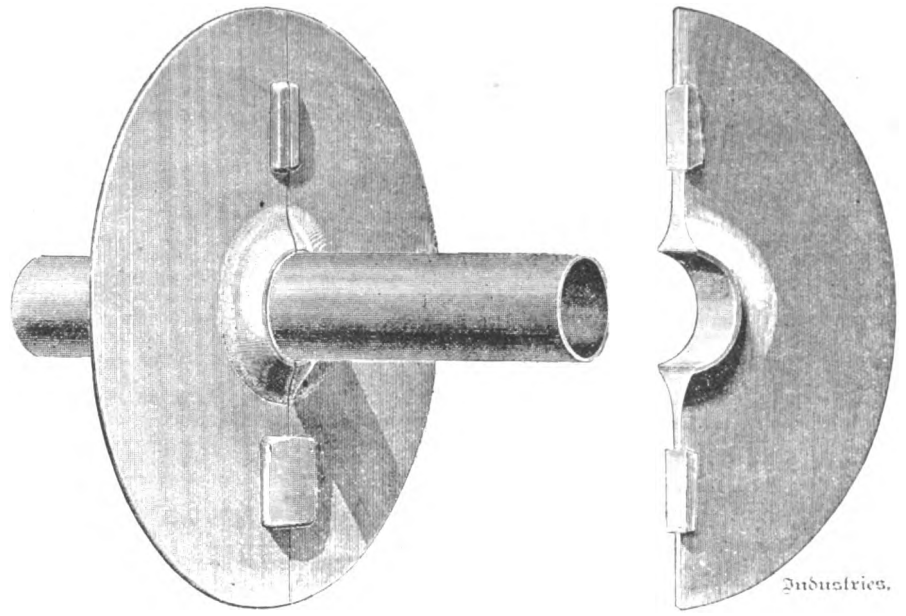


Fig. 1. Fig. 2.

IMPROVED DISCS FOR HEATING AND COOLING PURPOSES.

We are indebted to our American contemporary, *The Iron Age*, for the accompanying illustrations representing an improved form of "gills" or discs, which are intended for attaching to pipes in order to increase their cooling or heating surface. Fig. 1 represents the disc attached to the pipe, while in Fig. 2 half of the disc is shown detached from the pipe. The connection between the two halves is made in the following manner: On each half disc lugs are cast on, which project laterally on both sides, and have slightly inclined sides. When the two parts are put together, as shown in Fig. 1, these lugs correspond exactly, and by slipping an iron cap over each pair of lugs, as shown in the lower part of Fig. 1, a firm connection is effected. The pressure which may be exerted by means of the wedge-shaped lugs and caps is sufficient to keep the discs in position on the pipes. The efficiency of these discs is shown by the fact mentioned by the De La Vergne Refrigerating Machine Company, that by applying them to the cooling pipes, one lineal foot of pipe is now sufficient instead of 4ft. formerly necessary. A corresponding effect may of course be obtained in increasing the heating surface of pipes. We understand that these discs are made in three sizes, two round ones of 10in. and 14in. diam. respectively, and one of oval shape 10in. by 5in., in order to accommodate them to the space available.

THE DYNAMITE GUN.

Lieutenant A. H. Woolley-Dod, R.A., contributed to the Proceedings of the R.A. Institution an interesting paper on the pneumatic dynamite torpedo gun. A full description of this gun and its successful trial last year will be found in this paper, together with some general remarks which are of interest at the present time. It is pointed out that the gun is now a smooth bore, and the projectile is so long and so low in density that, according to Professor Greenhill's formula, the very rapid twist of one turn in 11 calibres would be required if rifling were attempted. This would severely try the thin walls of both shell and gun, added to which the high angular velocity would give an additional shock to the bursting charge, and the heat developed by friction would be a source of danger. Notwithstanding these difficulties, experiments are to be carried out to see how far rifling is possible. An interesting account is given of the electrical firing arrangements substituted for the percussion fuses which had at first been tried, but with unsatisfactory results. There are two batteries in each shell, one a wet one which is kept charged, the other a dry one, brought into action by being moistened. They are joined in series in a circuit in which is also included a piece of fine platinum wire, surrounded by gunpowder. The wire is placed at one end of a cylindrical capsule, the other end of which contains fulminate of mercury. The detonation of the latter detonates a cone of dynamite, which communicates its detonation to the main charge of gelatine containing 92 per cent. nitro-glycerine and 8 per cent. gun cotton. The circuit which is open during the flight of the shell is closed, on impact against a ship, by a projecting pin in the point of the shell, and the time between impact and detonation is regulated by the length of the column of gunpowder in the capsule. The wet battery is here the igniting agent. If the shell falls in the water, the dry battery is so arranged that the circuit is closed by being moistened by the water which is admitted to the battery through holes in the head of the projectile. By making these waterways more or less devious, as well as by designing the battery so that either a single drop or else a large quantity of water is required to complete the circuit, two other elements of delay, in bursting, may be introduced. According to Lieutenant Woolley-Dod, this gun should be compared, not with ordinary guns, but with torpedoes, as the object of the gun is not to obtain penetration, but to convey a large charge of violent explosive to a considerable distance, and there to detonate it. The dynamite gun has a great advantage, not only over the short ranging Whitehead torpedoes, but also over dirigible torpedoes, such as the Lay-Patrick, the Sims, and the Brennan. The maximum speed of these three is twenty-two miles an hour; they are all dependent for their action and accuracy on a long wire attached to the firing station, and they are steered by observation, which at ranges over one mile must be very difficult, except in a calm sea. They are all bulky; their cost is considerable, at least £1,500, and the proportion of weight of explosive to weight of torpedo is not one-tenth. It is also possible to avoid them by manœuvring, or to stop them by netting. The projectile from the dynamite gun, on the other hand, has a mean velocity of three hundred knots an hour; it can be fixed with accuracy at any range up to two thousand yards; it is comparatively light and inexpensive; and the proportion of bursting charge to weight of shell is greater than one-third. It can also be made to carry as large a charge as a torpedo. These projectiles are effective against the above-water portions of a ship as well as the submerged parts, and they cannot be evaded by manœuvring or netting. In studying this paper one cannot help being struck by the large field there is for a gun of this kind in protecting our great commercial ports, whose state of defence at the present time leaves much to be desired.

Metallic Shoe Soles.—A Nuremburg inventor has produced a shoe sole composed of wire net overlaid with a substance resembling india-rubber. These soles, which cost but half the price of leather, have been tested in the German army, and found to be twice as durable.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 6TH MARCH, 1888.

THE IRON MARKET.—Business in the iron trade has been slightly checked by a combination of circumstances. The heavy snows of the last two weeks have delayed building operations at the moment when fresh orders were about to be given out. The negotiations with Italy for the prolongation of the treaty of commerce have fallen through; and there is an uneasy feeling in the money market, occasioned, it is said, by apprehensions concerning the fate of the Panama Canal scheme. But though the market has shown less life, prices have remained very firm. The latest news from the provinces is encouraging. In the North, the trade in finished iron gradually acquires more life and vigour. The situation is improving in the Ardennes, where founders are especially busy. The crude iron trade of the Meurthe-et-Moselle grows more animated. The scarcity of pig in Belgium has occasioned a demand for foreign produce that has greatly benefited the Longwy district. Forge pig is very firm in price, but foundry is a little weak.

APPREHENDED FINANCIAL CRISIS.—An uneasy feeling pervades the commercial world, arising from the apprehension of impending disaster. A gigantic financial crisis is expected in consequence of what is now regarded as the inevitable and speedy collapse of the Panama Canal scheme. The uncertainty of the situation arising from this cause, and from the altered commercial relations with Italy, tends to disorganise the markets and to obstruct the flow of trade.

THE CYCLE MAKING INDUSTRY.—An effort is being made to establish at Saint Etienne large and complete works for the manufacture of cycles. Hitherto bicycles and tricycles have been imported from England and Germany; but the trade having grown to great importance an enterprising firm of engineers have resolved to establish this industry in France.

COMMERCIAL RELATIONS WITH ITALY.—The war of tariffs between France and Italy has broken out, and the conflict is regarded with enthusiasm on this side of the Alps. That the enthusiasm is of a spurious sort goes without saying, since there is obviously nothing to gain and much to lose in the struggle; but a sort of wild joy is affected here at the prospect of dealing injury to Italy through her trade. Time will probably make the cost severely felt, and dispel some of the glory which now surrounds the enterprise. The new retaliatory tariff has been voted by the Legislature with a precipitancy that reveals the existence of very unfriendly feelings towards our Italian neighbours. This state of things, which is conducive to the restriction of trade between Italy and France, will afford our German rivals an opportunity of which they will readily avail themselves.

A FRANCO-GERMAN CUSTOMS UNION.—Count de Leusse, a former Deputy, has published a pamphlet, in which he propounds a question, not yet, perhaps, within the range of practical politics, but interesting from its suggestiveness. He proposes to restore and preserve peace between France and Germany by uniting them in a community of commercial and industrial interests. His scheme, which originated, it is said, with the Crown Prince, is to create a Customs Union, embracing, in the first instance, France and Germany, but designed ultimately to absorb Belgium, Switzerland, Holland, Austria, and possibly Italy and Spain. In this way, says the author, we should form a great home market, sufficiently extensive to be self sufficing and capable of defending itself against over-sea competition.

BERLIN, 5TH MARCH, 1888.

THE IRON MARKET.—Although no change has as yet taken place in the demand for crude iron in the Upper Silesian district, some of the blast furnace owners begin to doubt whether the present exceptionally brisk trade will continue, and they evince a disposition to make concessions to consumers in order to secure orders ahead. On the whole, the prospect is still fairly good, which is partly due to the hopes raised by the budget. It is estimated that about £1,000,000 worth of work required for the army will directly or indirectly benefit the iron trade, whilst the State railways will during the year require a further equipment of railway material and rolling stock, which may roughly be estimated at £5,000,000. The railway budget last year amounted to £3,600,000, a large portion of which sum has yet to be expended, so that the railways will keep the iron trade fairly well employed for at least two years to come. According to statistics just published, the total production of crude iron throughout Germany —including Luxembourg—during January amounted to 346,962 tons, of which 177,321 tons were puddled and spiegel iron, 31,213 tons were Bessemer iron, 102,779 tons Thomas iron, and 35,649 tons foundry pig. The Dortmund Union have considerably extended their business by the purchase of the Victoria mine, near Porta, and of the new Wohlverwahrt mine, near Bückeburg. Both mines contain a good quality of red ironstone, and thus assure a cheap raw material to the Union. The fourth blast furnace recently erected at these works will be blown in shortly. At a recent competition for the supply of 1000 tons of ingot iron railway sleepers for the Würtemberg State railways, Messrs. Stumm Brothers, of Neunkirchen, obtained the contract at 131s. per ton, delivered free at Heilbronn. The Dortmund Union and the Rhenish Steel Works quoted 135s., and the Hörde Company 134s. Messrs. Stumm Brothers quoted 122s. at their works.

TEXTILES.—Jute spinners are fairly well employed, and prices have during the past month been repeatedly raised in sympathy with the foreign markets. Business in knitted goods is also satisfactory, and there is a good demand, especially for the cheaper kinds. In hosiery a fair number of orders, especially for better qualities for export, has been received. In tricots the demand is good, but prices are still depressed. As, however, the prices of yarn are steadily rising, it is confidently expected the tricots will also improve shortly.

BABCOCK & WILCOX BOILERS IN GERMANY.—Mr. Knight, the manager of the Babcock & Wilcox Company, of Glasgow, who are represented in this town by Herr L. Jahn, has made a contract with the works formerly known as Schwartzkopf & Co., of this town, under which the latter company will manufacture Babcock & Wilcox boilers on payment of a royalty. As reported a fortnight ago, these boilers were hitherto manufactured in Germany by Messrs. Schmidt, of Küstrin.

EXHIBITION OF SAFETY APPLIANCES.—It is proposed to hold next year in Berlin an exhibition of appliances for insuring safety to life and limb in manufacturing operations. One of the objects of the Exhibition is to bring about such legislative changes as will tend to the greater safety of workmen. The promoters have already organised sixteen separate committees, which will deal with the following branches of the subject: I., Safety appliances on moving machinery generally, coupling gear, winding machinery, &c.; II., appliances for use with motors and boilers; III., fire risk in artificial lighting; IV., safety appliances against poisonous gases, liquids, &c., and wearing apparel for the purpose. Committees V. to XII. deal with safety appliances to be used in the following trades; Metals, wood working, textiles, paper and leather, articles of food, chemicals, glass and pottery, mining and quarrying, and building. Committees XIII. and XIV. deal with safety appliances for traffic on land and water; XV. deals with agriculture and forestry; whilst XVI. is charged with collecting, arranging, and classifying the literature on the subject. Prospectuses and regulations may be obtained post free from the director of the Exhibition, Herr Max Schlesinger, Kochstrasse 3, Berlin. Applications for space must reach this gentleman not later than the 1st July.

VIENNA, 5TH MARCH, 1888.

THE COAL MARKET.—The coal market continues active. It is proposed to build a new railway line from Prague, *viâ* Kladno and Pilsen, and so open a short route between these towns and Bavaria and Southern Germany. This line will compete with the Western Railway of Bohemia, and it is expected by its establishment that a further impulse will be given to the Bohemian coal trade.

THE IRON MARKET.—No improvement in the condition of the crude iron market has taken place during the past week. On the one hand, Styrian works have to compete with coke-produced crude iron, which is cheaper; whilst on the other, the large stocks of the Hungarian State iron works, which have been thrown on the market, have a tendency to depress it. In Austria-Hungary there has been a greater demand this week for rolled iron and cast iron ware than has been experienced for two or three weeks. In consequence of the unfavourable season, iron for building purposes is not in very good request, and no increase in the price of girders has taken place; but some advance is expected in large sheets and tank plates. The quantity of bar iron now being sold in Bohemia is still unsatisfactory; but the demand for agricultural implements, and especially ploughshares, has increased. Large quantities of agricultural implements are being imported into Bohemia from Upper Silesia notwithstanding the import duty, and these goods compete very keenly with the same kind of articles manufactured in Styria. A fair demand exists for galvanised and tinned sheets, and also for black sheets.

TEXTILES.—In former years a good spring business has been the rule at this period; but this year everything is quiet, and orders for the spring have not yet been placed. Buyers from Hungary and Galicia are expected to come into the market during the present month, which will cause a slight revival. In cloth and millinery goods there is a tendency to copy English striped patterns. Owing to increased import tariffs, German competition in worsteds is somewhat less keen at the present moment, and Austrian makers have now a chance of increasing this trade. It is, however, somewhat unfortunate that the reputation of this article as made here is not very high, so that it is difficult to do an export trade. The war of tariffs with Roumania has almost completely paralysed the export business to that country, and to overcome this difficulty some Austrian spinners and weavers have recently sent goods to Roumania by way of Germany; but their German rivals have petitioned their Government to take steps to prevent this practice. The German Government has not interfered; but the publicity thus given has had the effect of throwing considerable difficulties in the way of Austrian exporters.

SHIPPING IN TRIESTE.—Statistics on the trade of the port of Trieste during the last year have just been published. During that year a total of 4369 sailing vessels, representing 212,785 tons, and 3664 steamers, representing 1,172,092 tons, entered the port. The total number of vessels is therefore 8033, and the total tonnage 1,384,877 tons, as compared with the previous year, when the figures were 6806 vessels, with a total tonnage of 1,151,708 tons. The majority of vessels trading from the port of Trieste sailed under the Austrian flag. Amongst these were 2685 sailing vessels, representing 88,226 tons, and 3103 steamers, representing 696,254 tons. During the year 8128 vessels cleared the port, of which 4450 were sailing vessels, and 3678 were steamers, the total tonnage amounting to 1,393,524 tons.

BRUSSELS, 6TH MARCH, 1888.

THE COAL MARKET.—There is a good sale at remunerative rates, and coke is very scarce, in consequence of the large demand on the part of blast furnaces. Coal for metallurgical purposes is firm, the time for the renewal of contracts being near. The outlook in the Charleroi district is decidedly favourable, in spite of the stoppage of canal traffic and the scarcity of railway waggons, while at Liège there is a constant demand from French sources.

THE IRON MARKET.—Foundry pig continues dear. Rolling mills and engineering works are well employed. There is a good demand for sheets and special sections in spite of the threatened war of tariffs with Italy. There is a number of orders for rails from America; but still the steel works of the Centre and Liège are not so busy as they might be. Cockerill is not supplied with constant work, and Selessin has been disturbed by an explosion. La Meuse and St. Leonard works are well supplied with orders, the former now being engaged in locomotive building. The Hoboken shipbuilding yard, near Antwerp, is busy; but M. Beer, of the Jemeppe yard, is not doing much. Contracts will shortly be given out for metallic roofing in connection with the extension of the Malines Arsenal.

TELEPHONY.—Yesterday the following means of telephonic communication were opened between Brussels and Paris: (1) Between the subscribers and exchanges on the Brussels system on the one part, and the public call offices at the Paris Exchange on the other; (2) between the subscribers and exchanges on the Paris system, and the public call offices at the Brussels Exchange; (3) between the private establishments and public offices of Brussels which have secondary wires to the exchanges on the one part, and the subscribers to the Paris Exchange at Paris on the other. Experience has shown the necessity of using a complete metallic circuit at Brussels in order to obtain satisfactory communication with Paris.

THE VAN RYSSELBERGHE TELEPHONE SYSTEM.—This system is to be adopted for a number of lines in Japan, and an order has been received by Messrs. Mourlon Frères, of Brussels, for all the material necessary to fit up one of the principal telegraph lines in that country for telephonic communication. A similar order has been given to the same firm by the Bolivian Government. The railways of Greece are also going to apply the system for communication between the various signal boxes on their lines.

THE EXHIBITION.—The buildings of the English section are being rapidly erected, and occupy about 50,000 sq. ft. The machinery section only requires to be covered in, and the annexes will be immediately commenced. In the latter case material from the Antwerp Exhibition will be used. The masonry of the horseshoe building is finished, and the iron work is being proceeded with. The frost has delayed work a good deal, and should it continue the date of opening will have to be postponed. The machinery section will be comparatively unimportant, and metallurgical works will be poorly represented. One of the most interesting portions of the Exhibition will be the electrical department.

GAS LIGHTING.—The Society of Belgian Gas Engineers are raising funds for a permanent exhibition of gas lighting and heating appliances, which will be on a larger scale than that which was promoted by the town. It is proposed that experiments should be made with new inventions; but as the arrangements are in the hands of a certain ring, it is doubtful whether this portion of the scheme will prove a success, as inventors and makers of special apparatus may not care to submit their productions to the judgment of possible rivals. A new gas lamp is being introduced here which consists of the following parts: A regenerator carrying the burner and distributing the hot air both inside and outside the flame, a burner of the Argand type connected with the gas supply pipe, the frame work of the lamp carrying the chimney, and a globe which is fastened to the regenerator so as to prevent the admission of cold air from outside. This lamp is not influenced by currents of air, and gives a white and agreeable light. It is claimed for it that its efficiency is higher than that of regenerative lamps with inverted flame.

DÜSSELDORF, 5TH MARCH, 1888.

THE IRON MARKET.—The external aspect of the iron market remains unaltered. Pig iron of all sorts is in brisk demand, and prices are very firm. But if we search beneath the surface, we find influences at work to bring to a speedy end the period of activity through which we have been passing. The extreme animation of the market has been largely due to speculative buying occasioned by the syndicating of the trade, and the consequent successive and easily foreseen advances in the prices of all classes of iron goods. The high level to which prices have now been forced begins to tell so heavily upon the demand for consumption, both at home and abroad, that speculators

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are not likely to push their operations much further. The production of pig iron has nearly reached the highest attainable point, and though hitherto the demand has kept pace with the supply, it is, partly for the reason just stated, and partly owing to the constant shrinkage of the export trade, likely to decrease soon. The make of pig in January averaged 11,192 tons a day, against 11,608 tons in December. This falling off has, however, no significance, being attributable to the New Year holiday season. The tendency of business to shrink in the immediate future is indicated by the languor in merchant bars which is beginning to show itself in the trade. The full capacity of the works may be assumed at a monthly output of 24,000 tons, but the fresh orders booked in the first two months of the year scarcely exceeded 20,000 tons. The blast furnace owners have under consideration a proposal to sell pig at a reduced rate to makers of finished iron and steel who can show that it is required for the execution of foreign orders. To such straits has the artificial system of syndicates brought us! What relief this will afford remains to be seen.

Migration of the Crude Iron Industry.—A recent article appeared in *Industries* directing attention to the fact that under the present conditions of smelting it is advantageous to transport the fuel rather than the ore. The same idea has taken root here in a scheme for transferring the blast furnace industry of the Lower Rhine and Westphalia to Lorraine, the "Minette" ore district, whence the furnaces now derive their supplies of ore. Efforts are being made to obtain a reduction in the railway rates for the carriage of this ore; but it is urged in support of the new scheme that as about two tons of ore are needed to yield one ton of pig, it would be advantageous to carry one ton or less of coke to furnaces erected at the iron mines. A simple calculation shows that the cost of transporting the coke to the mines and conveying the pig iron back to the Rhenish-Westphalian finished iron works would amount to only about three-fourths of the present cost.

The Yarn Market.—The demand for tow yarns continues brisk for all numbers. Flax yarns are more inquired after; but though important dealings in the latter have taken place within the past few days, spinners still complain of the insufficiency of demand. Prices are moreover at too low a level.

LILLE, 6th March, 1888.

Textile Manufactures.—The failure of the negotiations with Italy, and the prospect of a war of tariffs between that country and France, has considerably disturbed the textile manufacturing industries of this locality. The loss of the Italian markets must seriously curtail our export trade, and delay the revival which seemed about to take place. The influence of this untoward event has damped the spirit of the woollen market at Roubaix, and occasioned little short of a panic in the silk goods trade of Lyons. The outlook is discouraging, and for the moment a tone of despondency prevails. These depressing influences apart, the situation shows some improvement. There is more activity in linen goods, and a better demand is springing up for cotton fabrics. The spinning industry is getting upon a better footing. Cotton yarns are in fairly strong demand, at the more remunerative prices which are now current, and flax spinners have plenty of work in hand. The wool spring trade is in a very unsatisfactory state.

Flax and Yarn Markets.—The demand for home grown flax is unabated, but the supply is running short. This circumstance has given an upward tendency to prices. The low rate of exchange has led to large purchases of Russian flax. Tows are quiet for home consumption; but some heavy dealings have taken place for export. Linen yarns are still in good demand, prices being very firm. Jute yarns are still much sought after. The Ghent markets are less active, both for raw flax and for yarns; but prices have not given way.

The Iron Market.—The iron market has developed no new feature since my last report. A steady progress towards recovery is being made. Business has been hindered by the wintry weather of the past two weeks, but there is no lack of fresh orders. The demand for plates continues very brisk. Perfect unity of aim and action having been established between the manufacturers of this locality and those of the Centre, prices now rest upon a firm basis.

WINTERTHUR, 5th March, 1888.

Engineering Trades.—Messrs. Sulzer Brothers, of this town, have turned out their thousandth valve engine. These engines were first made here twenty years ago, from the designs of an English engineer, Mr. Brown, and have since found a very ready sale. Messrs. Sulzer have lately used them largely in combination with the Linde refrigerating machines made by them, in which they do an export trade to Africa, Asia, and South America. Messrs. Escher, Wyss, & Co., Zürich, are also making a specialty of refrigerators on the Windhausen system. In this machine the working fluid is carbonic acid.

Paper Making.—A new kind of paper for packing meat, butter, cheese, and other provisions, has been brought out by Messrs. Robert Bareiss & Co., of Balsthal, Solothurn, under the name of parchment paper. It is made from chemically prepared fibres, without any admixture of chlorine or other bleaching compound, or of any colouring matter. The paper is not weighted, and is to a great extent impermeable to water and oil. It neither sticks to the substance which it envelopes, changes its colour, nor leaves any smell.

A Works for the Manufacture of Preserves.—A fruit and vegetable preserving works is to be established at Lucerne, with a capital of £10,000. It appears from the Customs statistics that the annual imports of dried fruits have risen during the past twenty years from 220 tons to 3100 tons. The annual value of the imports, three-quarters of which come from Germany and Austria, is £80,000, and of the exports only £3,200, so that the new establishment will experience no difficulty in finding a market for its products.

MILAN, 5th March, 1888.

Italy's Foreign Trade.—Statistics giving the value of the imports and exports during the past year have recently been issued. The total value of the imports during 1887 was about £63,000,000, being an increase of £6,000,000 as compared with 1886. The exports during the past year are valued at only £39,000,000, showing a decrease of £5,500,000 as compared with 1886. The large difference of £24,000,000 between imports and exports is partly due to the fact that towards the latter end of the year importers found it prudent, in view of the new Customs tariff which came into force on the 1st January, to considerably increase their stocks beyond immediate requirements. The greatest activity in imports was shown in chemicals, linen yarns, raw cotton, and cotton piece goods; also in woollen cloth and silk piece goods. The effect of the new protective policy is very plainly seen in a rise of prices, varying for different commodities from 5 to 20 per cent., as compared with the ruling rates in December.

Electrical Engineering.—A contract has just been concluded between the Oerlikon works and a large woollen goods manufacturer near this town for the erection of an electrical plant capable of transmitting 250 h.p. over a distance of 550 yards, with a guaranteed efficiency of 78 per cent. Power is supplied by turbines at the generating station, where it will be used to actuate two Oerlikon dynamos coupled in series, and the current will be sent to the mill by three wires to the two motors at the mill in the same manner as was adopted in the Kriegstetten installation. The makers of the plant are confident that of the 250 h.p. transmitted to the spindles of the dynamos, 200 h.p. will be actually available at the mill.—Some trouble has been experienced in Milan with the Edison tubes. Owing to settlements in the ground and to the heavy traffic these were frequently broken, causing considerable leakage of current. The Electric Lighting Company are therefore taking up all the Edison tubes, and are re-laying the conductor in wooden troughs with insulation.

MADRID, 5th March, 1888.

Railways.—Tenders are invited for a line to connect Algeciras with the Andalusian railway system, the last day for receiving the same being 14th May. A subvention of about £440,000 is offered by the Government, and the business is almost certain to fall into the hands of an English company, the promoters of which have already made preliminary surveys. In this case, as in most other Spanish railways, there should be a profit, provided that the cost of construction is kept within reasonable limits, and that the financing of the scheme is sound. A concession is asked from the Government for the construction of a one-metre gauge railway from Oviedo to Infiesto, Asturias. The length of line will be thirty miles, and the estimated cost of construction £83,000. It is expected to pay a dividend of 10 per cent.

The Barcelona Exhibition.—This Exhibition now seems likely to be successful. Applications have been received for more space than is available, and the work is being rapidly pushed forward.

Spanish Shipbuilding.—There are at least two shipbuilding yards to be established at Bilbao—one by Señor Martinez de las Rivas in connection with Sir Charles Palmer, and the other in connection with the new company registered in London, with which Lord Brassey is associated. Great interest is manifested in marine and industrial circles as to which of the two will receive the first contracts from the Government. As far as the three cruisers are concerned, I should say they will be placed with that yard which is the more Spanish in its constitution. The chances appear to be in favour of the former of the two, owing to the high reputation of Señor Martinez de las Rivas as a man of business, and to Sir Charles Palmer being well known as a shipbuilder. Very little is expected from a third yard which is to be established by La Viscaya Blast Furnace Company in connection with the French Gironde Company.

NEW YORK, 25th February, 1888.

The Iron and Steel Market.—The settlement of the miners' strike, though advantageous for the company and the miners, will have a depressing influence both on the coal and the iron trade. The Wyoming district has been sending into the market as much coal as was sent last year from all the anthracite coal fields. Some furnaces will now be able to make cheaper and better iron; but the demand is not likely to rise, and the fact that customers could buy their iron with no advance in price while the strike was on will make them feel now it is over that they certainly ought to have some reduction. As sellers are beginning to feel anxious for business, there is but little chance of a firm market. In the pig iron market at present the supply is greater than the demand, and the rates are sure to come down. With the exception of a few large orders, business in manufactured iron is dull. Prices are nominally 2 cents per lb., but for important orders discounts amounting from 10 to 15 cents per 100lb. are given. Some mills are closed entirely, while the majority are running about three-quarters time. The steel rail market continues firm, and the prospects for an increasing demand are very good. A liberal amount of orders has been entered during the past week with nothing below $31·50 per ton at the mill.

The Metal Market.—The copper market has been dull, with no change in price. The tin market is very quiet. There have been only a few inquiries for lead, except for speculation, and it is doubtful if the present prices will hold unless the demand increases.

The Nail Trade.—The effects of the great nail makers' combination in the East is making itself felt in the Western district. The estimated production throughout the States is nearly 1,000,000 kegs, of which 550,000 are made by the Eastern Association, and 340,000 by the Western Association.

Electromotors.—The use of electromotors, where considerable power is required, is becoming more common, and the demand exceeds the supply for motors to replace steam or gas engines in the smaller manufacturing establishments. Until within the last few months, Messrs. Van den Houten & Co., of New York, have used a 10 h.p. steam engine to drive the presses in their printing establishment. The steam was supplied by the mains, but the service was so bad that it was determined to try electricity. A 7½ h.p. (rated) Sprague motor was procured, and has been doing all the work required without interruption. It drives four large Gordon cylinder presses, and three Gordon job presses, with ease.

Lighthouse Lens.—The largest lens ever brought to this country will be placed in the Sandyhook Lighthouse. It has been made in Paris, at a cost of £3,000, and is 15ft. in height, the internal diameter being 8ft. It is of the hyper-radiant type.

Cast Steel Gun.—The boring of the new large cast steel gun has now been completed. A flat drill, which had to be sharpened after every 9in. bored, was used. The total distance bored was 193·5in. The grain of the steel has been found to be remarkably uniform. The gun will now be turned on the outside, after which it will be sent to Washington to be rifled and tested. About 1200lb. of cuttings have been bored out by the drill.

PHILADELPHIA, 25th February, 1888.

Tunnel Lighting by Electricity.—Workmen are *engaged* in putting the Westinghouse converter system of electric lighting into the Hoosac Tunnel. Owing to frost, the work of laying the wires has been considerably delayed. The conduits are of ¾in. Canadian pine, seasoned three years, soaked in a composition of tar and oil, and painted with tar outside, before laying in the trench. About sixty miles of wire will be used for mains and lamp connections. There are to be 1250 25-c.p. lamps fixed to the side walls of the tunnel, 6ft. above the top of the rails. Metallic parts on the lamps are avoided as much as possible, or securely protected from the bad effects of the sulphurous gases and moisture. It will be some time before the work is finished, although the time stipulated in the contract is already past.

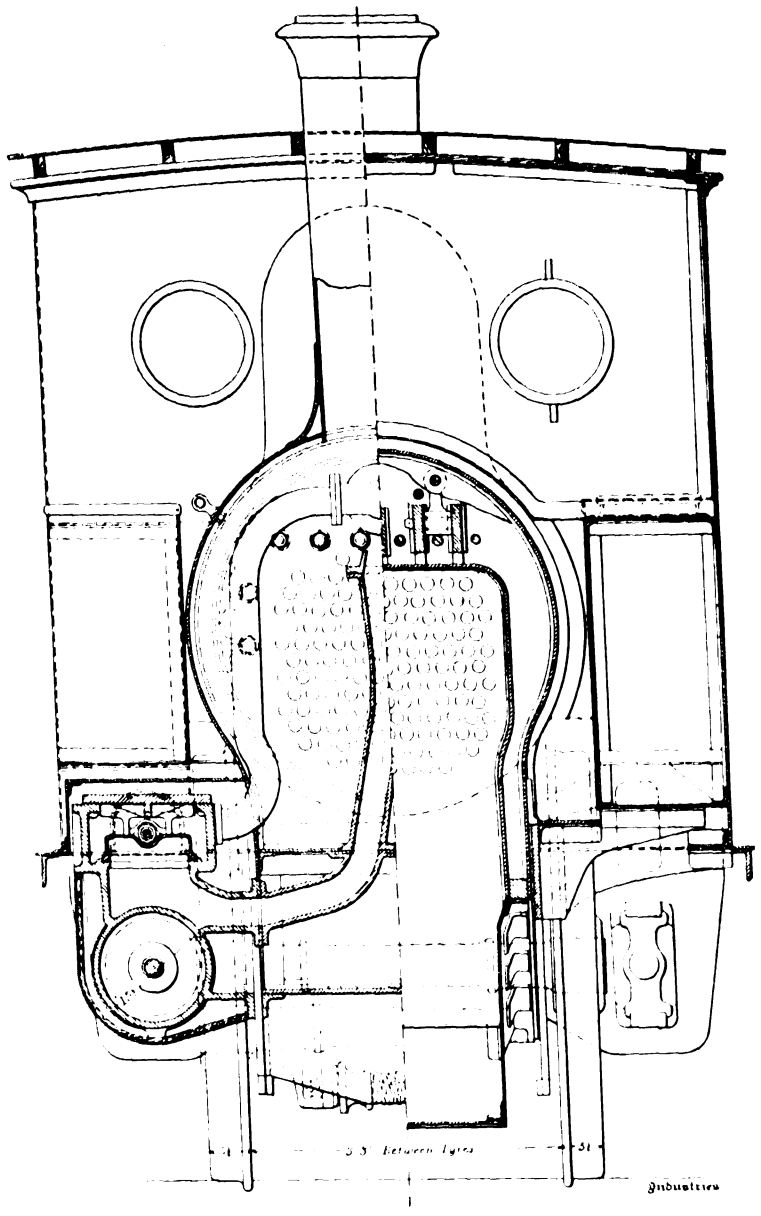
Steel Car Wheels.—The Pittsburg Steel Casting Company has been making some steel car wheels by a new process. While the metal is cooling the moulds are quickly rotated to compress the material in the rim, and so strengthen it. The wheels are said to be very strong and durable, and much lighter than the paper wheels. They are selling at 4 cents per lb., which makes them more expensive than cast iron, but still very much cheaper than paper or built up steel wheels. After the wheels are cast they are re-heated, and rolled on the tread and flange until perfectly round, which process hardens the surface and reduces the wear on wheel and rails. The wheels successfully stand the test required by the Pennsylvania road.

Shipbuilding.—The steamer "Puritan," now being built at Chester, Pennsylvania, for the Fall River Line at a cost of £300,000, will be the largest vessel of her class afloat. The hull is of steel, 420ft. over all; 404ft. on the water line; beam, 52ft., and 91ft. over the guards. She will draw 12ft. of water. Her gross tonnage is estimated at 4650, and displacement 4200 tons. The engines are to be vertical beam compound, with cylinders 75in. by 9ft., and 110in. by 14ft. The boilers are to be of steel, of the return tubular type, to stand 110lb. per square inch. The horse power is to be 7500. Feathering paddles, 35ft. diam., are expected to drive the vessel at twenty-one miles per hour, by making twenty-four revolutions per minute.

Railway Bridges.—The necessity of governmental supervision of bridges is shown in a report of the Massachusetts Railroad Commission. The State law requires that plans of all such structures should be submitted to the commission; but it was found that many companies had no plans or strain sheets of many of their bridges, nor any definite knowledge of their condition. Unsuspected weakness was discovered on many of the roads, and steps are being taken to remedy the defects.

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TANK LOCOMOTIVE FOR THE JAPANESE RAILWAYS.



END ELEVATION.

TANK LOCOMOTIVE FOR THE JAPANESE GOVERNMENT RAILWAYS.

We give above and on our two-page supplement for this week, and also on page 244, illustrations of one of a series of eight-wheel tank locomotives, built by Messrs. Nasmyth, Wilson, & Co., Limited, engineers, Patricroft, near Manchester, from the designs of Mr. F. H. Trevithick, M.Inst.C.E., locomotive superintendent for the Japanese Government Railways. It will be seen from our illustrations that the cylinders are 13½in. diam., and the stroke 20in. The coupled wheels are 51in. diam.—when the tyres are half worn—and carry a load of 17 tons 8¾cwt. when the engine is in full working order. The tractive force per pound of mean effective cylinder pressure is $\frac{13{\cdot}5^2 \times 20}{51} = 71{\cdot}5$lb., and the boiler pressure is 140lb. per square inch. The leading and trailing wheels are fitted with Mr. Webb's well known radial arrangement, by means of which the rigid wheel base is reduced to 7ft. 6in.—the distance between the centres of the coupled wheels. We understand that these engines have given great satisfaction both as regards steadiness of running and general capability for work.

THE TASMANIAN RAILWAYS.

The island of Tasmania, or Van Dieman's Land as it was formerly called, lies to the extreme south of Australia, between 40° 15′ and 43° 45′ south latitude, and between 144° 45′ and 148° 30′ east longitude. It is separated from Australia by Bass Strait, 120 miles wide; but it is in telegraphic communication with the Australian continent, and therefore with Europe, the Tasmanian and Victoria submarine telegraph being worked by the Eastern Extension Telegraph Company upon a guarantee from the Tasmanian Government. The greatest length of the island is 230 miles, and its greatest width 190 miles. Its surface is estimated at 26,215 square miles, or about 6000 square miles less than Ireland. The total area, exclusive of islands and lakes, is 15,571,500 acres, or inclusive of these, 16,778,000 acres. The population at the last census in 1881 was 115,705, and it is estimated to be now close on 140,000 persons. Tasmania is a mountainous country, having hills ranging from 1000ft. to 6000ft. in height. It has several extensive lakes on the high central tableland, and these form the sources of the chief rivers, of which there are several. The climate of Tasmania is very salubrious, and the island is recommended as a sanatorium for invalids, the hot north winds of Australia being tempered by the 120 miles of sea at Bass Strait. The chief products are tin and gold, wool, wheat, oats, barley, potatoes, timber, hops, fruit, jam, and whale oil. The Government of Tasmania, with a view to encourage special manufacturing industries, have offered bonuses from time to time, of which the following are yet unclaimed.

Sugar from beet or other products grown in the colony, bonus £2,000; 200 tons to be manufactured in one year.

Salt.—On 300 tons being manufactured in one year, a bonus of 10s. per ton for the first hundred tons, and 5s. per ton for the second and third hundred.

Corn Sacks or Woolpacks.—Bonus £1,000. The quantity of sacking suitable for working up into those articles turned out in one year to be 40,000 yards.

Up to about four years ago Tasmania was considered a sleepy colony, and was dependent upon Australia and England for the supply of most articles of general consumption. Now the country has awakened; trade is developing and railways are extending in various directions. During the past three years no less than 27 jetties have been erected. Better vessels are visiting the ports of the colony, and large and handsome warehouses and business establishments are being erected in the chief towns.

The first line constructed in Tasmania was the Launceston and Western Railway, connecting Launceston with Deloraine, 45 miles to the west. It was originally constructed by a private company, but eventually it fell into the hands of the Government. It is a substantial line, 5ft. 3in. gauge, and equipped in a superior manner. The other Government lines being all of 3ft. 6in. gauge, it was decided to mix the gauges, and a third line of rails was laid down about three years ago, and practically all traffic is now conducted over the 3ft. 6in. gauge. An extension was made on the 3ft. 6in. gauge from Deloraine to the river Mersey, a distance of 37 miles on the North-west Coast, passing through a mineral and agricultural country. The cost of construction to the end of 1885, including the Mersey extension, was £658,012, whilst the net revenue for the same year was £66,424. The main artery of communication through the colony runs nearly north and south, from sea to sea. It is known as the Tasmanian Main Line Railway, and is the property of a British company, and constructed under a Government guarantee of 5 per cent. per annum upon a capital of £650,000. This main line connects Hobart Town on the South Coast with Launceston on the North Coast, a distance of 133 miles. At Evandale the Main Line Railway has a junction with the Launceston and Western Railway, and with running powers over it. The cost of construction and equipment of the Main Line Railway was £1,182,352.

The other Government lines completed or in course of construction are: (1) The Fingal Railway, from Corners Station on the main line to St. Mary's on the East Coast, a distance of 47 miles. This line passes through an agricultural country, and opens up the coal fields of Mount Nicholas in the vicinity of St. Mary's. (2) The Parattah and Oatlands Railway, 4¼ miles long, connecting the township of Oatlands with the main line. The cost of construction was £10,249. This railway belongs to the class of light lines, and is worked by a single engine and carriage. (3) The Derwent Valley line, 24¼ miles long, from Bridgewater, near Hobart, to Glenora. The estimated cost is £140,000. The contract for its construction was let to Mr. J. Falkingham, of Melbourne. In consequence, however, of the unsatisfactory rate of progress, the contract was terminated by mutual consent, and the work completed by the Government. In connection with this railway, it was decided that the whole of the wrought iron cylinders and girders required for the large bridge over the river Derwent should be manufactured locally. The engineer, in reporting upon the progress of the work, stated that it was an advantage so far as encouragement was given to local enterprise; but he regretted the loss in time and money, which would otherwise have been avoided. (4) The Scottsdale line, from Launceston to Scottsdale, 47 miles long. The estimated cost is £300,000, and the contractors are Messrs. Boland & Scott, of Launceston. (5) The Tullery Extension Railway, from Deloraine to Formby, 37¼ miles long. This railway it is proposed to extend to Ulverston, and ultimately as far as Emu Bay, and there join the Van Dieman Company's line.

The Van Dieman's Land Company's Railway or the Emu Bay Railway is a private line, and runs from Emu Bay, on the North Coast, to the Mount Bischoff Company's tin mines, 48 miles in the interior. The gauge is 3ft. 6in., the same as on the standard Government lines. This line runs through a densely timbered country, and has some sharp curves and steep inclines. Formerly it was merely a tramway for conveying tin from the mines to the coast. The rolling stock has been mostly constructed by the Bristol Waggon Company. The locomotives are adapted to burn wood, and are of the American type, and built by the Hunslet Engineering Company, Leeds. Besides the lines opened and in course of construction, the Government have sanctioned the Green Ponds Railway from Brighton Station, on the Main Line Railway, to Apsley, at an estimated cost of £106,500; the Sorell Railway, on the South Coast, from Bellerive to Sorell, at a cost of £61,800; the Chudleigh Railway, being a continuation of the Launceston and Deloraine line, from Chudleigh Road Station to Mole Creek, to cost £30,000; and the North-Western Railway from Formby to Ulverston, referred to above, which is estimated to cost £69,700. The Government have also authorised surveys for further lines, viz., from Kimberley's Ford *viâ* Sheffield to the Western Railway, 18 miles long, on the North-west Coast; Ulverston to Emu Bay, 17 miles long, already mentioned, from Tunack to Parattah station on the Main Line; Autill Ponds, to Cressy and Longford; Lower Piper branch, Scottsdale Railway, 14 miles; Glenora to the Ouse, 21 miles; Scottsdale to Upper Ringarooma, 23½ miles. The amount authorised for these surveys is £7,500, and according to the report of the engineer-in-chief (Mr. J. Fincham, M.Inst.C.E.), a good deal of the surveying work is already done, and the plans, sections, and working drawings necessary for contract, with lithographic copies of same, are nearly complete. Specifications and bills of quantities are prepared as far as possible, whilst particulars for contracts for rails have been prepared, and now are

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in the hands of the Agent General in London. From the above it will be seen that the Government of Tasmania has a good deal of railway work either in hand or in prospect; and as railways are after all only a means for serving the trade of a country, it would seem that the Government is confident of a considerable expansion of the general trade of Tasmania. British manufacturers will, therefore, do well not to lose sight of what is being done in this small but relatively busy colony. Nearly the whole of the railway work now in hand has been initiated by the last Government, under the Premiership of the Hon. A. D. Douglass, Q.C., the former Agent General in England, and the Hon. Nicholas J. Brown, Minister of Public Works. The rails, locomotives, carriages, and other railway material were obtained from England.

SHIPBUILDING NOTES.

The lightest draught stern wheel passenger steamer ever built on the Mersey was launched from Messrs. James Taylor & Co.'s yard at Birkenhead, on the 29th ult. The "San Fernando" has been built to the order of Messrs. Japp & Kirby, of Liverpool, and has been specially designed for inland navigation in South America. The engines work at a steam pressure of 160lb. with an early cut-off, and the boiler is of very large proportions to suit the combustion of wood as fuel. The load draught of water is 18in.; the speed, 12 miles an hour; and the revolutions of the paddle, 62 per minute. The vessel is built entirely of steel, in segments for shipment; the length is 100ft.; breadth, 13ft. 6in.; depth of hold, 4ft.

On the 29th ult., Messrs. S. P. Austin & Son, Sunderland, launched a sailing vessel of the following dimensions; Length between perpendiculars, 235ft.; breadth moulded, 37ft.; depth of hold, 22ft. The vessel is constructed of Siemens-Martin steel, and will be fitted up with the latest improvements. It was built on speculation, and has been recently sold as a foreign order.

The Belgian Government has contracted for the construction of a second fast steamer for the mail traffic between Dover and Ostend. The steamer is to be built by Messrs. Denny & Brothers, Dumbarton, who have now in course of construction the first of the new fleet which the Belgian Government have determined to place on the English mail route.

On Tuesday afternoon was launched from the yard of the builders, Messrs. Raylton, Dixon, & Co., Middlesbrough, the steel screw steamer "Fulford," built to the order of Messrs. J. M. Lennard & Sons, of Middlesbrough. She is of the following dimensions: Length, 267ft.; breadth, 36ft.; and depth, 19ft. 6in.; and she will carry a dead weight of over 2500 tons. She is built on the well deck principle, with long bridge deck extending to foremast, and is in many respects a great improvement upon the last vessel built for the same firm, for whom Messrs. Raylton, Dixon, & Co. have already built six steamers. She will be fitted with triple expansion engines on the latest improved principle by Messrs. Blair & Co., Limited, Stockton.

On Tuesday last, Messrs. W. Gray & Co., West Hartlepool, launched a fine steel screw steamer of the following dimensions: 300ft. over all, 38ft. beam, and 22ft. 2in. depth, of 3500 tons dead weight capacity, built to the order of Messrs. T. Appleby & Co., West Hartlepool, and classed 100 A1 at Lloyd's. The vessel is of the well decked type, with poop aft, containing saloon and cabins for officers and a few passengers, long raised quarter deck, long bridge of extra strength right up to fore hatch, and containing comfortable quarters for the crew. The usual topgallant forecastle is fitted forward with Emerson, Walker, & Co.'s windlass. The hull is built on the web frame principle, dispensing with hold beams, and giving a clear hold for working cargo; five hatches are fitted, four steam winches, steam steering gear, and two donkey boilers; with double bottom under the holds for water ballast. The boats are carried on beams overhead. The vessel will in every respect be well equipped for general trading. The engines, which are on the three-cylinder triple expansion principle, are being supplied by Messrs. Blair & Co., Limited, Stockton-on-Tees. The vessel has been superintended during construction by Captain Baker, on behalf of the owners, and is the eighth vessel owned by Messrs. Appleby & Co. which has been built by W. Gray & Co.

On the 28th ult., Mr. James Laing, Deptford Shipyard, Sunderland, launched the finely modelled screw steamer "Ben Clune," built to the order of Messrs. John Morrison & Son, North Shields. The vessel has been constructed of Siemens-Martin steel, and has a raised quarterdeck, hurricane house from after end of engine room to foremast, and topgallant forecastle. Bracket frames are fitted in the lower holds. The principal dimensions are: Length between perpendiculars, 275ft.; breadth moulded, 38ft.; depth of hold, 20ft. 6in.; and the deadweight capacity, 3000 tons on a light draught. The vessel will be schooner rigged, and fitted with triple expansion engines of 180 n.h.p. by Mr. George Clark, Southwick Engine Works. This is the eleventh vessel constructed by Mr. James Laing for the same firm of ship owners.

TRAFFIC RETURNS.—The following are the receipts of the Great Northern Telegraph Company: February, 1888, £20,400; 1st January to 29th February, 1888, £41,800; corresponding months, 1887, £39,600; 1886, £38,680.

Notices of Meetings.

THIS WEEK.

SOCIETY OF ARTS.—Saturday, 10th March, 3 p.m. Dr. Mann lecture on the "Protection of Buildings from Lightning," by Professor Oliver J. Lodge, D.Sc., F.R.S.

PHYSICAL SOCIETY.—Saturday, 10th March, 3 p.m. Papers to be read on "A Reflecting Galvanometer," by Mr. G. L. Addenbroke, and on "A Theory Concerning the Sudden Loss of Magnetic Properties in Iron and Nickel at a High Temperature," by Mr. Herbert Tomlinson.

NEXT WEEK.

SOCIETY OF ARTS.—Monday, 12th March, 8 p.m. Cantor lecture on "Alloys," by Professor Chandler Roberts-Austen, F.R.S. —Wednesday, 14th March, 8 p.m. Ordinary meeting. Paper to be read on "Technical Instruction in Agriculture," by Professor John Wrightson.—Friday, 16th March, 8 p.m. Indian Section. Paper to be read on "The Origin, Progress, and Influence of Universities in India," by F. J. Mouat, M.D.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 13th March, 8 p.m. Ordinary meeting. Paper to be read with a view to discussion, "Economy Trials of a Non-condensing Steam Engine—Simple, Compound, and Triple," by Mr. P. W. Willans, M.Inst.C.E.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, 14th March, 8 p.m. Paper to be read on "The Construction and Use of the Hopper Dredger," by Mr. A. C. Schönberg, M.Inst.C.E.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Wednesday, 14th March, 7-30 p.m. Ordinary meeting. Discussion on Mr. J. T. Milton's Paper on "Slide Valve Gears." Paper to be read on "Stockless Anchors and Fittings," by Mr. G. W. Sivewright.

ROYAL INSTITUTION OF GREAT BRITAIN.—Thursday, 15th March, 8 p.m. Lecture on "Microscopical Work on the Least and Simplest Forms of Life," by the Rev. W. H. Dollinger. —Friday, 16th March, 9 p.m. Lecture on "Coral Reefs and Islands," by Mr. John Murray.

ARCHITECTURAL ASSOCIATION.—Friday, 16th March, 7-30 p.m. Ordinary meeting. Paper to be read by Mr. A. Oliver.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 16th March, 3 p.m. Paper to be read on "The History of the Native Army of Bombay from 1837 to 1887: its Constitution, Equipment, and Interior Economy," by Major-General W. E. Macleod.

THE SOUTH STAFFORDSHIRE INSTITUTE ON IRON AND STEEL WORKS' MANAGERS.—Saturday, 10th March, 6-30 p.m. Ordinary meeting. Paper to be read by Mr. Thomas Turner, Assoc.R.S.M., on "Notes on American Foundry Iron," by Mr. W. J. Keep, C.E., Superintendent of the Michigan Stove Company, Detroit, Michigan, U.S.A., and Mr. T. Turner.

PRICES CURRENT, 8TH MARCH.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/4	Cash
Scotch Warrants, m/n		38 11	"
Hematite Warrants, m/n		41 10	"
Stocks in Stores. Scotch	954,850—Inc. for week,	3560	Tons
Middlesbro'	331,390—Dec. "	2976	"
Hematite	211,710—Inc. "	378	"

Exclusive of stocks in makers' yards.
Makers' prices are firm, but no new business is offering.

	No. 1.	No. 3.		
Coltness	48 3	42 3	f.o.b.	Glasgow.
Gartsherrie	45/-	41 9	"	"
Dalmellington	40 6	38 6	"	Ardrossan
Eglinton	39 3	37 9	"	"
Glengarnock	44 3	40/-	"	"
*Derbyshire	—	36 6	f.o.t.	Works.
*Lincolnshire	—	32 6	"	"
*Lancashire	—	37/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.	Best.	
Middlesbro' Bars	£ 4 17 6	£ 5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 2 6	5 12 6	Manch'r.
" Angles	5 12 6	6 2 6	"
Crown Sheets	6 12 6	7 2 6	"
" Hoops	5 10 0	6 0 0	"
"Siemens-Martin" Steel Boiler Plates		7 17 6	"
" Ship and Girder		7 12 6	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53 6	43 6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2 6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	10	0	to	£19	15	0
Copper: British Cakes and Ingots	80	0	0	"			
" Chili Bars	81	10	0	"	82	0	0
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	5	0	"	15	10	0
" English Sheet	16	5	0	"	16	10	0
Tin: Straits	166	0	0	"	166	10	0
" Australian	167	0	0	"	167	10	0
" English Ingots	161	0	0	"	163	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—The copper market is gaining in strength as the arrangements of the French syndicate are being widened and strengthened. An arrangement has now been made with nearly all the English smelters, by which they are included in the operation. Prices for manufactured copper will now be steadied, as there is scarcely any chance of underselling, and the present price of "strong" is a low one relatively to the market price of raw copper. Chili bars are quoted at from £81. 15s. to £82, whilst the price of strong copper is £90. It is expected, therefore, that orders for manufactured copper, so long withheld, will now be brought out, and that the copper trade will be in a healthier condition.

TIN.—Quotations for Straits keep steady at about £166 per ton for spot parcels. Stocks are well held, and prices show no signs of giving way at present.

LEAD is again a trifle easier. Spanish is quoted £14. 15s. to £14. 17s. 6d.

SPELTER.—We have no change to report.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	28	0	0
" Ceylon	"	24	15	0
Cottonseed	"	20	0	0
Cod	"	19	0	0
Lard	"	41	10	0
Linseed	"	18	10	0
Palm, Lagos	"	21	10	0
Rapeseed: English	"	23	10	0
Seal: Pale	"	23	10	0
" Brown	"	17	0	0
Sperm	"	41	10	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	6
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6 11/16
" Spirit	"	0	0	7 3/4

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6½	—	0	1	6¾
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3¼	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	12	5	0	—	12	10	0
" Liquor	lb.	0	0	3½	—		.....	
Bleaching Powder	ton	7	10	0	—	7	15	0
Bisulphide of Carbon	"	13	0	0	—		.....	
Borax	"	28	0	0	—		.....	
Benzole (90%)	gal.	0	3	7	—	0	3	9
" (50 90%)	"	0	2	7	—	0	2	9
Copper Sulphate	ton	21	0	0	—	22	0	0
Copperas	"	1	10	0	—	2	2	6
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	22	15	0	—	23	0	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	10	0	—	25	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	6	—		.....	
" Prussiate (Yellow)	"	0	0	7⅞	—		.....	
" Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	17	6	—	7	0	0
" " (" 60%)	"	5	17	6	—	6	0	0
" " (Cream, 60%)	"	5	15	0	—	5	17	6
" Crystals	"	2	10	0	—	2	12	6
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	8	0	—	6	10	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

THE "DEFLECTOR" MINERS' SAFETY LAMP.—Mr. Andrew Howat, of Manchester, has lately designed a new miners' safety lamp which is an improvement on the Mueseler and Marsaut lamps. The leading feature of novelty is the use of a flanged ring of metal fitted tightly between the outer metal bonnet and the outer gauze cylinder, and fixed upon the rods of the lamp frame at a convenient distance above the air inlet. This flanged ring acts as a deflector, and by it the whole of the air admitted for combustion near the bottom of the bonnet is deflected downwards, passing through the gauze into the burner portion of the lamp. The light burns brilliantly, and there is no danger of the flame travelling through the gauze.

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HOME INDUSTRIES.

MANCHESTER, 8TH MARCH, 1888.

THE IRON TRADE.—The iron trade in this district is passing through a period of stagnation. There are several large parcels of iron to be ordered, but buyers expect a further fall in quotations, and act accordingly. The chronic congestion in pig iron stocks prevents any advance in price. Bar iron is in the same condition as pig, and although makers profess to be very firm there is a decided weakness in quotations, common bars being purchasable at £5 per ton. Steel is a little firmer than iron, and a considerable quantity of plates and bars are being sold. Girders and constructional wrought iron work are selling very slowly. It is generally expected, however, that when prices have settled down all classes of iron will be bought much more freely than at present.

THE ENGINEERING TRADES.—There is very little change in the position of engineers in the district, but the tendency is decidedly towards improvement. A few days ago the wages question created new difficulties at Blackburn. A partial strike occurred, which has ended in an advance of wages of 2s. per week, half of the advance to take place at once, and the remaining half in June. Boiler makers continue to be well employed, and are receiving many new orders; and, generally speaking millwrights are doing well. Tool makers are also obtaining a greater number of orders. Machinists continue to be busy, and are in a condition which is highly satisfactory with regard to everything except that of prices. It is again stated that the premises lately occupied by the Junction Iron Works Company, at Miles Platting, have been purchased by Mr. Samuel Brooks, who intends to manufacture carding engines and roving frames. Loom makers are all busy, and in the bulk of cases are sold well forward; but the quotations for plain calico looms are now very low. Gas engine makers are moderately employed; but we understand that the new form of gas engine manufactured by Messrs. Andrews & Co., Limited, of Stockport, is being freely sold, having been lately much simplified by the removal of the slides.

A NEW PATENT COTTON OPENER.—Messrs. Crighton and Son, of Manchester, have just put in the market a new form of cotton opener which embodies many improvements. The grids are altered in design, so that the cotton is driven by the beater arms into recesses of such a shape that the cotton can remain motionless until the beater has passed. The bottom of the recesses are open, and the effect is that while the material is in the recess any dirt, leaf, or seed can readily fall. The defect observable in the ordinary type is that the leaf and seed in being forced through the grids carry a portion of the fibre with them, and this is entirely obviated in the new patented machine of Messrs. Crighton. The cleaning is more perfect than in the ordinary machine, while the amount of extra cotton passed through, which was formerly wasted, is from 1½ to 2 per cent.

LONDON, 8TH MARCH, 1888.

THE MONEY MARKET.—The demand for money is only moderate, but rates are harder than they have been for weeks past, for the supply is rather short. On Monday those who had borrowed from the Bank for a week for settlement purposes were not able to relieve themselves from their obligations to the Bank, as there was not enough money outside, and a considerable proportion of the loans had to be renewed. The discount rates for long bills remain easy. The stock markets are still quiet, there being exceedingly little business to transact. There are consequently but few alterations in prices, except where speculative dealings affect the market. Diamond shares are the favourite medium for speculation just at present, and there seems no limit to the extent to which the shares of the South African diamond mines can be driven up. The tone in foreign securities is firmer, and copper shares look healthier again, if there can be real health where the strength is at best artificial. The improvement is due to the conclusion of arrangements between smelters and the syndicate. The fears of the embodiment of a conversion scheme in the Budget still tends to depress the market for British funds.

COMPANIES.—The following new companies have been registered since our last report: The Union Cement Company, Limited, with a capital of £25,000; Lofts' Patent Stove Company, Limited, with a capital of £10,000; Taylor's Eagle Brewery, Limited, with a capital of £140,000; the Bournemouth Electric Light and Power Company, Limited, with a capital of £4,000; Gold King, Limited, with a capital of £350,000, to work mines in the United States; the Gas Patents Syndicate, Limited, with a capital of £25,000; the Gülcher (New) Electric Light and Power Company, Limited, with a capital of £70,000; the Comstock Mining Company, Limited (United States), with a capital of £250,000; the Ship Canal Lock Company, with a capital of £300,000; James Chambers & Co., Limited, with a capital of £20,000, to carry on the business of soap manufacturers; Flower & Son, Limited, with a capital of £350,000, to carry on business as brewers; the African Mines Development Company, Limited, with a capital of £20,000; the Union Dairy Company, Limited, with a capital of £100,000; the British Gas Meter Company, Limited, with a capital of £10,000; the South-Western of Venezuela (Barquisimeto) Railway Company, Limited, with a capital of £240,000; The Paper Fibre Company, Limited, with a capital of £60,000; Jagersfontein and South African Diamond Mining Association, Limited, with a capital of £250,000; the South Tokatea Gold Mine, Limited (New Zealand), with a capital of £95,000; the Castlecarry Fireclay Company, Limited, with a capital of £10,000; the Scandinavian Stove Company, Limited, with a capital of £5,000; the Magnetic Iron Mountains Smelting Company, Limited, with a capital of £200,000; the Crow's Nest Gold Mining Company, Limited (Nova Scotia), with a capital of £100,000; the Old Lout Mining Company, Limited (United States), with a capital of £105,000; the Ticket Punch and Register Company, Limited, with a capital of £50,000, to carry on the business of mechanical and electrical engineers; New San Acasio Mine and Freehold Land Company, Limited (Mexico), with a capital of £400,000; the Adamant Cement Company, Limited, with a capital of £50,000; and the Llwyd-Coed Slate Quarry Syndicate, Limited, with a capital of £16,000. During February 233 companies were registered, with a total capital of £17,755,235.

METALS.—The stocks of copper in England and France at the close of February are stated by Messrs. H. R. Merton & Co. at 44,943 tons, while 6600 tons are advised from Chili, and 1050 from Australia, making a total of 52,593 tons, as compared with 45,492 tons at the close of January, and 59,546 tons at the end of February last year. It is stated that the principal lead merchants of the United States have made an arrangement with the European lead producers for the "call" of their output for three years at £16 per ton. If this be correct, a rise in lead may be anticipated.

THE NAVY.—In the memorandum explanatory of the Navy Estimates, issued by the First Lord of the Admiralty, it is stated that a year ago it was anticipated that during the financial year 1887-88 twenty-five ships, with an aggregate displacement tonnage of over 90,000 tons, would be completed. This programme has been nearly realised. Six armoured ships have been completed, one completed with the exception of having her guns on board, and three will be ready in a few months. Fifteen protected and unprotected vessels will also be added before the close of the financial year. In addition, rapid progress is being made with the armoured ships "Camperdown," "Anson," and "Immortalité," and the protected cruiser "Forth." Work on the "Trafalgar" and "Nile" is well advanced.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 26th February, amounted to £1,063,955, on 15,831¾ miles; as compared with £1,106,437 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 122¾ miles, or 0·7 per cent., and a decrease in the receipts of 3·8 per cent. The Betchworth Tunnel, on the London and Brighton Railway Company's line, near Dorking, which has been closed since last July, when the roofing fell in, was re-opened for traffic last week. A new line was opened on the London and South-Western system, on Tuesday, between Brockenhurst and Christchurch, which considerably shortens the journey between London and Bournemouth. The line is between ten and eleven miles in length.

THE ITALIAN TARIFF.—The British Chargé d'Affaires at Rome informs the Foreign Office that the new Italian Customs tariff will be applied at once to all foreign imports except French goods, on which differential duties will be levied. Except in the case of goods imported direct from British ports, certificates of origin will be demanded in the case of all imports.

GLASGOW, 8TH MARCH, 1888.

STOCK EXCHANGE.—At a meeting of the members of the Stock Exchange, held last Friday, it was resolved to reduce the charges for commission on the purchase and sale of stocks. The rates upon certain classes of stocks are reduced 50 per cent. During the past week the market has fluctuated slightly, showing a hardening tendency in some securities.

COPPER SMELTING IN SPAIN.—The decree of the Spanish Government prohibiting open air smelting has caused some interest in Glasgow, owing to the large copper interests here. The prohibition, following upon the consolidation of the copper syndicate, is likely to have some effect in maintaining the advanced price.

SHIPBUILDING.—Messrs. T. B. Seath & Co., of Rutherglen, have received instructions from the North British Railway Company to build a paddle saloon steamer for their Clyde coast traffic. The new vessel is to be 200ft. long by 21ft. beam. The engines and boilers will be made by Messrs. Hutson & Corbett, Glasgow. An order has been placed by Messrs. Hermann, Stursberg, & Co., New York, with Messrs. Russell & Co., Greenock, for a steel screw steamer to carry 3500 tons of oil. The dimensions of the vessel will be: Length, 310ft.; breadth, 39ft.; depth, 25ft.

THE ADMIRALTY AND SCOTCH COAL.—H.M.S. "Devastation," now lying in the Forth at Queensferry, has been supplied with a quantity of Scotch coal. It will be remembered that representations were made some time ago as to the needlessness of bringing Welsh coal round by steamer for the use of the guardship.

ELECTRIC LIGHTING OF MUNICIPAL BUILDINGS.—At the monthly meeting of the Town Council, held on March 1st, the recommendation of the Committee on the New Municipal Buildings as to electric lighting was adopted. The Council decided to accept the offer made to them by Messrs. Muir, Mavor, & Coulson, for the supply of an electric current from their central station in Miller-street. The contractors will supply a current at a potential of 100 volts for 600 16 c.p. lamps, at a rate chargeable by meter of 5s. per 100 ampère hours. A minimum charge of £250 is to be made, a discount of 20 per cent. being allowed on charges above this. The contract is fixed for three years, with an option on the part of the Corporation to extend it should they think fit.

PHYSICAL SOCIETY OF GLASGOW UNIVERSITY.—At a meeting of this society, Mr. Maclean, President, in the chair, Mr. Thomas Gray, B.Sc., exhibited and described an improved apparatus for the determination of the intensity of the horizontal component of the earth's magnetic field. A magnetometer, consisting of a small magnetic needle, about 1 cm. in length, mounted in a light aluminium frame, carrying a small mirror suspended in a vertical glass tube, fixed to a wooden base plate, is supported on a light but rigid wooden frame, which is capable of turning round a vertical axis. Two deflector magnets, mounted on suitable stands, are carried by a strip of thick glass which turns round the same vertical axis in such a way that the deflectors are always on opposite sides, and at equal distances from the magnetometer needle. The method is, in principle, the same as that of Gauss, and the apparatus is a more perfect form of that described by Mr. Gray in the "Phil. Mag." for December, 1885, the *sine* method being adopted in this case instead of the *tangent* method, as described in the paper just referred to.

(From our own Correspondents.)

LIVERPOOL, 7TH MARCH, 1888.

NEW INDUSTRY FOR BEBINGTON.—On account of the ship canal works interfering with the soap works of Messrs. Lever Bros. of Warrington, they have purchased land at Bebington adjoining the Bromborough Pool, and have now commenced the erection of very extensive works, which, when completed, will cover nearly 3 acres. The buildings will be all fire proof, and will be divided into departments, each specially constructed for the different operations, and will consist of soapery, frame room, drying room, stamping room, offices, workmen's dining room, mechanics' and joiners' shops. There will be a railway shed, and a loading pier for the steamers of the firm, which will have easy access into the Mersey from the Pool outside the Liverpool Docks and Harbour Board estate, thus avoiding all dues. The amount saved on tallow for master porterage, railway carriage, dock and town dues, will be about 8s. 7d. per ton. Electric light is to be provided, and there will be a tower 90ft. high, with a capacious tank for fire extinguishing and other purposes. The foundation stone was laid on Saturday last.

THE TIMBER TRADE.—There has been very little import of Quebec pine during the last month, while the consumption has been larger than either of the previous two years in February, and if the present consumption continues the market will soon be empty. The present stock consists of about 144,000 cub. ft. square, and 148,000 cub. ft. waney. The imports of pitch pine have been 28,000 cub. ft. hewn timber, and 2000 cub. ft. planks; the consumption has been 76,000 cub. ft. hewn, 157,000 cub. ft. sawn, and 5000 cub. ft. planks; the present stock amounting to about 360,000 cub. ft. total, 78,000 cub. ft. of which is sawn. About 1000 cub. ft. of red pine have been consumed, a similar quantity now remaining in stock. During the past month there has been a large consumption of N.B. and N.S. spruce and pine deals. 115,000 cub. ft. of oak have been imported, the consumption having been 96,000 cub. ft.; the present stock is very large, amounting to 221,000 cub. ft. Honduras mahogany is in good request, and early supplies of Tabasco should command good prices. The last cargo of Minatitlan was sold by auction on the 27th ult., at full prices.

SHEFFIELD, 7TH MARCH, 1888.

THE HEAVY TRADES.—The output of Bessemer and crucible steel is very great, and the former particularly is growing in demand. Springs, tyres, axles, and other railway material are on order both for home and Colonial railways; and one firm in the locality is busy on best sections of rails for Continental use. The engineers are busy, chiefly for foreign customers; and China is ordering heavy manufacturing materials. At the rolling mills work is plentiful, and for ship plates there is a moderate call. Crucible cast steel castings are on extensive order, and the noted firms, who have made this branch a specialty, are well off for work.

LIGHT BRANCHES.—A fairly satisfactory trade is being done in cutlery and electro-plate. Travellers on the Continent report an increasing demand for general hardware, and orders for best descriptions of cutlery are more numerous.

LEAD.—Considerable interest has been aroused by the statement that a lead "corner" is being formed. If such turns out to be the case some of the Yorkshire and Derbyshire dales, rich in stores of lead, should be benefited. For years lead has been at such a price that it has scarcely paid for the getting. But with a prospect of higher quotations, and the promise of the Midland Company to construct a railway from Dore to Chinley, the mine owners of the Peak of Derbyshire may find that their opportunity is at hand.

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LEEDS, 7TH MARCH, 1888.

IRON AND STEEL.—Purchases of iron and steel have not been quite so extensive within the past few days, owing to rather firmer prices. Buyers are waiting, most of them being under the impression that quotations, in view of the keen competition, will fall again. Nevertheless, the demand for heavy material continues brisk. The makers of hydraulic machinery, and various descriptions of shipbuilding material, are very busy; and there is a good market for boilers, small engines, and some kinds of colliery plant. Railway material is also in request; and though orders for locomotives on home and foreign account are not so plentiful as they might be, still makers are sanguine that the steady development of railway enterprise must benefit them before long. It has been suggested that a railway on the Lartigue system should be made from Leeds to Roundhay Park. For station roofing, fencing, and similar work there are good orders on hand, and engineers' tools and cut nails are selling well.

TEXTILES.—Owing to the prolonged winter and the delay in the spring demand, many houses are only doing a quiet trade. Some firms are still busy with heavy woollens. The ready made clothing factories are working hard in anticipation of an extensive spring and summer demand. There has been a flutter in some quarters of Leeds about Lord Dunraven's inquiry into the sweating system in the East End. Many foreigners are employed in the ready made clothing departments of Yorkshire towns; and it is not unlikely that the sphere of the inquiry may be extended to the provinces.

NORTH STAFFORDSHIRE, 7TH MARCH, 1888.

STEEL WORKS.—The preparations of the Shelton Iron and Steel Company for the production of steel are now approaching completion, and the company hope to have their metal in the market in a short time. The progress of this new departure in local trade has been watched with much interest in the district, and its further successful development is awaited.

STAFFORDSHIRE CHAMBER OF AGRICULTURE.—At a well attended meeting of this chamber, held at Stafford on Saturday last, Mr. T. Carrington Smith, the chairman, introduced a discussion on the recommendations contained in the report of the Department Commission for the promotion of agricultural education by the establishment of farming or dairy schools, and he alluded to the generally prevalent desire throughout the country for some system of technical education. Mr. Smith briefly reviewed the principal suggestions of the committee in connection with agriculture, these being: (1) That increased facilities should be offered for the study of its principles in rural elementary schools, and that gardens, allotments, and farms should be encouraged in connection therewith; (2) that intermediate schools should be founded for this purpose; and (3) that a central school of agriculture should be established for Great Britain, probably at Rugby. The Railway Rates Bill now before Parliament was also discussed, and the following resolution unanimously passed: "That this chamber urges Her Majesty's Government to amend their Bill dealing with railway rates, so that such Bill should prohibit railway companies from charging preferential rates for foreign manufactured goods or imported produce."

BIRMINGHAM, 7TH MARCH, 1888.

THE HARDWARE TRADES.—Business in these industries is by no means so brisk as it was at the beginning of the quarter. This state of things is directly traceable to the speculative advance in the price of metals. By the action of the syndicate metals have been forced up to a position quite out of all relation to the demand for finished goods. Some manufacturers who were well stocked before the rise can do business at present prices with a profit, and they are underselling those who were not so fortunate or so shrewd. The orders for spring goods that are now coming in are certainly disappointing, this being, however, due to the bad weather, which is the chief factor in causing the briskness which exists among manufacturers of heating appliances, stoves, fenders, and similar goods. In brass tubes and sheets there is little doing, but for steel tubes and steel and iron locomotive and general railway appliances there is a fair demand for the Indian, Colonial, and other foreign markets.

THE WATER COMMUNICATION SCHEMES.—The committee appointed by the Birmingham Corporation to examine the various proposed schemes for establishing improved water routes between the Midlands and the sea coast have, it is understood, decided to report in favour either of the route *viâ* the Trent Valley to Hull or of the London scheme. Communication with Liverpool they consider equally important, but there is at present no definite proposal for a waterway in this direction. They are in favour of the work being undertaken by a public trust, and recommend that the Government should be asked to insert clauses in the Railway and Canal Traffic Bill empowering local bodies to deal with canal trusts.

SOUTH WALES, 7TH MARCH, 1888.

BARRY AND CADOXTON GAS WORKS—The directors of this company report that they hope to have the works ready to supply the district by the coming autumn. £2,232 had been expended up to 31st December, leaving a balance on the called up capital of £3,898.

THE WELL'S LIGHT.—Messrs. Cross Brothers, of Cardiff, have been exhibiting at the Hayes this economical form of "Lucigen." It is claimed that one lamp can produce a light of 2000 to 3000 candle power, at a cost of about 3d. per hour, and, no doubt, it will be found invaluable by contractors and for night work in large open spaces.

IRON PYRITES.—La Société Commerciale d'Affrétements and de Commission of Swansea and London are introducing an exceedingly pure ore almost wholly composed of iron and sulphur, which they are importing from Spain, and from which a very pure acid is obtained. Some lots recently imported are said to have given satisfaction, but the price, about £1 per ton f.o.b., militates against its extensive use.

BARROW-IN-FURNESS, 7TH MARCH, 1888.

GENERAL TRADE IMPROVEMENT.—The general increased confidence which has followed the resuscitation of the shipbuilding trade at Barrow, and the acquirement of the large yard of the Barrow Shipbuilding Company by the Naval Construction and Armaments Company, Limited, is showing itself in a variety of ways. Shop property which has been tenantless for years, is being taken up by tradesmen anxious to avail themselves of an improved trade which has yet to come, and the doleful hopes which were at one time entertained in reference to the commercial state of the town have given way to brighter anticipations for the future.

IRON AND STEEL.—There is no change to note in the iron and steel trades. Orders are freely offered for pig iron, but prices are at a very low point, and makers still decline to recognise the prices at which hematite warrants are changing hands, but quote 43s. 6d. to 44s. per ton net f.o.b. for mixed parcels of Bessemer iron, and at these rates some of the best brands have been sold. Stocks in the hands of merchants and speculators are large, and there is reason to believe that the production is too large. Steel rails are brisk at £3. 18s. 6d. for heavy sections. There is less inquiry for plates and angles, but makers are fully sold. Blooms, billets, hoops, and bars are brisk; but other classes of steel are slow of sale. There is a better tone in the shipbuilding, engineering, and ironfounding trades. Iron ore is quiet at late rates. Shipping in the district is fairly well employed.

MIDDLESBROUGH, 7TH MARCH, 1888.

PIG IRON.—The iron masters' returns for February have been a surprise. It was known that Connal's stores had been diminishing for some time, but few suspected the amount of decrease over the whole of the stocks. The 12,179 tons to which the decrease amounts should have its effect upon prices. The market, however, is more than ever in the hands of speculators. Makers are not doing much in the meantime, as they do not care to accept current prices, which are nominally 31s. 6d. for early, and 31s. 9d. for April-June delivery for No. 3 G.M.B. Warrants are 31s. 1½d. per ton cash for Connal's No. 3 G.M.B., and 42s. nominally for Connal's hematite. Makers' hematite being quoted at from 32s. to 34s.

SHIPMENTS OF PIG IRON.—These still continue to be favourable. Notwithstanding the boisterous weather the shipments for February exceed those of January by 5490 tons, and those of February last year by 14,170 tons.

FINISHED IRON AND STEEL.—The great activity in the finished iron trade has caused a scarcity of forge iron, which consequently has advanced in price so much that more has been given for forge than for No. 3—31s. 9d. and even 32s. having been paid under the pressure. In finished steel the pressure is chiefly on the plate departments. The steel rail trade is not so active, and very low prices are mentioned as having been accepted. There is still a very heavy turn-out of steel sleepers, and the docks are crowded with them, being shipped off to India and elsewhere.

SUNDERLAND, 7TH MARCH, 1888.

IRON WORKS.—There is now an activity in the local rolling mills and forges which has been unknown for years. Messrs. S. Tysack & Co., of the Fulwell Iron Works, have all their puddling furnaces in operation. The forges of Mr. Thomas Ray, Messrs. J. L. Thompson & Sons, and Messrs. Calvert & Co., are especially well supplied with work. Messrs. Lumsden & Co., Limited, of the Strand Iron Works, have also been successful in securing a number of orders for anchors and chain cables from local shipbuilders.

COAL SHIPMENTS.—The coal trade returns for last week are more favourable than for the previous one, 77,500 tons being shipped, 59,200 tons coastwise, and 18,300 tons to foreign ports. In the corresponding week of last year the total shipments were 69,917 tons; 950 tons of patent fuel, and 580 tons of coke were also shipped during the last week.

SUNDERLAND SHIP OWNERS' SOCIETY.—At the last meeting of the local Ship Owners' Society, it was reported that a communication had been received from Mr. B. Waymouth, secretary to Lloyd's Register, stating that the representation of out-ports was amended as recently as 1883, and that the committee saw no reason for increasing the number of representatives for Sunderland and other out-ports. After some discussion, in which regret was expressed that the Liverpool Underwriters' Registry no longer existed, the formation of a new opposition classification society was advocated, and it was ultimately agreed to communicate with the Clyde and Newcastle Associations to endeavour to arrange for further joint agitation.

NEWCASTLE, 7TH MARCH, 1888.

SHIPBUILDING.—Judging by the appearance of the yards the shipbuilding industry in this district is now in almost as satisfactory a condition as it was at the height of the busy period which terminated in 1884. The most notable event which has recently occured in connection with the industry, is the re-opening of Messrs. Palmer's Howdon yard, which took place towards the close of last week. The keel for a vessel of the largest class is now being laid in one of the berths, and arrangements are in progress for the laying down of several other keels immediately. It is estimated that by midsummer at least 1000 hands will be employed at this establishment, which has been unproductive for the past four years; and there is reason to believe that its re-opening has not, on the present occasion, been resorted to as a mere temporary expedient to work off pressing orders, but that the firm intend to keep it permanently going in the future. At the Jarrow yard belonging to the firm there are seven vessels, representing over 20,000 tons carrying capacity, on the stocks, and other large vessels are to be laid down as soon as berths are ready for them. Messrs. Hawthorn & Leslie have put down keels for four vessels lately, and two others are being plated and framed. Messrs. Armstrong, Mitchell, & Co. are commencing the construction of three large vessels at their Low Walker yard, while two others are in frame, and a sixth (intended for the petroleum trade) is being prepared for launching. Messrs. W. Richardson & Co. have just put down two keels, which, with the vessels in progress, make five berths occupied. The firm have ordered from a Sunderland boat builder thirteen boats (eight of them lifeboats) for a large mail steamer they are about to launch, and which, it is understood, has been sold to a Spanish company. Messrs. Swan & Hunter have on the stocks four large vessels, one of which will shortly be launched; and Messrs. Schlesinger & Davis, who at present have only two berths occupied, will shortly have double that number in use, as they have just secured orders for two vessels. The Tyne Shipbuilding Company are busily pushing on the work of three large vessels ordered by local owners, and they have other important orders on their books. Messrs. Readhead and Messrs. Dobson have all their berths occupied, and Messrs. R. Stephenson & Co. have three keels laid, besides a vessel in course of plating.

ENGINEERING.—Every large marine engineering establishment on the river is now quite full of work, but, as in other departments of the engineering industry, trade is not so brisk, and nothing like a scarcity of hands has yet been experienced. Messrs. Hawthorn & Leslie are now engining the second of the Chinese passenger steamers lately launched from their Hebburn yard. In the locomotive branch business is not particularly good, and some establishments, which formerly made this class of work their exclusive specialty, are now largely engaged in marine work. The ordnance works at Elswick are scarcely so busy as they were a few months ago, and a gradual reduction of hands has been taking place for some time past. The brassfounding department of Messrs. Watson & Son's establishment, High Bridge, Newcastle, is especially brisk at present, and they have a great many orders for their special pumps for steamship use. This firm are about to introduce a new "mechanical lubricator," the invention of Mr. J. R. Fothergill, of Hartlepool. The makers have formed very high expectations regarding the success of this invention, and their confidence appears to be well grounded, seeing that in a recent trial at sea, extending over a period of two months, it proved admirably adapted to the purpose intended. It may be stated that it gives a constant sight feed, and appears to be quite free from the objections known to exist in condensing lubricators. Messrs. Noble & Lund, machine tool makers, Forth Banks, have been very busy for some time past, and have still several orders to execute for machine tools of various descriptions.

BELFAST, 7TH MARCH, 1888.

SHIPBUILDING.—Great activity is still the rule in the various yards, and the stocks are rapidly filled up with vessels of large tonnage. During the past fortnight Messrs. McIlwaine & Lewis launched a large steel screw steamer named "Titanic," for Messrs. H. & J. Scott, of Belfast; and Messrs. Workman, Clark, & Co., Limited, launched the first of the two caissons for H.M. Dockyard at Haulbowline. Messrs. Harland & Wolff are reported to have received an order for a large screw steamer, one of four just placed with various builders by a Liverpool firm for their Atlantic, Mediterranean, and Danube trades. This firm has also completed and handed over the s.s. "Oceana," the latest addition to the Pacific and Oriental Company. This fine vessel was entirely built, engined, and equipped at Belfast. Repairs are more numerous than earlier in the winter, and several cross Channel steamers are at present undergoing their annual overhaul.

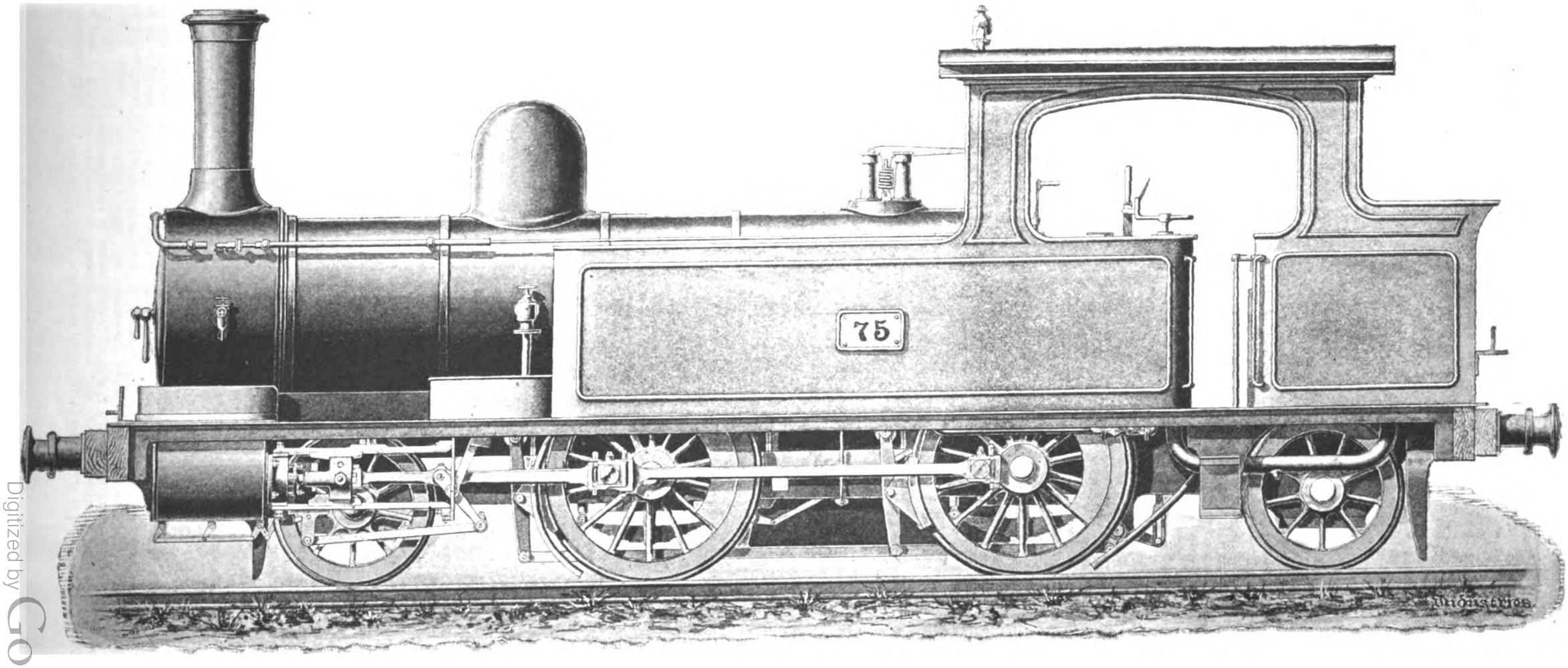
MINING.—Two important discoveries have been made in the North and South of Ireland. Syenite of the finest quality and of a rich emerald green colour has been found by Mr. Joseph Weir, Rosstrevor, in one of the hills of the Mourne range, which was already known to contain red and grey granite. Gold has also been found near Dunmanus Bay, County Cork; several samples of the quartz have been assayed, and have been found rich in gold. The lode is said to be about 1¼ mile long by 6ft. wide.

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TANK LOCOMOTIVE FOR THE JAPANESE GOVERNMENT RAILWAYS.

CONSTRUCTED FROM THE DESIGNS OF MR. F. H. TREVITHICK, LOCOMOTIVE SUPERINTENDENT, BY MESSRS. NASMYTH, WILSON, & CO., LIMITED, ENGINEERS, BRIDGEWATER FOUNDRY, PATRICROFT, NEAR MANCHESTER.

(For description see page 240.)



SIDE ELEVATION.

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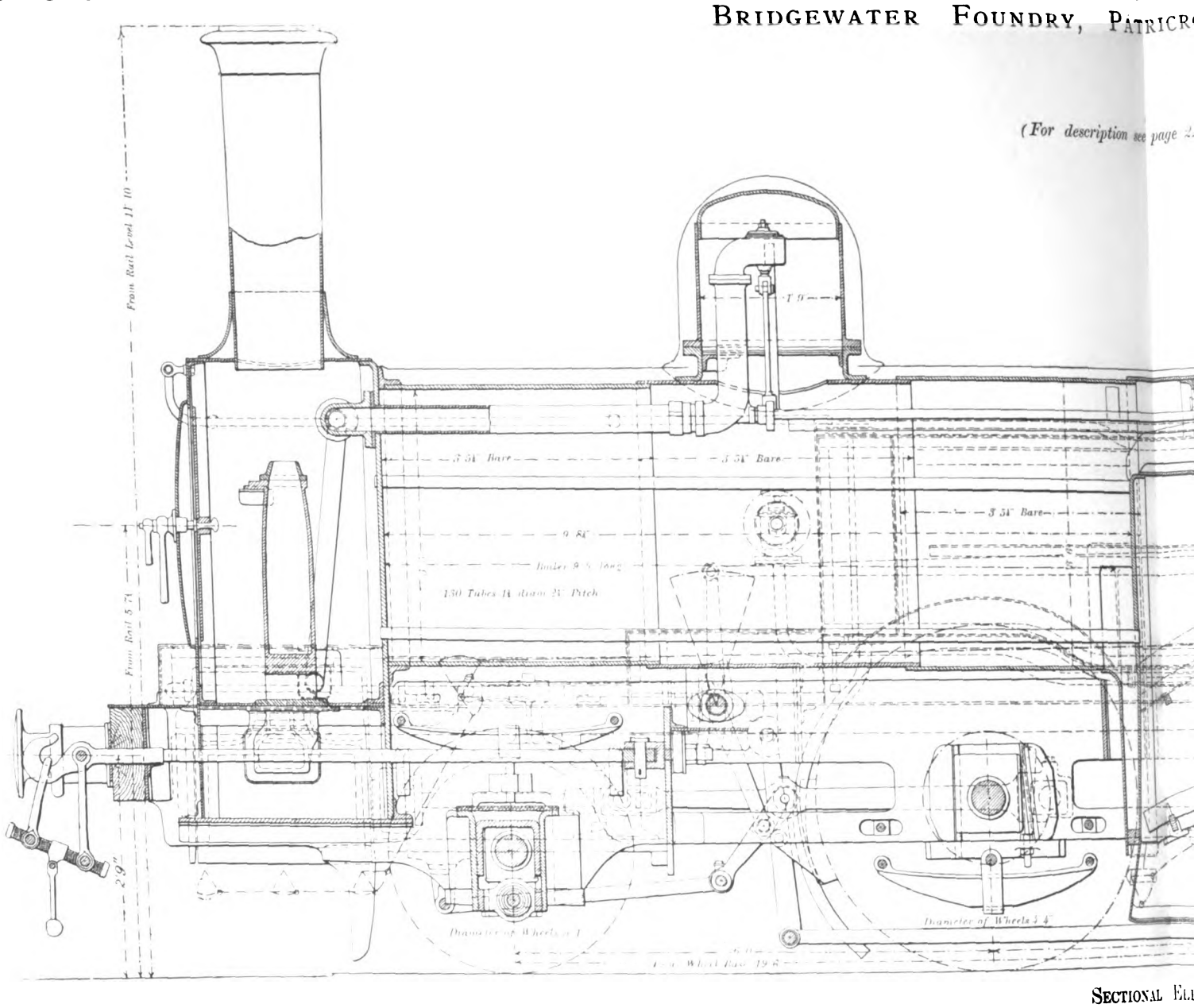
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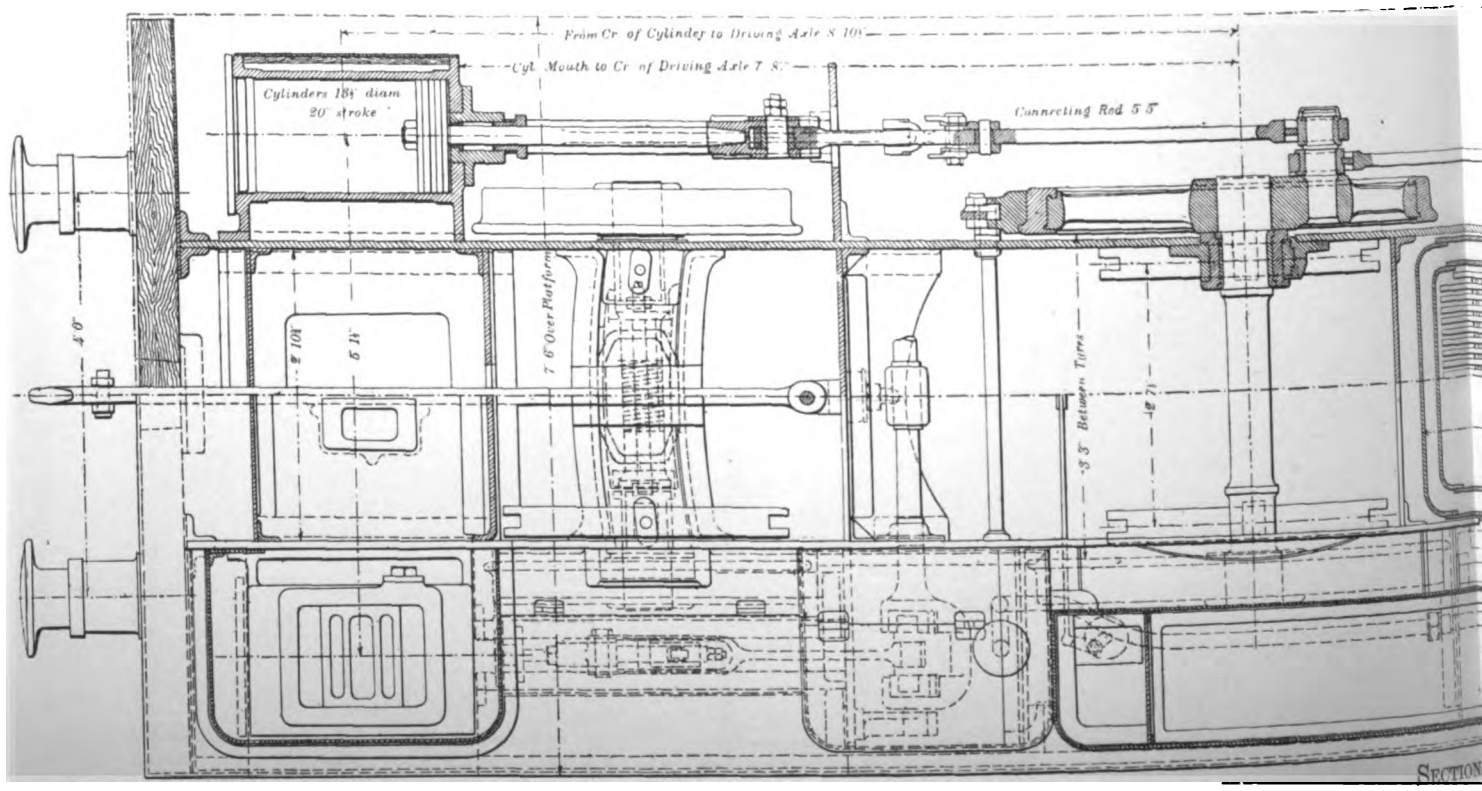
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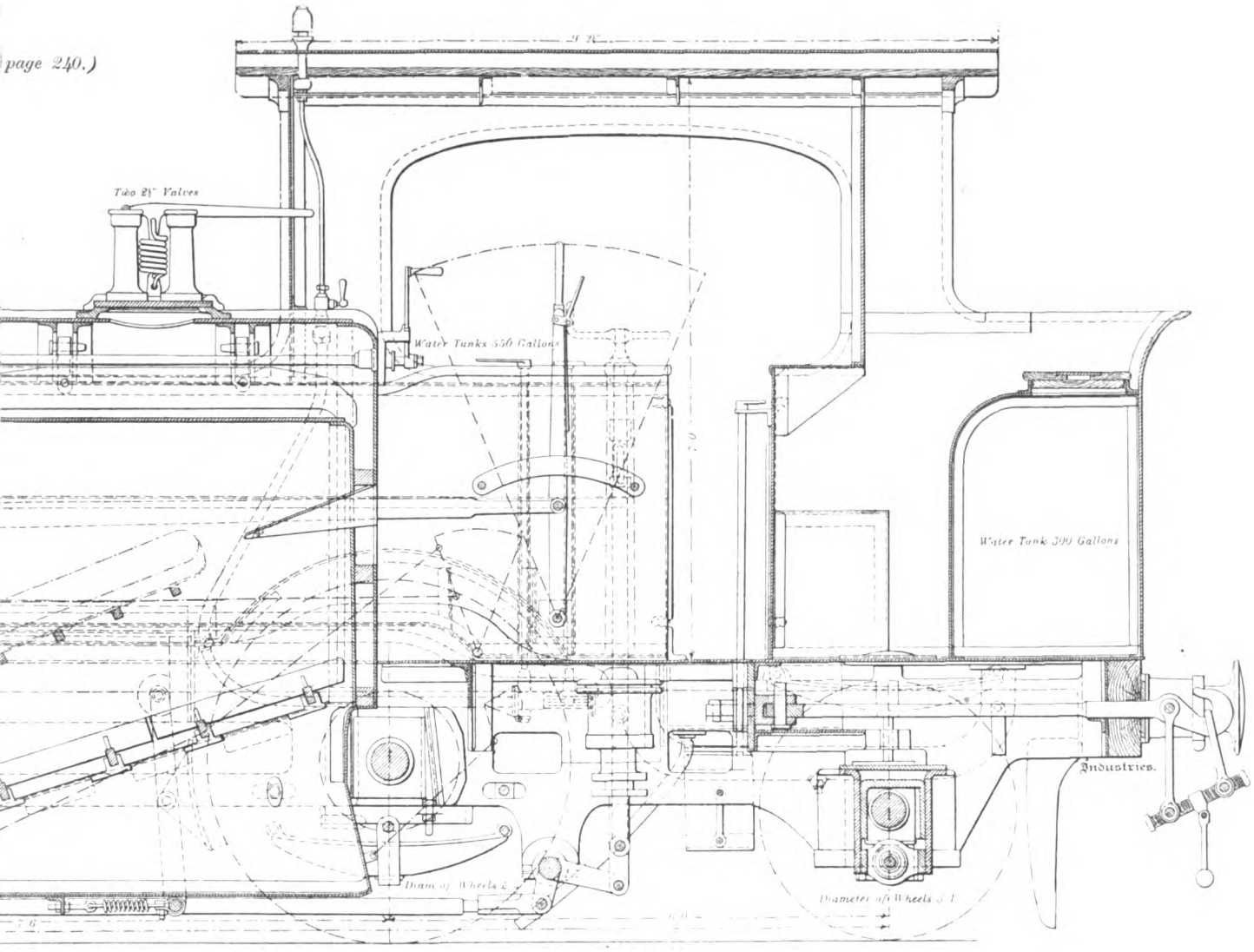
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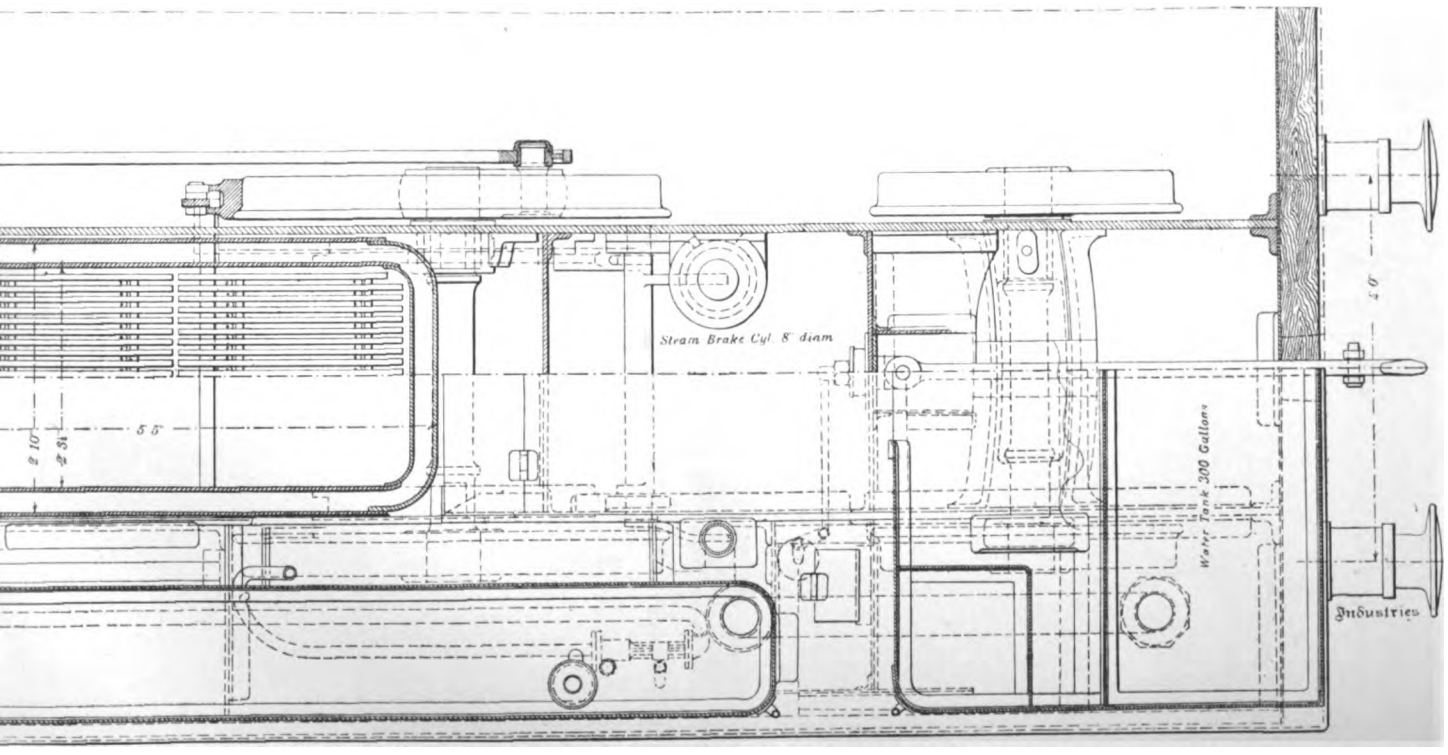
JANESE GOVERNMENT RAILWAYS.

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„ INTERNATIONAL NEWS Co., 31, Beekman-street, New York.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
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Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 9TH MARCH, 1888.

THE PARIS EXHIBITION.

IT is gratifying to learn, from the proceedings which took place at the Mansion House on the 29th ult., that the unfriendly attitude assumed by our Government towards the great French Exhibition of 1889 will not have the baneful influence on British industry which at one time seemed inevitable. The question, hitherto obscured and distorted by political animosities, begins to offer itself in another and a truer aspect. Viewing it in this new light, we are disposed to regard with wonder the spectacle of our rulers, and others in exalted stations, holding aloof from an undertaking of this character on the ground of a coincidence of dates, that seemed to impart to it political significance. The anarchist party in France has striven to connect this Exhibition with the centenary commemoration of the Great Revolution. But for the great majority of persons it is but a repetition of the scientific, industrial, and artistic show held in Paris in 1878. Its character is mainly industrial. It is designed to exhibit the progress made within the last eleven years, and to afford an opportunity to manufacturers to ascertain their relative position in the industrial world, and to buyers to inform themselves concerning the actual state of industry and trade. It would ill become us, who pride ourselves on our practical good sense, to refuse to take part in an exhibition of this nature on mere sentimental grounds. Happily this folly is not likely to be committed. The spirit of independence which animates our manufacturers has been aroused, and a vigorous effort is being made to repair the mischief done. After all the attitude of the Government is not wholly to be regretted. Individual enterprise has been stimulated to action, and British manufacturers, left to their own resources, have found the occasion one in which they may dispose of their affairs in the way most conducive to their interests. The co-operation of the Government in past times has not been productive of unmixed good. Unpleasant recollections gather round what is known as the "South Kensington ring." It is not our business to seek out the grounds of this discontent; it is enough that it exists. Clearly, with this distrust on the one side, and irritation on the other, there could be no sympathy between the representatives of the Government and those in whose interests they were deputed to act. As matters now promise to shape themselves, there is hope of obtaining efficient representation through an organisation composed of chosen members, and subject to control. Thanks largely to the initiative of M. Berger, and the hearty co-operation of the Lord Mayor, a movement has been set on foot to promote this object. Already their efforts in this direction have borne fruit in the appointment of a Provisional Committee and the formation of the nucleus of a fund for carrying the project of a complete Executive Committee into effect. This committee will allot space to exhibitors, make and collect such charges as may be necessary to cover the costs of the British Section, and generally look after the interests of the parties concerned. The influential character of the Provisional Committee is a guarantee of success; it now remains for intending exhibitors to second the efforts made on their behalf by responding promptly to the invitation.

No argument is needed to force home the obvious truth that British industry must be amply represented at Paris in 1889. The occasion will be one of perhaps unparalleled importance. Place and time are favourable to the event. Paris is a peculiarly suitable spot for an exhibition of this sort, being easily accessible from all parts of the Continent, and a centre to which men from all parts of the world seem naturally to gravitate. The period, if only peace be preserved in Europe, is likely to be one of brisk, if not thriving, trade. In such circumstances, absence, or what would perhaps be worse than absence, an imperfect and mean exhibit on our part, would amount to a confession of weakness very damaging to our reputation. It would be to relinquish to our rivals all the advantages of the situation. The time has gone by when we could treat our customers in this masterful fashion. We have already lost heavily from our unwillingness to admit the possibility of a rival becoming formidable. Year by year competition grows keener, and in 1889 the Champ de Mars will become an arena in which the struggle for supremacy will be very fiercely engaged in. What the United States Government thinks of the opportunity is sufficiently shown by its grant of £40,000 to insure a fitting representation of its manufactures. Besides the United States, and the Central and South American Republics, Switzerland, Greece, Servia, and Japan will be officially represented. The countries which will be unofficially but probably largely represented are Great Britain, Belgium, Holland, Italy, Spain, Portugal, and Turkey. Executive committees are being organised at Vienna, Buda-Pesth, St. Petersburg, and Warsaw. England and Germany are the only countries where no National Committee has been formed; but the latter country now seems disposed to abandon the attitude of reserve hitherto maintained. Of our colonies, New South Wales, South Australia, Victoria, and New Zealand will be strongly represented. The Canadian Government is disposed to aid any of its subjects who wish to exhibit, and arrangements are being made to give prominence to Indian produce. To mention these facts is to show the impossibility of abstention on our part.

An important question for intending exhibitors is that of cost. In this matter the French Government promises to deal liberally with its guests. Space in the Exhibition will be allotted free, but a charge will be made to cover the cost of flooring, partitions, decoration, and general supervision. These items will together amount to a sum varying from £1 to £1. 10s. per square metre of flooring. The total space reserved for the British Section is about 5500 square metres. It will be well to warn intending exhibitors that gangway space will be deducted; that is to say, of 100 square metres applied for, only about 50 or 60 square metres may be available for stands. Here the proposed Executive Committee will confer advantage by economising expenses, and acting as intermediary between the French authorities and the exhibitor. Stands and glass cases and covers for the exposition of goods will be received and returned duty free, as in 1878. The cost of installation in the case of machinery in motion will depend on the magnitude of the works required for foundations. The aggregate of the costs in the agricultural section will scarcely exceed 15s. per square metre. An important consideration is the cost of transport. This has been reduced to a minimum by the generous con-

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cession of 50 per cent. on the ordinary rates charged by the French railway companies for all goods conveyed to and from the Exhibition, except works of art and specially valuable articles. A uniform charge of 10 francs a ton will be made for the conveyance of goods from the railway station to the Exhibition building. The French authorities are careful to point out that the whole of the material required for the fitting up and decorating of the British Section may be worked up in England and imported duty free at these reduced rates. The representatives of the London, Chatham, & Dover, and the South-Eastern lines present at the Mansion House on the 29th, expressed their willingness to afford exhibitors every facility for the transport of goods. The Lord Mayor says he is acting with the full approval and concurrence of the Government. There should, therefore, be no insuperable difficulty in the way of carrying out the project which he has undertaken to promote. The way has been cleared, and it now rests with the manufacturers themselves to evince their interest in the matter by contributing their share in the furtherance of the scheme.

ELECTRIC LIGHT LEGISLATION.

Lord Thurlow's Electric Light Act Amendment Bill was read a second time in the House of Lords on Monday last. The arguments brought forward in support of the Bill, and the discussion which followed, did not materially differ from what took place in the House of Lords about a year ago. At that time everybody was agreed that the Electric Lighting Act of 1882 should be amended, and yet owing to political complications nothing could be done in the interval. We referred to this question in our issue of the 11th March, 1887, and the arguments we then used in support of the Bill are still valid, but since that time they have acquired additional force. A year ago the distribution of electricity by alternating currents and transformers was just beginning to make headway in the United States. At the present moment this system forms one of the most important industries in that country; and to judge by the rate at which it has come into favour, a further and much larger development of it will doubtless take place within the present year. Well might English electricians cast envious glances upon their successful American rivals, who, instead of having to wait for the removal of restrictive legislation, can devote all their energies to actual practical work, and do a large business, which benefits not only themselves but also their customers. Lord Thurlow, in introducing the Bill, pointed out that since the passing of the Electric Lighting Act of 1882, fifty-nine provisional orders and five licenses had been granted to companies, and fifteen provisional orders and two licenses to local authorities. We need hardly remind our readers that in nearly all these cases these powers were obtained not with a view to immediately begin work, but simply for the purpose to hold the field against possible rivals, who might otherwise have later on acquired the right of supplying electricity to the districts concerned. The companies and local authorities who applied for licenses or provisional orders had at the time of their application no very distinct idea how to set about for doing the work; but they thought it prudent to take such a legal position as would enable them at any future time, when they could elaborate a definite scheme, to carry this into execution. Unfortunately, this time had not arrived when the provisional orders lapsed, and most of these enterprises may now be regarded as finally shelved. The position of the electric lighting industry in this country may therefore be truly described as anomalous. Notwithstanding the fact that England was first in developing the dynamo machine, the storage battery, the glow lamp, the transformer, and various systems of distribution on a scientific basis, we have hardly any large central stations for the public supply of electricity, whereas in the United States there are, according to Lord Thurlow, 120 electric light companies, paying dividends of from 6 to 14 per cent., and in Germany there are 604 companies supplying electricity. Even in a country like Italy, which we are apt to regard as being backward in modern improvements, the electric light is making rapid headway in all the large towns. Viewed in the light of these facts, insufficiency of apparatus cannot be pleaded as the reason for the absence of progress in this country, and we must look for the causes to legislative restrictions, and the timidity of capitalists. We are assured by Lord Thurlow that about one hundred millions worth of capital could find useful employment if the legislative restrictions to electric lighting were removed. This figure, though very large, does not seem excessive if we consider that the estimated capital of American electric lighting undertakings has already reached about forty millions.

Now what are the legislative restrictions which prevent the useful employment of this capital and a proportionate amount of labour? First and foremost it is the clause providing for the compulsory purchase of the central station by the local authorities at the expiration of twenty-one years. Lord Thurlow in his Bill last year suggested that if compulsory purchase without making any allowance for goodwill was to remain a provision of the Bill, this purchase should not take place before the expiration of fifty years, or at least forty-two years; but on the whole he should prefer to shorten the preferential term, and provide for a system of purchase under which the station would be taken over as a going concern, with a fair allowance for the goodwill of the business. In the present Bill the term of compulsory purchase is settled at forty-two years, and we think no reasonable objection can be urged against the clause. To object to compulsory purchase after forty-two years on the ground that the electric light contractors would during that period not have had sufficient opportunity for recouping themselves for their outlay, would be tantamount to a confession that the supply of electricity must be a losing business, and such a proposition must of necessity prevent capitalists from investing money in electric light undertakings. If American companies find it possible to earn a dividend of from 6 to 14 per cent. within a few years of establishing their stations, there is no reason why English companies should not do the same. That the price of gas is less in England than in America can hardly influence the dividends of electric light contractors. We know perfectly well that at present we cannot supply the electric light as cheaply as gas light, but then the electric light is an article of luxury for which consumers will gladly pay two or three times what they now pay for gas. On the other hand, it is probable that, with improvements in the manufacture of incandescent lamps, the cost of lighting will yet be considerably reduced. We have lately heard of a new glow lamp brought out in Berlin, which requires only 2·25 watts per candle power. Compared with the usual incandescent lamp, this is a reduction of about 40 per cent. in the energy required to produce a given amount of light. Dynamos, storage batteries, and transformers are all being continuously improved, so that it is not unreasonable to expect that within the next few years the cost of supplying the electric light will be considerably less than what it is now. Hence, if it be possible for a central station at present to earn a dividend, when these improvements come into use the profits must naturally increase, so that a station started now may, with good management, count upon earning a very substantial dividend for the next forty-two years, after which the proprietors may well afford to sell the plant at its ordinary market value, without any allowance for goodwill. In order to work at a profit it is, however, absolutely necessary that contractors should have a limited monopoly. The supply of electricity, like that of gas and water, is in itself of such a nature that it cannot be carried on profitably except on a large scale, and to do this it is evidently important to prevent indiscriminate competition. The hardships sometimes inflicted by water companies on consumers are frequently cited as a warning why we should not allow electric light companies to obtain any monopoly; but it must not be forgotten that the two cases are totally different. Water is an absolute necessity of life. If a water company refuses to supply certain persons in a district, except at exorbitant charges, they not only prejudice the health of the persons so treated, but that of the whole district. On the other hand, if an electric lighting company were to refuse to supply certain persons in a district, these could always fall back upon gas or some other means of illumination, without suffering in health to anything like the extent which would result from their failing to obtain water, whilst the sanitary condition of the other consumers in the district would of course not be affected in the slightest degree. The objection to a monopoly is therefore not based on sanitary grounds, but is simply a commercial question. This objection may therefore be met by stipulating a fixed maximum charge for current, or by a sliding scale; but even if the charge for current were left an open question, to be settled by an agreement between the electric light company and their customers, no great difficulty could arise. Electric light companies have to meet the competition of other illuminants, and of electricity itself. At present large establishments in London are lighted electrically, the current being supplied by machinery on the premises; and it will obviously be to the advantage of the central station to induce these large establishments to become customers. It is therefore necessary that the company's charges to these large customers should not exceed the cost of producing electricity on their own premises, and if a clause were inserted into the Bill rendering any preferential treatment of large customers illegal, small customers would secure a supply on equally favourable terms.

Whilst we thus see no reason to object to giving electric light companies a monopoly for the supply of electricity, we think a clause should be added to Lord Thurlow's Bill prohibiting the use of overhead electric light wires. At present the only large central station in London—that of the Grosvenor Gallery—distributes electricity by wires stretched over the house tops and crossing the streets in all possible directions. These wires are of necessity a source of danger, not only because they are themselves liable to break and fall into the street, but also on account of the telephone and telegraph wires with which they might become entangled. Only a few weeks ago a case happened in New York, when a telephone wire snapped and fell across an electric light wire. A horse was entangled by the telephone wire and killed by the shock, whilst the driver, who went to disentangle his horse, was fortunately pulled back by a bystander, and thus escaped the same fate. Accidents of this nature are almost sure to happen if we allow high tension overhead wires to multiply indefinitely, and we hope that a clause will be inserted before the Bill becomes law under which no electric light wire of any description whatever will be allowed to be placed overhead.

PROSPECTS OF BRITISH AND GERMAN TRADE WITH ITALY.

The failure of the negotiations for the renewal of the treaty of commerce between Italy and France has directed attention to the commercial relations existing between those two countries. Interest in the question, already strong from its important bearing on the trade of Europe, has been intensified by the attitude of resistance and retaliation assumed by the French. A war of tariffs is threatened, an event that must necessarily modify in no inconsiderable degree some of the conditions under which commercial intercourse is now carried on. Italy and France, naturally bound together by the ties of race, have hitherto been closely allied in trade. Their mutual dependance, preponderating, indeed, largely on the side of the former, is strikingly apparent in the statistics of trade for the year 1886, the latest complete issue. From these we learn that the Italians sent one-half of their exports of all sorts to France, while one-third of all their imports was made up of the commodities received from the latter country. The total value of this trade amounted to £33,120,000, of which sum the exports make up £19,280,000 and the imports £13,840,000. The Italian goods purchased by French consumers consist principally of raw silk, wine, oil, cattle, and food stuffs. The French goods sold to Italian customers are chiefly the products of manufacturing industries. Of late years a certain degree of estrangement has arisen between the two peoples. Political jealousies have contributed something towards this antipathetic feeling, and something more has resulted from the agitation got up in France against the employment of Italian workmen. A consequence has been a gradually increasing loss of trade to France. The latest and not the least potent event tending to engender unfriendly sentiments, is the refusal of the Italian Government to continue to their Gallic neighbours the favour accorded them by the treaty which expired with the year 1887. This refusal has given rise to some bitterness of feeling among the French, who show their resentment by threatening to impose heavy additional duties on all goods of Italian origin. Already steps have been taken to carry this threat into effect, and a war of tariffs, which thus seems probable, must very seriously derange the commercial relations now existing between the two countries, and occasion a diversion of trade in several directions. Here arises the interest felt strongly by the Germans, and in a scarcely less degree by ourselves. The French hope to obtain a sufficient supply of the commodities hitherto derived from Italy, from Spain, Hungary, Algeria, and Tunis. But it will not be so easy to find equivalent outlets for their own goods. In this respect the Italians have the advantage. They can easily enough supply all their wants from Germany and England, and extend their export trade at the same time to Switzerland, Germany, and Belgium. Obviously, then, the changes which are taking place will be favourable to German and to British trade.

The course of political events in recent times having brought about community of interests between Italy and Germany, friendly relations have been established, resulting in close intercourse, and a transference to the latter country of a portion of the trade formerly possessed by France. These changes in the current of trade were rendered possible by the creation of better means of communication between Germany and Italy. The opening of the St. Gothard Railway in 1881 supplied what was wanting for extensive commercial intercourse, and marks the beginning of that remarkable growth of trade which has profoundly disturbed the industrial situation in France, and awakened apprehensions for British commerce with the Italian peninsula. The statistics of German

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trade with Italy afford instructive reading, and it would be hard to find a parallel case of rapid growth. In the five years ending with 1886, the declared value of the German exports rose from £2,640,000 to £5,160,000—that is, it was practically doubled in half a decade. The value of the French exports shrank in the same time from £14,400,000 to £13,840,000. The increase is general; but it is chiefly observable in the commodities which form the bulk of British trade. The progress recorded in some of these is startling. Thus we find such rates of increase as the following: Coal and iron, from £440,000 to £1,280,000; woollen goods, from £360,000 to £520,000; cotton goods, from £240,000 to £320,000; colonial wares, from £320,000 to £400,000; chemical products, from £80,000 to £240,000; leather and leathern goods, from £160,000 to £240,000; glass ware, from £80,000 to £240,000; and silk goods, from £100,000 to £200,000. We have in these figures unquestionable evidence of vigorous life, and an indication of what that life may develop into in the future. If changes of this magnitude could take place under the conditions which have prevailed in the past, we may reasonably anticipate further progress when a war of tariffs between France and Italy shall have more profoundly disturbed the relations hitherto existing.

These events and tendencies claim the earnest attention of British traders. New influences are at work and changes are in progress which will affect for good or for evil—according as we bear ourselves in the matter—our position in the industrial world. If we are content to remain supine in the midst of these changes—to let events take their course without an effort to direct them, then all the advantages of the situation will be acquired by our more enterprising rivals, the Germans. But if by prompt and decisive action judiciously directed, we bring our superior influences to bear, we may turn to our own profit the opportunity afforded by these altered circumstances. We showed on a former occasion how the new traffic will tend to expand our trade with Italy in coal and pig iron to the detriment of Germany. This advantage is ours without seeking it. But to make advantages in other directions against German competition, to turn to account the present and prospective relations of France to Italy, there is need to bestir ourselves. Our trade has hitherto not shown the same vitality that distinguishes that of our rival. The total declared value of our exports to Italy amounted in 1882 to £6,480,000. In the following year this value increased to £7,122,000, from which point it gradually declined to £6,092,000 in 1886. It is true that last year it expanded to £7,794,000, an increase of £1,702,000 in one year. But we must not delude ourselves into the belief that this represents a genuine growth of trade. In part it is doubtless real. Thus we have an increase of £84,666 in coal and £136,869 in pig iron, which may be considered permanent gains. But in the main the augmentation is to be attributed to speculative dealings entered into in anticipation of the new tariff. The direction in which we may hope to gain by the conjuncture of events under consideration is chiefly that of textile goods. The products of French mills exported in 1887 to Italy amounted in value, for woollen cloth and stuffs, to £688,000, and for the heavier classes of cotton goods to £144,000. Raw wool to the value of upwards of £235,000 was also exported in the same year. Whatever shrinkage occurs in this trade must be made up by additional purchases from German and British manufactures. Add a growing consumption, and we have a fair prospect of expanding trade. But whether—and this is the point to which we wish particularly to direct attention—the advantage is to accrue mainly to German industries, or is to be largely shared by our own, is a matter that depends wholly upon ourselves. The times call for energetic action and a display of tact on our part. For this reason it is to be regretted that events have occurred, and are still in progress, of a character calculated to prejudice our interests with our Italian customers. We allude to the action which some ship owners have taken in the matter of freights to Genoa. Insufficient accommodation in that port has occasioned delays in unloading that have provoked British ship owners to retaliate with greatly increased freights. This obviously is playing into the hands of our rivals. The Chambers of Shipping and of Commerce may find a profitable occupation in seeking a less objectionable means of facilitating the discharge of cargo in Italian ports.

THE RAILWAY COMPANIES AND THE CARRIAGE OF FISH.

Under the auspices of the National Sea Fisheries Protection Association, and of Sir E. Birkbeck, its chairman, a short Bill has been introduced into Parliament to secure one uniform scale of through railway rates and charges—which may be unhampered by terminals—for the carriage of the common kinds of fish by the various railway companies of the United Kingdom. The provisions of the Bill are directed to relieving the congested state of our central wholesale markets, by obtaining reasonably cheap and rapid transport for the common kinds of sea fish, in quantities of 1cwt. and upwards, from the coast to the various inland centres of population, and thereby securing a plentiful distribution amongst our inland towns and villages, and other impoverished centres; but they are not intended to interfere with the rates now levied for prime fish, nor with those for quantities of less than 1cwt. of common fish. At the present time the rates charged under the authority of various Acts of Parliament for the conveyance of the common kinds of fish vary under different conditions and circumstances, and are often so oppressive as to retard the development of our sea fishing industry, and to restrict the distribution and consumption of this nutritious class of food. If the measure we now refer to becomes law, it will be known as the Railway (Carriage of Common Kinds of Fish) Rates and Charges Act, 1888, and will come into operation on the 1st of January, 1889. It will govern the charges for conveyance of forty-one different kinds of fish, the trade in some fourteen of which is already a large one, and may be expected to receive a considerable impetus. The revision of the existing rates proposed by the Bill is certainly of a drastic character, amounting in some instances to a reduction of over 100 per cent.; but having regard to the general circumstances of this industry, to some of which we propose to allude, and to the increase which may be anticipated to result in the volume of traffic, we are of opinion that, while conferring an inestimable benefit on the poorer classes, it would not detrimentally affect the revenues of the companies concerned. In this connection, however, some means should be contrived to insure the benefit of the proposed revision in the rates reaching the consumers, and not finding its way simply into the pockets of the retailer. This point we commend to the attention of the Conference of representatives of the sea fishing industry to be held in London during the present month.

At some of the large works and institutions of our industrial centres, quantities of the common kinds of fish are regularly purchased direct from the sea ports, and disposed of amongst employés and dependants at a price sufficient to cover the prime cost, carriage, and incidental expenses, which should average all round something under 3d. per pound. It may, perhaps, be necessary to guard here against any possible misconception of the expression "common kinds of fish." It embraces those genera of a popular character, such as cod, herrings, mackerel, shrimps, &c., as opposed to what are recognised as "prime fish," such as salmon and soles, and does not in any way touch the question of quality. The Bill also provides for the return of empty packages used in the conveyance of common kinds of fish at a charge which shall in no case exceed half the prescribed rate for the same package if it were full, and the charge is to be calculated on its actual weight as delivered to the railway company.

This is not an unfitting opportunity to direct public attention to the lack of practical results from the "Fisheries" Exhibition, which was held in London several years ago, and to the vast importance of promoting a better acquaintance with the existing conditions of our British fishing industry. In 1886, Sir E. Birkbeck obtained the assent of Mr. Mundella, as representing the Government, to his motion for the establishment of a central department, to be charged with the care and control of all the fisheries; but, owing to the exigencies of Parliamentary business, the matter has since been shelved. While the German Government carry on considerable and detailed investigations in connection with their fisheries, while statistical returns are annually published by the Norwegian Government, while the United States and Canada collect every possible information as to the productiveness and value of their fisheries, and while the Scotch Fishery Board is doing a work of great utility, England alone, though so largely dependent upon this industry as a source of food supply, and as a field of occupation, not only is without a special State Department in this connection, but actually publishes no reliable information indicative of the true condition of our fisheries, and showing whether their productiveness is increasing or decreasing. In consequence of the division of authority in fishing matters amongst different departments, the spasmodic investigations and reports of Royal Commissions have been practically fruitless. Salmon and fresh water fish that do not migrate to the sea come under the supervision of the Home Office; oysters and bait fisheries are looked after by the Board of Trade; other sea fisheries, if in English territorial waters, also come under the control of the Board of Trade, but if outside that limit, under the Foreign Office and the Admiralty; while fish landed in English ports fall under the purview of the Customs. Under such conditions it is not a matter for surprise that information obtainable with regard to our fisheries is meagre and unreliable. And yet there would seem great advantages to be derived from a regular publication of statistics of the take of fish, the time of the appearance of fish, the different conditions of temperature, wind, tide, and weather under which fish is taken, the abnormal or normal appearance of fish, and such like information. That the industry in question is of no mean importance may be gathered from the fact that the value of fish which is annually cured in Great Britain reaches a sum of £5,000,000 sterling; and there can be no doubt that a considerable development would follow from the adoption of regulations drawn up as a result of careful investigations by a central authority. Considerations of space will only permit us to give two instances to demonstrate the value of careful inquiry in this connection. Taking the herring fisheries of Scotland, about half a century ago the estuary of the Moray Firth was most sought after, and shoals of fine plump herrings, with their usual accompaniment of whales, porpoises, and dogfish, found their way up as far as Cromarty. There were large curing establishments on both sides the Firth, and for some years the fishery was abundant, when, in an unaccountable manner, the herrings suddenly disappeared, and were found only about the entrance of the Firth and on the Caithness side. It was not until 1877 that a successful beginning was made at the Shetland fisheries, and in the following year 120 boats were engaged on that ground. In 1885 there were as many as 830 boats, and the quantity of herrings caught was equal to one-half the total supply from the coasts of the mainland. In 1886, however, this fishery proved a comparative failure.

Before concluding our remarks we would again direct attention to the Bill before Parliament for promoting a better distribution of the common kinds of fish throughout the whole country, and we cannot better show the necessity of special facilities than by referring to the fact that, in cases of large catches, herrings have had to be thrown by thousands into the sea or sold to farmers for manure.

Letters to the Editor.

THE PHYSICAL SOCIETY.

To the Editor of "Industries."

Sir,—In the otherwise adequate report (on page 214) of some words of mine spoken at a meeting of the Physical Society, on the 25th ult., there occurs a slip of some importance. What I said was, that if there were a want of symmetry *both* in the armature *and* in the field magnet poles of an alternate current dynamo, there would result an inequality in the e.m.f. of a period equal to that of the rotation of the machine, though *neither* departure from symmetry if existing separately would occasion such an inequality. Your reporter has made it appear that dissymmetry in either case would have this result.

Yours &c.,
Silvanus P. Thompson.

City and Guilds Technical College,
Finsbury, London, 3rd March, 1888.

PROPOSED LEGISLATION FOR STEAM BOILERS.

To the Editor of "Industries."

Sir,—Mr. Powis Bale's anxiety in his recent letter to convince your readers that he is such a competent authority, that his experience is so great, and his position so "perfectly independent and unprejudiced," is somewhat amusing; but "he doth protest too much."

In his first letter to you, he asserted "that thousands of boilers are in use that ought to have been on the scrap heap long ago;" but, under correction, these "thousands of boilers" have dwindled miserably down to "many such boilers are in use" in his letter in your last week's issue. This may be taken as a sample of the facts he offers for our consideration; but I am sorry to see that he has not yet grasped the fact that "(1) inspection by Board of Trade officials and (2) inspection by boiler insurance companies under Board of Trade direction" are simply synonymous and convertible terms—"six of one and half a dozen of the other." This will no doubt be self evident to the rest of your readers. The proposed Bill speaks of the boiler inspecting societies as delegate societies, and the Board of Trade reserve to themselves, by the proposed Bill, the power to make, rescind, and vary rules with respect to the survey of steam boilers, and will only appoint as delegate societies such societies, companies, or body of persons whose rules for the time being are approved by the Board of Trade officials. Let Mr. Powis Bale explain where the preference lies.

In your issue of the 17th ult. he states, "I have long advocated that all boiler attendants should possess a certificate of competency that they are capable of undertaking the work," and he thinks that a Bill to that effect should be passed. A sufficient knowledge of the subject would have shown him that this opinion is exploded, and that it is no longer put forward by experts. The annual reports of the Assistant Secretary to the Board of Trade would, I think, be ample to show him how completely unnecessary and uncalled for such a piece of legislation would be. By referring to these reports, he will find that Mr. Thomas Gray, the Assistant Secretary, in his first report upon the working of the Boiler Explosions Act, 1882, dated 17th October, 1883, states that "there is no reason for yet assuming that any material diminution in the number of explosions may be expected to result from the systematic examination of and granting certificates to the men employed in working the boilers."

Again, the Assistant Secretary to the Board of Trade reports in September, 1884, that, "as the explosion can be attributed to neglect or ignorance on the part of the boiler attendant in three cases only, or four at the most, there is still no reason for assum-

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ing that any material diminution in the number of explosions may be expected to result from the systematic examination of, and granting certificates to the men employed in working, the boilers." And again the Assistant Secretary reports in October, 1885: "The smallness of the number of explosions (four) due to ignorance on the part of the boiler attendant still bears out the conclusions arrived at in previous reports, and shows that the risk of explosions generally would not be materially lessened by the introduction of a system making it compulsory for attendants to hold certificates of their fitness for the work entrusted to them." The Assistant Secretary to the Board of Trade reports on the 31st August, 1886, and finally in his last report for the year ending 30th June, 1887, that after an experience of five years of explosions, he has seen no reason to alter these conclusions.

It is evident from these repeated and extremely definite expressions of opinion on the part of the Board of Trade, that the question of certificating attendants may be dismissed from consideration, whatever Mr. Powis Bale and your other correspondents think or state to the contrary. It is unnecessary to add further evidence on the point. It is well known to those who have carefully studied the question that this matter was thoroughly and carefully investigated before the Board of Trade took up the question, and the same decision arrived at.

The recent article in your contemporary, *The Engineer*, simply confirms in the most positive terms the position I have taken up, and says: "There is no approach to a popular demand for Government inspection of steam boilers. The feeling is all the other way. The relations of the Board of Trade with ship owners on all that concerns marine boilers are so unhappy, *that no one acquainted with the facts wishes to see the authority of the Board extended to our factories or our railways.* . . . For ourselves we may repeat what we have often said before, viz., that we are flatly opposed to the idea of Government interference in the matter of boiler inspection." The italics are mine; these quotations will show what assistance your contemporary offers to Mr. Powis Bale and his views. His reference to the article is somewhat curious in view of the fact that boiler attendants are never even mentioned in it. I have now shown what ground Mr. Powis Bale had for his last assertions.

Let me again refer to the annual reports of the Assistant Secretary to the Board of Trade, and we shall then be able to follow the course taken by the Board of Trade with relation to the working of the Boiler Explosions Act of 1882, and the plan which has been adopted to render it nugatory and ineffectual, so that further legislation might be forced upon the country upon that very plea. The first report, issued on the 17th October, 1883, states: "Provision is made in the Act for an inquiry of a more expensive and formal character, but no case has arisen during the year raising any complex or difficult question that an engineer inspector could not deal with, and therefore inquiries of the more formal and more expensive character have not been ordered." This in face of Mr. Carlisle's report, No. 29, so scathingly criticised by your correspondent "Boiler" in your last issue, where the only conclusion "an engineer inspector" could arrive at as to the cause of an explosion was that it was caused by "the excessive strain thrown on the seams, and the flattening tendency of the top of the furnace caused by the sudden contraction of the top of the furnace and flue in consequence of the furnace door being open for a period of from five to ten minutes whilst the furnace was being cleaned, the dampers being open at the same time."

Surely, so far at least as the "engineer inspector" was concerned, a complex and difficult question had arisen, and a "more formal and more expensive" inquiry was undoubtedly required and should have been made. In the Assistant Secretary's report for September, 1884, he again states: "Provision is made in the Act for an inquiry of a more expensive and formal character; but no case has arisen during the year raising any complex or difficult question that an engineer inspector could not deal with, and therefore such inquiries have not been ordered." In October, 1885, he states: "No formal inquiry of the kind provided for by Section 6, sub-section 2, has been held during the year, the preliminary investigation having been found fully sufficient to trace the explosions to their true cause." Again on August 31st, 1886, he remarks: "It has not been found necessary either to institute a formal investigation in any case which has occurred during the year, or to take legal proceedings of any kind under the Boiler Explosions Act;" and, lastly, in the report for the year ending 30th June, 1887, he states that "no formal investigation has been held during the year, the preliminary inquiry having in each case been found quite sufficient to determine the cause of the explosion. This has also been the case in each of the preceding years during which the Act has been in operation; and in some respects it is of course satisfactory that the causes of all the explosions reported upon should have been ascertained without in any instance necessitating the increased expense which a formal investigation before two commissioners would have involved. But, on the other hand, this fact has been attended by one serious disadvantage. By the terms of the Act a court of formal investigation has power to order the costs and expenses of inquiries or investigations, or any part thereof, including therein the remuneration of persons holding such inquiry or investigation, to be paid by any person summoned before it, or by the Board of Trade; but no provision of this kind is made in cases in which only a preliminary inquiry is held. The consequence is that, however gross may have been the neglect or mismanagement of the person responsible for the explosion, there are no means of enforcing payment of any part of the expenses incurred in connection with the preliminary inquiries. These have to be borne by the Government, while the person really to blame finds himself exempt from all liability as regards the costs." Anyone not familiar with the provisions of the Boiler Explosions Act, 1882, might suppose from the manner in which the Assistant Secretary to the Board of Trade harps—in every report he has written—upon the string that "the preliminary inquiry in each case has been found quite sufficient to determine the cause of explosion," that the Board of Trade had no power in such a case to order a formal inquiry, whereas the Bill distinctly states: "If it appears to the Board of Trade, *either upon or without such preliminary inquiry*, that a formal investigation of the causes and circumstances attending the explosion is expedient, the Board of Trade may direct a formal investigation to be held."

Apart from the fact that the conclusions of the engineer inspector not being in many cases either in accordance with the facts or common sense, or at all reasonable to a professional mind—as shown in the case of Report No. 29, for example—and therefore directly at variance with the Assistant Secretary's statements, there is the undisputed fact that many of the explosions were of such a character that it was desirable, from a punitive point of view, to hold a formal investigation, and to saddle the careless owner with the costs.

Had this plain, straightforward, common-sense course been adopted, the number of explosions would have fallen to those which can only be considered as accidental and inevitable. The mere dread of an inquiry of any sort, without fear of fine or punishment, has reduced the number of explosions during the operation of the Act since 1882 no less than 40 per cent. Had the powers of the Act been brought into action, as they ought to have been, the subject would now have been settled, and preventable explosions practically a thing of the past. The question arises—Why have the officials of the Board of Trade not carried into action the provisions of the Act of 1882, and why, instead of instituting ineffectual criminal actions against poor engine drivers, did they not in the many gross cases of neglect and wanton disregard of all precaution, make formal investigations? Formal investigations should be held in every case where blame could be fairly laid to the owner or user of the boiler. That could be often easily decided, without the necessity of a preliminary inquiry; for in many of the cases ample evidence is at once forthcoming. The official mind would know how to make this "more expensive" process so costly that a single experience of its action would send the offender into the bankruptcy court, and his fate would be a sufficient warning to others. The Board of Trade have further powers under the Boiler Explosions Act, 1882, to "cause every such report to be made public in such manner as it thinks fit." This power enables the Board of Trade to publish in the journals of the district where the explosion occurred a short report, with their observations upon the cause. It is a power that has never once been put in force, although it would have had a great and powerful effect, as the infamy that would attach to any reckless, parsimonious owner would have been amply sufficient to warn and deter others. Writing in October, 1885, the Assistant Secretary states that, "There is reason to believe that the publication of the Reports of these investigations is proving of considerable utility. From the frequency of the applications made for them by persons interested in legal proceedings arising out of the explosions, it is evident that they are being generally used in civil actions; and in this way it is likely that the impartial investigations provided for by the Act will tend ultimately to render steam users more careful, and thus to reduce the number of explosions arising from their neglect." For some inscrutable reason, or perhaps for the want of reason, these Reports are not issued until months after the explosion to which they relate. Take the last four, issued simultaneously about the 20th of last month. No. 244 occurred on the 22nd November, 1887; No. 245 on the 25th October, 1887; No. 246 on the 9th November, 1887; and No. 247 on the 26th October, 1887, or about three and four months after the date of the explosion. In many cases this unnecessary delay would entirely destroy their value, and under the most favourable circumstances seriously reduce their value. There would appear to be no reason why such Reports should not be issued within a fortnight of the date of the explosion, if the examinations were conducted and reported upon by capable men, who could of their own knowledge and experience decide as to the cause of the explosion without reference or assistance. A short *résumé* and statement of the cause should then, in such cases as desirable, be published in such papers as might be found desirable, and another powerful agent for the prevention of boiler explosions set in action. If such a report were published, and the costs of a formal investigation cast upon a boiler owner who had been contributory to an explosion, there is little doubt that the Board of Trade would seldom have an opportunity, if ever, of again inflicting such a punishment.

Why have the Board of Trade officials smothered the Act of 1882, and never put its powers in force? What are the objects the permanent officials have in view? Is it the benefit of the steam user, the boiler maker, or the public? Would it be unkind to endorse the opinion of your correspondent "Pro Bono Publico," that it is, to use his own words, "an unwarrantable plot to foist upon the nation a new department, with additional berths for place-seeking officials, in direct opposition to the deliberate opinion of the Select Committee of 1871, and in the absence of any public agitation or demand for such a step"?

Let the steam using public of this realm awake! If they allow the inspection of their steam boilers to pass under the control of the Board of Trade, it will involve an expenditure of £50,000,000, and, at 3 per cent., an annual charge of £1,500,000, independent of the cost of carrying on the inspection, which may be fairly taken at another £500,000. Harassing interference when laying down new plant, and with the working of old, with all the irritation and annoyance due to dictatorial supervision and interference, will be some of the minor troubles that will flow from want of firmness at this crisis. Let your representatives know what your opinions are, and let there be no doubt as to the result.

Yours, &c.,

Manchester, 5th March, 1888. ECONOMISER.

TO THE EDITOR OF "INDUSTRIES."

SIR,—When Mr. Powis Bale advocates the desirability of granting certificates of competency to those entrusted with the care of steam boilers, he only expresses the opinion of many others, myself included. That there are many so-called "cheap men" put in charge of steam boilers, and that they daily jeopardise the lives of thousands, can hardly be denied. The following is an advertisement cut from a leading London daily paper: "Youth, 16, intelligent, abstainer, seeks employment; look after engine and boiler, or any like capacity; no experience." When it is possible for such an advertisement to appear, the wonder to me is that more serious accidents do not occur; but of course we hear nothing of the vast number of narrow escapes which daily take place. If it is necessary for an engineer at sea to have a certificate of competency, why should not a modified one be in vogue on land. It could harm no one, would add to the longevity of the boiler, lessen the coal bill, increase public safety, and improve the status of the men.

Yours, &c.,

A. C.

London, 6th March, 1888.

BOILER EXPLOSION NEAR BURNS' COTTAGE.

ON the 1st inst., about three p.m., a small boiler, which had been erected outside a smithy fronting the road near Burns' cottage, at Alloway, near Ayr, belonging to Mr. William Thomson, exploded. It supplied steam to an engine used to drive lathes, and for other purposes, in the smithy. The boiler, which appears to have been bought second hand, is about 2ft. in diameter, 5ft. 9in. in length, and is plain cylindrical in form, with cambered ends flanged in. The shell is $\frac{5}{16}$in. thick, riveted with one seam running the whole length. There was an unstrengthened manhole 14in. by 10in. It was provided with a safety valve, 2in. diam., loaded to about 48lb. per square inch, a glass water gauge, and other mountings. The boiler was torn in two pieces through the solid plate, close to the one longitudinal seam. No serious injury to any person occurred; but two children who were looking in at the smithy door, and two others who were playing at the back of the smithy, were somewhat cut and bruised. The boiler was not under inspection or insurance. Between the smithy and Burns' cottage a two storeyed house has lately been built, and the upper part of the boiler was thrown over it—rising to a height of about 60ft.—and fell upon the roof of the stable of Burns' cottage 70 yards distant, while the lower half was found in a garden 30 yards away. A hay stack at the back of the smithy was set on fire. The part of the stable nearest the smithy was completely wrecked, and the room where Burns was born, which adjoins the other end, had a narrow escape, as the upper half of the boiler fell through the roof of the bedroom of the keeper of the cottage, which adjoins the well known kitchen. It is only about eighteen months since Burns' cottage was in much risk of being destroyed by fire, owing to the accidental burning of an adjoining house.

Books Received.

Practical Physics for Schools and the Junior Students of Colleges. By BALFOUR STEWART, M.A., LL.D., F.R.S., and W. W. HALDANE GEE, B.Sc. (London). Vol. I.—Electricity and Magnetism. London and New York: Macmillan & Co.

Practical Guide for Trade Mark Owners. Edited by HENRY KERBY and PEREGRINE VARNALS. London: Trade Mark Protection Association, 2, Lancaster Place, Strand.

The Gas Engineers' Manual and Gas Companies Directory for 1888. Edited by WM. OWLER. Birmingham: *The Gas Engineer*, J. Wright & Co., Thimble Mill Lane.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. December 20th, 1887, Meeting.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Vol. XIV., parts 2, 3, and 4.

American Chemical Journal. Vol. X., No. 1. Baltimore: Ira Ramsen.

American Journal of Mathematics. Vol. X., No. 2. Baltimore: Publication Agency of the John Hopkins University.

Catalogue of Electrical Apparatus. Helsby, near Warrington: The Telegraph Manufacturing Company, Limited.

Transactions of the American Society of Civil Engineers. September, 1887. New York.

The Architect's, Surveyor's, and Engineer's Compendium, 1888. Edited by JOHN E. SEARS, A.R.I.B.A. London: E. Marlborough & Co.

Manual of the Coal Mines Regulation Act, 1887. By JOHN C. CHISHOLM. London: Stevens & Sons. Edinburgh: Bell & Bradfute.

Reviews.

TEXT BOOKS OF COMMERCE: (1) Natural History of Commerce; (2) Technical History of Commerce; (3) Growth and Vicissitudes of Commerce; (4) Recent and Existing Commerce. By John Yeats, LL.D. Third edition, revised and much enlarged. London: GEORGE PHILIP & SON. 1887.

This re-issue of Dr. Yeats' valuable text books of commerce comes at a very opportune time, when the minds of commercial men are being stirred about the necessity for improved commercial education, as there are

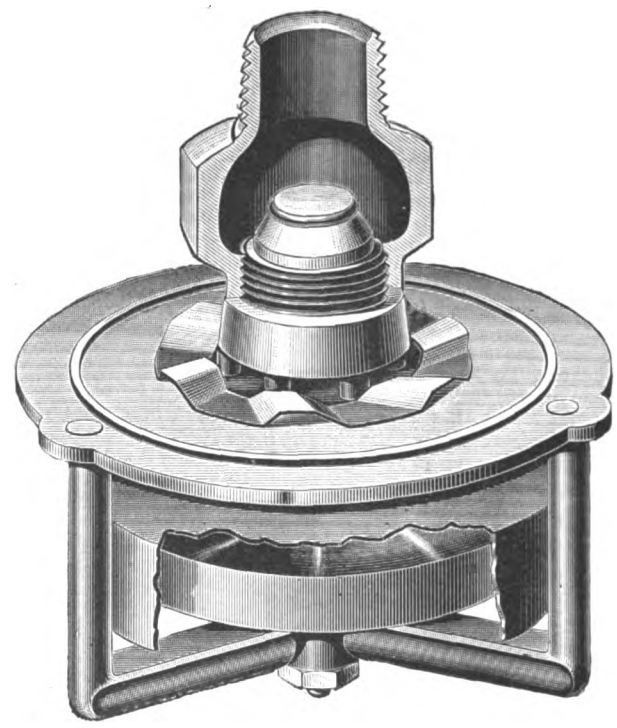
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few better calculated to aid in the creation and development of sound, healthy opinions on the subject. The author gives as a preface to the volumes some extracts from a letter he published in the "Journal of the Society of Arts," showing a few of the difficulties that retard the progress of higher commercial education, and prevent the study of commerce as a science in England, which ought to be carefully studied by all who are interested in the subject. He shows that indifference is the greatest difficulty, and misapprehension of our true position causes it; and he then discusses the various objections which are made to a systematic course of commercial training, and points out that there is really no novelty or specialty in the education of commercial men, beyond what is required in every other calling and profession, and he indicates that the "Science of Commerce" comprises an acquaintance with commercial history and geography, social and political economy, mercantile occupations, goods in all varieties, currencies, weights and measures, bullion and exchanges, transit and transport, insurance and securities of all kinds, consular duties, chambers of commerce, &c., and further, that an efficient commercial man must be an adept in correspondence in several languages, general commercial law, accounts, wages in different countries, international obligations, and means of communication. Dr. Yeats' books do not pretend to include all those subjects; but we have no hesitation in saying that their contents should be known to every commercial man, and we have much pleasure in recommending them, especially to those of our readers who have anything to do with the management of schools. The "Natural History of Commerce" treats of each substance wherever it originates, above ground or beneath the surface, shows what is done with it to make it useful, and indicates where it is bought, sold, or largely consumed. In arranging the subject, the simplest divisions have been adopted—those of the mineral, vegetable, and animal kingdoms; in each of these the products are classified, and scientific terms are attached for wider reference. The "Technical History of Commerce" not only gives a record of economic progress, but furnishes material standards of comparison between nations, and enables us mentally to estimate results; and it shows that with nations, as with individuals, only three conditions are possible for all—they must go forward, retrograde, or perish. A state of balance may perhaps be maintained during the early stages of existence, but not when environments are constantly changing. In the "Growth and Vicissitudes of Commerce," students have opportunities of learning the lessons which are taught by the rise and progress and the fall of nations, and it lays open a wide field for historic and antiquarian investigation. The volume which is likely to be read with the greatest amount of interest is that on "Recent and Existing Commerce," as it appeals most directly to everyday wants, as it shows the merchant where and when what he wants can best be had, and where that which he offers is most likely to be introduced with advantage. It contains a brief review of British industry and trade, a survey of our colonial and foreign relations, a retrospect of the commercial policy of 1840-87, and a section on the natural divisions of commerce, based upon similarity of produce and seasons of shipment, and set forth within well known geographical limits or trade areas. The volume is intended to be a picture of universal industry, in which the most important factors are selected as objects for study and comparison. On the whole we scarcely know of any other four books which will give the merchant more correct ideas regarding what should be his aims and methods than those which we have been very shortly considering.

A Course of Lectures on Electricity. By George Forbes. London: Longmans, Green, & Co.

At a time when we are being inundated with books treating of electrical subjects, we are apt to be somewhat hypercritical, and to judge the latest literary production in this field with greater severity than would be the case if such books were few and far between. Considering the glut in electrical literature, it is a somewhat bold undertaking for a scientist of Professor Forbes' standing to come forward with what is practically a text book on electricity. We have already many text books, and they are all very much alike. We find in them described the same experiments, the same theoretical explanations, and, in many cases, almost the same illustrations. But Professor Forbes' book is an exception, and notwithstanding our objection to the multiplication of electrical books, we are glad he has written this work, because it is eminently adapted to popularise the science with intelligent readers who are not trained electricians. The great fault in many so-called popular books is their scientific inaccuracy. The writers of such books either have themselves not sufficient scientific knowledge, or if they be well up in the subject, they seem to labour under the delusion that nothing like vigorous scientific treatment is admissible in a popular work. In the book under review, all this is different. Not only is the author a thorough master of the science, but he has the wish and the ability to transmit what he knows to his readers in lucid and simple language. The book is the outcome of a series of lectures delivered by Professor Forbes, in the spring of 1886, at the Society of Arts; but he has added to the five lectures one which he delivered in 1884 at the Electrical Exhibition in Philadelphia. Regarding this addition, we will at once say that the book, in our opinion, would be better without it. Certain portions of the last chapter which contains this lecture are practically repetitions of general principles and experiments treated in the previous chapters, whilst the more practical parts referring to dynamo machines, and which are not repetitions, are at the present moment obsolete. It is of very little value to bring forward at the present time such machines as the Alliance, the Wilde, the first Siemens, and the original Gramme machine. During the last four years the science and practice of dynamo construction have far outgrown these early attempts, and if the author considered a chapter on dynamos necessary, he would have done better to re-write it entirely, giving due prominence to modern machines. The rest of the book is, however, excellent. It is divided into five chapters or lectures, with the following titles: Potential and Electromotive Force, Electric Current and Resistance, Magnetism, Electromagnetism, and Electromagnetic Induction. The most interesting part of the first chapter is that where the author deals with the mechanical strains occurring in a dielectric under the action of an electric potential, and the beautiful experiment to show how the strain affects luminiferous ether. When dealing with thermo currents in the second chapter a very neat experiment is given by which a drop of water is frozen under the Peltier effect. In the chapter on magnetism we would specially draw the reader's attention to a quotation from Dr. Scoresby, who in 1824 had already conceived the idea of the chain of magnetic molecules in almost the same manner as Weber and Hughes have done in our time. The rotation of the plan of vibration of a beam of light is also shown by a most elegant experiment with two Nicol prisms and an electromagnet. The illustration, however, is somewhat misleading, because no coils of wire are shown round the magnet, which thus appears to be a permanent steel magnet. In the subsequent chapters the author explains the mechanical inter-action between electric currents and magnets, the electromagnetic induction, the telephone, the Arago disc experiments, and kindred matters. The book can be thoroughly recommended for the general reader in preference to the orthodox text books.

THE HETHERINGTON-DRAPER SPRINKLER.



During the past few years the use of automatic sprinklers for the purposes of fire extinction has become very general. In most cases they are constructed either with a valve or a cap, which is held in position by a bar fastened by means of solder of such a composition that it fuses at a certain temperature. As soon as the fusion of the solder takes place the sprinkler opens and the water is freely poured upon the fire. All sealed sprinklers of this type suffer, however, from one defect, viz., that once opened they cannot be closed until the water is emptied out of the pipes to which they are connected, thereby using more water than is required to put out the fire; and the damage done by this excess of water is often considerable, as in one case the loss from fire was only one-sixth of that arising from the damage done by the water. Our illustration shows an improved sprinkler of American origin, which is being manufactured by Messrs. Hetherington & Co., of Manchester, and which, it is claimed, overcomes this defect. The orifice from which the water is discharged consists of a flat circular seat, on to which a button or mushroom valve is forced by the pressure of the water. The valve has a shank passing downwards, and screwed at its lower end. Just below this orifice a corrugated brass washer is placed, which revolves rapidly when a jet of water falls upon it, thereby distributing the water over a large surface. A short hermetically sealed cylinder made of brass is fitted in its centre with a tube, through which the shank of the valve passes, and lock nuts are placed above and below the cylinder referred to. The latter contains a volatile fluid which readily expands when heated.

The action of the apparatus is as follows: In fixing the sprinkler, it is necessary to determine the temperature —about 140°F.—at which it is to act. The lock nuts on the shank of the valve are accordingly set in such a manner as to lift the valve as soon as the sprinkler has attained the temperature decided upon. The liquid in the cylinder is expanded by the increase of temperature, and the convex covers, which are held at the sides, are forced outwards, thereby actuating the valve through which the water is discharged. The amount of lift of the valve is regulated by the lock nuts. In order to prevent the cylinder from being cooled by the water, a brass shield is placed a little way above it, surrounding the cylinder on all sides, but allowing the air to circulate freely round it. This shield protects the cylinder not only from the water discharged from its own sprinkler, but also from adjacent ones. As soon as the temperature of the air falls below the point at which the sprinkler is set to act, the liquid inside the cylinder begins to resume its original bulk, and the pressure of the water on the top of the valve closes it. As soon as the valve is closed, the apparatus is quite ready to act again if required, which is an important improvement in this design. In some tests made with shavings, arranged in such a manner as to allow the flames to spread only slowly, the fire was extinguished and the discharge of water stopped in three minutes from the time of kindling. A quantity of straw soaked with paraffin, lighted at one point, was extinguished and the water cut off in 2½ minutes, the portion burnt being about 12ft. in diameter. We have already referred to the advantage of cutting off the water as soon as the fire is extinguished; and with the additional advantage of being simple in construction and very strongly made, this sprinkler should prove a very efficient means of putting out fires before they can become serious.

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FARM HOMESTEADS OF ENGLAND.

By Professor T. J. Elliot.

This is a subject of great importance, both to the land owners and the land occupiers of England. For without buildings the former could not let his land; and unless the homestead is well designed and suitable for the purposes of the farm, the tenant will find it a difficult matter to carry on successfully the various operations of farming. It is, therefore, a necessity to both. Years ago—say some twelve or fifteen—the homesteads of England had the most careful attention paid to them by some of our best architects and agricultural engineers. But those were days of prosperity, when, owing to keen competitions, farms were not only let well, but in many cases fictitious rents were easily obtained. The landlords receiving high rents were in a position to spend money in the erection of large, and in some instances expensive, farm homesteadings. Now, however, times have changed, and the change has been of such a radical character that the landlord's income barely provides him with the means for living, much less allowing him a margin to spend on new buildings, or even in the repairs of old ones. And for the last few years little attention has been paid to their condition.

The matter thus turns upon the questions: (1) What are the considerations, so far as economy with efficiency is concerned, which must guide the agricultural builder in designing and erecting new homesteadings; and (2) from what source in future can the impoverished landlord of the present day obtain the means for supplying his tenants with necessary building accommodation? Before answering these questions it will be well to understand distinctly what agriculture really is. Let us then look into it. In the ordinary course of farming we find that it is necessary, in order to maintain the proper chemical and physical condition—or, in other words, the fertility—of the soil, to grow a succession of crops differing not only in their character and bulk, but also in the means required for their profitable conversion. Nature, through its vast store room, the soil, aided by artificial means, supplies the agriculturist with the raw material in the form of plant food. But before this plant food can be used for the benefit of the farmer, several acts of husbandry are required for its profitable utilisation. And again, the produce thus obtained requires further preparation before it can be realised, viz., in dressing or preparing the corn for market, and in the conversion of the hay, root, and green crops into meat. We thus see, therefore, that the art of agriculture is neither more nor less than the manufacture of raw materials into food for man and beast. In other words, agriculture is a manufacturing business, and agricultural homesteadings are the factories belonging to the trade of farming.

We are now in a position to answer the first question by saying it will be the duty of the architect or agricultural engineer to supply the farm with buildings in the simple form of a factory; and if he takes for his guide the class and style of buildings used in manufacturing trades other than that of agriculture, he will find by comparison that they are less pretentious as regards design, although equally sufficient for the purposes for which they are erected. There has always been a tendency to introduce a great deal of unnecessary display into the designs for farm buildings. Some would say, "But all this is necessary, seeing that they are so much exposed to the criticisms of passers by, and if ugly ones were built, they would mar the beauty of the surrounding country." The answers to these observations are: (1) Place your farm on a site not at all conspicuous; and (2) should such a site be impossible to obtain, build them neatly and plainly, and relieve them by a little judicious planting of trees near them.

The architect having done his part by reducing to a minimum the cost of the homesteading, it devolves upon the owner—assuming he is a poor man—to look around and see what are the helps at his disposal so as to obtain the amount of capital required. These may be enumerated as follows: (1) He may raise money by means of a mortgage on the freehold of his property; (2) he may apply for assistance to such societies as the General Land Drainage and Improvement Company, who, by a private Act of Parliament, are authorised to advance money for improvements of this sort, and can if necessary make a rent charge on the freehold of the estate extending over a period of thirty-one years; (3) should the estate be entailed, the owner may make use of Earl Cairns' Settled Land Act, by which a portion of the estate may be sold for the improvement and benefit of the remainder. In conclusion, it may be of interest to many if I can show the proportion of rent per acre per annum received by the landlord for his land, and how much of the annual rent is swallowed up by the homesteading.

Assume a farm of mixed arable and pasture land of two hundred acres, worth 30s. per acre. Two hundred acres at 30s. equals a rent of £300 per annum, allowing about 7 per cent. of the rent to be required annually for repairs, and that the value of land is at "par"—or equivalent in value to consols. The fee simple value of the farm would be worth 28·5 years' purchase on the rent. Thus £300 × 28·5 years = fee simple value of holding, £8,550. A house, a set of buildings, and three cottages would be required, and would cost £1,500; making roads, fencing, and water supply would cost £400; total, £1,900. The value in fee simple of land taken by itself = £6,650. Land in its natural state, without being chargeable with repairs of buildings, is worth 33½ years' purchase. Therefore £6,650 (fee simple value) divided by 33½ years' purchase is equal to £199. 10s. net rent per annum, or nearly 20s. per acre over the two hundred acre farm. The land therefore produces to the landlord 20s. per acre; the buildings swallow up 10s. per acre; making the rental value 30s. In a future article I will endeavour to show that the landlord gets more in comparison for his land per acre as the size of the farm increases. I will also compare the loss per acre which the landlord sustains on the buildings, with the amount he would be charged for an advance made to him by any of the loan societies for the purpose.

MANGANESE STEEL AND ITS PROPERTIES.

At the ordinary meeting of the Institution of Civil Engineers, held on the 28th ult., the President being in the chair, two papers were read on Manganese Steel, viz.: (1) "Manganese in its Application to Metallurgy," and (2) "Some Novel Properties of Iron and Manganese," both by Mr. Robert Abbott Hadfield, Assoc.M.Inst.C.E.

The first paper commenced with a statement that Hadfield's Steel Foundry Company, Sheffield, was, some time ago, in search of a material suitable for making castings which should possess hardness and toughness, as ordinary steel castings did not combine these qualities. Cast steel, unlike cast iron, could not be "chilled;" this was a great disadvantage, for although steel castings of ordinary temper might be exceedingly tough, as soon as hardness was reached, by an addition of carbon or other elements, the toughness rapidly decreased, the material became brittle, and did not possess the intense hardness of chilled iron. Even cast steel with more than 2 per cent. of carbon was comparatively soft; and whilst chilled iron cylinders, 0·79in. in diam. by 1in. long, remained unaltered under a load of 100 tons per square inch, cast or forged steel cylinders, if unhardened, shortened from 15 to 40 per cent., according to temper. If molten steel of any temper, as hitherto made, was run into an iron mould used for making "chilled rolls," when cold the grain of the casting would be somewhat closer than if cast in sand, but still quite soft, easily indented, and the metal might be turned in ordinary lathes. The same article made from cast iron of suitable mixtures would be intensely hard on the surface. Here, then, was a drawback to cast steel, as although it might be hardened when immersed in water or oil, this application was impracticable to the many irregular forms dealt with by steel founders; besides, the intense strains brought to bear by such hardening process would cause the articles to crack and break into pieces. It had therefore been thought that an account of the results noticed in connection with the material termed "manganese steel," might prove of interest to the Institution of Civil Engineers, particularly as it offered advantages over ordinary steel in some points. Moreover, it seemed to afford new fields for investigation in metallurgy, since many of the results noted in its production were contrary to general experience. Laws, hitherto accepted and considered to be well defined, were apparently set on one side, and it was possible therefore, by the facts being discussed, to throw light upon the subject. The field for investigation and extension in the knowledge of the alloys of iron was very wide, but as yet comparatively little had been done. The knowledge of steel had so far been principally confined to carbon steel or alloys of iron and carbon, about nine-tenths of the steel made being of this class. The first paper principally dealt with and described the experiments; the physical properties noticed in the material, and the conclusions to be drawn therefrom being more particularly defined in the following one. Special attention was drawn to what essentially constituted the peculiarity of manganese steel. Whilst the belief hitherto held, that steel became brittle and comparatively worthless when the manganese exceeded 2·75 per cent. was correct, it had now been proved that by adding more of the same metal, so as to obtain in the material under treatment not less than about 7 per cent. manganese, the result was a new metal. The apparent paradox thus took place, that whilst manganese alloyed with iron, if present in the proportion of not less than 2·75 and up to about 7 per cent., gave a very brittle product; when its proportion was increased to not less than 7 and up to about 20 per cent., the result was a material possessing peculiar and extraordinary strength and toughness. The brittleness of the cast material seemed to partake more of the nature of glass, or other similar substance, than of a metal such as steel. Cast bars, about 2⅝in. square in cross section, 30in. long, were supported upon bearings 2ft. apart, and broken under hydraulic pressure, the breaking load being carefully noticed in each case. One of these specimens, containing 0·37 per cent. carbon and 4·45 per cent. manganese, was fractured under a pressure of 3¾ tons; whilst a bar of ordinary cast iron stood 12 tons, and the higher percentages of manganese, 17 and 20 per cent. respectively, stood 29½ and 38 tons. Another instance was afforded by a bar casting, containing 4·73 per cent. manganese, being dropped from a height of 3ft. to 4ft. on a floor paved with cast iron, when fracture occurred in two or three parts of the bar at the same time, showing its extraordinary fragility. Pieces from another specimen, containing 0·48 per cent. carbon and 4·9 per cent. manganese, though exceedingly ductile when hot, in the cast state when cold could be reduced by a hand hammer to fine powder, no cohesion seeming to exist between the particles. On the other hand, a specimen of forged material, containing 13·75 per cent. manganese and 0·85 per cent. carbon, when water toughened, had a tensile strength of 65 tons per square inch, with 50·7 per cent. elongation; and another specimen, 69 tons and 46 per cent. respectively. In the latter case, the tensile load, calculated on the area of the bar at the moment of fracture, was equal to 102 tons per square inch. The combination of hardness and toughness found in this material led to experiments as to whether edge tools could be cast from it. These tools, whilst not equal to those made of forged, hardened, and tempered steel, had afforded some remarkable results. The author exhibited some castings as they left the moulds, the cutting edges merely being ground up, and neither hardened nor tempered. These included a cast axe, which had chopped through cold iron, along with the pieces of iron cut through. Another axe of the same quality, which had been used for over two years, readily shaved off the hair on the back of the hand; and cast razors had been made which, whilst not equal to those of ordinary steel, had done fairly well. A cast adze and chisel for wood were also shown, both of which had been constantly in use for over two years, and had cut through the hardest knots and hard wood. Manganese steel possessed toughness to resist severe usage, and hardness to prevent permanent set without bending or buckling. Some of the tests showed that the material had these qualities in a most remarkable degree. The tests were made with an ordinary drop tup, sliding between steel rails fastened to strong timber supports, which was allowed to fall on Browning's coupler castings. The tup weighed 2321lb., and the drop could be varied from 1ft. to 27ft. Each casting was placed vertically, and the tup allowed to fall upon the jaws, the permanent set being carefully measured after each blow. Exact particulars of the remarkable results obtained from the manganese steel were given. The couplers tested were an American malleable iron casting; a manganese steel casting, containing 9·37 per cent. manganese, tested just as cast; a tough mild steel casting, containing 0·25 per cent. carbon, having a breaking strength of 32 tons per square inch, with an elongation of 30 per cent. on 2in.; also two manganese steel castings, water toughened, containing respectively 9·75 and 14·25 per cent. manganese, which were unbroken, notwithstanding that the latter had more than 300 foot-tons of energy expended upon it. The author directed attention to the peculiar hardness of this steel, both in its cast and in its forged condition. The specimens were so exceedingly hard that it was scarcely possible to machine any of them on a practical scale; the hardness was most intense in the cast material containing 5 to 6 per cent. manganese, which no tool would face or touch. A gradual decrease then occurred, and when about 10 per cent. was reached the softest condition was attained. Then an increase again took place, and at 22 per cent. it was very hard, still not so much so as in the 5 per cent. specimens. After passing 22 per cent. the cause of hardness became more complicated, owing to the presence of more carbon, 2 per cent. and upwards; in fact, the material began to partake more of the nature of cast iron, but it had greater transverse strength. A test bar, with 14 per cent. manganese, which elongated 44·5 per cent. without fracture, and had a tensile strength of 67 tons, was put under a double geared 18in. drill. Over an hour was occupied in drilling one hole ½in. in diameter by ⅝in. deep, during which time fifteen to twenty holes of the same size could have been easily drilled in mild steel. Similar results from specimens sent to different engineering firms confirmed the above, yet this specimen could be indented by an ordinary hand hammer. Although, when being turned, it appeared harder than chilled iron, its softness was particularly noticeable when testing the material for compression. Specimens of 10 per cent. manganese steel, 1in. long by 0·79in. in diameter, notwithstanding they required several days' preparation in the lathe owing to their hardness, yet under a compression load of 100 tons per square inch shortened 0·25in., and the harder kind 0·1in. to 0·13in. Chilled iron or hardened steel would stand this test without any alteration. Attention was also directed to the fact that a load of 27 tons per square inch, which in ordinary mild steel would cause fracture, and an elongation of 30 per cent on 8in., only elongated manganese steel 0·53 per cent. on the same length. A hammered manganese steel bar was compared with a best quality steel railway axle of the same diameter as the manganese steel bar. The results of the tests showed that on the manganese steel bar or axle an energy of 498 foot-tons produced total deflections of only 39½in.; whereas on the special steel axle an energy of 348 foot-tons produced total deflections of 105¼ inches. Assuming the manganese steel to have been capable of resistance without fracture, and the deflections to have continued in the same proportion, an enegy of no less than 1360 foot-tons would have been required to effect the same deflections that 348 foot-tons produced on the special or carbon steel axle. The peculiarly combined toughness, hardness, and stiffness of manganese steel, either cast or forged, were very clearly brought out in these tests. The material therefore seemed well adapted to resist severe stress before fracture, and yet at the same time to show very slight alteration under stress. The author stated that the results having been often anomalous as compared with ordinary steel, special care had been taken to thoroughly verify each experiment. If contradiction sometimes occurred, it might be partly explained by the want of knowledge requisite in dealing with a new material. In conclusion the author referred to the inadequacy of the explanations offered with reference to some of the peculiarities noticed in manganese steel. His remarks were therefore in many instances offered only in the nature of suggestions for the consideration of scientific and metallurgical authorities. The field for investigation was very wide, and his object had been to describe the experiments made with care and exactitude.

In the second paper considerations were offered as to the causes of the results noticed in the previous one; but before proceeding to these the author remarked that some decision ought to be arrived at upon the exact meaning of the word "steel." Numerous combinations or alloys were being manufactured to which this term was given. It had hitherto been applied to malleable alloys or mixtures of iron and carbon, and the author pointed out some peculiar features in alloys or compounds of iron and manganese which also possessed a steel-like nature. In some correspondence with the author, Mr. R. Mushet wrote: "Your material is really not steel, but an alloy in certain proportions of iron and metallic manganese containing

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also carbon, but as little of that as you can help. Your alloy possesses some of the properties of steel, and it is to a certain extent a substitute for steel, just as brass, which is not copper, is nevertheless a substitute for copper." Whilst there was much to be said for this view, it was open to consideration whether iron formed actual compounds or mere mixtures or alloys. Steel had been defined by Bresson as "a particular state of iron produced by its union with bodies the nature of which can vary. There are three classes: first, steels composed of iron and carbon; second, those of iron, carbon, and a third body; third, those formed of iron and another body which is not carbon." It would be seen from the properties of manganese steel that this view was correct, and that bodies other than carbon could play a constituent part in the conversion of iron into steel; in fact, Faraday, long ago, was reported to have made an alloy of iridium and iron which possessed steel-like properties, although no carbon was present. When plunged in water the behaviour of manganese steel was quite different to that of ordinary carbon steel, no hardening action taking place. Water certainly caused the material to become stiffer, but in a different degree to hardened carbon steel; for a piece of manganese steel after such treatment was slightly more easily touched by a file; therefore the process was termed water toughening. The increase in stiffness was marked, the tensile strength rising from 40 to 60 and in some cases over 70 tons per square inch; but this was not a mere stiffening or hardening effect in the ordinary sense of the term, for in carbon steel such rise was invariably accompanied, when the cooling medium was water, by a considerable decrease in the ductility or elongation, whereas, in manganese steel, just the opposite effect was produced. When, however, the samples contained below about 7 per cent. manganese, this treatment seemed to exercise little or no influence, and the material was comparatively valueless where toughness was requisite. After a large number of tests on the action of heat and sudden cooling upon this material, it had been found, generally speaking, that the higher the heat of the piece treated, and the more sudden and rapid the cooling, the higher would be its breaking load and the greater its toughness or elongation. This was very apparent from the results of six bars which were heated as uniformly as possible to a yellow heat, and plunged into water of 72°F., which gave breaking loads varying from 57 to 63 tons per square inch, and elongations of 30·8 per cent. to 50 per cent. For comparison, another test bar of the same material was heated in precisely the same way and degree, but plunged into water at a temperature of 202°F., when the results were only 53 tons and 32·8 per cent. The more rapid cooling of the other test bars was evidently the cause of their superiority, the chemical composition of all being the same. It was also thought that sulphuric acid, being a rapid conductor of heat, might give good results as a cooling medium. The experiment was therefore made with a bath consisting of equal volumes of water and sulphuric acid, and on 8in. the extraordinary elongation of 50·7 per cent. was reached with a breaking load of 65 tons, the bar being thus drawn cold 4½in. before fracture. Another specimen on a 4in. length gave 56·75 per cent. Various experiments were made to show the influence of manganese upon forged iron, the former varying from 0·83 to 21·69 per cent. under different modes of treatment. It was found that oil had a beneficial effect on the metal, but not equal to either water or sulphuric acid; this no doubt was due to its lower conductivity. It was also noticed that the operation of merely heating the forged test bar to a yellow heat and cooling it in air had a very beneficial effect, the elongation in most instances being increased to 15 and 20 per cent., the tensile strength also rising 8 or 10 tons per square inch. It was not easy to understand the action of the water quenching process. As explained by Chernoff, the effect of oil tempering on ordinary steel was to produce a metal of fine grain, which possessed much greater strength than open, coarse grained steel. If, however, forged manganese steel possessed any difference of structure after being heated and water toughened, it was rather in the direction of a more open than a closer grain. But the most puzzling case in the author's experience was that of cast toughened specimens containing 9 per cent. manganese, at which percentage the crystallisation was very peculiar. An ingot 2½in. square in cross section and 2ft. long was cast in an iron mould. When cold, a piece was broken off under four blows of a steam hammer. The fracture showed the usual peculiar form of the 9 per cent. material, a form which to outward appearance was unchanged by any heats short of the melting point. The other piece was re-heated to a yellow heat and water quenched. In this the toughness was increased in a remarkable manner, ten blows of the steam hammer being required to break the bar, although the appearance of fracture was unchanged. This material possessed the peculiar property of being almost entirely non-magnetic, which was curious, seeing that iron was present in amounts eight or nine times greater than the manganese. An approximate idea of the amount of manganese contained in steel might be formed by passing a magnet over specimens; as the percentage of manganese increased, the effect of the magnet diminished. Upon reaching about 8 per cent. there was no attraction in the bulk, though fine drillings were influenced; but when 20 per cent. was reached, a magnet capable of lifting 30lb. of ordinary steel or iron would only lift pieces weighing a few milligrams. No advantage was gained in ordinary steel by adding more than 1·5 to 1·75 per cent. of carbon, an amount above this not producing steel with any greater degree of hardness. Hence, the analysis of the majority of Sheffield carbon tool steels showed not more than 1¼ to 1½ per cent. carbon; at these tempers the point of saturation, so to speak, seemed to have been reached, so that carbon itself could hardly be the sole cause of hardness. The question, therefore, of the crystallisation or structure became of great importance. No one could well mistake the difference of fracture in wrought iron and in mild steel, though both might give by analysis the same percentage of iron; in fact, wrought iron might even contain more carbon than mild steel, and yet the structure in no way resemble that of the latter. It was apparent, therefore, that iron did vary its form or structure. This was noticed by steel-casting manufacturers, who by judicious treatment could increase the elongation of steel as cast from 8 or 10 per cent. up to 30 per cent. Professor Barrett had noticed another point of difference between this and carbon steel. Manganese steel, when cooling, did not give any "after-glow." A Sheffield firm also reported that in rolling a length of 800ft. in one piece of this wire, the finer it became the more it seemed to retain the heat—in fact it appeared to gather heat in the process. In conclusion, the author again contended that some understanding should be arrived at as to the meaning of the term "steel." In the past this word had sufficed well enough for an alloy or compound of iron and carbon; but the latter was in many instances now being replaced by other elements, such as manganese, chromium, silicon, or tungsten. The author held that steel was but a particular state of iron produced by the union of that metal with bodies the nature of which might vary.

The papers were illustrated by an extensive collection of samples of manganese steel, and of ordinary steels, which will remain on view at the Institution for a few days. The discussion on these papers was resumed on Tuesday last.

THE CHEMISTRY OF THE LEADEN CHAMBER.

Recent investigations upon the action of sulphurous acid on nitrous acid, and on the compounds derived from sulphuric acid and containing nitrogen, have tended to clear up the chemical changes which take place in the leaden chamber in the process of the manufacture of sulphuric acid; but we are as yet far from a complete solution of this complicated problem. For many years past, there has been considerable discussion and much experimental investigation on the nature of the so-called crystals of the leaden chamber, and the part played by the oxides of nitrogen in the formation of sulphuric acid. Until comparatively recently it was believed that nitric acid was the only substance capable of converting the sulphurous acid gas into sulphuric acid, and that the nitric peroxide formed in this change subsequently underwent decomposition with the water or steam present in the chamber, re-forming nitric acid and nitric oxide, which in presence of air was immediately oxidised to nitric peroxide again. These changes can be represented by the following chemical equations:—

$$SO_2 + 2\left.\begin{matrix}NO_2\\H\end{matrix}\right\} O = \left.\begin{matrix}SO_2\\H_2\end{matrix}\right\} O_2 + 2NO_2 \quad \ldots\ldots(1)$$

$$3NO_2 + \left.\begin{matrix}H\\H\end{matrix}\right\} O = 2\left.\begin{matrix}NO_2\\H\end{matrix}\right\} O + NO \quad \ldots\ldots(2)$$

$$NO + O = NO_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Winkler subsequently brought forward evidence to show that in presence of sulphuric acid nitric oxide was not oxidised to nitric peroxide, but that nitrous anhydride N_2O_3 was produced, and agreed with the explanation of the change first suggested by Weber, that the sulphurous acid was oxidised by the nitric acid, forming at the same time nitrous anhydride, which was able to convert another portion of sulphurous acid to the higher oxide, becoming thereby reduced to nitric oxide. The nitric oxide, according to him, was then oxidised by the air to nitrous anhydride, which was then capable of again reacting with a fresh quantity of sulphurous acid. These changes may be summed up in the equations:—

$$2SO_2 + 2\left.\begin{matrix}NO_2\\H\end{matrix}\right\} O + H_2O = 2\left.\begin{matrix}SO_2\\H_2\end{matrix}\right\} O_2 + N_2O_3 \ldots\ldots(1)$$

$$SO_2 + N_2O_3 + H_2O = \left.\begin{matrix}SO_2\\H_2\end{matrix}\right\} O_2 + 2NO \ldots\ldots(2)$$

$$2NO + O = N_2O_3 \quad \ldots\ldots\ldots\ldots(3)$$

The crystals which form in the leaden chambers where there is an insufficient quantity of steam or water present are believed by many chemists to be an intermediate product of the change, and they have been examined from time to time, and prepared in different ways, with a view of throwing some light on this question. Weltzien, many years ago, proved that a white crystalline compound was formed when nitrous anhydride was passed into sulphuric acid, and that its composition might be expressed by the formula $H(NO)SO_4$. Nitric peroxide also yields a similar crystalline compound with sulphuric acid of the formula $2H_2O.3SO_32NO_2$. De La Provostaye found that liquid sulphurous acid and nitric peroxide also yield a crystalline compound $SO_3.SO_2.2NO_2$, and Brüning, from his analysis of the chamber crystals, attributed to them the formula $N_2O_32SO_3$. They have also been produced when red and fuming nitric acid is added to concentrated sulphuric acid, when a mixture of nitric oxide and air is passed through sulphuric acid, and when sulphurous acid gas is allowed to act upon concentrated nitric acid, or a mixture of nitric and sulphuric acids.

From the experiments of Ramsay and Cundall, it seems probable that nitrous anhydride cannot exist in the gaseous state under the conditions given in the leaden chamber, but that it must be regarded as a mixture of nitric oxide and nitric peroxide; while Professor Lunge maintains that nitrous anhydride in passing into the state of gas is only partially dissociated. Lunge further contends that oxygen with an excess of nitric oxide forms mostly nitrous anhydride; but when excess of oxygen is present and both gases are dry, nitric peroxide is the only compound formed. In the presence of water, nitric oxide with an excess of oxygen, according to the same investigator, is altogether converted into nitric acid, while when nitric oxide and oxygen meet in presence of concentrated sulphuric acid no nitric acid or nitric peroxide is formed, but nitrosyl sulphuric according to the equation:—

$$2SO_2(HO)_2 + 2NO + O = 2SO_2(HO)(NO_2) + H_2O.$$

Lunge and Naef have also shown that under ordinary conditions the back chambers contain N_2O_3 and not NO_2, and they are of opinion that nitrous anhydride and not nitric oxide is the oxygen carrier in the vitriol chamber process. The reactions expressing the change, according to them, will be

$$2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2(OH)(NO_2) \ldots.(1)$$

$$2SO_2(OH)(NO_2) + H_2O = 2SO_2(OH)_2 + N_2O_3 \ldots(2)$$

These reactions, Professor Lunge considers, are modified in the first part of the chambers by the excess of sulphurous acid which is there present, and in the last part, where there is little or no sulphurous acid. The amount of water present also affects the changes which take place. He is also of opinion that no nitric peroxide can be present in the chambers when worked under normal conditions, and that any theory as to the reactions which take place, based on this assumption, is erroneous. In dry places nitric peroxide may be formed, and nitric acid if water is present; and the latter will then convert sulphurous acid directly into nitrosyl sulphate, thus:—

$$SO_2 + NO_2OH = SO_2(OH)(NO_2).$$

Lunge also considers that a considerable amount of nitric oxide is formed in the earlier chambers, owing to the denitration of the nitrosyl sulphuric acid by excess of sulphurous acid, thus:—

$$2SO_2(OH)(NO_2) + SO_2 + 2H_2O = 3SO_4H_2 + 2NO$$

and that the nitric oxide at once reacts with the sulphurous acid forming a further quantity of nitrosyl sulphate in the following way:—

$$4SO_2 + 4NO + 3O_2 + 2H_2O = 4SO_2(OH)(NO_2)$$

No nitric peroxide is thus formed, so that the principal changes which take place consist in a condensation of nitrous anhydride, water, sulphurous acid, and oxygen, to nitrosyl sulphate, or of nitric oxide, water, sulphurous acid, and oxygen, to the same compound. Nitrous anhydride is then again formed by the action of water on the nitrosyl sulphate. In the discussion which followed the reading of this paper at the Chemical Society, Dr. Wright stated that he was inclined to believe that sulphurous acid was capable of reducing the higher oxides of nitrogen to a lower state than nitric oxide, and that nitrous oxide and possibly nitrogen itself were also produced. Hjelt was the first to point out that the loss of nitric acid during the manufacture of sulphuric acid was due in a great measure to the presence of arsenic in the pyrites employed, and that in the Gay-Lussac tower, part of the nitrous acid is reduced by the arsenic in the sulphuric acid to nitric oxide. Some other cause than this must occasion loss, as when brimstone or other non-arsenical sulphur is used there is still a necessity for replenishing the chamber with nitric acid vapours; and Lunge, in his paper "Zur Theorie des Blei-Kammer Prozesses," recently communicated to the German Chemical Society, affirms that sulphurous acid does reduce nitric oxide to nitrous oxide both in the chamber and in the Gay-Lussac tower. A considerable loss of oxides of nitrogen is also caused when too much nitre is employed, as then a much larger proportion of nitric peroxide is formed; and when there is a deficiency in the amount of nitre employed, nitrous oxide, nitric oxide, and nitric acid are formed, and loss is occasioned.

Raschig has recently investigated the action of sulphurous acid on nitrous acid, and has shown that when neutral solutions of a nitrite and sulphite be mixed, a salt, which he terms a nitrilo-sulphonate, is formed, and thus on boiling with water is decomposed, forming an amido-sulphonate. The nitrilo-sulphonate also in presence of dilute sulphuric acid yields a salt which can be looked upon as an imido-sulphonate. Hydroxylamine also reacts with sulphurous acid, forming the same amido-sulphonic acid; and H. Raschig considers that some of these nitrogen sulphuric acids may be formed, when free nitrous and sulphurous acids mix with one another; they may therefore be intermediate compounds in the chemical changes which occur in the leaden chamber. He has not obtained any direct evidence in support of his views, and Professor Lunge, although admitting that nitrous oxide is formed by the reduction of nitric oxide by sulphurous acid, does not consider that these compounds of Raschig play any part in the change. Professor Lunge, in the paper already alluded to, draws attention to the fact that any light thrown on the chemistry of these complicated changes cannot be expected to materially benefit the vitriol manufacturer, as the practical conditions for obtaining the best yields are now known, so that there is only a theoretical interest attached to the points which are now under discussion.

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ENGLISH CHINA, OR TENDER PORCELAIN.*

The Chinese as a nation long possessed the secret of manufacturing a species of pottery differing from all other kinds in being semi-transparent. The secret of its production, however, was not discovered by Europeans until the beginning of the eighteenth century, when Böttcher, of Meissen, made the first European porcelain, and founded the manufacture of Dresden china. But England was not far behind in the solution of the problem, and a few decades later we find the manufacture of translucent pottery an established industry at Bow, whence the process was removed to Derby, ever since then renowned as a seat of china making. The methods discovered and adopted by the two nations are, perhaps, good examples of their characteristic qualities. By the employment of laborious research and unflagging application, Böttcher, after innumerable trials, imitated the Chinese, and made an article in every respect similar to theirs. The English potters, however, proceeded by original methods, and arrived by one happy stroke of genius at a material having the same translucency as true Oriental porcelain, whilst at the same time possessed of properties that have enabled our native potters to lavish upon it great beauty of finish and wealth of ornament. The single discovery whereby vessels of porcelain were made almost at a bound accessible to the poorest classes was the employment of bone ash, which, when added in due proportion to kaolin and ground china stone, imparts, under the influence of fire, the semi-transparency characteristic of porcelain ware. The effect thus gained, independently of chemistry, by the use of bone earth, has ever since remained to a great extent unexplained, or, at any rate, little understood by the writers of the few works on pottery manufactures, and we find it stated that the "phosphoric acid of the bone ash diffuses itself at a high temperature through all the materials, uniting them into a translucent enamel, which, being less apt to shrink and lose its form than the hard china body, may be baked in larger kilns, and with less risk of loss to the manufacturer;" and again, it is stated that "English china is rendered translucent by the addition to a pure plastic clay of a considerable proportion of glass forming materials, but the proportion is so regulated that, although the ware does not require excessive heat for its firing, its plasticity is sufficient to facilitate manipulation; moreover, the balance of fusibility and plasticity is so adjusted as to allow the introduction of sufficient calcic phosphate to reduce the shrinkage of the ware to a minimum, and at the same time greatly to add to its brilliancy. . . . The translucency of English china is due to the fusion of the felspar contained in the Cornish stone. The calcic phosphate performs many useful functions. In addition to reducing shrinkage, and enhancing the whiteness of the ware, it enables it by its infusibility to stand the fire requisite for the vitrification of the felspar, and adds lightness without materially affecting transparency." Here then we find calcic phosphate and bone ash used almost, if not quite, as synonymous terms; in the first case the phosphate is said to "diffuse itself," forming an "enamel" with the other ingredients; in the second it is said to impart infusibility, lessened shrinkage, and greater lightness to the ware, and the translucency is attributed to the felspar. The writers appear to have overlooked the double part which bone ash plays in the fabrication of porcelain. Very simple experiments will show that bone ash and phosphate of calcium (lime) are two very different materials when regarded from the potter's standpoint. Experiments made in a biscuit oven by the author, with the kind permission of Mr. John Hudson (Messrs W. Hudson & Co.), of Longton, throw considerable light upon the function of bone ash in china making. A number of mixtures were submitted to the oven during ordinary firings: (1) Bone ash, 7 parts; china stone, 4½ parts; kaolin, 4 parts. This, which represents the usual china mass, was mixed with water and moulded into a small article, and after drying it was fired. The result was a good translucent specimen of china. (2) In another experiment the following ingredients were used: 7 parts of pure calcium phosphate, with kaolin and china stone as before. The outcome was now a sample of white stone ware, quite devoid of transparency, which result effectually demolishes the theory of diffusibility and enamel formation on the part of the phosphate. (3) In this instance 5 parts of calcium phosphate were employed, with the addition of 2 parts of calcium carbonate (equal to $1\frac{1}{10}$ parts of calcium oxide or lime), and the same proportions of clay and stone as before. The product was true semi-transparent china, equal in all respects to ordinary china, as far as could be judged from the small specimen. Trial No. 2 therefore seems to show clearly that china does not owe its transparency, to any preponderating extent, to the china stone, although of course the stone must have some effect in this direction. Experiment No. 3, on the other hand, establishes the great effect exerted by the lime in bone ash in producing translucency.

The function of calcium phosphate still required elucidation, and much light was thrown upon the subject by similar trials in the biscuit kiln, using phosphate of aluminium instead of phosphate of calcium. Pure phosphate of aluminium, prepared without the use of alkaline salts, behaves exactly like pure calcium phosphate in the blow pipe flame and biscuit oven, being apparently quite unaffected. Either of these substances made by precipitation with sodium phosphate fuses readily, even after considerable washing, the liquefaction being produced by small traces of alkali obstinately retained by the precipitate. The fusibility of bone ash cannot be so explained, and is doubtless due to the silica. This constituent is not present in the original bones, but is derived from the mill stones and other sources; it is frequently present to the extent of 5 per cent., or even more, in potter's bone ash, with which the experiments were made. Using pure phosphate of alumina 7 parts, clay and stone as before, there was obtained neither porcelain nor stone ware, but a semi-fused and distorted object, translucent in an inferior degree, and very far from possessing the necessary rigidity in the fire. When 5 parts of phosphate of aluminium and 2 parts of calcium carbonate (equal to $1\frac{1}{10}$ parts lime) were substituted for the 7 parts of aluminium phosphate, the result was the same, but the translucency was a little greater, and the fusibility still more apparent. Evidently, then, aluminium phosphate cannot be employed in place of calcium phosphate, and the effect of the latter upon china must be due to other properties than its infusibility and non-liability to shrinkage, although these may be of advantage. The key to the mystery is readily found. Every experienced analyst knows how difficult it is to make a separation of phosphoric acid from calcium by dry reactions, even by fusion with such powerful agents as alkaline carbonates, and how comparatively easy it is to decompose aluminium phosphate by fluxing with alkalies in presence of silica. Hence we may conclude that in the indecomposable nature of calcium phosphate, under circumstances analogous to those of the alkaline separation, lies the potency of phosphate of calcium for the operations of the potter. In other words, this phosphate remains unattached and isolated, and being infusible at the heat of the oven, affords a support to the glassy substances formed by the mutual action of the alkali of the china stone, the lime of the bone ash, and the silica and alumina of the remaining ingredients. The calcium phosphate therefore acts as a backbone, and enables the English potter to employ a high percentage of vitrifying ingredients, and thus obtain the required translucency at a lower temperature than is possible in the manufacture of true china by the Oriental and German methods, and with less distortion and loss in firing. It appeared possible that if aluminium phosphate were mixed with its equivalent of calcium carbonate, together with clay and stone, the result might be formation of calcium phosphate and alumina, in which case a refractory china would be produced. Experiments, however, proved that this is not the case, the trials emerged from the biscuit oven semi-fritted and opaque. The capacity of calcium phosphate, therefore, does not appear to lie so much in its stability of formation at great heats, so to speak, as in its inertness when present from the beginning. With regard to its effect upon transparency, the author suggested that the relations between the indices of refraction of the calcium phosphate and of the glassy materials might not be without influence.

* Abstract of paper read by Thomas Bayley, before the Birmingham Section of the Society of Chemical Industry, on the 7th inst.

CHEMICAL REAGENTS FOR TEXTILE FABRICS.

Various reagents are now in use for the identification of the materials employed for the manufacture of textile fabrics, and recently the processes for the rapid detection of the presence of animal fibres in vegetable tissues and the converse have been much simplified. Animal fibres can be primarily distinguished from those of plant origin by their solubility in strong soda or other alkaline solvent, while the mineral acids char vegetable fibres, and have little or no action upon those derived from animals. Silk and cellulose are soluble in the blue ammoniacal copper solutions, from which the silk is re-precipitated by dilute acids, and the cellulose by several salts. Schlossberger uses a solution of nickel oxide in ammonia for dissolving silk mixed with cotton, in which the latter is insoluble. Nitric acid also dissolves silk, and colours wool and all animal fibres yellow. A mixture of mercuric and mercurous nitrates, for a long time known as Millon's reagent, has also the property of turning fibres of animal origin a red colour. As wool contains a small but constant quantity of sulphur, the blackening of a solution of litharge in a caustic alkali identifies the presence of this substance. Silk, however, is occasionally sulphured, and will then give a similar blackening with this reagent. The amount of silk present in a sample of cloth can be estimated by a method which is based on the fact first observed by Persoz, that it differs from other textile materials in being readily soluble in a hot and strong solution of chloride of zinc. The method of procedure is as follows: The dressing is removed by a preliminary boiling in dilute hydrochloric acid, and after washing the cloth is immersed in a bath of the chloride of zinc solution, which is prepared by dissolving one hundred parts of chloride of zinc, together with four parts of the oxide, in eighty-five of water. The loss of weight after washing and drying gives the quantity of silk present in the material. The amount of wool in the same material can also be determined by taking a fresh quantity, and noticing in a similar manner the loss of weight after it has been heated to 212° F. for a quarter of an hour in a solution of caustic soda of sp. gr. 1·02. Hœhnel has noticed that mulberry and wild silks behave differently when treated with a solution of chromic acid. Wool and mulberry silk dissolve rapidly in this solvent, while wild silk is only slowly acted upon. Boiling hydrochloric acid dissolves silk rapidly, while any wool present in the fabric increases in bulk, but does not dissolve. This method is also used as a means of determining quantitatively the relative amounts of these fibres in a fabric. If a mixture of wool, cotton, pure and wild silk be present, hydrochloric acid dissolves the mulberry silk first, and finally the Jamamai silk, while the wool is dissolved from the unaltered cellulose by means of a solution of caustic soda. Molisch's method for distinguishing between animal and vegetable fibres was recently alluded to in these pages. It is based on the fact that cellulose, when warmed for some time with a mineral acid, yields a small quantity of sugar, which can then be recognised by the addition of a solution of naphthol or thymol in alcohol, mixed with an equal volume of concentrated sulphuric acid. Naphthol under these conditions gives a deep violet colouration, and thymol a vermilion tint, if vegetable fibres were present in the original cloth. Sidoff has also noted that silk is dissolved by fused oxalic acid, while cellulose (cotton) only disappears on prolonged treatment. Wool is not attacked by this reagent. Lastly, the behaviour of various dyestuffs, *e.g.*, magenta, towards the different materials present, often affords a convenient means of identifying the substance used in the manufacture of the fabric.

THE UTILISATION OF TINNED IRON SCRAP.

With the recent increase in the price of tin, the various methods which have been devised for the recovery of the tin used in coating iron in tin plate become of greater interest, and during the last year several new processes have been devised which are likely to be exceedingly remunerative if the present price of the metal can be maintained. All the processes which have been proposed may be divided into two distinct parts, the first consisting in dissolving the tin from the surface of the iron, and the second in conveniently recovering the tin in a metallic state from the solution. In 1886 a method for extracting the tin from tinned sheet metal cuttings by means of hydrochloric acid gas was patented in France and in this country. The patentees, F. Bosshardt, of Manchester, and S. Montague, of Nantes, heat the cuttings in a closed vessel by means of superheated steam to a temperature of 150°C. to 160° C., and then introduce a current of hydrochloric acid gas prepared in an adjacent generator. In this way the tin is converted into its protochloride (stannous chloride), and is finally washed away from the unaltered iron scrap by water, which is pumped into the vessel from above, and distributed by means of a rose jet. The solution of stannous chloride obtained in this manner is then treated with zinc cuttings, which cause the tin to be precipitated in a crystalline metallic form, which can subsequently be melted and cast into bars. The scrap iron remaining in the vessel can also be utilised by being worked up into bars. Their apparatus has recently been modified in such a manner as to make the process a continuous one, and this has enabled the inventors to effect a considerable saving in the amount of hydrochloric acid employed. In this improved form, a series of brick work chambers, lined with asphalt, are packed with the tin plate cuttings, and are arranged so as to permit the hydrochloric gas to circulate from one to the others, and finally the waste gases, which escape into a flue, are found to be almost free from acid. Water spray and steam are employed for removing the chloride from the iron, and the second chamber is then allowed to receive the fresh hydrochloric acid gas, while the empty one is re-filled with a second charge of tin scrap and placed last in the series. The tin is obtained from the liquors by precipitation by means of zinc, iron, or lime. When the latter is employed, a deposit is obtained which is pressed and dried, and finally treated like iron ore. In the specification of a patent taken out some time ago by Mr. Biggs, an arrangement

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consisting of a revolving metal cylinder lined with asphalt is described, for containing the tin scraps to be treated. Hydrochloric acid of 17°Bé., and at a temperature of about 95°C., is stored in a cistern above this revolving cylinder, and is allowed to slowly fall on the tin scraps. The liquid runs from the cylinder into a tank beneath, and the washings are cooled to allow any lead which may be present to separate. Tubs fitted with revolving beaters have also been proposed by the same inventor in place of the rotating cylinders. E. Edwards, of London, and M. Ramos-Garcia, of Paris, have also patented a method in which the tinned iron is stripped of its coating of tin by immersion in a bath of hydrochloric acid, containing a small quantity of free nitric acid or perchloride of iron (ferric chloride). The solution of the metal is hastened by warming the bath in a current of steam, and the tin is electrolytically recovered from the solution, tin cathodes being employed upon which the metal is precipitated. When tin plate scraps are treated with hydrochloric acid, without any oxidising agent being present, the iron is also dissolved, and a mixture of ferrous and stannous chlorides is obtained in the solution. H. H. Lake, of London, and Worth & Co., of Frankfort-on-the-Main, agitate this liquid with finely divided precipitated chalk or calcium carbonate, which causes the precipitation of the tin as white oxychloride, $SnO\ SnCl_2\ 3H_2O$. This operation is conducted in closed vessels, to prevent the oxidation of the ferrous salt, which otherwise would also be precipitated with the stannous oxychloride. The closed vessel should also be filled with carbonic acid gas, in order to insure the absence of any oxygen. The precipitate of oxychloride is next filtered under pressure, and subsequently boiled with an additional quantity of carbonate of lime, which converts it into pure stannous oxide. These two changes may be represented by the equations:—

$$CaCO_3+3H_2O+2SnCl_2=SnO.\ SnCl_2.\ 3H_2O+CaCl_2+CO_2 \quad (1)$$

$$SnO.\ SnCl_2.\ 3H_2O+CaCo_3=2SnO+3H_2O+CaCl_2+CO_2 \quad (2)$$

The stannous oxide obtained can be converted into the metallic state by reduction with coal, or can be converted into pure stannous chloride by solution in hydrochloric acid. The hydrochloric acid can be recovered from the filtrate of calcium and ferrous chlorides by the addition of sulphuric acid, when calcium sulphate is precipitated, and after being allowed to settle is removed by decantation. The solution on evaporation yields sulphate of iron and hydrochloric acid, which can be utilised in the first operation.

Notes.

MACHINERY IN TURKEY.

The British Consul at Salonica states that steam flour mills are gradually spreading over the country, and that within the last two or three years several have sprung up in the interior—one at Argo-Nicola, another at Kilkitch, and one at Monaster—all being the outcome of native enterprise. The machinery and boilers are mostly of French origin, though in one or two cases they have been obtained from England. The Consul says that no doubt much more machinery of English make would be imported into Turkey if an agent of some manufacturing firm were established there. He also points out that as a rule joiners' work at Salonica is very inferior, and that it should be possible to create a good market for English wood working machinery.

METEOROLOGY.

Mr. Shaw has recently drawn up a report on the various methods employed by meteorologists for determining hygrometric constants. He has examined critically the results obtained by the saturation and chemical methods, and also the values given by the various dew point instruments. Most determinations of the pressure of water vapour in the air are indirect, and require a formula of reduction before an absolute value of the amount can be arrived at. In the formula employed in the chemical hygrometric method, which is provisionally regarded as the standard, it is assumed that Dalton's law is strictly accurate, and that it is possible to absorb all the moisture in the air by dehydrating agents. Sulphuric and phosphoric acid tubes are efficient for this purpose; but it is necessary that two tubes be employed to insure the complete absorption of the water vapour present in the air under examination. Regnault's hygrometer gives very satisfactory and concordant results after some practice; and the instrument perfected by Dines gives very easy determinations of the dew point which are within small limits of experimental error. Alluard's modification of Regnault's hygrometer and Bogen's apparatus also yield satisfactory results.

STEEL WORKS' EXTENSIONS.

Messrs. David Colville & Sons, of the Dalzell Steel Works, Motherwell, have just completed the erection of two additional open hearth steel furnaces, and the necessary gas producing plant. The furnaces are of the ordinary Siemens type, with a capacity of 25 tons each. Other alterations, involving a large outlay, are at present being made at these works, which are now capable of a monthly production of 7000 tons of finished steel. Messrs. Neilson are proceeding rapidly with their new steel works at Clyde Bridge, near Rutherglen, and manufacturing operations will shortly be commenced. The plant has been erected under the superintendence of Mr. Williamson, formerly of the Newton and Blochairn Steel Works. It consists of four fine 25-ton steel furnaces, with cogging and rolling mills for producing the heaviest class of plates and bars, all of a powerful and superior description. The other steel works in the district are all more or less engaged in alterations to enable them to meet the pressure caused by the exceptionally heavy demand for shipbuilding steel.

THE WAINWRIGHT CUPOLA.

On 30th December last we gave an illustrated description of this furnace, which burns natural gas, or producer gas, instead of coke. An experimental cupola on this principle, using natural gas, has recently been tested at Messrs. Price & Co.'s Foundry, at Pittsburg, with very satisfactory results. The bearers for supporting the charge were formed of hollow pipes, covered with fire clay tiles, their temperature being kept sufficiently low by currents of cold air constantly forced through them. A small quantity of coke was placed on the bearers, and on this the pig was charged in 2cwt. lots as fast as it melted, without any further addition of coke. The gas and air were forced into the combustion chamber by a positive rotary blower, and the molten metal was retained till required in the receiver below the charge bearers—its perfect fluidity for any length of time being insured by the intensely hot gas flame playing across its surface. Ordinary cupolas can be readily adapted for melting iron in this manner by the addition of a combustion chamber and charge bearers. Mr. Wainwright is hopeful that his furnace can also be applied to the reduction of iron ores by natural gas, with considerable saving in the cost of both fuel and plant.

WATER SUPPLY FOR 1888.

The rainfall in England during the first two months of the present year has been about 70 per cent. below the average; and unless exceptionally large quantities of moisture fall within the next three months, it seems certain that something approaching a water famine will be experienced during the coming summer. Last year, with a deficiency in the total rainfall of the British Islands of 27 per cent., the scarcity of water was severely felt, both in the country districts and large towns. This year, in the middle of February, Manchester had 2,000,000,000 gallons less water in store than at the same time last year; Liverpool had only 1,015,000,000 gallons in the reservoirs at Rivington, as against 3,700,000,000 gallons in February, 1887; while Sheffield had at that period less than half the usual quantity for the time of year. With the latter town the difficulty is further increased by the fact that dangerous lead poisoning begins to show itself among the inhabitants whenever the supply in the reservoirs falls unusually low. Manchester and Liverpool are presently engaged in gigantic water enterprises, and other towns are doing their utmost to improve their position; but few of these undertakings will be available this year; and as there is little to indicate any alteration in the prevailing meteorological conditions, the most careful husbanding of existing supplies becomes a necessity.

SHEEP SHEARING BY MACHINERY.

That labour difficulties are very often incentives to ingenuity is a fact well known to all who know anything of the history of industry, and it has just received another illustration in Australia. Strikes and the high wages demanded by sheep shearers have led to various attempts to apply machinery to the process of sheep shearing. This was long considered impossible; the first difficulty was to control the animal while being shorn, the second was the construction of the apparatus for shearing it. These difficulties have apparently been overcome by Mr. Woolseley, of New South Wales, and at a public trial a considerable number of sheep farmers and wool brokers from all the Australian Colonies united in the opinion that the machine did the work which its inventors claimed for it. It is very simple in construction, being on the same principle as the cutter of a mowing or reaping machine, and one of its chief advantages is that it does not require a highly skilled person to work it. An ordinary farm labourer can be taught its use in a couple of days, and its advocates claim a saving of fully 10 per cent. At the first public trial fifty or sixty sheep were shorn in a day of ten hours; eighty or ninety is a fair number for a good hand with a pair of shears, but in every sheep shorn by the machine there is said to be a saving of from 4oz. to 12oz. of wool. We fear, however, that except in countries where the cost of labour is high, the machine is not likely to be used to any great extent.

THE LICK OBSERVATORY.

Our American contemporary, *The Iron Age*, states that serious defects in the construction of this observatory will delay the time for fully demonstrating the power of the great telescope. The most serious is the mounting of the telescope on a hollow iron pier 30ft. high, which extra elevation, it is claimed, was not needed on a mountain 4000ft. above the level of the sea. Owing to its extremely great power, the telescope is so sensitive that the placing of a man's hand on the hollow iron pier is sufficient to throw the star entirely out of the field. This can only be obviated by the removal of the present pier, and the building of a solid one of brick or stone, or else placing the base of the instrument directly upon the summit of the mountain. Another serious fault is the removable floor for the great dome. Experience has demonstrated that instead of five it requires fifty minutes to effect the desired change of position of the floor, by which time the object of observation would, necessarily, be in a different place in the heavens.

SWISS RAILWAYS.

The Swiss Federal Council are desirous of gradually acquiring the entire Swiss railway system, and negotiations have been commenced with the North-East Railway Company, with a view to its purchase by the State. The history of this line and particulars of the negotiations form the subject of a Foreign Office report by the British Consul at Zürich, in the course of which he states that the Government consider that, for political and financial reasons, the Swiss railways ought not to be left in the hands of private companies, who in their turn are at the mercy of speculative shareholders, many of whom are foreigners. They are therefore determined to buy up all private railway companies in Switzerland, and to work the lines for the advantage of the Confederation. A majority for the first purchase, that of the North-East, is likely to be found in the Federal Chambers; but the result of the Referendum (popular vote) is at present somewhat doubtful, unless the suspicion can be thoroughly removed that the Government are going to pay too much for the line. During the spring session of 1888 the Federal Chambers will be asked to ratify the contract, which by that time will have been drawn up between the Government and the North-East Company, and the popular vote of the Swiss people will then be taken without delay.

A NEW METHOD OF PREPARING SAFRANINES.

MM. Barbier and Vignon have recently communicated to the French Académie des Sciences a new process for preparing these important dyestuffs. In an article on these colouring matters (*Industries*, Vol. II., page 123), we gave details of the ordinary method for preparing phenosafranine by the oxidation of a mixture of one molecule of paraphenylene diamine and two molecules of aniline according to the equation

$$C_6H_4(NH_2)_2+2C_6H_5NH_2HCl+4O=C_{18}H_{15}N_4Cl+4H_2O+HCl.$$

It is also well known that amidoazobenzene, under the influence of reducing agents, is converted into aniline and paraphenylene diamine, thus:—

$$C_{12}H_{11}N_3+2H_2=C_6H_4(NH_2)_2+C_6H_5NH_2.$$

In the new method, this reaction is allowed to take place in the presence of nitrobenzene, which furnishes the second molecule of aniline necessary for the formation of safranine and also the oxygen required in the subsequent oxidation. The change may be expressed by the following equation:—

$$C_{12}H_{11}N_3+C_6H_5NO_2+HCl+H_2=C_{18}H_{15}N_4Cl+2H_2O.$$

The authors use iron and hydrochloric acid for the reduction, and they find that this reaction takes place at a temperature of about 180°C. The nitrobenzene is added in slight excess, and at the end of the operation any that may be undecomposed is removed by distillation in a current of steam. The reaction takes about three hours for the complete conversion, which is indicated by the change of colour to a deep red. The colouring matter formed is dissolved in water and neutralised with ammonia, and, after filtration, is precipitated from the solution by the addition of salt. The phenosafranine is re-crystallised from hot water, and presents all the characteristics of the substance prepared by the old process. This method has also been applied to the preparation of other members of the safranine series by the substitution of amido-azo-toluol for amido-azo-benzol and other mone-nitrated aromatic hydrocarbons for nitrobenzene.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

24th February, 1888.

2741. Burton, J. D. ..... Calculating machines.
2742. Gay, R., & others..... Lifting and lowering machinery.
2746. Sugden & Binns ..... Boilers.
2756. Matthew, P. M. ..... Manufacture of water proof textile fabrics.
2765. Catlow, C..... Looms.
2767. Wright, S. H. ..... Exhaust pumps.
2774. Lake, H. H. ..... Burnishing machines (*Ross*).
2780. Butler, F. D. ..... Type writing machines.
2783. Tweddell, R. H., and others..... Hydraulic presses.
2788. Sergeant & Cook ..... Mitreing machines.
2804-5. Johnson, J. Y..... Gas engines (*La Société Salomon frères et Tenting*).

25th February, 1888.

2822. Foulds, J..... Propellers for ships.
2829. Sykes, G. W..... Looms.
2834. Jackson & Austin ..... Drilling machines.
2840. Dickie, M..... Looms.
2847. Vaughan, H..... Sheet metal box staple.
2848. Weild, E..... Opening and stretching fabrics.
2849. Hunter, A..... Valve gear for "Corliss" engines.
2850. Stitt, J. C..... Steam engines.
2859. Parr, S..... Warp beams.
2861. Unruh & Liebig..... Grain elevators.
2862. Sedgwick, J. H..... Newspaper printing machinery.
2871. Dutton, R..... Finishing piled fabrics.

27th February, 1888.

2884. Haswell, R..... Hydraulic accumulator.
2892. Hetherington and Hawarth..... Mules.
2895. Curson & Curson ..... Forcing waste steam back to boiler.
2896. Riley, J. ..... Basic hearth steel making furnaces.
2899. Riley, J. ..... Regenerative furnaces for steel making.
2903. Parsons, P. M..... Manufacture of steel.
2905. Black, J. M..... Colour printing.
2910. Lindley, L. ..... Sewing machines.
2912. Knowles & Tatham ... Carding engines.
2913. Oechelhaeuser, W. von Gas engines.
2914. Carver, J. E. ..... Sewing machines.
2915. Hamann, W. C..... Mills for grinding corn.
2916. Lane & Browne ..... Forging and rolling metals.
2922. Johnson, J. Y..... Machines for sewing knitted fabrics (*Quinquarlet, Valton, and fils*).
2928. Bell, T. H., & others... Rock drilling apparatus.
2930. Olsson, P. P..... Knitting machines.
2932. Haddan, H. J. ..... Leather smoothing machines (*Miller & Andreae*).
2936. Harper, J. ..... Screw propellers.
2937. Codling, R. B..... Machines for turning.

28th February, 1888.

2940. James, G. ..... Hydraulic presses (*Hobson*).
2944. Inskeep, J. C. ..... Boiler furnaces.
2950. McGrady, H. ..... Type writers (*Crandall*).
2953. Stokes, G. R. ..... Brake for locomotives.
2957. Lockerbie & Buchanan Brake gearing for railway carriages.
2965. Petrie & Fielden ..... Drying textile material.
2968. Smith & Cooper ..... Manufacture of cords.
2970. Craven, F. ..... Pickers for looms.
2978. Hosking, A. W. ..... Weighing machines.
2986. Higginson, J. ..... Governors.
2996. McNeill, D..... Paper making machines.
2999. Day, C. A. ..... Sewing machines (*Arnold*).
3000. Driggs & Schroeder... Breech loading ordnance.
3007. Fleury, P. A. M. D. O. de Bevelling and grinding glass.
3014. Braun, O..... Centrifugal machines.
3020. Abel, C. D. ..... Gas engines (*Gas Motoren Fabrik Deutz*).
3022. Worrall, T. D. ..... Printing in colours.

29th February, 1888.

3033. Hopkinson, J. ..... Shuttles for weaving.
3038. Bradbury, J. ..... Apparatus for weighing and pressing hay.
3039. Lee, J. F., & others..... Loom shedding motions.
3043. Richardson, C. J. ..... Textile machines.
3044. Hattersley & Hill ... Looms.
3045. Laing, W. R. ..... Spinning, doubling, and twisting frames.
3058. Yates, T. ..... Distributing printers' types.
3059. Koerner, A. C. ..... Breech mechanism of rapid-firing guns.
3069. Stebbing, J..... Rotary engines.
3080. Thornycroft, J. I..... Guns and projectiles.
3082. Fouquemberg, N..... Machinery for agglomerating fuel.
3095. Abel, C. D..... Igniting apparatus for gas engines (*Gas Motoren Fabrik Deutz*).
3098. Davis, C..... Armour plates.
3099. Gastrell, J. P. H. ..... Rotary engines.
3100. Wem, W..... Cartridge ejector mechanism.
3101. Turpin, E..... Breaking up rocks. (Ante-dated 17th February, 1888. Under International Convention.)
3104. Johnson, J. Y..... Winding yarn (*Quinquarlet and Valton*).
3105. Blacklock, J. ..... Circular knitting machines.

1st March, 1888.

3120. Koerner, A. C..... Rapid-firing guns.
3125. Newton, J. ..... Warp lace machines.
3129. Hök, W..... Steam generator.
3130. Whitehead, J..... Spinning of yarns.
3133. Sayer, R. C..... Cable tramways.
3135. Jackson & Martin ..... Type writers.
3138. Widnall, R. L. ..... Fire boxes of locomotives.
3144. Watkinson & Partington..... Brick making machine.
3147. Thompson, W. P..... Mills for grinding or pulverising (*Tixhon-Smal*).
3151. Archer, W. S..... Machines for scutching, carding, or separating fibrous materials.
3153-4. Binns, L. ..... Spinning and twisting frames.
3163. Ber, O. ..... Carriages.
3175. Sallandrouze, T., and others ..... Looms.

ELECTRICITY.

24th February, 1888.

2772. Hedges, K. W..... Electrical safety appliances.
2784. Imray, J. ..... Electrically lighting railway carriages (*Imray*).
2785. Lauckert, E. F. H. H... Electric glow lamps.
2794. McEvoy, C. A. ..... Electrical firing keys.

25th February, 1888.

2808. Joel, H. F..... Electromagnetic conductors.
2819. Nalder, F. H., & others Electrical measuring instruments.

27th February, 1888.

2876. Ward, M. R..... Electrically propelled vehicles.
2933 Haddan, H. J. ..... Regulating dynamos (*Hill*).

29th February, 1888.

3072. Rhoads & Tickhurst... Electric induction apparatus.
3075. Southey, A. W..... Electric arc lamps.
3097. Drake & Gorham ..... Secondary batteries.

1st March, 1888.

3149. Kayser, L. ..... Galvanic batteries.

CHEMISTRY.

24th February, 1888.

2777. Trickett & Noad..... Sodium oxide.
2778. Trickett & Noad..... Extraction of gold, silver, and platinum.

25th February, 1888.

2810. Tennent, R. B..... Distillation of shale.
2816. Williams, W..... Manufacture of salt chemicals.
2831. Parnell & Simpson.... Sulphuretted hydrogen.
2858. Tipping, H..... Oxygen and nitrogen.
2870. Tuthill, E..... Oil from birch tree bark.
2872. Overbeck, Baron de... Aluminium (*Hildwein and Von Schoenberger*).
2873. Overbeck, Baron de... Making alumina from clay (*Hildwein & Von Schoenberger*).
2874. Overbeck, Baron de... Manufacture of alumina from its sulphate (*Hildwein & Von Schoenberger*).

27th February, 1888.

2920. Maxwell-Lyte, F. ..... Basic lead salts.
2921. Caspers, C. J. ..... Impregnating liquids with carbonic acid.

28th February, 1888.

3004. Eckenstein, O..... Actinic light.
3016. Imray, J. ..... Yellow colouring matters (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, & others*).
3018. Buddicom, H. W. ..... Coating metal with tin.

29th February, 1888.

3094. Merck & Memel..... Hydrargyrum compounds.

1st March, 1888.

3122. Chance, A. M..... Alkali waste.
3124. Chance & Chance ..... Treating vat waste.
3134. Chance & Chance ..... Sulphuretted hydrogen.
3146. Ostermann & Lacroix. Non-magnetic alloy.
3148. Rigby, J. S. ..... Ammonia-soda process.
3165-6. Ellice-Clark, E. B... Sulphuric acid (*Lunge*).

MISCELLANEOUS.

24th February, 1888.

2739. Wright & Wright..... Gas burners.
2744. Smith, D. ..... Indicators for railway carriages.
2747. Smith, J..... Bicycle.
2748. Baldwin, E. S..... Nail for corrugated plates (*Davenport*).
2749. Pilliner, F. F..... Metallic corrugated roofing.
2752. Fulton, T. A. W..... Object finder for microscopes.
2754. Leeman, E. G. ..... Lamps.
2757. Fox, C. J..... Shielding flames.
2759. Walker, C. M..... Gas lamps.
2761. Phillips, R. E..... Softening water (*Harwood*).
2762. Phillips, R. E..... Disinfecting and purifying sewage (*Harwood*).
2763. Newman, C. F..... Utilising sewage refuse.
2764. Sharples, J..... Circular bits used in working wood.
2771. Morris, F. S..... Lock nuts.
2773. Tozer & Archer..... Locking nuts on bolts.
2775. Righton, W. J..... Instantaneous water heaters.
2779. Payne, W. J..... Apparatus for heating water.
2793. Lansard, J. E..... Lock nut.
2797. Munro, J..... Boxes for lowering concrete for the foundations of sea walls.
2803. Brunton & Griffiths. Artificial stone.

25th February, 1888.

2807. Brown, W..... Gas lighting.
2811. Rallings, H..... Joints for water pipes.
2812. Drakeford, I. ..... Boring tools.
2813. Moir, G..... Manufacture of briquettes.
2815. Fawcett, M..... Fire proof floors.
2823. Wyse & Baird ..... Horseshoes.
2826. Arnz, H..... Boring tools.
2832. Husselbee, E. ..... Cast iron pipes.
2833. Illsley, W. ..... Manufacture of bricks.
2838. Walker & Carver..... Woven fabrics.
2841. Stroudley, W..... Lubricating engines.
2842. Johnson, J. Y..... Tools for cutting stone (*Fabre and Tronche*).
2851. Utley, T..... Ships' side lights.
2852. Hayward, C..... Lithographic ink.
2853. Fullford & van Laun. Regenerative gas lamps.
2860. Owens & Jennings..... Stoves and grates.
2863. Maxwell-Lyte, F..... Treatment of sewage.
2864. Johnson, T..... Serving rope for the rigging of ships.
2865. Powell, J..... Root cutters.
2869. Pierce, A..... Fire escape.
2875. Vaughan, W..... Improvements in cabs.

27th February, 1888.

2879. Smith, D..... Slip bolt.
2881. Fenwick, T..... Disconnecting vehicles.
2882. Fenwick, T..... Loading heavy goods.
2883. Richardson, H. F..... Lighting lamps with the electric light.
2885. Sinnette, F. J..... Water tight seams and butts of vessels.
2891. Carroll, J..... Oil lamps.
2894. Best, R. H. ..... Gas lamps.
2897. Avake, A. G..... Fire escape.
2902. Humpherson, F. ..... Syphon flushing cisterns.
2907. Capel & Young ..... Opening metal cans.
2931. Lake, H. H. ..... Distribution of oil upon the surface of water (*Arnold*).
2934. Blatt, L. ..... Connections for pneumatic brakes.

28th February, 1888.

2939. Monk, J. ..... Horseshoe.
2943. Palmer, R. ..... Reducing the pressure in gas retorts.
2945. Ginman, N. J. ..... Valves for measuring the flow of water in pipes.
2948. Stokes, F. W. S. ..... Ventilation of tunnels.
2955. Ford & Wright ..... Self ventilating sewer pipe.
2956. Harris, A. B. ..... Fog signalling on railways.
2962. Bradbury, T. ..... Brewing beer.
2963. Clark & McInnes ..... Sighting the interior of steam boilers.
2969. Heard, T. H..... Spades and shovels.
2972. Clark, W..... Bookbinding (*Beckett*).
2974. Thompson, W. P..... Stoppers for bottles (*Firelli & Co.*)
2984. Stone, R. ..... Cement.
2987. Main, G. ..... Pipe connections.
2988. Eade & Eade ..... Water jet.
2990. Tucker & Gadsby ..... Tricycles.
2991. Buch, Carl von ..... Incandescence gas burners.
2992. Wilding, S. P..... Lining articles with hard rubber (*Dittenhoefer*).
2993. Creasy & Jeyes ..... Glass bottles.
2995. Johnson, S. A. ..... Obtaining clean water from rivers
2997. Effer, W..... Gas burners.
2998. Harrison, W. S. ..... Synchronising mechanism for clocks.
3005. Jones, W. ..... Cinder sifter.
3006. Lillie, S. M..... Apparatus for evaporating.
3008. Harrop, C. ..... Varnishing metal goods.
3010. Mumford, C. E. ..... Separators for seeds.
3017. Abel, C. D., & others ... Indicating the flow of liquids (*Kotliarewski*).
3021. Blakesley, T. H. ..... Barometer.
3024. Chandler & Chandler Purifying gas.
3025. Crastin, C. ..... Incandescent gas burners.

29th February, 1888.

3032. Walker, E. ..... Automatic sprinkler.
3052. Haran, N. G. ..... Joint for steam pipes.
3055. Ashforth, J. S. L. ..... Bench vices.
3061. Cox, H. G. ..... Carriage springs.
3062. Arnold, W. ..... Traction engine chimneys.
3065. Field, H. ..... Regulating the flow of team and water.
3070. Inwood, C..... Velocipedes.
3071. Pearson, J. ..... Miners' safety lamp.
3073. Thomson, A..... External screw stoppers.
3074. Kennar , D..... Valve or cock.
3078. Hay, A. ..... Hoisting slings.
3081. Erfurth, O..... Safety apparatus for lifts.
3091. Wright, S..... Manufacture of barrels.
3096. Laundry & Warren ... Twist augers.

1st March, 1888.

3110. Thompson, G. F. ..... Pulley.
3111. Thompson, G. F. ..... Separating grain.
3116. Barlow-Massicks, T. G. Stoppers for bottles.
3117. Mulligan, J..... Ventilators.
3121. Waddington, J. ..... Shuttle tongues.
3127. Rylands & Stoner..... Glass bottles.
3140. Poole, W..... Cinder sifters.
3143. Stone, J. H. ..... Terminals for hose pipes.
3155. Lewen, J. J..... Water pipes.
3156. Lawrance, H. ..... Ventilator.

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3158. Sheldon, J. ..... Metallic screws.
3159. Lowe, E. ..... Gas purifiers.
3160. Brockelbank, H. ..... Railway bridging.
3162. Lake, H. H. ..... Manufacture of nails (*Wilder*).
3164. Laber & Pöhler..... Lamps.
3168. Dewrance, J. ..... Lubricators.
3169. Osgerby & Lea ..... Regulating the supply of gas.
3170. Henderson, F. J..... Ball valves.
3172. Jones & Bridger ..... Manufacture of boots.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

3rd March, 1888.

16895. Mellor & Parker..... Knitting machinery.
2724. Sellars, J. C. ..... Converting reciprocating into rotary motion.
2814. Berly, J. A. ..... Dyeing spun textiles (*Lombard et Compagnie*).
2948. Yelland, J. ..... Glass melting.
2991. Lorrain, J. G..... Marine governor (*Finlayson and Gosselin*).
3251. Lynde, F. C..... Weighing machines.
3280. Chadwick & Consterdine-Chadwick ..... Printing.
3303. Peters, G. T. ..... Grab diggers.
3666. Turner, H. ..... Steam engines.
3937. Wilkinson, A. ..... Manufacture of paper.
4057. Greenwood, A. ..... Repeating fire arms (*Schweizerische Industrie-Gesellschaft*).
4217. Gutmann, G. R. A. ..... Sand blasts
4604. Middleton, H. ..... Submarine boats.
4757. Casper, E. ..... Gas engines (*Tavernier*).
4759. Sleep, W. H. ..... Water motors.
4772. Stawitz, J. W. ..... Water meters.
4780. Matthews, R. ..... Apparatus for refrigerating.
5135. Brown, A. G. ..... Compound engines.
5954. Low, R. ..... Tempering steel projectiles.
5970. Carver & Newton..... Traverse warp machines.
6043. Greenwood, A..... Repeating fire arms.
6051. Booth, J. ..... Manufacture of knitted fabrics.
6097. Blackman, A. L. ..... Dredgers and excavators.
6109. Maskrey & Phillips ... Manufacture of tin plates.
6128. Gatty, F. A..... Dyeing cotton yarns.
6130. Law, F. ..... Securing clothing to the bars of card flats.
6144. Picking & Hopkins..... Water ejectors.
6190. Weir & Weir ..... Heating of feed water.
6192. Pollard & Mather ... Colour printing machines.
6198. Mountain, M. B..... Regenerative gas furnaces.
6218. Holden, J. W. ..... Smoke consuming apparatus.
6260. Bennett & Bullon ... Loom temples.
6281. Goreham & Watson... Grinding machinery.
6290. Harfield, W. H..... Steam windlass for ships.
6602. West, H. J. ..... Grinding wheel.
6904. Stevenson, H., & others Spinning machinery.
7045. Greenwood, A. ..... Magazine fire arms (*Schweizerische Industrie-Gesellschaft*).
7299. Smith, P. ..... Twisting frames.
7443. Lorenz, W. ..... Breech closing mechanism for guns.
7662. Bower, T., & others..... Boring machines.
8027. Covell & Cram ..... Knitting machines.
9551. Lake, H. H. ..... Tack making machines (*Copeland*).
14026. Lake, H. H. ..... Looms (*Cree*).
15346. Bromhead, S. S. ..... Sewing machines (*Brautigam*).
1081. Granger, A. P..... Crushing machines.
1137. Hunt, E..... Twin screw propellers (*Henry*).
1160. Davey, H. ..... Steam boilers.
1303. Riley, J., & others ..... Manufacture of figured quilts.
1329. Gentry, O. H. ..... Steam boilers.
1333. Ganhe, O. W. ..... Chain elevators.
1419. Thompson, W. P..... Refrigerating apparatus (*Craft*).
1531. Abel, C. D..... Sewing machines (*Rudolph*).

ELECTRICITY.

3rd March, 1888.

4225. Hookham, G. ..... Dynamo-electric generators.
5562. Maxwell, W. ..... Generating electricity.
5709. Gravier, A. I. ..... Dynamo-electric machines.
5867. Kingsland, W. ..... Secondary batteries.
6168. Jackson, H. F..... Telephones.
17704. Herts, A. C..... Telephones.

CHEMISTRY.

3rd March, 1888.

4686. Gall & DeMontlaur... Chlorates of alcalies.
4846. Gutensohn & Cox ..... Coating iron with tin.
6107. Gardner, H. ..... Carbonic oxide (*Henderson*).
6294. Watt, A. ..... Treatment of zinc ores.
603. Dames, C. R..... Preparing fullers' earth.
1082. Weidig & Remmey ..... Absorption towers for the manufacture of muriatic or nitric acid.

MISCELLANEOUS.

3rd March, 1888.

1069. Edwards, W. H., & ors. Miners' safety lamps.
2943. Robertshaw, E. ..... Preventing accidents by overwinding.
3419. Thorne & Burr ..... Indicating the speed of ships.
3904. Stone, R. ..... Barrels.
4949. Wood, A. M. ..... Buoyant cable.
5060. Bayliss, W. ..... Screw nuts.
5134. Brown, A. G. ..... Valves.
5588. Simpson, J. C. ..... Valve.
5782. Edwards, J. ..... Cleaning the bottoms of ships.
5822. Breeden, J. ..... Valves.
5963. Ramsay, J..... Clutches.
5984. Bates, E. J. ..... Cleaning textile fabrics.
5991. Howe, A. C. E., & others Wind vane.
6021. Marquand, A. le ..... Drainage of houses.
6078. Swift, H. W..... Extracting ferrules from boiler tubes.
6103. Starley, J. K. ..... Tyres for the wheels of velocipedes.
6122. Wake, H. H..... Depositing concrete under water.
6135. Field, H. ..... Packing for steam engine glands.
6187. Longsdon, H. C. ..... Step ladders.
6215. O'Donnell, E. ..... Marking patterns upon cloth.
6232. Griffin, G. F..... Tin plate boxes.
6293. Greenwood & Lambert Manufacture of oil cake.
6316. Armytage, J. E. B..... Joints used in securing rails.
6346. Morse, A. T..... Roofing and wall tiles.
6347. Birch, J. A. ..... Anchors.
6352. Cranston, W. McI..... Twisting straws to make rope (*Walter A. Wood Mowing and Reaping Machine Co.*)
6358. Kempson, A..... Stoppering bottles.
6374. Qualter & Hall..... Elevating band chains for coal, ore, or other minerals.
6421. Hall, J..... Artificial fuel.
6469. Trotman, F..... Bottle stoppers.
6470. Smith, P. ..... Spindles.
6755. Harvey, H. A. ..... Coating the bottoms of vessels.
7085. Bayliss, T. R. ..... Primers for cartridges.
7554. Allan, C. E..... Signalling apparatus.
8167. Wilson, G. F. ..... Waterproofing textile fabrics.
8770. Carpenter, A. H. ..... Feathering blade wheels.
11185. Brenton, W. ..... Seed drills.
11205. Cregeen, H. S..... Gully trap and channel.
11783. Hall, J. ..... Artificial fuel.
13191. Hall & Phillips ..... Velocipedes.
14053. Devoll, W. ..... Oil lamps.
14321. Rees, T. H. ..... Printing on tin plates.
14581. Billson & Cooper..... Cleaning steam boilers.
16491. Buddicon, H. W..... Dipping tin plates.
16979. Anderson, T. ..... Tinning hollow ware.
17263. Lurie, C. ..... Velocipedes.
17829-30-31. Rogers, C. D. ... Screw threading.
770. Woodhead, T. ..... Bolts, rivets, and screws.
964. Graig, A. M..... Argand gas lamps.
993. Carter, H. W., & others Charging bottles with aerated water.
1007. Stone, J. H. ..... Fittings for hose pipes.
1089. Redfern, G. F..... Weighing scales (*Thomson*).
1113. Thomson, W..... Corking bottles.
1245. Alliott & Paton..... Disinfecting apparatus.
1296. Thomson, G. P..... Rolling chambers for ships.
1465. Haddan, R. ..... Carriage wheels (*Battle*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 25th November, 1887, inclusive.)

Year 1883.

5444. Haddan, H. J. ..... Examining germinative properties of grain (*Coldewe and another*).
5446. Nawrocki, G. W. von... Coupling, &c., draw bars of railway vehicles (*Madsen*).
5447. Jackson, C. A. ..... Telephones.
5448. Lake, H. H. ..... Telephonic apparatus (*Berliner*).
5451. Clark, A. M..... Alarums (*Luguer*).
5453. Allison, H. J. ..... Insulation of electrical wires (*Gilman*).
5454. Gibbon, T. H. ..... Railway rail joints.
5457. Walker, J. G. ..... Washing and drying of grain.
5459. Haddan, H. J. ..... Breech loading guns, &c. (*Burkhard & another*).
5468. Bowe, J. A. ..... Riveted joints.
5470. Lake, H. H. ..... Dynamo-electric machines (*McTighe & another*).
5471. Lake, H. H. ..... Telegraph and telephone lines (*Chambers & another*).
5472. Lake, H. H. ..... Electric lamps (*McTighe and another*).
5473. Price, A. P. ..... Oxide of zinc.
5474. Illston, G. ..... Tricycles.
5475. Cochrane, J. ..... Valves, &c.
5476. Allison, H. J. ..... Synchronising clocks (*Wilson*).
5477. Chadwick, J. ..... Finishing fabrics.
5481. Bauer, S. ..... Hand fire engines.
5484. Parker, J. G. ..... Tricycles.
5487. Reede, A. A. W. van ... Rotary engines.
4490. Salamon, N., & another.. Velocipedes.
5495. Blamires, T. H. ..... Looms for weaving.
5502. Hardingham, G. G. M. Blast furnaces (*York*).
5509. Evans, E. ..... Miners' lamps.
5512. Eads, J. B..... Ship railways and carriages.

Year 1882.

5512. Malet, O. W. ..... Barbed wire (*Malet*).
5566. Cherrill, N. K. ..... Exhausting bulbs of incandescent electric lamps.
5595. Cowles, E..... Candle moulding machines.
5608. Keighley, G..... Looms for weaving.

Year 1881.

5075. Dickinson, A. P., & ano. Sizing machines.
5081. Harrild, F. ..... Stereotyping apparatus.
5127. Pitt, S. ..... Setting, &c., printing types (*Burr*).

Year 1880.

4767. Weatherill, H. ..... Tricycles.
4771. Alexander, W. P..... Coupling, &c., railway rolling stock (*Thomas & another*).
4772. Clapp, W. J..... Compound for polishing metals.
4806. Stainton, W. ..... Pumping valves.
4822. Henderson, A. C. ..... Capillary generator (*Guignet*).
4886. Hopkinson, J., & ano.... Dynamo-electric machines.
4889. Lafargue, A. ..... Hydraulic lifting apparatus.
4902. Lyall, J. ..... Looms for weaving.
4911. Rowan, A. H. ..... Tramways.

Year 1879.

4739. Rymer-Jones, A. M..... Registering level for surveys.
4804. King, J. T..... Rock and ore crushers (*Forster*).

Year 1877.

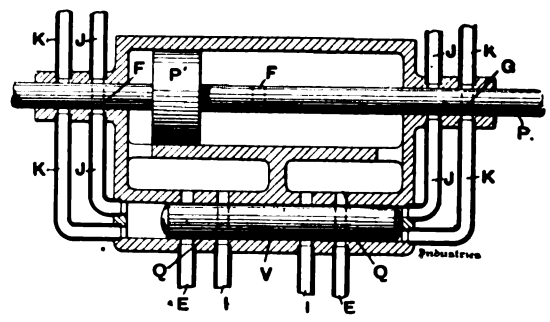
4346. Stephan, J. A. ..... Carburetted hydrogen and oxy-hydrogen gases.
4347. Robinson, J..... Fire bars for furnaces.
4385. Lewis, H. W..... Winding engines.
4407. Newton, J. ..... Twist lace machines.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Slide Valves.—*W. Donaldson, London.*—This invention relates to a method of opening and closing the port holes by means of a single cylindrical piston valve. The figure represents a sectional plan of the valve and the gear for operating it. In the double motor P¹ is the piston and P the piston rod, which contains the two passages F for the admission of the fluid to move the valve, and two passages G to allow the fluid to escape. The valve V is pierced by two passages Q; the passages I form the inlet ports and E the outlet exhaust ports of the cylinders. The ends of the valve chamber are put in communication with the motive fluid and the exhaust by means of the pipes J and K respectively. When



the passage F is opposite the pipe J the passage G is opposite to K. The fluid then enters the valve chamber and moves the valve, until the passages Q are opposite the inlet port I and the exhaust port E respectively. The fluid is thereby enabled to enter the cylinder through the port I, and moves the piston until the other passage Q comes opposite the other pipe J, in consequence of which the valve is moved in the opposite direction, and the actions of the parts are repeated. The inventor claims the mode of actuating the valve of a double acting motor, the motive cylinder of which is provided with inlet and exhaust ports opened by two ports in the valve by means of the direct admission and exhaust of the motive fluid through ports in the piston rod.—No. 3988. March 16th, 1887. 8d.

Combing Machines.—*J. Pickles, Bingley, and H. W. Whitehead, Leeds.*—Instead of the present construction of the steam chest of Noble's combing machines, the inventors employ a loose metallic steam chest. An additional flange is cast on the ordinary rack circle outside the rack teeth, and at the under side of the plate; a space is thus formed for the insertion of a loose square steam chest or pipe. Cross bars or spring boxes are fixed under the two flanges, and two set screws in them serve to regulate the position of the steam chest. Any required number of pulleys are placed outside the inner flange and underneath the rack circle. Each of the runners is carried on a stud, and regulating screws are provided for pressing the runners against the flange. These improvements are intended for the purpose of obtaining a greater heat to the combs, less friction on the rack circle, and a saving of oil and power. The inventors make one claim.—No. 3665. March 10th, 1887. 6d.

Mowing and Reaping Machines.—*S. B. Bamford, Uttoxeter.*—This invention introduces several improvements into the lifting arrangements and into the draught rod of the machine. On the under side of the double jointed hinge bar, at its lower end nearest to the main shoe, a double ended lever is pivoted, having a long and a short arm. The short arm rests on the bottom of the main shoe, on that side of its hinge nearest to the hinge bar, and the longer arm is jointed at its extreme end to a pin which is passed through a hole in the hinge bar, and is connected to the lifting lever by a chain and shackle. When the lever for lifting the hinge bar is used by the driver of the machine, the chain is tightened and the longer end of the double ended lever is lifted upwards, causing its shorter end to press on the main shoe sufficiently to prevent the outer end of the finger bar from dropping when it is lifted off the ground. The lower end of the draught rod is usually bent in the form of a hook, and connected to the hinge bar. Over the hook the inventor places a shield which slides on the draught rod and answers the double purpose of preventing the lodgment of grass, and of acting as a lock on the hook to prevent its opening out or giving way in case of strain. The inventor makes three claims.—No. 4500. March 26th, 1887. 8d.

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Boiler Furnaces.—*J. C. Stitt, Liverpool.*—The arrangement of the various parts of the furnace, according to this invention, will be understood by reference to the accompanying diagrams. Fig. 1 represents a sectional elevation of this invention as applied to a marine multitubular boiler, and Fig. 2 is a detailed view of the air supply devices. In Fig. 1, A designates the steam generator, B the furnace, C the combustion chamber, and D the feed water heater. E is an exhaust fan placed in the uptake F, and G are valves by which the gases can be either caused to pass through the feed water heater D, or direct up the funnel. The diaphragm D^1 causes the water to circulate in the feed

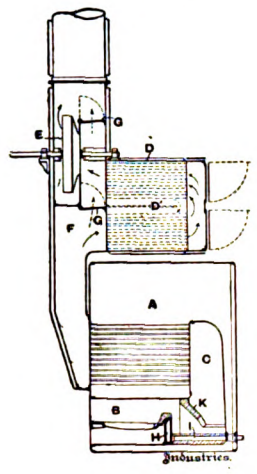


Fig. 1.

water heater in the opposite direction to the flow of gases in the tubes. The secondary air for burning the gases which have escaped from the furnace is supplied at the bridge from the chest H, and is led thence by the duct I. The arch K is made of fire brick. The details of the latter devices for the secondary air supply are shown in sectional elevation. The air is led from the duct I to the chest by the wing passages J. The door N allows access to the space beyond the bridge L, and the front of the chest H is perforated with a number of holes G, so arranged that jets of air are directed upwards through them. The arch K is disposed in such a manner that the unconsumed gases coming over from the fuel on the grate are supplied with the necessary

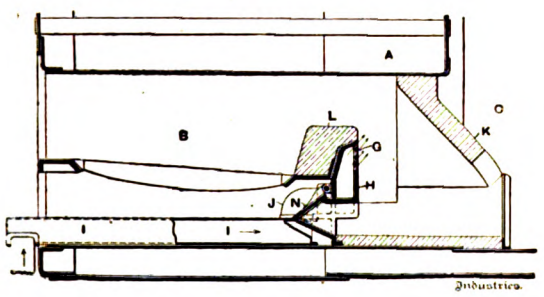


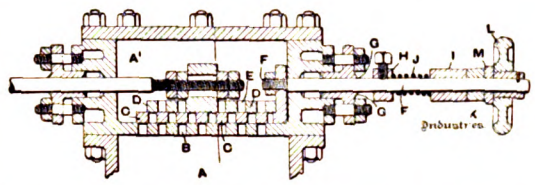
Fig. 2.

amount of air to consume them in presence of a heated surface of fire brick. The air is supplied to the chest H in measurable quantity by means of a fan. A secondary volume of air is also delivered by the fan E for the purpose of burning the unconsumed gases coming over from the fuel. The different pressures of the air issuing from the two fans are regulated so as to supply the theoretical volume of air. This fact renders it possible to obtain a higher temperature in the furnaces of steam generators than hitherto. In Fig. 2, the air chest is placed behind the bridge, and is shielded from the direct action of the flames. The chest and fire brick arch K are also placed relatively to each other in such a manner that the secondary air mixes with the fire gases when passing over the arch. This method of arrangement is not the only one described in this specification, but several modifications are introduced into the construction of the furnace. The inventor makes five claims for the introduction of the two supplies of the air as described, and for the construction of the parts.—No. 3274. March 3rd, 1887. 11*d.*

Apparatus for Cutting Stone.—*F. Butterfield, Keighley.*—The inventor dispenses with the differential motion described in Patent No. 4752 of 1880, and substitutes a train of reducing gear by which a slow feeding motion of the carrying table is obtained as well as a quick return. The table is arranged on friction rollers, and in order to meet the inequality of the wear and tear on those situated beneath the axes of the revolving cutters, they are mounted on independent carriages so as to permit of their vertical adjustment. In the rotating cutter holders the inventor employs supplementary and interchangeable nuts for insertion in the cutter holders in the event of a set screw breaking, and so obviates a considerable loss of time. The inventor makes three claims for these three improvements. —No. 5164. April 7th, 1887. 8*d.*

Winding and Doubling Machines.—*C. Sipman, Nottingham.* —Instead of placing the guide bar in front of the spindles which carry the bobbins, it is placed over the driving shaft with the guides in a horizontal position, so as to guide the threads on to the bobbins from above. With this arrangement one guide bar will do for both sides in double sided machinery; guides are fixed horizontally on both sides of the guide bar, and one shaft drives the spindles on each side of it. For regulating the tension and holding up the lever of the spindle the inventor makes use of a fork through which the thread runs; and in order to keep the thread in its proper place during its passage from the hank to the bobbin, it is run between two wires which are stretched across the frame. The inventor makes three claims for the arrangement of the traverse bars and guides, for the adjustment of the tension, and for the method of drawing off and guiding the thread, as described.—No. 5668. April 19th, 1887. 8*d.*

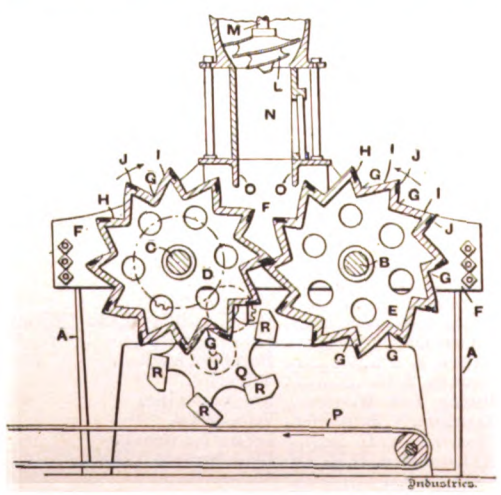
Valve Gear.—*A. H. Chartres, Derby.*—This invention relates to the construction and arrangement of an improved variable cut-off gear for steam engines. The accompanying figure represents a horizontal section through the essential parts. A slide valve (not shown) is arranged for admitting steam to the cylinder, and in the steam chest A a number of ports B are formed. The movable port plate C and the valve plate D work in a separate steam chest A^1. The slide valve of the engine is worked from the main shaft, and the valve plate D is similarly worked, but at double the speed. The plate C is worked by the governor, and it is arranged so as to travel intermittently over the ports B in the fixed port plate and the valve plate. This motion is effected by a rod, the collar H, and the spring J. A bevelled surface is formed outside, and is arranged to work with the wedge K, which is connected by a lever with the governor. A wheel L serves to adjust a collar on the step M to or from the wedge K, so as to check its to and fro motion, and so regulates the throw of the movable port plate C. Any



racing in the engine will act on the governor in the usual way, and the motion of the governor is communicated to the movable port plate C. This movement of the plate over the ports will partly or wholly cut off the steam from the main valve chest, and the regulation of the wedge K determines the amount of cut-off and expansion to be allowed. The details of the mechanism for operating the movable plate may be varied by forming a rack on the stem of the plate, gearing with a toothed quadrant actuated by the governor. In this case no check spring will be required. The inventor makes three claims for this cut-off gear.—No. 3681. March 10th, 1887. 8*d.*

Reeling Mechanism for Rolling Mills.—*F. H. Daniels, Worcester, Massachusetts.*—These improvements are designed with the object of removing the coil from the apparatus and discharging it on to a suitable platform. The reeling takes place round a series of upright fingers fixed in a horizontal plate; and another plate similar to this one is placed loosely on the top, and perforations are made in its surface to allow it to slip over the fingers. Levers are fixed to either side of this movable plate, and are connected to and operated by hydraulic mechanism after the coiling is completed. The movable plate is raised by the levers, and during this position the reel is removed. The inventor makes eleven claims for the details of this construction.—No. 4550. March 26th, 1887. 11*d.*

Brick Machines.—*W. P. Thompson, Liverpool.* (*W. T. Duval and H. Blunt, Washington, U.S.A.*)—The aim of this invention is to simplify the construction of brick machines, and to provide means for delivering the brick without any damage. Two rotary mould wheels are made with complementary cells on their peripheries which help to form the brick. The accompanying figure represents a vertical section of the improved machine. The main frame A sustains the ends of two parallel shafts B and C, which pass through and are secured to the mould wheels D and E. Each mould wheel is formed at its rim into a series of transverse pockets or indentations G. The two wheels are made to overlap each other slightly, and the grooves J are provided for the opposite projections to fit into. The wheels revolve with their ends against the inner faces of the



cheek plates F. As the wheel D revolves, one of its teeth on the inner descending side will overlap the edge of the corresponding teeth on the wheel E, leaving an open space above. The clay will enter this space, and is ready to be compressed into rectangular shape by the revolution of the wheels. The machine is driven by power applied to the shaft C. The feed motion for the clay consists of a revolving screw L attached to the lower end of a shaft M; and the plates O extending downwards prevent an escape of the clay from the top of the wheels. For off-bearing purposes the horizontal belt P is employed; the brick is received from the wheels D and E by the platforms of a revolving wheel Q. The inventors also describe two modifications of the arrangements for delivering the bricks, and make four claims for combination of the two wheels D and E, and for the delivering mechanism.—No. 15906. November 15th, 1887. 8*d.*

ELECTRICITY.

Dynamos.—*S. Z. de Ferranti, London.*—This invention relates to improvements in the dynamos described in the specification of Patent No. 3702 of 1883. The revolving armature is now to be mounted at the end of an axis, which also carries a driving pulley between its two bearings. The fixed magnets on each side of the armature are divided into four sections, two on one side and two on the other, and they are made so as to be easily slidden one away from the other. The armature is made of a number of coils ranged round the circumference of a disc; each coil is made from a strip of metal, which is hollowed in cross section so that the outer coils overlap the inner ones. The overlying coils are thus kept from shifting sideways, and also a much stronger coil is obtained which will retain its original shape during rotation. The ends of the coils which border on the periphery of the disc are received into semi-circular recesses in metallic blocks. Each of these blocks is on one side formed with a finger, which extends outwards from it radially, and lies along the side of the coil between it and the next, serving to carry round the coil with the revolving wheel. Pieces of metal of U shape are employed to prevent the coil flying outwards. Each of these pieces is formed with a plate on either side which extends towards the centre of the wheel, and comes on either side of the blocks resting against the inner bend of the coil. The plates extend inwards beyond the blocks, and a filling piece is inserted between them. A flange is made on the plates at their inner end by which they are fastened to the wheel. The inventor makes six claims.—No. 702. January 15th, 1887. 11*d.*

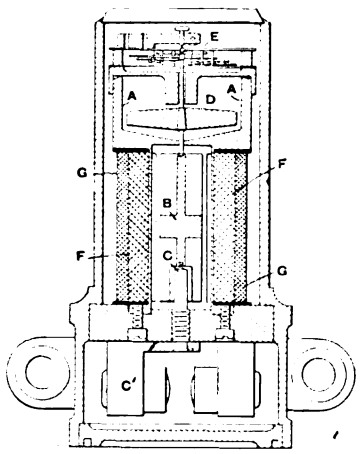
Dynamos.—*W. P. Thompson, Liverpool.* (*G. Westinghouse, jun., Pittsburg, Pennsylvania.*)—By this invention certain improvements are introduced into the construction of alternating current machines. The bed plate is formed of a single piece of cast iron, of rectangular form, with lateral projections, upon which the bearings of the armature rest. These bearings constitute part of a casting, which comprises the lower half of the field magnet plate for the machine. For the purpose of adjusting the frame upon the bed plate, a chain wheel is mounted on a shaft extending through and bearing in one end of the bed plate. By turning this wheel the position of the machine is easily altered, and the tension in the driving belts is thus adjusted. Half of the core projections are contained by the lower casting, and the remainder by another section, which constitutes the upper portion of the field magnet frame. The cores are preferably made of wrought iron, and are secured in their places by bolts. Their inner ends are constructed with re-entrant curves of a radius approximately the same as the armature, and their edges are turned away from the armature, in order to prevent a bunching of the lines of force. The armature consists of successive plates of thin rolled iron, placed side by side, and separated from each other by thin sheets of paper. Each plate is made with a number of holes for the purposes of ventilation, and the series of holes in the different plates correspond with each other. End plates are employed for the object of forcing the air through these holes in the armature. Thin sheets of mica cover the surface of the armature, in order to insulate the wire. The inventor makes ten claims.—No. 9725. July 12th, 1887. 8*d.*

Electrical Switches.—*C. M. Dorman & R. A. Smith, Manchester.*—This invention relates to that class of electrical switches in which rotary motion is transmitted through the cover of the switch from an external handle. The object is to obtain a good and air tight fit at the point where the actuating mechanism passes through the cover. The porcelain, or other vitreous material usually employed, is not easily made in an accurate shape, and in order to overcome this difficulty the inventors allow the handle to take its bearing in the hole in the cover of the switch, in which position it is constrained by flanges or by a gland. The motion is transmitted to the working parts of the switch by means of a crank pin and slot, or by two crank pins and a drag link, or by any other method whereby the motion may be communicated without undue friction when the axes of the two parts are slightly eccentric. The inventors make one claim for this improvement.—No. 14768. October 31st, 1887. 8*d.*

Disc Dynamo.—*H. B. Sayers, London.*—The coils of the armature are wound somewhat after the manner of the Siemens-Alteneck method. The conductors pass round half of the circumference of the disc, instead of crossing the cylindrical surface in a direction parallel to the axis. Also, instead of crossing the two ends of the disc in alternation, the conductor crosses the same end $\frac{1}{2}$ A B times, if A be the number of turns given to each section and B the number of sections into which the coils are divided. The conductor will then pass over to the other end, taking a spiral direction over the cylindrical surface. Segment-shaped spaces are formed by the conductors. These are filled in with thin iron plates varnished on their surfaces, and alternating with insulating material. The divisions between the plates must be parallel with the axis, and are preferably concentric with the periphery of the armature, and somewhat longer than the depth of the radial portion of the conductors measured parallel with the axis. The projecting ends are also made broader than the part which lies against the conductor, so that a nearly continuous surface is formed by the edges of iron and non-conductors; while the conductors are hidden from view except round their periphery. The armature is mounted on the spindle by means of two end plates, one being fixed to the shaft, and the other loose and provided with a nut by means of which it may be forced along the shaft. The poles of the field magnets are four in number, and are arranged so that the magnetic lines of force pass through the disc in a direction parallel with the axis; and their direction through one half is opposite to that in the other half. The armature may run very near to the pole pieces without the danger of heating the latter; and as the polar area may coveniently be made very large, the exciting force required is very small. The inventor makes four claims.—No. 717. January 17th, 1887. 8*d.*

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ELECTRICAL METERS.—*S. Z. de Ferranti, London.*—This invention relates to that class of meters in which the electrical current to be measured is made to pass through a bath of mercury in a magnetic field, described in Patent No. 5926 of 1883. Pole pieces are employed which do not retain residual magnetism, and the rotation of the mercury during the passage of a feeble current is effected by the use of additional coils of an insulated conductor around the pole pieces of the magnets. These coils form no part of the circuit whose current is to be measured, but is a branch circuit direct from the main conductor to the earth. The accompanying figure illustrates the construction of one of the forms of the meter. The metallic cylinder A is closed at the bottom and filled with mercury, and its inner surface is coated with shellac or



with some other insulating material. The cylinder B is immersed in the mercury, and is formed of a vertical stem of conducting metal with a collar projecting round it at the centre. Insulated coils of thin sheet iron surround the stem above and below the collar. The lower end of the stem rests on a fixed pivot C, which is in connection with one terminal C^1 of the meter. The upper end of the cylinder B carries a weight D to prevent the cylinder floating in the mercury. A train of recording wheels E are actuated by the upper extension of the axis or stem. The coil F of insulated wire surrounding the cylinder A forms part of the circuit of the current to be measured, and G is the additional coil of fine wire through which a branch circuit is conducted from the mains without passing through the mercury bath. The current to be measured enters the meter at the terminal C^1 and passes through the pivot C, then radially outwards through the collar to the cylinder A, and through the coil F to the other terminal. The mercury set in rotation by the passage of the current carries the cylinder B round with it, and the axis of the cylinder conveys the motion to the recording wheels. The inventor makes four claims.—No. 701. January 15th, 1887. 8*d*.

COMBINED ENGINES AND DYNAMOS.—*M. H. P. R, Sankey, Southampton, and P. W. Willans.*—The armature of the dynamo is mounted in the usual way on the overhanging end of the engine crank shaft. The bars of the commutator radiate from the shaft, and the commutator is placed on the end of the armature nearest the engine. The brushes, which press against this commutator, are arranged so that the line of contact crosses the radial divisions of the commutator at a slight angle, and overlaps two divisions with a narrow bearing surface of the brushes. The brushes and their holders are carried on the end bearing of the engine by a circular clip and two pins. The field magnets may be supported by girders or brackets, which extend from the base of the engine past the brush holders of the field magnets so as to protect the commutator. The inventors make two claims for this arrangement of engine and dynamo.—No. 4070. March 17th, 1887. 11*d*.

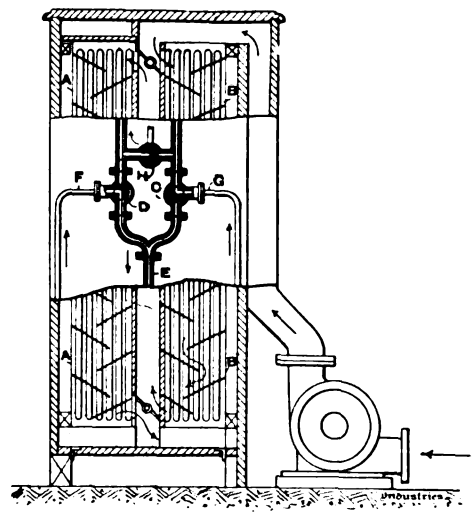
ELECTRIC BATTERIES.—*C. L. R. E. Menges, The Hague.*—This invention relates to that class of primary and secondary batteries in which the electrodes are formed with a core to assist in the generation of electricity, and to serve as a support for the active material. In the ordinary trellis work electrode, the transverse section of the bars which intersect one another has the form of an elongated rectangle. The improved electrode is constructed so that the parts which intersect have the form in transverse section of channels or gutters, so that the active material cannot leave its support either in a downward or lateral direction, even if the mass should no longer possess any cohesion at the centre of the plate. The sides of the channels meet at a right angle, and the area of the surface of the electrode is thus 1·41 times larger than that of an ordinary trellis work electrode of the same thickness. The electrode can be cast in a single piece by means of a special arrangement of the mould. The mould is so constructed that on opening it one half shall be compelled to move in the direction of the line of intersection of the sides of the channels, and thus moulds of sand or of metal may be used. The plate may be removed by pulling at the lower edge, whereby the whole plate is lifted, because the inclined sides of the channels act like wedges. The two parts of the mould are not adjusted one upon the other by means of bolts, but by means of triangular pieces which are fastened to one of the side parts, and which engage with the V shaped pieces secured to the other part. The upper part of the mould can then be moved along the sides of the triangular pieces in either direction. When this movement is effected in one direction, the cast plate will remain in the lower part of the mould. By replacing the upper part and effecting the movement in the other direction, the plate will be detached from the lower part and will remain in the upper part of the mould. However, as the plate had already been removed from this part of the mould, it adheres but slightly to it, and consequently its removal is easy. The inventor makes two claims.—No. 11923. February 19th, 1887. 8*d*.

CHEMISTRY.

TREATMENT OF COPPER PYRITES.—*J. Hargreaves, T. Robinson, and J. Hargreaves, Widnes.*—The copper, silver, gold, and sulphur contained in cupreous pyrites are separated from the oxide of iron by first rendering them soluble in a series of converting chambers, described in Patent No. 5681 of 1886. Each chamber is provided with earthenware grids, or perforated supports, to carry the pyrites. A tall vertical kiln is fitted with special apparatus for inducting hot gases, and causing them to permeate the pyrites. The gases enter the kiln under a lining hood, placed near the bottom, and apertures in the hood distribute the gases amongst the charge. To obtain an increased quantity of sulphur and sulphuric acid, hot air is admitted to the pyrites burners, mixed with heated sulphurous acid gas. Three separate interchangeable burners are employed. After the burning is completed, the oxidised pyrites is rendered soluble by moistening it when cold with strong solutions of chloride or sulphate of iron, or liquid hydrochloric or sulphuric acid, and heating the mixture in the closed chambers by passing hot gases through them. The resulting sulphate or chloride of copper is in a marketable state, and the gold and silver is precipitated by means of iodides. The inventors make twelve claims for this improved process.—No. 3704. March 11th, 1887. 8*d*.

MISCELLANEOUS.

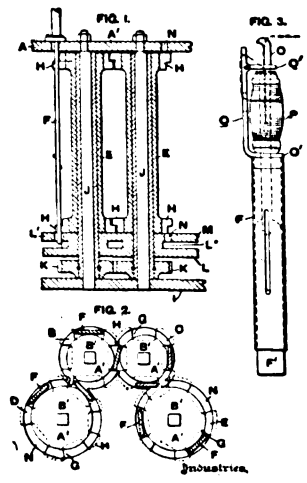
REFRIGERATING APPARATUS.—*J. Imray, London. (La Compagnie Générale pour la production du froid, Paris.)*—In the specification of Patent No. 2387 of 1885 an apparatus is described for cooling air by means of the alternate vaporisation and condensation of a volatile liquid, such as ammonia. Two sets of coils were used, one of them for cooling the air and the other for compressing the gas into liquid form. The heat given off in the latter coil was utilised for melting the rime deposited on the refrigerating coil. The present invention introduces improvements in the construction of this apparatus. A third set of coils is combined with the other two so as to operate in the following manner: At every alternation of the two coils there exists in the refrigerating coil a volume of gas which has nearly attained to the temperature of the air supplied. This volume is made to pass through the other coil, where its heat serves to melt off the rime. Again, while the refrigerating fluid is kept constantly circulating through the third coil, the air which has been



cooled below the freezing point by the other coils, and has deposited its moisture, is passed over the third coil. This air, being almost absolutely dry, deposits no rime, and consequently becomes cooled to a very low temperature. If, after a time, a little rime is found on the third coil, it is only necessary to pass the warm air over it. The accompanying figure shows a vertical section of the apparatus. Supposing the coil A to have had the rime removed from it, and that the coil B is covered with rime, the vapour is distributed by the cock H through A, and will drive out the vapour therein contained which has become warm, while the rime has been melted off the coil. The warm vapour passes through G C into B, the rime of which has been melted. The pump then draws it through F, D, and E. The cock C is turned one quarter round, causing the cold vapour in A to pass directly to the pipe E, which leads it to the compressor; the cock D is also turned round one quarter, so as to inclose the vapour contained in B. The rime having been entirely removed from the latter, the position of the cocks is reversed, and the actions are repeated. The refrigerating vapour is caused to circulate through the tubes A B alternately. The dried air, after having been cooled in these coils, is made to pass to the third coil, through which the refrigerating vapour circulates continuously. The air in contact with these surfaces will be readily reduced to a low temperature. Three claims are made for this improved process.—No. 3793. March 12th, 1887. 8*d*.

SPINNING MACHINERY.—*P. Eadie, Paisley; R. Eadie, Manchester; and J. Eadie, Paisley.*—This invention relates to the rings and travellers employed in ring spinning and ring doubling machines. The ring is provided with a vertical tubular portion, and also with a flange by which it is supported upon the ring rail. A circular opening is made in the ring rail in order to receive the flange, and the ring is prevented from passing through the ring rail by means of a projecting part formed either on the flange or on the ring rail. The traveller is formed of a straight or nearly straight part of greater length than the tubular part of the ring; the ends of the straight part are folded back over the ends of the tubular part. In some cases the upper extremity of the traveller is bent towards the straight part. The lower end of the traveller is prevented from moving beyond a certain distance outwards from the spindle by means of a projecting ring formed upon the under side of the flange. A groove is made in the upper end of the tubular part of the ring to allow the thread to pass from the traveller to the spindle. In order to lubricate these parts, a right or left handed screw thread is formed in the tubular part for the retention and distribution of the oil. A hole in the ring allows the passage of the oil to these threads, and as the traveller passes over the screw thread it becomes lubricated. Instead of the screw threads the tubular part of the ring may be grooved horizontally for the same purpose. The inventors make four claims.—No. 4880. April 1st, 1887. 8*d*.

BRAID MACHINES.—*J. Lami, Paris.*—The present improvements are introduced into the construction of braid machines, in order to enable them to be worked at a greater speed. The accompanying figures show how this invention is carried out. Fig. 1 represents a vertical portion of the machine, including two of the carriers for impelling the racers or bobbin holders; Fig. 2 is a plain view showing the race circles in the upper platform; and Fig. 3 is an elevation of one of the racers and its bobbin. The machine is constructed with four platforms A L M I. In the platforms A and M are cut the race circles N, in which the racers travel. Each racer is formed of a flat tube F fixed to plate O^1, and provided with a flat weighted spindle F^1. This spindle works in the tube F, and its movement is limited by a pin fixed to it, and working in a slot in the tube. The



upper end of the spindle is also flat, and is provided with an eye through which the thread passes. A hole is made in the top of a round tube O, and the thread also passes through the opening before it leaves the racer. The tube O is fixed to a vertical extension Q of O^1. A hole in the projection Q^1 is made for the passage of the thread previous to its entry into the eye in the spindle F^1; and a forked pawl attached to Q^1 engages with the teeth on the upper end of the bobbin P. The portions of the platform which are isolated by the race circles are connected to the frames by the central pins J. The racers are caused to travel through the complete circuit by means of the carriers B C D E, in whose recesses G the racers work. The fixed pins J are supported in the base I, and the cylindrical bosses L^2 connect the platforms A and M together. By this apparatus the carriers impel the racers through the whole circuit of the race circles, and the threads are held in tension and the racers in equilibrium by means of the weighted spindles. The inventor claims: (1) The construction of the spindle and bobbin as shown in Fig. 3; (2) the construction of the race carriers as shown in Figs. 1 and 2; and (3) the improved apparatus as described.—No. 16492. November 30th, 1887. 6*d*.

VULCANISED METAL OBJECTS.—*J. Bosch & W. Kumpfmiller, Munich.*—The object of this invention is to obtain sheets and jars combining the rigidity of metal with the resistance of vulcanite to acids. The receptacles are formed from perforated sheets of metal, or from wire gauze, and on both sides of this frame work are placed sheets of vulcanised rubber. These parts are then subjected to pressure; the rubber is thereby connected over all parts of the sheets through the perforations, and the two layers of rubber are joined together as one block. In performing this process, the metal vessel to be vulcanised is treated with chloroform before applying the plates of rubber. By this invention, great strength is imparted to an uncorrodible vessel, and the two coats of rubber are made immovable by their being joined together through the perforations in the metal skeleton. Two claims are made.—No 17467. December 19th, 1887. 6*d*.

PAPER CUTTING MACHINES.—*H. J. Salmon, J. Capper, and W. H. Duffett.*—In paper machines as ordinarily constructed the gauge at the back is moved to and fro by a hand screw. In order to overcome the disadvantages incident on this method, the inventors gear the screw shaft of the gauge with a pulley which is constantly rotated by the motive power of the machine. Apparatus is supplied for easily throwing this shaft in and out of gear. Arrangements are also made for showing the distance of the face of the back gauge from the cutting knife. For this purpose an endless band of thin steel is placed round two pulleys, and one side of the band is connected with the gauge so as to move to and fro with it. The face of the band is marked in inches and fractions, and there is a pointer at the front of the machine for indicating its motions. The paper is kept against the face of the gauge when it is moving back from the knife as well as when it is moving towards it, by means of two or more endless bands, which pass over two pulleys at the back of the machine and on the table near the knife respectively. The paper to be cut is placed over these endless bands which keep it close against the gauge. In some cases the bands may have motion imparted to them for the purpose of feeding the paper

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against the gauge. The inventors claim the method of driving the gauge screw, the arrangement of the steel ribbon for the purpose described, and the combination of the tapes for propelling the paper against the gauge, and the bands for keeping the paper against the face of the gauge when it is moving from the knife.—No. 4825. March 31st, 1887. 11*d*.

Covers of Rotating Shafts.—*W. Taylor, Oldham.* (*F. Lejeune, Vienna.*)—This invention relates to a locking device for the covers or guards of rotating shafts, and consists essentially of a stud on the cover, in combination with a hook operated automatically by the rotation of the shaft. A collar is formed on the shaft, and has a projecting portion with an inclined surface. On the bearing of the shaft a boss is fitted loosely, and is prevented from rotating with the shaft by a stud. In the boss is a recess with an inclined surface corresponding to the inclined surface of the collar. A hook on the boss engages with a stud which is fixed on the cover. When the shaft is being rotated the cover is locked by the hook and the stud, and cannot therefore be turned back or removed. When the shaft is stopped, when the inclines agree with each other, the recess in the collar allows the boss to move close to it, thereby disengaging the hook and releasing the guard. Immediately the shaft resumes its revolution the incline in the collar throws the boss back and brings the hook over the stud, thus automatically locking the cover. The inventor makes two claims.—No. 17239. December 15th, 1887. 6d.

Spindles.—*W. Sumner, Almelo, Holland.*—In order to prevent the wearing at the external bearing of the spindle and at the internal part of collar bearing, the inventor introduces a special construction of both bolster and spindle. The spindle is reduced at its bearing part or at the traverse part of its bearing, and a bush of phosphor bronze or other metal is applied to the inside of the old collar bearing. The bush also fills a portion of the hole of the bobbin, and its inside fits freely but firmly in the reduced bearing part of the spindle. A countersink is formed in the upper collar as a reservoir for a lubricant, and a hole at the side allows the oil to pass to the spindles. The inventor makes three claims.—No. 11327. August 19th, 1887. 8*d*.

Utilisation of Furnace Slag.—*G. J. Snelus, Workington.*—The slag from the Siemens-Martin steel furnaces is allowed to run in a thin layer upon a cast iron plate, so that it can be easily broken up into pieces when cold. The broken pieces are then either used over again in the blast furnace or are used for road metal. The inventor makes one claim for this method of treating the slag.—No. 4389. March 23rd, 1887. 6*d*.

Apparatus for Cutting Coal.—*T. Bower, R. W. Bower, and J. Blackburn, Woodlesford, Yorkshire.*—The object of this invention is to improve the construction of the cutters, and also to simplify the means employed for its operation. The cutter bars are made of such a form that they can more readily be withdrawn from the work. A section of the improved form is shown in Fig. 2. The cutter bar A is made of taper form towards its outer extremity, and the cutters B are gradually reduced in size. The base of the cutters B may be of polygonal form, and diamond-pointed steel bits C are screwed into them. When electricity has been used for driving these bars, the motor has usually been constructed separate and distinct from the

FIG. 1.

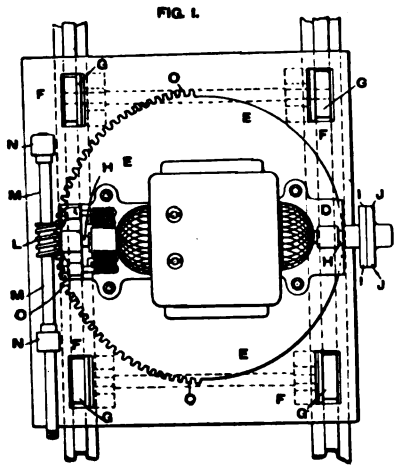
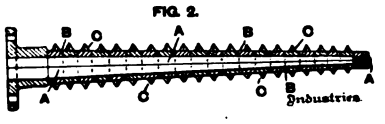


FIG. 2.



machine. According to this invention the motor is coupled directly to the machine as illustrated in plan in Fig. 1. An Immisch motor D is mounted on a turntable E carried on a bed plate F. The wheels G support the whole frame work. The motor shaft H has a coupling plate I at its end, corresponding with another plate J on the cutter bar A. The rotary motion is imparted to the turntable by means of a worm L mounted on a shaft M, and the gearing O on the rim of the table E. Any other motor may be applied for this purpose beside the Immisch. The inventors make two claims: (1) For the form of the cutter bar; (2) for the disposition of the motor and the gearing for the operation of the machine.—No. 16955. December 9th, 1887. 6*d*.

Vulcanisation of Waterproof Fabrics.—*H. H. Waddington.*—The fabric to be vulcanised is passed continuously through a chamber of such dimensions and so arranged and heated that the vulcanisation is completed during its passage from one end to the other. Inside the chamber are arranged a number of rollers in two series, over and under which the fabric passes. A certain number of these rollers are driven by gearing, and some of them are made hollow for the reception of steam. Several of the rollers near the outlet are cooled by a current of cold water, in order to give a finish to the india-rubber. The inventor makes two claims for the method and for the apparatus. —No. 15680. November 16th, 1887. 8*d*.

GERMAN PATENT ABSTRACTS.

Electrical Switches.—*W. Fritsche, Berlin.*—The inventor has designed this switch for the transmission of strong electric currents. The difficulties met with in constructing these apparatus are that the surfaces in contact must be very large, and it is consequently difficult to manufacture them in such a manner as to insure contact all over the surface. Moreover, even if a perfect contact be made when the switch is new, the surfaces soon begin to wear, so that after a short time the contact becomes imperfect. The inventor has overcome these difficulties

Fig. 1.

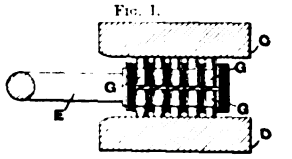
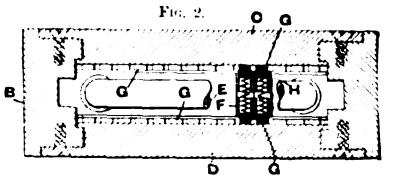
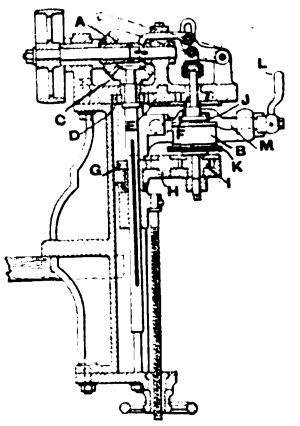


Fig. 2.



by dividing the transmitting area into a number of small surfaces which are easily made with sufficient accuracy. The terminals to which the wires are connected consist of two metal plates C and D, separated by insulating pieces A and B. The connection between C and D is effected by inserting the piece S. The body of S carries a number of perforations into which hollow pieces of metal G fit, which are pressed into contact with C and D by the coiled springs H, shown in Fig. 2. The air circulating through the spaces between G materially assists in keeping the switch cool.—No. 42143. May 13th, 1887.

Closing the Lids of Tins.—*A. Reiche, Dresden.*—The arm A carries a roller which folds the extremity of the cylindrical part of the tin over the loose end cover. The tin B is held between



two discs J and K, which are rotated by the bevel wheels A and C, and the spur wheels D, E, F, G, H, and I. By means of the lever L, the roller is pressed against the tin.—No. 41893. December 28th, 1886.

UNITED STATES PATENT ABSTRACTS.

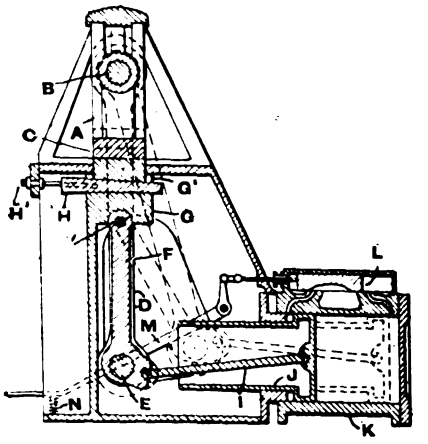
Cushioning Device for Pistons.—*E. F. Smith, Brooklyn.*—A supplementary steam pipe is introduced through the lower circular end of the upright cylinder, and communicates directly to the interior space in the cylinder. At a short distance below the cylinder, the steam pipe enlarges into a steam box, in which is enclosed a swinging check valve. Below this valve is another which is operated by a crank connected by a link to a trip lever. The trip lever is pivoted to the slide block on the piston rod. The latter valve is operated intermittently by the moving parts of the machine, so as to be open as the piston ascends through its upward stroke. Towards the close of the downward stroke the valve is closed, the swinging check valve falls against its seat, and the imprisoned steam acts as a cushion for the descending piston. This supply steam plays no part in the actuation of the machine, but only serves the subsidiary purpose of cushioning. The inventor makes four claims.—No. 377840, dated 14th February, 1888.

Treating Fibrous Ware.—*H. Carmichael, Malden, Massachusetts.*—The fibrous ware is first thoroughly dried and then raised to a considerable heat. In this state it is placed in an earthenware vessel, into which is forced a mixture of asphalt and colophony, or the dark coloured resin obtained from turpentine. The proportions of the mixture are one part of asphalt to five of colophony. During the process all air is exhausted from the vessel, and the mixture is thus forced in by the outside pressure.—No. 377928, dated 14th February, 1888.

Electrolyte Compound.—*G. B. Pennock, Brooklyn.*—In order to prevent evaporation and crystallisation in an electric battery, the inventor makes use of a certain depolarising jellied compound as an electrolyte. This compound is formed by the addition of mineral wool to such acids as sulphuric and chromic in an aqueous solution. The porous cup of the battery with the electrodes contained in it are placed in this compound. The inventor makes four claims for the method of manufacture and application of this new electrolyte.—No. 377210, dated 31st January, 1888.

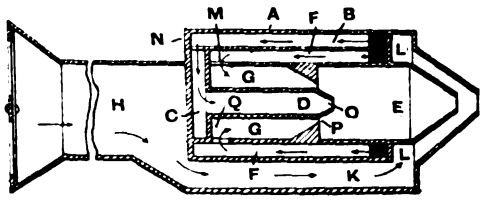
Copper Ores.—*T. Kiddie, New Brighton, New York.*—This invention relates to an improved process for separating the impurities and precious metals from copper ores. After desulphurisation and calcination the resulting mass is dissolved in a sufficient quantity of sulphuric acid to produce a neutral solution. Hydrated oxides of alkali metals or iron are then added with or without heat and agitation; the impurities are thereby precipitated, and they settle to the bottom with the precious metals and other insoluble matter. The sulphate of iron and copper which are produced by this process are afterwards treated in the usual way. The inventor makes two claims.—No. 377809, dated 13th February, 1888.

Hydraulic or Steam Press.—*J. F. Allen, New York.*—In the accompanying diagram two positions of the improved mechanism are shown. The motor cylinder K is fitted with a trunk piston J. The piston rod I is connected to the strut F, which is pivoted at its fixed end to the lower platen G. The other end of F is pivoted by means of the shaft E to the rod D, and the upper end of D is connected by the shaft B to the top of the movable platen C. The movable platen C is constructed with grooves in its sides, so that it may reciprocate vertically in the slotted bearings A, while the lower platen G¹ is supplied with a mechanism for



raising and lowering its seat according to the work which is being performed. This mechanism consists of a wedge plate H, which is inserted between the two parts of the platen G and G¹, and the lower surface of G¹ is also cut to the same angle with the horizontal as the angle of the wedge. The screw H¹ serves to adjust the wedge between G and G¹, and thus regulates the height of the platen. The valve for admission and exhaust of the motive fluid is shown at L, and its movements are controlled by the hand lever M. The inventor makes four claims for the details of this press, and for the combination of the platens with the rods connecting them with the source of power.—No. 377132, dated 31st January, 1888.

Hydrocarbon Oil Burner.—*G. K. Cummings, New York.*—The invention here illustrated is a device for successively vapourising the oil and mixing it with steam and previously heated air. The steam, which is used for heating and evaporating the oil, is introduced into the superheating chamber F, and it then pursues the course indicated by the arrows. While in the chambers F and G it heats the surrounding chambers B and K. The oil enters the chamber B, and becomes partly volatilised there, and the vaporisation is completed in the reservoir C and in the nozzle D. The air which is required for combustion is admitted to the space K, where it is heated by contact with the



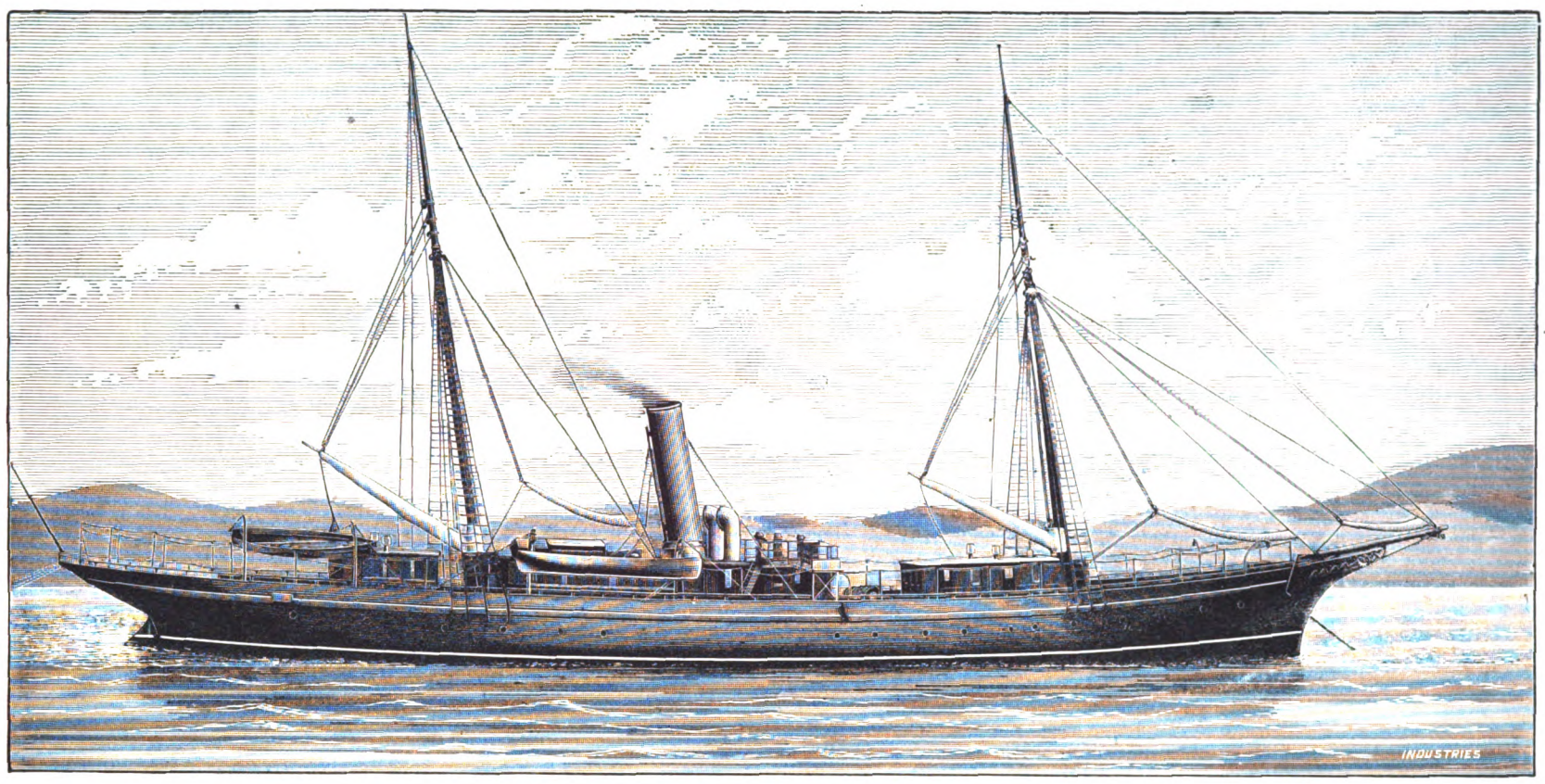
wall of the steam chamber F. The steam issues through the nozzle P, and draws out the vaporised oil into the mixing chamber E. The mixture then passes out through the nozzle of the mixing chamber E, where the heated air and the gaseous fuel mix. They afterwards pass out through the nozzle in the outer casing A, and burn in the usual way. The air and oil being thoroughly heated, furnish a powerful flame. The inventor makes eight claims for this burner.—No. 377146, dated 31st January, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE STEAM YACHT "THETIS."

(For description see page 261.)



GENERAL VIEW.

THE EFFICIENCY OF STEAM SHIPS FROM THE OWNERS' POINT OF VIEW.

THE concluding lecture of the course, which has been delivered during the winter months under the auspices of the Clyde Steam and Sailing Ship Owners' Association, was given last Monday evening, by Mr. Henry Dyer, C.E., M.A., vice-president of the Institution of Engineers and Ship Builders, Scotland, the subject being "The Efficiency of Steam Ships from the Owners' Point of View."

After some introductory matter indicating the general extent of the subject, Mr. Dyer proceeded to consider the items which affect the resultant efficiency, and to which the ship owner ought to direct his attention. These items may be arranged in three groups: (1) Those relating to the hull of the vessel; (2) those relating to the engines and propellers; (3) those relating to the equipment, the officers and men, and the ship owner himself. It was mentioned that the design of the hull of a vessel ought to be studied from at least three points of view: (*a*) As to its shape; (*b*) as to its strength and weight; (*c*) as to its method of construction. The shape of the vessel affects both its stability and the resistance it offers to propulsion through the water, both of which were briefly considered. It was stated that many of the huge merchant steamers are built with the least possible margin of stability, and that very often that is reduced by "careless or ignorant method of loading." With regard to the influence of the shape on the resistance to propulsion, more attention to that subject was urged, as some ship builders and ship owners seemed to think that anything in the shape of a ship which could be made to float can be propelled at low speeds at economical rates. They pay considerable attention to the engines, and do all they can to obtain a saving of an additional quarter of a pound of fuel per i.h.p; but they seem to forget that the shape of the hull is a very important factor in the consumption of fuel, and that it is possible for an old fashioned ship with a well formed hull, although its engines are wasteful, to be to them a more economical ship than one whose hull is badly shaped, even although it has engines of the most improved design. It was pointed out that from a commercial point of view, if a steamer is to be adapted to easy propulsion, it must have a sharp form, and that within reasonable limits; nothing is gained by the box form, but that much is lost, and further, that the same weight or quantity of cargo may be carried with much less expense in a moderately fine ship than in one of the box type. The subject of the strength and weight of the hulls of vessels was then discussed, and its bearing on their commercial efficiency considered, and the necessity for some modifications of Lloyd's rules was urged.

Coming to the consideration of the efficiency of the engines and propellers, it was pointed out that this may be divided into three components: (1) The efficiency of the boilers; (2) the efficiency of the engines, (*a*) as heat engines, (*b*) as machines, (*c*) as regards their weight and the space they occupy; (3) the efficiency of the propellers. But stoking was mentioned as one of the chief causes of the loss of efficiency of boilers, and it was shown that this may neutralise even the best design and construction. Regarding forced draught, it was urged that a series of trustworthy public trials be made with the object of supplying some definite information on a subject concerning which very little is practically known, and about which a very wide difference of opinion exists. The advantages of the use of liquid fuel were referred to, as well as some of the dangers and difficulties attending it. A somewhat detailed description of the development of the marine engine was then given, and the various points affecting the efficiency indicated, including the use of high pressure steam, the simple, compound, triple, and quadruple expansion engine, and the functions of the steam jacket. The state of our knowledge regarding the efficiency of the mechanism of marine engines was touched upon, and the necessity for definite experiments urged, as the modern marine engine is at present in such a stage that the comparison of ordinary compound with triple or quadruple expansion engines, in the manner in which it is usually done, is very apt to lead to wrong conclusions.

The following figures were quoted to give some idea of the economy of fuel caused by successive improvements of the steam engine. In Smeaton's early engines on the Newcomen principle the consumption of coal per i.h.p. per hour was nearly 30lb.; in his later ones 18lb. Cornish engines are reported to have had a consumption of nearly 11lb. in the year 1811; 1·73lb. in 1842; and 2·90lb. in 1872; while Watt is said to have begun with 8·3lb. and ended with 2·7lb. These figures of course all apply to land engines. In 1863 the average consumption of coal in the best marine engines was 4½lb. per i.h.p. per hour; in 1872 it had been reduced to about 2¼lb.; and now with triple and quadruple expansion engines it is as low as 1½lb. or 1¼lb. It was stated that the triple expansion engine has saved the ship owner about 25 per cent. of coal consumption, allowance being made for the smaller space occupied by the machinery and coals.

The weight of the engines and boilers on board a ship (and consequently the space they occupy) has a considerable effect on its commercial efficiency, or profits it yields to its owners; for if economy of fuel be obtained by a sacrifice of space, or by great additional weight, the commercial efficiency of the ship may be considerably reduced. Every ton of deadweight capacity is worth on an average £10 per annum for earning freight; that is to say, that every one hundered tons saved from the weight of the engines and boilers, without increasing the cost of working, is equivalent to £1,000 a year additional income to the owners. The weight of machinery, including engines, boilers, water, and all fittings ready for sea of ordinary merchant steamers is about 480lb. per i.h.p. In some cases this has been reduced to about 390lb., and Mr. Marshall, of Newcastle, recently stated that he was of opinion that it might be reduced to 250lb., and he undertook to construct engines under ordinary commercial conditions which should not exceed this. The lecturer thought, however, that few engineers or ship owners would in the meantime be inclined to go so far as this, but still the subject is one deserving more attention than it usually receives.

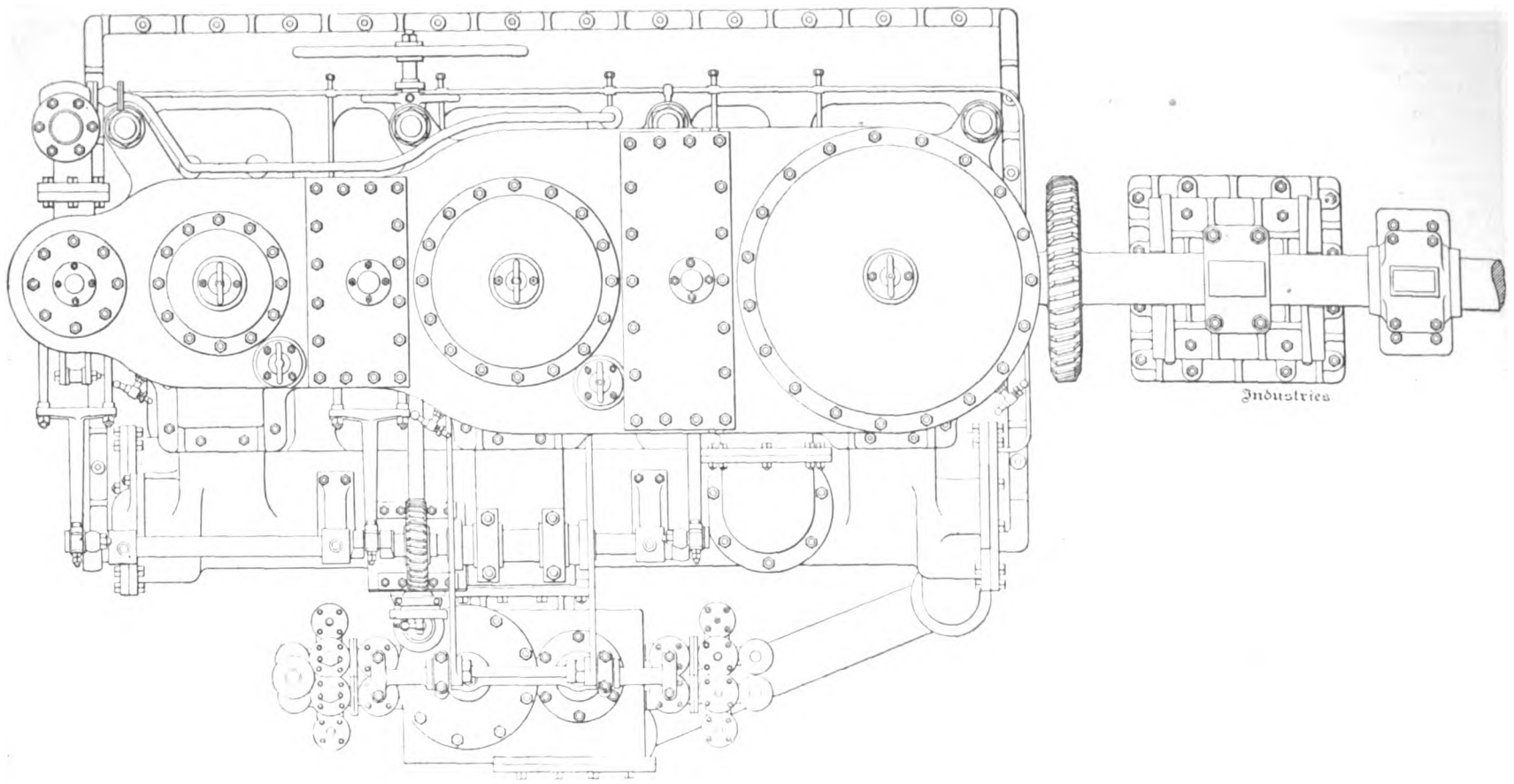
The subject of the propulsion of ships, of trial trips, and progressive trials, and the lessons to be deduced from them was then considered, but our space will not allow us to enter on them. It ought to be remembered, however, that in testing the economical performance of ships, too much dependence should not be put in the results of short trial trips. These, however honestly conducted and reported, are generally carried out under conditions which it is impossible to obtain under long voyages; and in any case the data derived from trial trips should be supplemented by the results of observations made during these voyages.

Coming to the last division of his subject, Mr. Dyer considered the efficiency of the equipment and management of ships under the following heads: (1) The efficiency of the mechanical appliances for working them; (2) the efficiency of the officers and men; (3) the efficiency of the ship owners. In 1854 there were 4·36 persons employed per 100 tons, while in 1885 the number had been reduced to 2·76 persons, and further, the number of persons now required to work a steam vessel is about one half of what it was at the beginning of Her Majesty's reign; a fact which proves how necessary it is for the ship owner keeping himself informed regarding the most recent developments of mechanical engineering. The increasing complicated duties of the ship owners, officers,

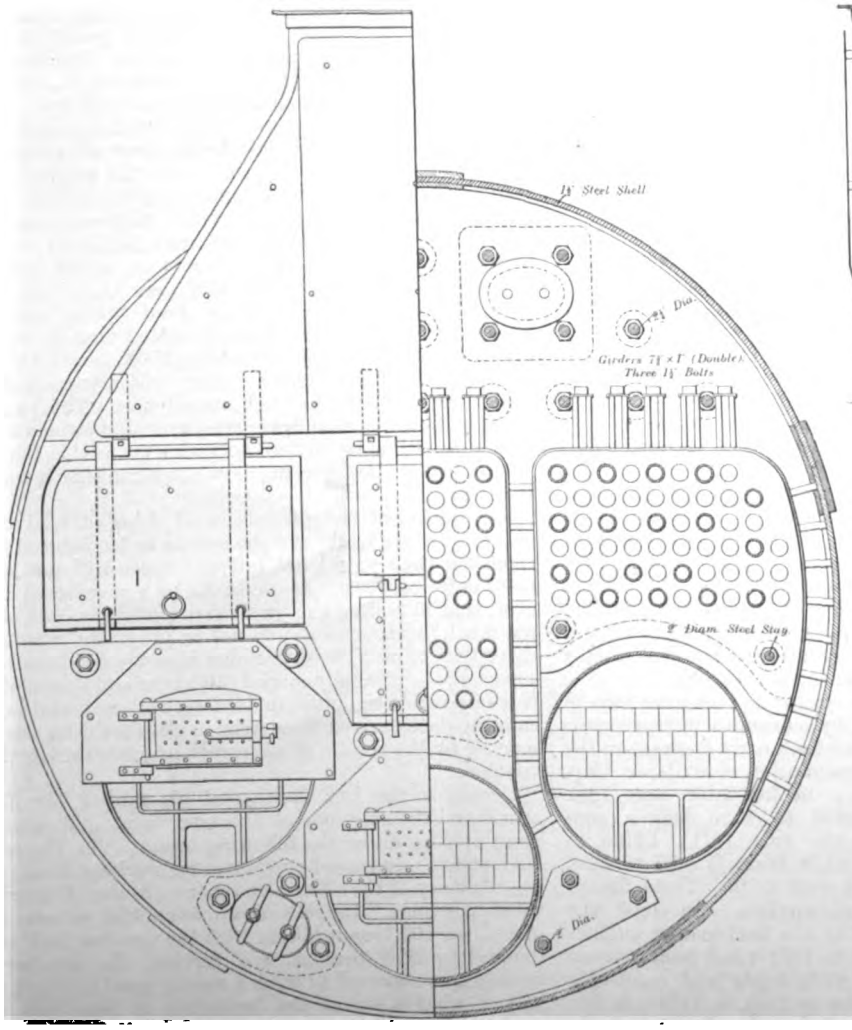
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ENGINES AND BOILER OF THE STEAM YACHT "THETIS."

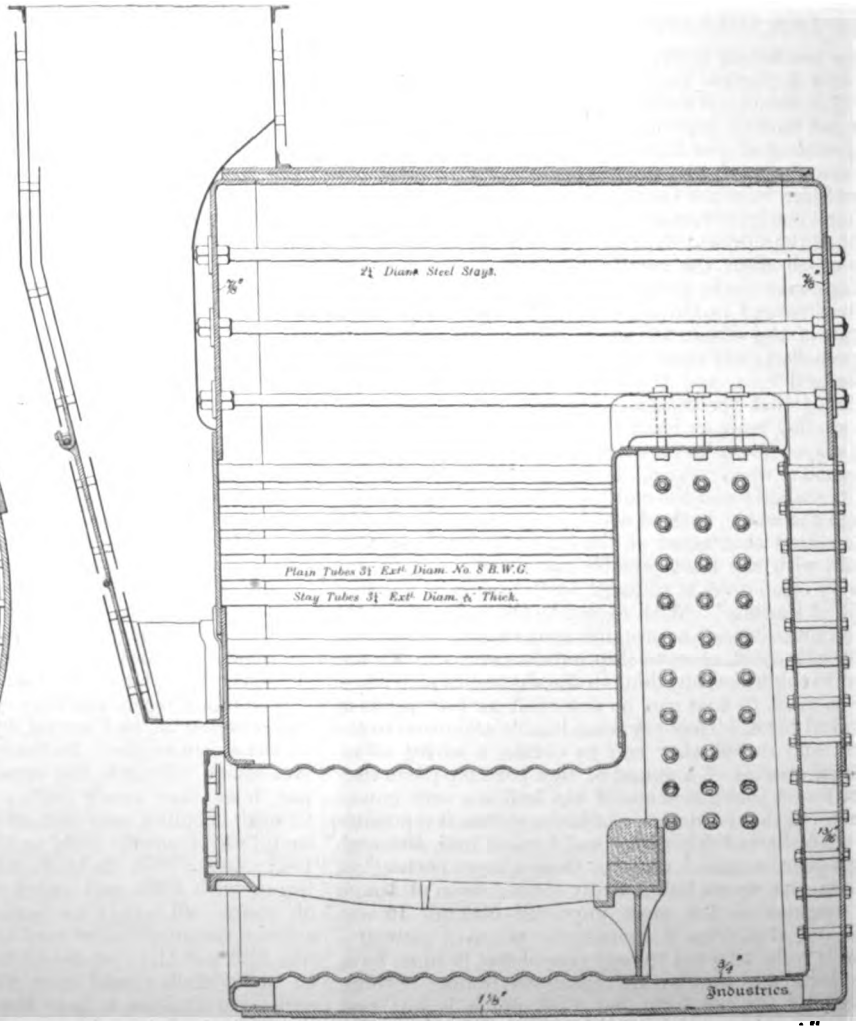
(For description see next page.)



GENERAL PLAN OF ENGINES.



END ELEVATION.



SECTIONAL ELEVATION.

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and men indicated the necessity for a more thorough training than had been customary in former days, and Mr. Dyer mentioned some of the matters which ought to engage their attention.

The latter part of the lecture was taken up with a brief consideration of the place of legislation in ship building and ship owning, and undue interference on the part of the Government was deprecated. Voluntary co-operation, which will habituate men to independent activities, should be encouraged, which, while strengthening their own consciousness of personal rights, would show the ship owners that those rights can only be enforced when they respect the just claims of others. The efficient design and construction of steam ships is a collection of compromises of a great many qualities, which if carried to extremes, are incompatible with one another; and their management involves considerations which are opposed to the profit of the ship owner, or the interests of the public and the crews; and the skill with which their conflicting elements are welded into one comparatively harmonious whole, should be the true measure alike of the ship builder, the marine engineer, and the ship owner.

POSSIBLE NAVAL COMBINATIONS AGAINST ENGLAND.

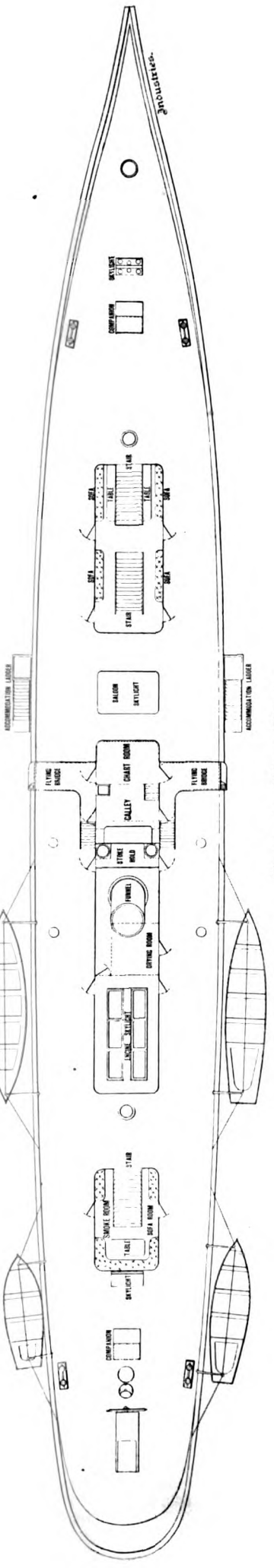
Admiral Thomas Symonds has just issued an interesting table showing the probable strength of possible combinations of naval powers against Great Britain. The data from which his conclusions are drawn are those of the Parliamentary return of the comparative strength of British and foreign navies. From these figures it appears that Britain can bring into action in all 73 armour clads, 44 of which are classed as obsolete. Of the remaining 29, 15 are first class armour clads, 2 are second class, and 12 are cruisers—only nine of these last being fast cruisers. Against this navy, France can bring 63 armour clads, 26 of which are first class, 29 are obsolete, and 8 are armoured gunboats of moderate speed. Of the Italian navy there is no report of obsolete ships, though the list of 19 first class and 2 second class ships of war cannot be taken as excluding obsolete vessels, for 9 of these are more than twenty years old. Admiral Symonds assumes the possibility of a Franco-Italian combination against Great Britain, which would involve a naval struggle between 73 British armour clads and 84 armour clads of the allied navies. In the same way, a Franco-Russian alliance would bring against our fleet of 73 an allied fleet of 87. A Franco-German alliance would bring against us a combined force of 76 large armour clads and 14 small armour clads. Admiral Symonds also draws attention to the circumstance that the modern English armour clads have unarmoured ends, and that 49 out of the 73 are armed with muzzle loading guns, while the armaments of all the vessels comprised in the above possible combinations are breech loading. Admiral Symonds expresses his belief that the efforts of the French Government to secure a maritime superiority to all other nations have been successful. The superior armament of their large armour clads, and their continued activity in naval construction, have given them, Admiral Symonds thinks, a preponderating naval power. The table also enumerates and contradicts certain statements of Lords of the Admiralty and others as to the strength and efficiency of our navy.

THE STEAM YACHT "THETIS."

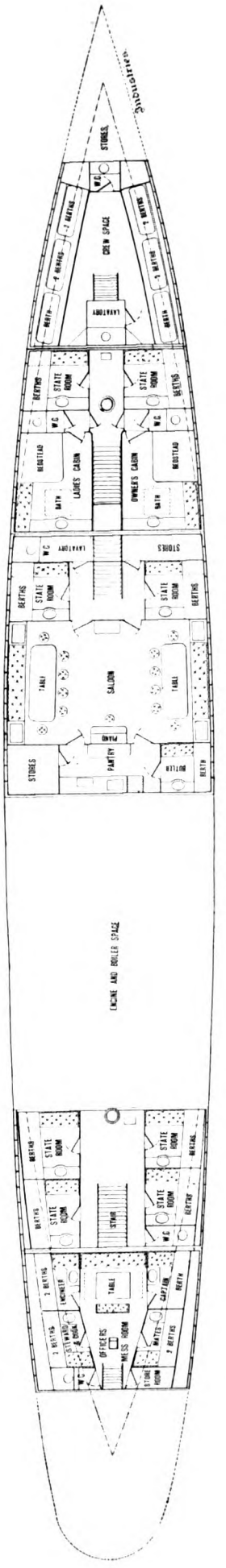
This handsome vessel was built to the order of Mr. J. Donaldson, of Messrs. John I. Thornycroft & Co., London. The order was intrusted to Messrs. Muir and Houston, Harbour Engine Works, Glasgow. The "Thetis" is a screw steamer of 510 tons, yacht measurement. The leading dimensions are: 166ft. 10in. on water line, moulded breadth 25ft., moulded depth 15ft. 6in. The vessel is built of mild steel, but the scantlings are the same in dimensions as if of iron. It has been built under "special survey," and is classed 100A1 in Lloyd's Yacht Register. The keel, stem, stern post, and rudder frame are of forged scrap iron. The ship is divided into nine water tight compartments by eight bulkheads. These bulkheads are absolutely water tight, there being no openings in them of any sort. They are carried to the main deck level, so that communication between the different compartments of the ship must be made by the deck. Each of these compartments, so isolated from each other, was tested under water pressure before the vessel was launched. Any two compartments may be full of water with perfect safety. In each there is fitted an independent ejector (Thornycroft's patent) capable of discharging 40 tons of water per hour, as well as a powerful hand pump. This sub-division into isolated compartments, with these mechanical appliances for the discharge of water, should an accident occur to any of these compartments, would

DECK PLANS OF THE STEAM YACHT "THETIS."

CONSTRUCTED BY MESSRS. MUIR & HOUSTON, HARBOUR ENGINE WORKS, GLASGOW.



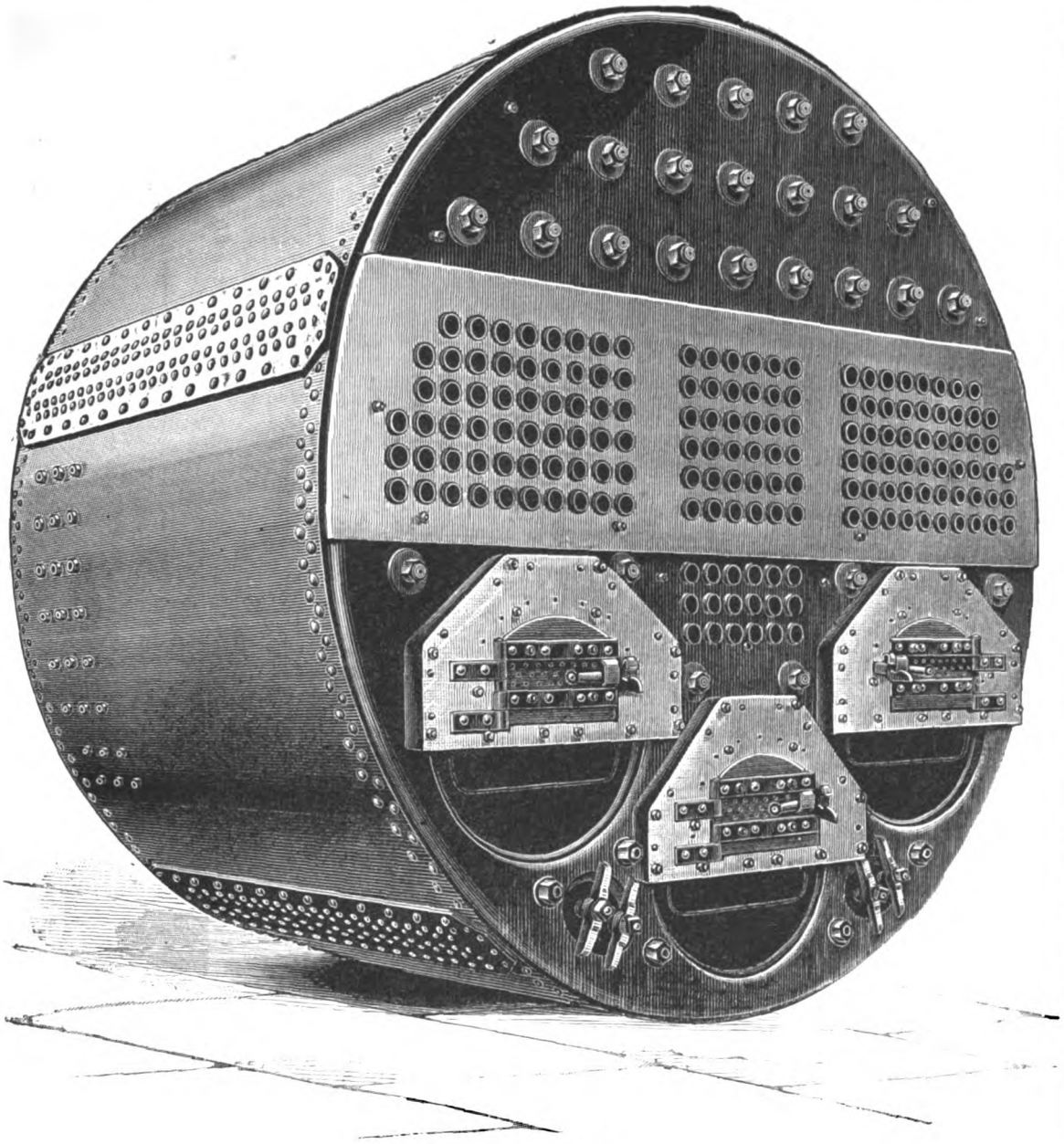
PLAN OF MAIN DECK.



PLAN OF LOWER DECK.

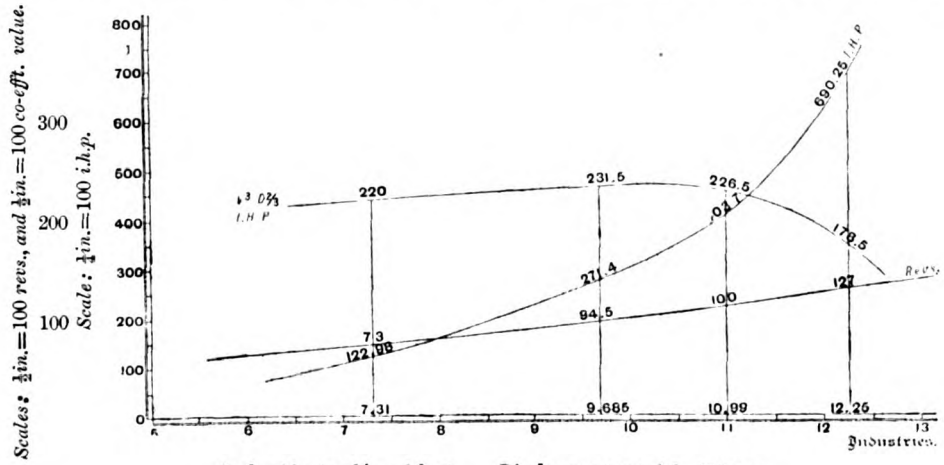
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MAIN BOILER OF THE STEAM YACHT "THETIS."



General View.

PERFORMANCE CURVES OF THE STEAM YACHT "THETIS."

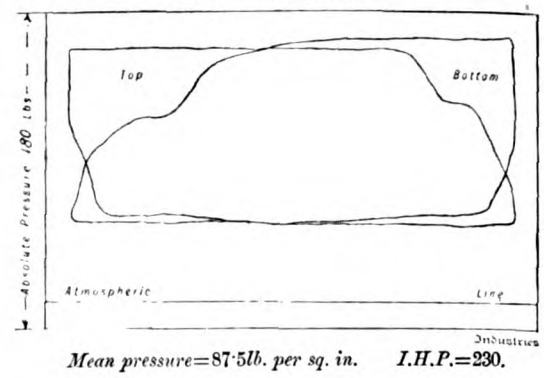


Scale of knots: ½in.=1 knot. Displacement on trial=572 tons.

render the vessel unsinkable under almost any conceivable conditions. The general arrangement of the lower cabins is as follows: Aft, officers' quarters and state rooms, 16ft.; between officers' quarters and engine room, four state rooms, &c., for strangers, 16ft.; engine and boiler space, with cross bunker, 35ft. Engine and boiler spaces are divided by a water tight bulkhead; communication between them is through a passage in the deck house. Saloon, two state rooms, pantry, lavatories, &c., 30ft.; owner's cabin, ladies' cabin, two state rooms, lavatories, &c., 22ft.; the crew space forward is 22ft. The saloons, cabins, state rooms, and holds below are ventilated by Boyle's ventilating apparatus. Baths, heated by steam coils, are fitted in the owner's and ladies' cabins. The vessel is lighted throughout with electricity, fitted by Messrs. Muir, Mavor, & Coulson, Glasgow, as described by us on page 549, Vol. III. The steering gear is Messrs. Thornycroft's patent, and is the same as that used for their first class torpedo boats. A hydraulic transmitter is used for steering from the bridge, with alternative arrangement for steering by hand or by gear aft or at the bridge as required. The steam windlass is of special design, and is fitted with small pumps for washing the cable and anchors. The deck house over engines and boilers is built of steel, and contains chart room, galley, and drying room.

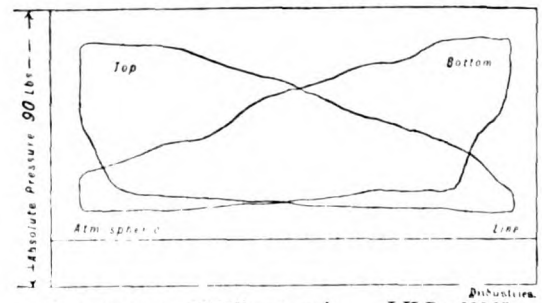
The engines, which we illustrate on our two-page supplement this week, and on pages 260 and 263, are of the triple expansion type. The cylinders are respectively 14in., 23in., and 36in. in diameter. The stroke in each case is 27in. The cylinder covers are of box section polished all over, and the cylinders are all lagged with teak. The intermediate and low pressure cylinders are both fitted with Thornycroft's patent equilibrium slide valves. In the surface condenser, the tube plates are of Muntz metal, as are also the studs exposed to sea water. The connecting rods and piston rods are

High Pressure Cylinder.



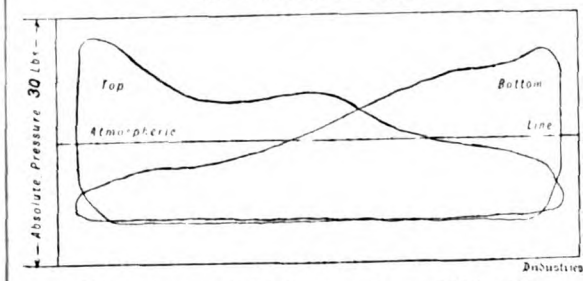
Mean pressure=87·5lb. per sq. in. I.H.P.=230.

Intermediate Cylinder.



Mean pressure=32·75lb. per sq. in. I.H.P.=236·25.

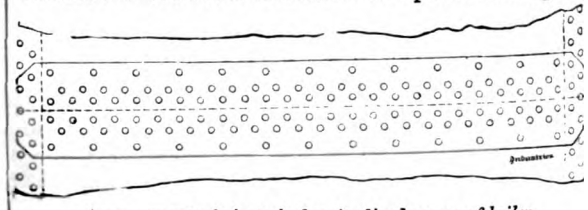
Low Pressure Cylinder.



Mean pressure=12·725lb. per sq. in. I.H.P.=224.

of forged scrap iron. The air and circulating pumps are worked by levers from the intermediate engine. There are two feed pumps and two bilge pumps; valves, valve chests, &c.—all of these being of brass. The crank shaft is built of selected forged scrap iron, and is 7in. diam. The thrust block is on the horseshoe principle, with rings of gun metal fitted to collars on the thrust shaft. There are two intermediate blocks with patent metal strips on bottom half. The propeller is made of a mixture of cast iron and steel scraps.

The main boiler, illustrated on pages 260 and 262, is made of Siemens-Martin steel, and is of the cylindrical return tubular type. It is constructed to Lloyd's requirements for a working pressure of 160lb. per square inch. The shell of the boiler consists of five plates running the



Arrangement of rivets in longitudinal seams of boiler.

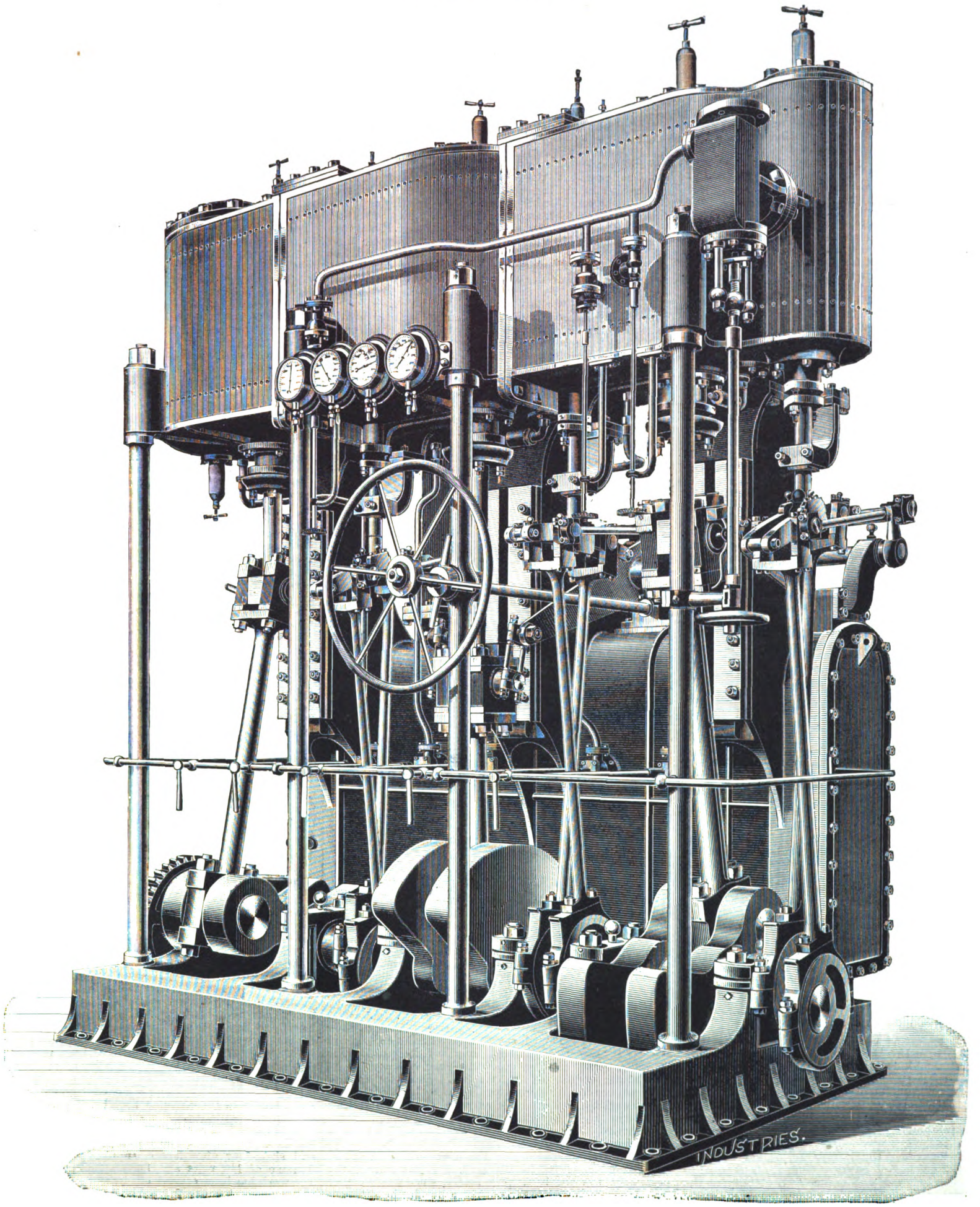
full length of the boiler. The circular seams are double riveted, and the longitudinal seams are triple riveted, as shown in the illustrations. There is, in addition to the main boiler, an upright donkey boiler made for a working pressure of 60lb., to supply the electric engine when there is no steam in the main boiler. We give above diagrams taken from the engines while running at their normal speed, and also a diagram containing the performance curves.

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TRIPLE EXPANSION ENGINES OF THE STEAM YACHT "THETIS."

CONSTRUCTED BY MESSRS. MUIR & HOUSTON, ENGINEERS, HARBOUR ENGINE WORKS, GLASGOW.

(For description see page 261.)



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FOREIGN INDUSTRIES

(From our own Correspondents.)

PARIS, 13TH MARCH, 1888.

THE IRON MARKET.—People are beginning to ask whether the evils attending the existence of the middleman do not outweigh the advantages. The question has been raised by the Paris iron merchants, who seem bent upon committing commercial suicide. The weather, the rupture of commercial relations with Italy, and the uneasy feeling resulting from the death of the German Emperor, have combined to check the course of business. Alarmed by what calm judges regard as merely a temporary lull, the merchants have sought to force the market by concessions in prices, thereby disorganising the trade, that seemed to have been placed on a secure basis. The irritation on the part of the manufacturers is great, and there are muttered threats of extending the practice of dealing directly with the consumer. The latest reports from the provinces describe the state of trade everywhere as quiet. The North is disturbed by labour disputes; but here and there we see continued activity. Thus the demand for wire in the Haute-Marne, and for plates in the Nord, is unabated, and both bars and plates constitute an animated market in the Ardennes. The near prospect of war, which obstructs business generally, acts as a stimulant in some directions. Thus large orders are being received by the great steel works on account of the navy and coast defences. The statistics of production in the second half of 1887 show great activity in the later month of the year. The output of forge pig amounted to 620,524 tons, against 610,319 tons in the first half year; of foundry pig to 195,684 tons, against 154,250 tons; of finished iron to 395,363 tons, against 378,897 tons; and of steel to 238,160 tons, against 212,696 tons. This shows an increase of 6·74 per cent. for the second half year for pig iron, and 7·1 per cent. for finished iron and steel. The average production in the last six months of 1887 was about equal to that of the whole year 1885, which was largely in excess of that of 1886.

THE METAL MARKET.—Stocks of copper have again increased, according to last week's reports. The syndicate has so far prevented a relapse in prices, but the present state of things cannot be long maintained It is generally believed here that although a sudden collapse is not to be looked for, prices must gradually recede. The efforts which are being made to increase production, aided by a restricted consumption, will operate, slowly perhaps, but continuously, to depress the market. The Société des Metaux held a meeting on Saturday, at which a report was read claiming for the Society the credit of having saved the copper industry from ruin. It was stated that the purchases made by the company in excess of their requirements have been sold at a remunerative price to Mr. Secretan, on the understanding that he engages to return them to the company at the same rate if they require him to do so. An extraordinary meeting is to be held, at which a proposal will be submitted to increase the capital by £1,000,000. Last year's profits amounted to £640,000. Speculation in tin in Holland has occasioned some buying here, with the result that prices have gone up from £3 to £5. Rumours of a combination between the principal lead mines of Europe and America have had the effect of bringing about a rise of 4s. Spelter is weaker by about 4s. per ton.

INDUSTRIAL SUCCESSES.—The Russian Government has, it is said, decided to remodel its war material within the next three years. The Bange gun having been preferred to the Krupp, the Cail Works will be called upon to furnish what is wanted in that department. The steam dredger built by Henri Satre, of Lyons, for the port of Santander, having been proved capable of raising 186 cub. metres an hour, a quantity greater than that required by the specification, the Spanish Government has given other important orders to the same firm for the harbour of San Juan, at Porto Rico.

AGRICULTURE AT THE PARIS EXHIBITION.—The Minister of Agriculture has decided to acquire for the great Exhibition of 1889 the means for comparing the present state of agriculture in France with that existing previously to the year 1789, and for setting forth the changes which have taken place in the interval of one hundred years. To this end he has issued a circular calling upon the Prefects to search the departmental and municipal archives for documents relating to the subject, and to obtain from local societies all the information they may be in possession of. The result of this inquiry should be a very interesting collection of documents and specimens of more than national importance.

BERLIN, 12TH MARCH, 1888.

THE COAL MARKET.—The coal market is fairly active. As compared with the beginning of the year, the prices at present obtainable are somewhat higher. The demand for coke and coking coal is also good, and prices are rising. Owing to the continuation of the cold and frosty weather, coal for domestic purposes is still in good request. Bore holes have been sunk in the district of Düderode and Osterode in prospecting for lignite, and enormous deposits have been found.

THE IRON MARKET.—The German iron market continues firm, and the amount of business done is about equal to that of the previous week. The increased activity of the iron foundries in Upper Silesia has caused more inquiry to be made for scrap iron, in which material an advance in price is imminent. Forge pig is quoted at from 50s. to 54s., and foundry pig at from 56s. to 58s. A fair demand exists for waggon wheels, sleepers, and for water pipes. The demand in the latter article is due to the damage done by the severe frosts. Merchant bars for home consumption are quoted at 140s., special sections at 155s., and boiler plates from 160s. to 165s. Foreign competition, as was to be expected in the present position of the syndicated trades, is beginning to make itself severely felt, and has already forced the rolled iron syndicate to adopt the special measure of leaving open the prices for materials supplied to the Hamburg free port district up to next October. This measure is directed more especially against English imports into the free district of Hamburg, which have lately considerably increased. The association of sheet makers met on the 8th inst. at Siegen, and resolved to establish a common sales bureau for the northern part of the Westphalian district. The base price has been increased from 150s. to 152s. for the home district, and to 165s. for Schleswig-Holstein.

THE FOREIGN TRADE OF GERMANY.—Statistics have now been issued concerning the export trade of Germany during January, 1888. In cotton goods the total quantity exported amounted to 2693 tons, as against 2799 tons in the same period of the previous year. There was also a reduction in the export of iron goods; but in cement there was a considerable increase, the quantity exported during January, 1887, amounting to a little over 8000 tons, whereas during the same month this year over 10,000 tons were exported. In spirit there is also an increase from 5652 tons to 7218 tons. Sugar, on the other hand, has slightly declined, the figures being 36,144 and 35,447 tons respectively. Paper and paper goods have risen from 6760 tons to 7961 tons. The imports of breadstuffs have under the new increased tariffs considerably declined.

SALT.—Representatives of salines and salt mines recently met at Halle with a view to syndicating the trade, or if that should not be feasible, to agree at least upon an increase in price from the 1st April next amounting to about 1s. per ton. The Government salines of Prussia, Bavaria, Würtemberg, and Baden abstained from sending representatives, and private mine owners fear that the Government works will oppose their policy of artificially forcing up prices. They have requested the Government salines to enter into contracts with the private salines, under which the former would agree not to undersell the latter; but up to the present no favourable reply has been received. If the Government salines hold out, one of two things will happen. The private works will either give up their policy of concerted action, or they will begin to undersell the Government salines, so as to bring them to terms.

AID TO NATIVE INDUSTRY.—To aid in promoting the interests of the manufacturers, the German railway authorities and ship owners have agreed to remit, the former 50 per cent., the latter 25 per cent. of the freights on all goods consigned to Melbourne for the great Exhibition of this year.

THE MANUFACTURE OF GLOW LAMPS.—The company which manufacture the Seel glow lamp in this town are about to considerably enlarge their works. The lamps have proved so economical and lasting that the demand has of late greatly increased. The necessary machinery and apparatus for the enlargement of the works have been ordered from Messrs. Fritche & Pischon, of Berlin, who make a specialty of apparatus for the manufacture of glow lamps. With the new plant, the time required to evacuate the lamps is much reduced, and the loss of quicksilver, sometimes occurring through breakage of the old Sprengel pumps, is also said to be avoided. It was often found that when a pump broke, quicksilver found its way into the clothing of the workpeople, and to protect them from such accidents, which are prejudicial to health, the pumps will be placed outside the work rooms. In adopting this precaution the company have anticipated the objection which sooner or later is sure to be raised by the sanitary authorities against the indiscriminate use of quicksilver in the manufacture of incandescent lamps.

VIENNA, 12TH MARCH, 1888.

THE IRON MARKET.—The condition of the crude iron market in Austria-Hungary has not materially changed since my last report. For finished iron the market remains firm. Business in bar iron is fairly active, but the demand for sheets has somewhat fallen off. Works are fairly well employed, and it is expected that large orders for locomotives and railway waggons will shortly be given out by the State railways. The syndicated iron works in Austria-Hungary recently decided upon an increase in the price for girders of 8s. per ton, which came into force on the 1st inst. This increase in price shows that a good spring trade is expected, and that if peace be maintained an active business in building iron and other sections is probable. The axletree syndicate have also agreed on an advance in price of 16s. per ton, this increase being attributed to the high price which has to be paid for the raw material. Following the example of other branches of the iron trade, the works manufacturing ploughs have now formed themselves into a syndicate, with a view to improving their condition. That this step has been taken is not surprising considering the depressed state of the small iron industry. In Hungary, business during the past week has not been very active, since the weather has been unfavourable and river traffic is difficult. Building operations are therefore somewhat delayed, and warmer weather is much desired. The prospects of an active building season are good, and many private and public buildings are already in progress. In railway material the demand is fairly good, and it is expected that large contracts will shortly be given out for sleepers and rails. The metal market remains firm. A new company, with a capital of £90,000, has been formed for the exploitation of tin mines in the neighbourhood of Karlsbad, in Bohemia.

ELECTRIC LIGHTING.—The town of Temesvar, which was one of the first to adopt the electric light, is now about to extend it. At present the lighting is on the series system, using Brush dynamos, arc lamps, and groups of incandescent lamps; but as this system does not lend itself easily to indoor use, where each lamp must be under independent control, a scheme has been elaborated by the resident electrician for the use of alternating current machines and transformers. The particular type of transformer to be used is that made by Messrs. Kremenezky, Mayer, & Co., of this town. A very interesting electric light installation was started at the beginning of this month at the Künstlerhaus, where a jubilee exhibition of pictures is now being held. The building dates from the year 1868, but has been repeatedly enlarged. In December last year the council resolved to abolish gas and substitute for it the electric light throughout. In making this installation, care was taken to arrange the lighting in such a way that the current might at a future time be supplied from a central station. At present the current is supplied by engines and dynamos erected in a shed some distance behind the premises. The engine house stands on the brink of the river Wien, where the ground is very treacherous, and a foundation of piles had therefore to be provided. The motive power consists of two semi-portable engines, each of about 400 sq. ft. heating surface, one supplied by Marshall, Sons, & Co.—the other by the Austrian State railway works. Each engine drives a large Drexler dynamo, which is a close imitation of the Hopkinson type. The machines are shunt wound, and have bar armatures, the output being 800 ampères at 70 volts. The circuits from the engine house consist of four naked copper cables ·86in. diam., carried on posts and insulators over the roof of an intervening house to about the middle of the roof of the Künstlerhaus, below which point is fixed the distributing switch board. The installation comprises 70 arcs for indoor use, 8 arcs for outdoor use, and a trophy of 30 glow lamps. All the arc lamps are arranged in parallel, and are of different candle power, consuming 10, 12, and 15 ampères according to the special artistic effects required. For lighting the buffet, and some rooms without windows, there is a second small plant of gas engine, dynamo, and eight arc lamps in series. The installation has been erected by Messrs. B. Egger & Co., of this town, under the superintendence of Herr von Pichler, the engineer to the Künstlerhaus. The erection of the machinery house and machinery occupied only fourteen days. Immediately over the engine house pass about two hundred telegraph and telephone wires; but as yet no disturbance from the heavy currents has been noticed in these wires.

BRUSSELS, 13TH MARCH, 1888.

THE COAL MARKET.—The price of industrial coal is well maintained, and for April delivery an advance of 10d. per ton is asked. The stoppage of canal traffic continues to prove very inconvenient. Large coal is quoted at 16s. to 16s. 10d. per ton; unscreened, 8s. 10d. to 9s. 7d.; small, 6s. 5d.; coke dust, 6s. 10d.; coke, 11s. 2d.; half washed coke, 12s.; washed coke, 13s. 2d. The Mons market is firm, and sellers obtain their own prices, while no one thinks of objecting to the higher rates for coke. At Charleroi business is also satisfactory.

THE METAL MARKET.—The market is very firm, owing to the high price of pig iron. The Athus Company have fixed their rate at 38s. 5d. up till September. At Charleroi the rates are 48s. for special brands of foundry pig, and 44s. for ordinary foundry pig. The syndicate will have no difficulty in maintaining their price so long as orders for finished iron do not decrease; otherwise rolling mills would not be able to pay current rates. Some more contracts will be made by the State railways at the commencement of next month. The Belgian rail makers' syndicate, which was dissolved at the close of last year, is to be re-constituted. Business is good in sheets, angle iron, tyres, and light rails. Messrs. Le Fèvre have contracted for the railway station of Kinkenpois, near Liège, for £13,958. La Métallurgique has received some important work for Nice, La Franco-Belge has obtained an order for a number of locomotives for the Mediterranean Railway, and Thy-le-Château has orders for Switzerland. Owing to blast furnaces being re-lighted, and to the introduction of English Nos. 3 and 4 pig, the prices of the raw and finished material are now somewhat more in harmony with each other.

GLASS WORKS.—Good orders have been received from America, not only for the best quality of ordinary glass, but also for coloured and fancy descriptions. The English market is improving. There is a good demand from Japan, and freights to the extreme East being lower, orders are coming in from China.

ELECTRIC LIGHTING.—The Dyle-Bacalan engineering works have installed the electric light, thirty arc lamps and sixty-four glow lamps, supplied from a Lahmeyer dynamo of 110 volts and 110 ampères, being employed. The work has been carried out by the Société Industrielle of Brussels. Twenty Jablochkoff arc lamps, which have been used hitherto, have been discarded.—M. Vlierboom

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has fitted up a house in the Boulevard Bischoffsheim with the electric light. He uses twenty Gadoh accumulators of 44lb. each, including the weight of the glass cells. Each cell contains nine plates. The daily discharge of the battery is about forty ampère-hours, but reaches occasionally sixty. The battery is charged from a Gerard dynamo driven by a 1 h.p. Körting gas engine. In another private installation twenty-five Gadoh accumulators, weighing altogether 10cwt., are used for thirteen Khotinsky lamps of 1 ampère and 50 volts. The dynamo is driven by a 2 h.p. Lenoir gas engine.—The house of M. Lepage, Chaussée de Wavre, is entirely lighted by arc and glow lamps from the Thomson-Houston station, which supplies the Molière Theatre. Another house in the neighbourhood will also instal the electric light.

Belgian Foreign Trade.—A comparison of the foreign trade of Belgium during January last, and in the same month of 1887, shows a diminution both in the exports and imports over all. The trade with France and England, however, shows an increase.

Fountain Lighting at the Exhibition.—The illuminated fountains to be used at the Brussels Exhibition will be of a different character to those used in London and Manchester. Only one very powerful arc lamp will be used, and special effects obtained by the differential rotation of two coloured glass discs. The rays will strike a mass of pulverised water produced by revolving nozzles, and by this means a more brilliant effect is expected with only half the power which would otherwise be required.

Signalling Balloons.—Two Bruce signalling balloons, one 20ft. and one 15ft. diam., will be shown at the Brussels Exhibition, each being fitted with six glow lamps supplied from 25 E.P.S. storage cells.

DÜSSELDORF, 12th March, 1888.

The Iron Market.—It is not easy to account for the present animated aspect of the iron market. On the whole there is little or no abatement of the activity which has distinguished the iron trade of Germany for some months past, and judging from outward appearances business is likely to continue brisk throughout the current year. But the situation is not so firmly established as it appears to be. The foreign trade is suffering severely from the effects of high prices, and it is hard to see how, with dear ore and coke, the blast furnace owners are to afford to the manufacturers of finished iron and steel who work for the foreign markets, that relief in prices which it has been proposed to make. But symptoms of returning languor are not wholly absent from the home trade. Bars are less sought after, and are likely to be more neglected now that the price has been further advanced 2s. 6d. per ton. The demand for pig iron continues brisk, and is amply sufficient to absorb the production. The quantity available for consumption in the first month of the current year, that is, the production and imports, less the exports, amounted to 346,164 tons, against 286,595 tons in January, 1887, an increase of 59,569 tons, or 21·1 per cent. Spiegel is still in strong demand, and forge is more sought after. Dealings now take place for delivery in the third quarter. There is a very brisk inquiry for basic steel pig, but Bessemer is somewhat neglected. Except for bars, the finished iron and steel markets are fairly animated. A large business is being done in plates, the current prices, £7. 5s. for common, and £8. 5s. for boiler plates, being willingly paid. Common plates rolled from ingot iron sell at £6. 15s. and £7. Sheets are in moderate demand at £7. 10s., with a prospect of an increasing business as the season advances. Hoop iron sells readily at from £6. 15s. to £7. The market is dull for steel wire, the home price of which is £6, and the export price from £5. 3s. to £5. 5s. per ton. Steel works generally are fully employed. A statement in a Belgian journal to the effect that negotiations are in progress between Belgian and British manufacturers to establish a syndicate for the purpose of raising the export prices of finished iron has had a favourable influence on the market here.

German Iron Abroad.—The Customs returns for the first month of the year fully justify the apprehensions of those who see in the existing abnormally high prices a serious obstruction to the development of our foreign trade. The following are the exports in January, compared with those of the same month of 1887: Pig iron, 13,585 (19,879) tons; scrap, 1982 (4417) tons; half wrought iron, blooms, ingots, and puddle bars, 2390 (3277) tons; finished iron, bars, angles, and plates, 15,965 (21,175) tons; wire, 19,427 (21,043) tons; rails, 6691 (16,449) tons; other railway iron, 3153 (2536) tons; and manufactured goods, other than machines, 15,229 (13,332) tons; total of all classes, 78,422 (102,108) tons—a shrinkage of 23·2 per cent. In finished iron, the falling off is chiefly in bars. While the exports have diminished, the imports have increased, the total of all classes imported in January being 16,230 tons, against 14,856 tons in the same month of last year.

Locomotives for Italy.—The great engineering firm of Henschel & Son, of Cassel, has received an order for twenty powerful locomotives for the Italian Mediterranean Railway. This further proof of a growing commercial intercourse with Italy is also evidence of the good reputation which German manufactures have acquired abroad.

English Competition at Hamburg.—English competition in iron at the free port of Hamburg is making itself severely felt. The syndicate price for bars is now £6. 5s. English bars of equal quality can be delivered in Hamburg at a cost of £5. 8s. To meet this competition, the German rolled iron syndicate is compelled to deliver to the Hamburg merchants, whose purchases amounted last year to 13,200 tons, at the same price, viz., £5. 8s.; but, with forge pig at 53s., that price must leave a loss on the transaction.

LILLE, 13th March, 1888.

Textile Manufactures.—The cold weather, which begins now to break up, and the disturbing event which has occurred at Berlin, acting upon a feeble market, have further retarded the course of business in textile goods. The week has been a period of average activity in linen fabrics, the record of business transacted at Armentières being but slightly below that of the preceding week. But the woollen trade of the Roubaix-Tourcoing district has become weak generally, and almost lifeless in some particulars. Prices have a downward tendency all round. Business in piece goods is at a standstill. Buyers have a full stock of summer goods, and until these have been dispersed they are reluctant to enter into engagements for winter stock. The Calais tulle trade is moderately active, and the prospect for the spring is encouraging, but prices are very low. The article most in demand is "chantilly." A Roubaix correspondent writes me that "a movement has been set on foot by some of our most influential manufacturers to establish here a practical school of commerce for the better training of those who are destined to follow commercial pursuits."

Flax and Yarn Markets.—There is still a strong current of business in home grown flax, both for home consumption and for export, and prices are in consequence very firm. A good deal of Russian flax has changed hands. The demand for yarns is still brisk, and prices remain firm. Tows are somewhat less sought after. In jute yarns there is still a fairly animated market. Italian hemp is more inquired after, and holders are asking higher prices. The Ghent market for flax is less active; but as the supply falls off, prices are firm.

The Iron Market.—Business in iron has lost some of the vigour which characterised it a week ago; but the tone of the market is hopeful and strong. Perhaps the chief disturbing cause has been the manifestation of a spirit of discontent among the workmen. Several strikes have occurred, involving a large number of hands. The men claim an advance in the rate of wages, to enable them to benefit by the higher prices now current. The Hallez Works at Louvoil have received an order from the Western Railway Company for 100 tons of fish plates, at the price of £10. 8s. 5d. a ton; and the Sirot-Mallez Works at Thiout have obtained from the same railway company an order for 250 tons of tarred chair pins at £11. 3s. 2d. a ton. The Northern Railway Company have ordered for trial from Van Kalek, of Valenciennes, 40,000 steel chair pins manufactured hot. The price is £14. 8s. a ton.

Steam Tramway.—The General Council of the Ponts et Chaussées have decided to adopt steam traction on the new tramway between Lille and Tourcoing.

The Sugar Trade.—The annual consumption of sugar in France amounts to about 425,000 tons. Last year the yield of home grown beets fell a little short of 400,000 tons. Thus France must import about 25,000 tons to supply the deficiency. Had the season been favourable, there would have been an excess of about 100,000 tons for export. In view of the reduction of stocks which must result from the deficient yield in all the beet growing countries of Europe, French growers would have considerably increased their average of 1888 had not the situation been rendered uncertain by fresh legislation and the proposed abolition of the system of bounties. As it is, the extent of land under beet will be practically the same as in 1887, so that the advantage will be left to our rivals the Germans. The knowledge of this fact intensifies the bitter feelings roused by the Bounties Conference, and renders the opposition more stubborn.

MADRID, 12th March, 1888.

Pig Iron.—In a recent letter I referred to the termination of the agreement between the pig iron makers of Bilbao. This has led to the market being very unsettled, and at this moment there are no reliable quotations for pig iron at Bilbao, either for home consumption or export. The rates, however, are much under those which were fixed by the syndicate.

Steel Making in Asturias.—The Naval Department contracted some time ago for the supply of 3000 tons of steel with Messrs. Duro & Co., of La Telguera. The firm placed their steel making department under the charge of M. Langhalle, the French engineer. They then found that they could not obtain the desired quality of steel by the ore process, and began to use scrap iron. Since then their gas furnace has failed, and the naval authorities have ordered the material from England.

The Barcelona Exhibition.—It is now evident that the Exhibition cannot be opened as intended by the 8th of April, and the King's birthday—the 17th of May—is now spoken of as the date of opening, though it is doubtful whether the Exhibition will be in readiness even then. The applications for space have been very numerous, and it has been found necessary to enlarge the annexes. A large building, which is to be used as an hotel while the Exhibition lasts, has been very rapidly built, the time taken being only fifty-three days.

Mining Statistics.—The value of the mining statistics of Spain will be much improved in future, as a central office has been established by the Government at Madrid, whose duty it will be to collect accurate statistics. Up to now, the data have been obtained in a loose manner from the mine owners themselves, and nothing was done to ascertain whether they were correct or not. As the owners have to pay a duty on the area mined, and also a duty of 1 per cent. on the gross production of each mine, they naturally were interested in understating the extension of mines and the quantities extracted. The present statistical office has power to make investigations, and is to assist the Finance Minister in recovering duties. It is estimated by the office that on an average the underrating amounts to 40 per cent.

Huelva Sulphur Fumes.—According to the semi-official press, the Government intends coming shortly to a decision on this long disputed question. M. Sundheim is at present in Madrid as the representative of the Rio Tinto Company.

Coke Furnaces at Bilbao.—The coke furnaces which are being built at Bilbao on M. Carvés' plan at the works of the La Viscaya Companyare now nearly finished. The coal for these furnaces will be procured from England, and it is expected that the coke can be produced at a cheaper rate than it can be imported. Owing to the amount of handling it undergoes the imported coke has the disadvantage of containing a large proportion of dust.

NEW YORK, 3rd March, 1888.

The Coal Market.—The coal market is practically unchanged. Supplies are increasing slowly, as nearly all the Schuylkill miners have returned to work. Prices are still high, with apparently no tendency to fall; but if the present increased production be continued prices will soon drop back to their normal figure. The bituminous market is quiet. It is probable that the present rate will be maintained during the coming season.

The Iron Market.—The settlement of the strike is expected to increase the business in pig iron, but no change in the market has yet taken place. There is more demand for bars, several large orders having been placed during the past week. The Pennsylvania Railroad hast just placed orders at their Altoona shops for the construction of one hundred engines and 3500 freight cars; and 2200 cars and seventy locomotives have been contracted for with outside parties. There is more business being done in plate and tank iron. Mills are, however, not working to their full capacity, and prices are unchanged. Steel rails are in fair demand, but there have been no large orders placed lately, and prices are still about $32 per ton. In other forms steel is in pretty good request, and the mills are moderately busy.

The Metal Market.—It has been rumoured for the past two weeks, and is now positively asserted in certain quarters, that the Calumet and Hecla mines have contracted to sell all their output for three years, amounting to about 150,000,000lb., to the French syndicate, at 13 cents per lb. As these mines have hitherto been opposed to all combinations to increase the cost of copper, no great weight is as yet attached to this assertion. A fair average amount of business has been done in tin, and for March delivery prices have risen from 34·85 cents to 36 cents per lb. The amount in stock is smaller than usual, and prices are likely to go rather higher. The lead market is firm, with slightly better prices, but moderate business. Spelter is quiet and weaker. There are very few transactions, and prices are 5·30 cents per lb. for American domestic.

Corliss.—By the death of Mr. George H. Corliss at Providence in his 70th year, the engineering profession has lost one of its most eminent members. In 1846 he first turned his attention to the improvement of the steam engine, and ten years later the Corliss Steam Engine Company was incorporated. His success in building the large engine for the Centennial Exposition made him well known to engineers everywhere, and engines built after his design are to be found all over the world.

Railways.—The western approach to the Poughkeepsie bridge is rapidly being completed, a large force of men being employed in laying the track. The Erie Railroad Company is constructing a new drawbridge over the Hackensack river. There will be two passage ways, one on each side of the tower, which will allow of the largest craft passing through. The bridge will be worked by steam power. Automatic locking and signalling apparatus and switch rails will be used.

Canals.—A strong effort is being made by the representatives of New York City and Buffalo to secure an appropriation of £200,000 from the State Legislature for the New York State canals. The importance of the canals is shown from the amount of grain carried by them. While the canals were open in 1887, the receipts in New York were upwards of 75,000,000 bushels, while those of Philadelphia, Boston, and Baltimore, combined, only amounted to 33,000,000 bushels. New York received by canal alone 46,000,000 bushels, or 61 per cent. of the entire amount. The Merced Canal, which was commenced five years ago, has now been opened for traffic. The canal is twenty-seven miles long, 100ft. wide at the top, 70ft. at the bottom, and 10ft. deep. It is in the heart of the San Joaquin Valley, 140 miles from San Francisco, and runs from the Merced River, through what has been an almost barren plain, to the town of Merced, on the Southern Pacific Railway. It will irrigate 300,000 acres of land.

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THE WORKING OF AN ENGLISH RAILWAY.

We are indebted to the *Times* for the following abstract of an interesting lecture, delivered on the above subject by Lieutenant-Colonel Findlay, of the Engineer and Railway Volunteer Staff Corps, at the School of Military Engineering, Chatham, on the 8th inst. The lecturer referred to the London and North-Western Railway Company's system of working as an example for the illustration of his subject, as he had an intimate acquaintance with that company's arrangement of working.

The lecturer began by pointing out the close connection between his subject and those questions which might be supposed to engage the attention of military engineers. Thus, in case of an invasion, our safety would largely depend upon the perfect equipment and efficient working of the network of railways covering these islands. The Government, mindful of this fact, had some years ago instituted the Engineer and Railway Volunteer Staff Corps, composed of engineers and the general managers of most of the principal railways, the intention being that, in case of invasion, these gentlemen should work the railways as they did in time of peace, but should act under the directions of military commanders. The railways would have to be given up to the service of the State, and he himself anticipated no difficulty in concentrating a large body of troops within a very brief period of time. In the early part of 1885, the War Office instituted a kind of test of the ability of the companies to perform this task. The attempt was, of course, only made on paper, but as far as it went it was satisfactory. The test took the form of an exercise, proposed by order of the Commander-in-Chief, and constituted, in fact, a problem to which we were required to furnish the solution. We were asked, said the lecturer, to assume that an invading force, numbering 150,000 men, had commenced to disembark on the coast between Southend and Shoeburyness, and that hostile vessels were simultaneously ascending the Blackwater river to land a strong detachment at Stangate Abbey. Instructions were supposed to be issued by telegraph for the concentration of six army corps, numbering about 130,000 men, on the line of Stanford-le-Hope, Billericay, and Chelmsford, with a view to occupy the Basildon position and repel the invader—three corps being brought up as rapidly as possible and the remainder within forty-eight hours. We were told where the troops were stationed all over the country—north, south, east, and west—and the number of men composing each division. We assumed that the ordinary traffic would be suspended for the time being, that land could be encroached on wherever necessary for the construction of temporary platforms of sleepers and ballast for loading artillery and cavalry, and for other purposes, and that all the railways could be worked as one. We submitted tables showing the number of trains required, where each would start from and the hour of starting, the route travelled, the hour of arrival, and the times allowed for refreshment and other purposes on the journey. The total number of trains employed was 515. The speed was about twenty-five miles an hour, exclusive of stoppages, the trains following each other on the same lines at intervals of fifteen minutes, and the last train was timed to arrive at Chelmsford within forty-five hours and fifty minutes of the hour at which the order was supposed to have been given by telegraph. Thus, in theory at any rate, we put our defenders in a position to drive the invaders into the sea. In the case of our being engaged in a war on the Continent, it would also be necessary that railway engineers should accompany our forces, in order to deal with foreign lines. For this purpose a beginning had been made by the embodiment last year of a force of 631 men at the London and North-Western works at Crewe. This corps is almost entirely composed of men who in their ordinary avocations are smiths, fitters, firemen, &c., and they are undergoing, in addition to the ordinary infantry drill, a course of instruction in military engineering. The lecturer then proceeded to the main subject of his address. The immense and continuous development of railway traffic during the last fifty years had, he said, taxed to the utmost the ability and inventive genius of those engaged in its management, and of constructive and mechanical engineers, in order to keep pace with it, and to admit of its being conducted with regularity and dispatch, and with a minimum of delays and mishaps. The traffic consisted of varying elements. There are, the lecturer explained, express and mail passenger trains running at a speed of forty-five miles an hour, and even more in some cases; others at a somewhat less speed; stopping trains, calling at every station, and running at a rate of from twenty to twenty-five miles an hour; local suburban trains, running for short distances at a fairly high rate of speed, chiefly for residential purposes; express goods trains between the larger towns, attaining a speed of twenty or twenty-five miles an hour; slow, stopping goods trains, for serving smaller towns and villages; and, finally, the heavy coal trains running out of the great colliery districts to every centre of population. All these various trains, heavy and light, fast and slow, some stopping at the stations, and others dashing through them at high rates of speed, have to be accommodated to a great extent upon the same line of rails, yet all to keep their time and fulfil their appointed functions—and, briefly, this is the great problem which railway management has to solve. Such a service cannot be carried on under all circumstances—whether by night or day, in fogs, in snowstorms, in wind or rain, and under all other adverse conditions—without entailing hardships and dangers upon the men engaged in the working; but it was pleasing to state that the great army of men of all grades in the employment of the London and North-Western Railway Company show at all times a state of complete discipline and cheerful devotion to duty which could not be exceeded by any body of men whatever, and which, although perhaps not so well understood or appreciated by the public as might be the case, reflect the highest credit upon them. To carry on this great traffic the main essentials are a sound permanent way, powerful and efficient engines, an ample supply of suitable rolling stock, the most perfect signalling and telegraph arrangements, especially the block telegraph system, continuous brakes, and last, but not least, a highly trained and thoroughly qualified staff. Each of the subjects thus introduced the lecturer discussed in detail. He described the system of keeping up a thoroughly efficient and experienced staff. The company, he said, began by appointing lads of fourteen as boy porters, telegraph clerks, and to other similar employments, and when these lads grew up to be men they were experienced in the various branches of employment, and were able to fill such posts as became vacant. To the training of signalmen the most scrupulous attention was paid, and their appointments were never confirmed until after a thorough examination—especially in the matter of colour blindness—they were found to be fit for the posts they had to fill. Guards of passenger trains were selected from the porters, and guards of goods trains from the goods porters and shunters, always after a rigid examination and with due regard to general intelligence, capacity, and character. For the superior positions of inspectors, foremen, station masters, and the higher grades of the service, it was the invariable rule to select men from the lower ranks solely on the ground of merit, irrespectively of seniority or any other circumstances. Thus it was no unusual thing for a station master, by reason of special aptitude, to rise to the position of divisional superintendent, and even general manager. The company were not unmindful of the material welfare of the men they employed, and three insurance funds had been established in connection with the company, by means of which the men were provided for in the event of sickness, accident, or old age. The lecturer then entered into general statistics. The total number of the staff was 55,217. The total mileage was 2548 miles; the number of engines, 2541; carriages, 4548; goods and coal waggons, 53,555. The train mileage during the year ended June 30th, 1887, was, passenger, 19,533,957 miles; goods and mineral, 18,158,107, a total of 37,692,064 miles. In other words, the engines ran nearly a mile and three-quarters every second, or 104 miles every minute, and practically they put a girdle round the earth every four hours. During the year the number of passengers was 56,465,260, and the number of tons of goods and minerals carried was 33,937,758. The revenue derived from all sources was, from passenger traffic, £4,185,818; goods traffic, £5,974,319; or a total of £10,160,137. In order to explain how the engine working was arranged, the time and speed of running, and the intersections of the trains at places where goods and slow trains had to shunt into sidings for the fast trains to pass them, the lecturer exhibited a section of the line between Preston and Carlisle. If the theory of the time bill could be realised absolutely in practice, it would represent the perfection of railway travelling; but owing to bad weather (especially fogs and snowstorms), to the fluctuations of traffic and other uncontrollable causes, this ideal could never be kept up. When the calculations of the time table were upset arrangements had to be left to the discretion of the station masters and the foremen. The most that could be done on the part of the management was to lay down certain rules and principles for the guidance of the men. The lecturer then explained the system of signalling by coloured lights, so that trains might be distinguished from one another, more especially at night. Further, he said that in the last twenty years trains had more than doubled in weight, and that the speed had increased in some cases as much as 14 per cent. In consequence new engines had to be constructed capable of dealing with greater weight and speed. Indeed, there was nothing more striking than the contrast between the primitive machines which were considered triumphs of engineering skill in the early days of railways and the magnificent engines of modern times. The engines now employed were of eight distinct types. The old engines with a single pair of driving wheels were being superseded by the compound engines invented by Mr. Webb. The engine Dreadnought had, while working a train of 321 tons over a space of 105 miles, attained a speed of forty-four miles an hour with the expenditure of 39cwt. of coal. Of course with such rates of speed it was necessary to have powerful and trustworthy brakes for bringing the trains to a stand quickly when required. The brake gear used on the company's line was of two kinds, the vacuum and the Westinghouse. The question of safety then led the lecturer to deal with the system of signalling and telegraphing the trains, and the ingenious devices employed for securing gates at level crossings, turn tables, and canal bridges. The signalling of the London and North-Western Railway had, he said, involved the erection of 1400 signal cabins containing 30,000 levers, and of 14,000 signals, at an expenditure of £2,000,000. The steel rodding for actuating the points would form a continuous rod from the Land's End to John O'Groats, while the wires which work the signals would stretch from Liverpool to New York. Electricity also was a great factor in the working of railways, and he described the system of the block telegraph used as an auxiliary to the working of the out-door semaphore signals. The total number of bells used was 4850. As to ordinary message telegraphs, the number transmitted over the company's wires during the year was 14,573,607, showing an increase of 60 per cent. during the last decade. The mileage of wire on the system was 18,115 miles, and over 100,000 coils were in work. The lecturer then proceeded, with the help of diagrams, to describe the system of shunting as carried on at Edge Hill, situated on the Liverpool and Manchester Railway—the first one constructed by George Stephenson, now nearly sixty years ago. Fogs, he said, upset the arrangements and caused anxiety more than all other elements of difficulty put together. The fog of the week ended January 14th was the most severe visitation remembered. Delays were inevitable; but with the exception of one or two trifling mishaps, the traffic, owing to the precautions taken, was carried on during the week without any actual interruption, and without accident or injury to a single passenger.

SOME RECENT REPORTS ON BOILER EXPLOSIONS.

The Board of Trade have recently issued several Reports of Preliminary Inquiry relating to boiler explosions, which we propose to notice. The first, No. 244, relates to the explosion of a small, plain horizontal cylinder boiler, with flat ends, and externally fired, belonging to Mr. William Foley, mineral water manufacturer, Cradley Heath, Staffordshire. The explosion occurred about nine a.m. on the 18th of November, 1887, without causing injury to any person. The boiler was 31½in. diam., 7ft. long, with ends flat, and attached to shell by angle iron rings 2½in. by 2½in. by ⅜in. All the plates were ⅜in. thick, excepting the upper part of the back end, which was ½in. thick. The name of the maker and the age of the boiler were unknown, it having been bought second hand by Mr. Foley in the summer of 1880, but it was evidently very old. The front end plate of the boiler was reduced in thickness by grooving internally for nearly three-fifths of the circumference close to the rivets by which it was attached to the angle iron ring, so much so that it became unable to withstand the ordinary working pressure of 30lb. to which it is assumed the safety valve was loaded, and consequently it was blown out, the boiler being at the same time projected backwards, resulting in the destruction of the chimney and damage to surrounding property. This explosion was due primarily to an error in its design—no provision having been made for stiffening the ends, so as to prevent the constant buckling and bending action going on while under pressure, which could easily have been avoided by riveting strips of T iron across the ends, or the same object could have been attained by cambering the ends sufficiently to avoid deflection—and finally, to the grooving which resulted from the constant mechanical action, due to the flat form of the ends being unnoticed on this occasion, although it is evident that on some former occasion a similar defect in the back end had been observed, and the upper half of the end replaced by a thicker plate in consequence. The boiler was neither inspected nor insured.

Report No. 245 does not refer to the explosion of a steam boiler, but to the bursting of a stop valve chest fixed upon a main range of steam pipes connecting eighteen boilers at the silk mills of Messrs. Lister & Co., Bradford, Yorkshire. The accident occurred at about six o'clock in the morning of the 25th October, 1887, by which one man was killed. The valve box and cover were of cast iron, and the valve, seat, spindle, gland, and bush, of brass. The thickness of metal at the fracture ranged from $\frac{7}{16}$in. to $\frac{13}{16}$in. The stop valve which burst, the diameter of which was $7\frac{7}{8}$in., and the pipes to which it was attached, were made and fitted about the year 1872, and no previous accident or even serious repairs had been reported.

Report No. 246 describes the explosion of the boiler of a portable engine at Newton Court, Dilwyn, Herefordshire; it was the property of Mr. Llewellyn Hancock, Westfield Villa, Leominster. The boiler was made by Messrs. Tuxford & Sons, of Boston, in 1859, and was twenty-eight years old when it exploded, on the 9th November, 1887. There is nothing to cause surprise in connection with this accident, which resulted in severely scalding one man. It was an old worn out boiler, dangerously corroded at the part that gave way, and worked with an inoperative safety valve. It was neither under inspection nor insurance.

Report No. 247 refers to the explosion of a boiler on the 26th October, 1887, rented and worked by Messrs. John Cowan & Co., Clady Bleach and Dye Works, Dunadry, near Belfast. It was a Cornish boiler, 30ft. long, 6ft. diam., plates ⅜in. thick, the flue 3ft. diam., and fitted with seven Galloway tubes, name of maker unknown and age doubtful, but was placed in position by Mr. William Weir, a former tenant of the works, in 1865; the working pressure being 45lb. In June, 1887, the boiler was moved from its seating, and the part of the shell that had rested upon the seating walls was cut out, and renewed by longitudinal strips 20in. wide. After the explosion, it was found that these strips were much wasted where they had rested on the seating walls, and reduced for a great part of the length of the boiler to about ⅛in. thick—in fact, for a short distance the thickness did not exceed $\frac{1}{16}$in. The boiler was blown into several pieces, and two men were killed. The boiler had been under the inspection and insurance of the English and Scottish Boiler Insurance Company, Limited, Manchester, since the 19th May, 1880, and their inspector appears from the Report to have thoroughly examined the boiler on the 18th December, 1882, and again on the 22nd February, 1887. Mr. Traill remarks upon this explosion that "it is hardly credible that the boiler could have been in good condition when last thoroughly examined, 22nd February, 1887, as it is not probable that such serious corrosion has taken place since then."

Report No. 248, more recently issued, refers to the explosion of a boiler belonging to Mr. John Morris, Barton-on-Humber, near Hull, which occurred on the 17th October, 1887. The boiler was of the Cornish type, 3ft. 8in. diam., 9ft. 7½in. in length, made of ⅜in. plates, single riveted, containing one flue 2ft. 2in. in diameter, also ⅜in. thick. The end plates were of the same thickness. It was provided with a stop valve, one safety valve $2\frac{1}{16}$in. in diameter, one of Schaffer & Budenberg's steam pressure gauges graduated to 80lb. per square inch, two water gauge glasses and fittings on each side of the furnace, one feed check valve, and one blow-off cock. The safety valve was apparently loaded to about 39lb. per square inch. The

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boiler was made in 1866, by Messrs. Good & Menzies, Hull, and after passing through two other hands, was bought by Mr. Morris in 1883. It was neither under inspection nor insurance. The explosion was caused by shortness of water, apparently owing to the choking of the water gauge glass having escaped the attention of the attendant, but did no damage to property or injury to any person. In fact it is extremely doubtful whether anything that could be fairly called an explosion took place, as the inspector states that "the plates of the furnace were distorted gently up to the point of fracture"—1¼in. in length. According to the report "the mortar of the setting of the boiler was not disturbed in the least degree."

Five months have nearly elapsed since the last mentioned explosion took place, and yet the preliminary report was only issued a few days ago.

SHIPBUILDING NOTES.

A very successful trial trip was made last Saturday of the new s.s. "Indra," built by Messrs. Thomas Royden and Sons, of Liverpool, the machinery being made by Messrs. Fawcett, Preston, & Co. The length is 360ft., breadth 44ft., depth 28ft. 6in., gross tonnage 3,582. She is fitted with double bottoms and deep ballast tank forward. Her engines are of the triple expansion type with cylinders 27in., 44in., and 71in. diam. respectively, and a stroke of 4ft. There are two double ended steel boilers, each with six furnaces fitted with Galley's patent fire bars, the working pressure being 150lb. per sq. in. The propeller blades are of cast steel bolted to a cast iron boss.

The official trial trip of the "Hoopoe," one of the Cork Steamship Co.'s vessels, was made on the Mersey last week, when a speed of 12¼ knots was attained on the measured mile, the engines running 70 revolutions per minute. The vessel has been fitted with new machinery by Messrs. David Rollo & Sons, Liverpool. The engines are on the three cylinder, three crank, direct acting principle, with cylinders 21in., 33in., and 53in. diam. respectively, with a stroke of 36in. There are two single ended steel boilers, carrying steam at 160lb. pressure.

There was launched from the yard of Messrs. John Blumer & Co., North Dock shipbuilding yard, Sunderland, on the 9th inst., the iron screw steamer "Hampton," built to the order of the Commercial Steam Shipping Company, London. The vessel has a short poop, raised quarter deck, hurricane house, and topgallant forecastle, and has been built on the cellular double bottom system, with web frames, hold beams being dispensed with. The principal dimensions are: Length, between perpendiculars, 280ft; breadth, moulded, 38ft.; and depth, moulded, 21ft. 6in. The engines and boilers are being fitted by the North-Eastern Marine Engineering Company, Limited, South Docks. The engines are of the triple expansion type, and have cylinders 21½in., 36in., and 59in. diameter; 39in. length of stroke, and are 190 n.h.p. The deck machinery includes four steam winches, Pepper's patent steam steering gear, by Messrs. Rodgers & Co., Stockton-on-Tees; and Harfield & Co's patent steam windlass and capstan.

On Saturday, the 10th inst., Messrs. Edward Withy & Co. launched from their shipyard at Hartlepool a steel screw steamer, built to the order of Mr. George Steel, West Hartlepool, for Messrs. Steel, Young, & Co., London. This is the one hundred and fifty-second vessel on the builders' books, and the twenty-sixth built by them for the same owners. The vessel is a fine type of a modern cargo boat, is built of Siemens-Martin steel, is over 300ft. in length, with a large measurement and deadweight carrying capacity, has a long raised quarter deck, short poop, and long bridge house, with a topgallant forecastle; the main bridge, quarter and forecastle decks, skylights, bulwarks, rails, bulkheads, cargo battens, &c., are built of iron or steel. The main and after holds are built on the web frame system, dispensing with hold beams, thus enabling the steamer to carry cargoes of the most bulky description, such as machinery, torpedo boats, large guns, &c.; has a cellular bottom all fore and aft (Withy & Sivewright's patent), and the after peak will also be available for water ballast. She is fitted with four steam winches, two donkey boilers, and patent direct steam windlass on forecastle, hand and steam steering gear amidships, and patent screw standby gear aft. The accommodation for officers and passengers is under the poop aft, and is fitted up in hardwood, with beautifully hand painted panels, by the firm's lady decorative staff. The vessel is rigged as a two masted fore and aft schooner, with iron masts; and is built to the 100 A1 class at Lloyd's, under the personal superintendence of Mr. George Steel. She will be fitted with triple expansion engines by Messrs. T. Richardson & Sons, Hartlepool.

Last week Messrs. J. F. Waddington & Co. launched from their shipbuilding and engineering works, at Seacombe, near Liverpool, a handsomely modelled screw tug, called the "Sunbeam," intended for towing purposes at Belfast. She has a guaranteed speed of 10 knots, and is fitted with engines of 50 h.p.

NAVY CONTRACTS.—A parliamentary paper has been issued in which are given detailed instructions for the Director of Navy Contracts in the purchase of all stores, supplies, and machinery for the use of the marine forces and establishments, and for the conclusion of all contracts in connection with the same, and also for the Surveyor of Stores as to the examination and receipt of stores.

Notices of Meetings.

THIS WEEK.

SOCIETY OF ARTS.—Saturday, 17th March, 3 p.m. Dr. Mann Lecture on the "Protection of Buildings from Lightning," by Professor Oliver J. Lodge, D.Sc., F.R.S.

NATIONAL ASSOCIATION OF COLLIERY MANAGERS.—Parent Society. Meeting at Manchester, Saturday, 17th March, 1 p.m.—South Staffordshire Branch. Meeting at Wolverhampton, Tuesday, 20th March.

NEXT WEEK.

SOCIETY OF ARTS.—Monday, 19th March, 8 p.m. Cantor lecture on "Alloys," by Professor Chandler Roberts-Austen, F.R.S.—Tuesday, 20th March, 8 p.m. Applied Art Section. Paper to be read on "What Style of Architecture should we Follow?" by Mr. Wm. Simpson.—Wednesday, 21st March, 8 p.m. Ordinary meeting. Paper to be read on "The Evils of Canal Irrigation in India, and their Prevention," by T. H. Thornton, C.S.I., D.C.L.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, 19th March, 8 p.m. Paper to be read on "The Polariscope and its Applications to Brewing," by Mr. John Heron.

ROYAL INSTITUTION OF BRITISH ARCHITECTS.—Monday, 19th March. Ordinary meeting. Paper and discussion.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 20th March, 8 p.m. Ordinary meeting. Paper to be discussed: "Economy Trials of a Non-condensing Steam Engine—Simple, Compound, and Triple," by Mr. P. W. Willans, M.Inst.C.E.—Friday, 23rd March, 7 30 p.m. Students' meeting. Paper to be read: "Principal Types of American Swing Bridges," by Mr. Henry W. Hodge, Stud.Inst.C.E.

INSTITUTION OF NAVAL ARCHITECTS.—Wednesday, 21st, Thursday, 22nd, and Friday, 23rd March. Annual meeting.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, 21st March, 7 p.m. Address by the President, Dr. W. Marcet, M.D., F.R.S., on "Atmospheric Electricity," illustrated by experiments; after which Mr. G. J. Symons, F.R.S., will make a short communication on "The Non-existence of Thunderbolts; elucidated by accounts of searches after them, and the exhibition of specimens." Exhibition of apparatus connected with atmospheric electricity, including lightning conductors, photographs of lightning, and damaged objects, and of such new instruments as have been invented and first constructed since the last Exhibition.

ROYAL UNITED SERVICE INSTITUTION.—Wednesday, 21st March, 3 p.m. Paper to be read on "Land and Water Transport in the Soudan and on the Nile," by Major E. A. de Cosson, F.R.G.S.—Friday, 23rd March, 3 p.m. Paper to be read on "Naval Mobilisation," by Rear-Admiral Colomb.

INSTITUTE OF PATENT AGENTS.—Wednesday, 21st March, 7 p.m. Paper to be read and discussed on "The Proposed Patent Law in Switzerland," by Mr. G. G. M. Hardingham, Fel. Inst.P.A.

LIVERPOOL ENGINEERING SOCIETY.—Wednesday, 21st March, 8 p.m. Paper on "Filtration of Sewage," by Mr. Turner, to be further discussed.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, 22nd March, 8 p.m. Paper to be read on "Electrical Stress," by Professor A. W. Rücker, M.A., F.R.S., and Mr. C. V. Boys.

ROYAL INSTITUTION OF GREAT BRITAIN.—Thursday, 22nd March, 3 p.m. Lecture on "Microscopical Work on the Least and Simplest Forms of Life," by the Rev. W. H. Dollinger.

PRICES CURRENT, 15TH MARCH.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/4½ Cash
Scotch Warrants, m/n		38/10½ "
Hematite Warrants, m/n		41/10 "
Stocks in Stores. Scotch	957,446—Inc. for week,	2596 Tons
Middlesbro'	329,330—Dec. "	2060 "
Hematite	211,358—Dec. "	352 "

Exclusive of stocks in makers' yards.
Market quiet, and little business offering.
Scotch shipments 6769 tons, against 10,690 tons for same week last year.

	No. 1.	No. 3.	
Coltness	48/-	42/-	f.o.b. Glasgow.
Gartsherrie	45/-	41/6	" "
Dalmellington	40/3	38/6	" Ardrossan
Eglinton	39/-	37/9	" "
Glengarnock	44/-	40/-	" "
*Derbyshire	—	36/-	f.o.t. Works.
*Lincolnshire	—	32/6	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.	Best.	
Middlesbro' Bars	£ 4 17 6	£ 5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 2 6	5 12 6	Manch'r.
" Angles	5 12 6	6 2 6	"
Crown Sheets	6 5 0	6 10 0	"
" Hoops	5 5 0	6 5 0	"
"Siemens-Martin" Steel Boiler Plates		7 17 6	"
" Ship and Girder		7 12 6	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	10	0	to	£19	15	0	
Copper: British Cakes and Ingots	80	0	0	"				
" Chili Bars	80	7	6	"	80	10	0	
" Manufactured (strong)	90	0	0	"				
Lead: Common Pig	15	2	6	"	15	7	6	
" English Sheet	16	2	6	"	16	7	6	
Tin: Straits	166	0	0	"				
" Australian	167	0	0	"				
" English Ingots	159	0	0	"	160	0	0	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—There has been a moderate business done during the past week at prices ranging from £81. 17s. 6d. to £80. 7s. 6d. per ton for sharp cash parcels. The French syndicate are actively continuing their negotiations with the English smelters, and it is likely that an arrangement will be completed which will embrace the whole copper trade, whereby prices will be regulated and steadied for a long time to come. Meanwhile there is very little copper going out from the manufacturers. Old stocks bought at low prices are being cleared off first, both at home and abroad. The home manufacturers of copper goods are thus being seriously affected for want of work, and the artisans are only half employed in consequence.

TIN.—Straits very steady at £166 for sharp cash parcels, three months quoted £133 per ton.

LEAD.—Spanish is slightly easier; English is also lower.

SPELTER.—Quotations are unaltered.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	10	0
" Ceylon	"	24	15	0
Cottonseed	"	20	10	0
Cod	"	19	0	0
Lard	"	41	10	0
Linseed	"	18	15	0
Palm, Lagos	"	21	10	0
Rapeseed: English	"	24	5	0
Seal: Pale	"	23	10	0
" Brown	"	17	0	0
Sperm	"	41	10	0
Whale	"	14	0	0
Turpentine	per cwt.	1	7	6
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6¾
" Spirit	"	0	0	7¾

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6½	—	0	1	6¾
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	12	0	0	—	12	5	0
" Liquor	lb.	0	0	3½	—		.....	
Bleaching Powder	ton	7	10	0	—	7	12	6
Bisulphide of Carbon	"	13	0	0	—		.....	
Borax	"	30	0	0	—	31	0	0
Benzole (90%)	gal.	0	3	7	—	0	3	9
" (50/90%)	"	0	2	7	—	0	2	9
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	5⅞	—		.....	
" Prussiate (Yellow)	"	0	0	7⅛	—		.....	
" Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom { Bags	ton	2	10	0	—	2	12	6
Salts: Epsom { Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1½
" Caustic (White, 70%)	ton	6	17	6	—		.....	
" " { " 60%	"	5	17	6	—		.....	
" " (Cream, 60%)	"	5	15	0	—		.....	
" Crystals	"	2	10	0	—	2	12	6
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	10	0	—	6	12	6
Zinc Sulphate	ton	7	0	0	—	8	0	0

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HOME INDUSTRIES.

MANCHESTER, 15th March, 1888.

The Cotton Trade.—The chief feature of this trade during the week has been the weakening of the prices of raw cotton, in consequence of the confirmation of the reports of the large production in America during the current year. Prices of all classes of American have fallen ⅛d., and, as consumers are generally well stocked, there is every probability of still lower rates being reached. Business in yarn has been steady, and the whole of the production is being easily disposed of. Some buyers are anticipating lower prices; but there seems to be abundant evidence that the production of yarn is not greater than the demand for it, and in consequence it is not probable that lower rates will rule. Cloth manufacturers assert that they are short of orders; but there is no desire to sell unless full current prices are obtained. Cloth producers are well under contract, and quotations are well maintained. With a falling cotton market, new contracts will only be made at lower rates, but at present the number of these is very small. In a report of the Council of the Amalgamated Association of Operative Spinners, it is urged that a margin of 2¾d. per lb. between middling Orleans cotton and 32's cop twist should be reached before the trade can be considered satisfactory. At present it is about 2½d., and many mills are making good profits.

The Merchandise Marks Act.—The inquiry conducted by the Manchester Chamber of Commerce as to the method of reeling yarns terminated on the 12th inst. Without anticipating the report of the committee, two things may be noticed. First, that it appears to be necessary to reel the yarns according to particular measurements used in different countries; second, that when so reeled, the counts of yarn and the number of hanks in the bundle should be stamped on or attached to the outer cover. If the second condition is adhered to there is no possibility of fraud, and it is probable that the report of the committee will, while allowing a wise latitude in the process of reeling, insist upon the necessity for correct marking.

The Ship Canal.—Rapid progress is being made in this undertaking, The shares show a little improvement in value, and the ordinary shares are a trifle higher than the preference. The directors have recently issued a circular to ship builders and owners, calling attention to the fact that, in view of possible charters being obtained for the port of Manchester hereafter, the top masts of steamers should not be made higher than 40ft. A considerable advance has taken place in the value of property in the vicinity of the docks, which are now in course of formation.

LONDON, 15th March, 1888.

The Money Market.—The rates charged for the loan of money this week are in advance of those recently ruling, even at last settlement. There has been a fair demand for accommodation for Stock Exchange purposes, though the account has not been remarkably heavy. The rates of discount for long periods are still moderate. Since last Thursday two events have taken place which have considerably affected the stock markets. The expectation of the Emperor William's death had depressed the foreign markets for several days, and the fears arising from the imminence of Mr. Goschen's conversion scheme had for a time adversely affected Home Government securities. But when the Emperor's death occurred on Friday, and when the terms of the Chancellor of the Exchequer's project were made known the same afternoon, the markets at once assumed a buoyant tone. The news from Berlin had been more than discounted, and was followed by a gradual recovery in all the markets. Mr. Goschen's scheme has been well received, and its equitable terms have operated favourably upon the funds. At the same time there is still a feverish anxiety in many quarters to buy stocks, which will give 3 per cent. with good security. Indian and Colonial stocks, and home railway preferences and debentures, continue to reap the benefit of this demand. The ordinary shares of the British railways have improved materially in price with the opening of the new account. As a speculative medium, copper shares have quite given place to diamonds, and the shares of the Cape companies have reached a ridiculously inflated price. Strong "bear" influences are now at work upon them; but though the bears prophecy a glut of diamonds and a fall in the price, their case is weakened by the fact that the enormous production at the Cape in the last few years has not flooded the diamond market, which is stronger now than it was a year ago. But this does not make it any less a fact that the prices of Cape diamond shares are far too high for the value of the properties.

Our Foreign Trade.—The Board of Trade returns for February are satisfactory, the exports amounting to £18,992,423, as compared with £17,255,133 in the same month of last year, an increase of 10 per cent. Nearly all the items show an improvement, the only important exception being worsted fabrics, the value of which has decreased by 12 per cent. The imports amounted to £29,532,776, as compared with £28,513,994 in February, 1887, an increase of 3½ per cent. In wheat, Indian corn, flour, and wool there have been large decreases; copper shows an increase in quantity of 28 per cent., and in value of 104 per cent.

London Chamber of Commerce.—The annual report of this Chamber of Commerce states that the past year was one of steady and progressive work. Owing to the facts which had been submitted by the Chamber to the Postmaster General and the Chancellor of the Exchequer, a new service for the dispatch of patterns had been introduced. The question of commercial education had been actively taken up by the Chamber, and besides encouraging evening classes in the Metropolis, a circular was issued to all the members of the Chamber requesting them to state what proportion of foreign labour was employed by them; for what reasons foreigners were employed, and in what respects British clerks failed to meet requirements. From replies received it appeared that foreign labour was employed because it was cheap, disciplined, intelligent, willing, and better trained than our own. It was considered that the disadvantages of the present position could be remedied only by more complete education and special training, particularly in languages.

The Paris Exhibition.—We have already in our last issue, and in that of the 3rd ult., given particulars of the terms upon which exhibits will be received at the Paris Exhibition of 1889. In connection with the electrical section, a meeting of intending exhibitors has been called by the Secretary of the Society of Telegraph Engineers and Electricians for Monday, the 19th inst., at 3 p.m., at the Institution of Civil Engineers, to make further arrangements for organising a British electrical section. The council of the Society have received notice that the following firms among others will take part in the Exhibition: Anglo-American Brush Electric Light Corporation, Limited; Clark, Muirhead & Co., Limited; R. E. Crompton & Co.; Electrical Power Storage Company, Limited; Elliott Brothers; John Fowler & Co. (Leeds), Limited; W. T. Goolden & Co.; Greenwood & Batley; W. T. Henley & Co., Limited; The India-rubber, Gutta-percha and Telegraph Works Company, Limited; and Woodhouse & Rawson, Limited. A public meeting is also to be held at the Mansion House to-morrow (Friday) to consider the steps which it is proposed to take in order to secure a suitable representation of British manufacturing arts and industries at the Exhibition.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 4th March, amounted to £1,116,180 on 15,837 miles, as compared with £1,132,727 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 128¼ miles, or 0·8 per cent., and a decrease in the receipts of 1·4 per cent.

New Pier.—A new iron pleasure pier is to be built in the centre of the Marina, at St. Leonards. It will be 900ft. long. The contractors for the work are Messrs. Head, Wrightson, & Co., of Stockton-on-Tees.

Compressed Air Cars.—Cars driven by the Mékarski compressed air engine are now being run on the London Street Tramways Company's line between Holloway Road and King's Cross. The air is compressed at a station, and stored in reservoirs which are placed under the cars, each charge allowing of a run of ten or twelve miles. The cars are fitted with air brakes, which enable them to be stopped in a little over their own length.

Rating of Machinery.—Sir W. Houldsworth has introduced a Bill in the House of Commons to amend the law relating to the rating of hereditaments containing machinery.

GLASGOW, 15th March, 1888.

Stock Markets.—The influence of the death of the German Emperor upon the stock markets was unimportant. The event had been anticipated, and there has not appeared any circumstances pointing to imminent danger of resulting European complications. Most of the home railway stocks have gone up a little; the North British Stock rose ⅜ on the announcement of the dividend.

Proposed Scoto-Irish Tunnel.—A secret survey has lately been made in the North of Ireland and on the Mull of Kintyre, with the object of arriving at data for an estimate of the cost of a tunnel across the narrow strait which separates Ireland from Scotland. It is said that Sir Edward Watkin has interested himself in the scheme; possibly with a view to prove the practicability of a long sea tunnel. It is said that the estimated cost is eight millions sterling, or about a million per nautical mile. On the Irish side the existing line of railway approaches within a few miles of the promontory which forms the nearest point of Scotland; but on the Scottish side an approach railway of about eighty miles would have to be constructed from the Lochgilphead station of the Crinan Railway, now under construction, to the Mull of Kintyre, where would be the entrance to the proposed tunnel. Even this would not give continuous railway communication between England and Ireland, for the western terminus of the short railway which is intended to connect the west coast of Argyllshire with the Firth of Clyde, is situated at Kilunn, on the Holy Loch, from which passengers have to be conveyed by steamer across the Firth to Greenock. Even though communication were effected between the Mull of Kintyre and the Oban Railway, which would bring it into direct connection with the railway system of the country, the route so opened up between England and Ireland would be extremely roundabout. The avoidance of a sea passage is of course so important an element, that even an extension of time might be calculated as not altogether condemnatory. By far the most suitable point for a tunnel, had the depth not been almost prohibitory, is the strait, almost as narrow as the other, between Port Patrick and Donaghadee. This would have given almost direct connection between Belfast and Scotland and the North of England.

Opening of New Market Buildings.—The Bazaar, as the Glasgow market is called, has been entirely rebuilt, lit with electric light, and otherwise embellished at a total cost of £20,000. The new building was formally opened on Thursday last by a commission of the Town Council.

Government Shipments and Harbour Dues.—A number of Glasgow gentlemen were members of the deputation which placed before Mr. W. H. Smith the views of the shipping interest in respect to the exemption from harbour dues of shipments to India on Government account. A considerable quantity of railway material is shipped annually at Glasgow for the Indian State railways, and these shipments are exempt from harbour dues, which are in consequence proportionally heavier upon private shippers. A considerable point was made by Mr. W. P. Sinclair, M.P. for Falkirk district, who showed that the grievance arose through the Government having taken over the railways of India from the hands of private companies. The private companies had of course to pay harbour dues, but when the railways became State property the payment of dues upon these shipments stopped. The Marquis of Hartington, who accompanied the deputation, emphasised this view very strongly.

Collision of Two Glasgow Ships.—On Friday last, during a dense fog in the Channel, two Glasgow ships, the "Tasmania," a four-masted sailing ship, and the "City of Corinth," a full-rigged ship, both belonging to Glasgow, came into a collision which resulted in the loss of the latter vessel. The "Tasmania" belonged to Messrs. P. Dennistoun & Co., and was a vessel of 2175 tons register. The "City of Corinth" belonged to Messrs. George Smith and Sons, and was a ship of 1220 tons. The "City of Corinth" was built in 1870, but the "Tasmania" was built quite recently.

Proposed Visit of the Institute of Naval Architects.—At a meeting composed of the councils of the Institution of Engineers and Shipbuilders in Scotland, the Clyde Steam Ship Owners, and the Clyde Sailing Ship Association, it was resolved to invite the Institute of Naval Architects to hold its summer meeting in Glasgow this year. The meeting will as usual take place about the beginning of August.

(From our own Correspondents.)

LIVERPOOL, 14th March, 1888.

Tranmere Ferry Pier.—The plans for the low level pier intended to replace the one destroyed in the storm before Christmas have not been approved by the Conservators of the Mersey and other officials connected with the traffic on the river. It has therefore been decided to repair the pier and restore it to its original shape, *i.e.*, a high level pier with a floating landing stage and approach bridge. The work has been entrusted to Messrs. J. Gordon Alison & Co., Birkenhead, and it is expected that it will be completed and in time for the summer traffic.

British-grown Tobacco in Liverpool.—Although a large portion of the tobacco grown in England has been pronounced by experts to be of good quality, the leaves have been subsequently spoiled in the curing. A crop grown by Messrs. Carter was placed in the hands of Messrs. Cope, of Liverpool and London, some time ago; it has now been carefully cured by experienced men, and in a short time will be offered to the public, who will then have an opportunity of testing its quality.

The Liverpool Tramway Service.—The directors of a local company have made an offer to the Tramway Company to work the cars on some of the routes by steam power, but nothing has yet been definitely settled. The City Council have sanctioned the carrying of parcels by the cars. A new class of car is being also introduced, which is a great improvement on the old ones, both as regards comfort and safety; the circular staircases are done away with, and two side flights being fixed instead. The seats are more conveniently arranged, four being fixed on the driver's platform. The brakes are worked independently by either driver or guard.

SHEFFIELD, 14th March, 1888.

The Heavy Industries.—The demand for iron and steel is steadily improving, and it is believed that the present month will show a more encouraging result, even with regard to trade in unwrought steel with the United States, which in February only amounted to £109,735, against £207,960 in the same month last year. Manufactured iron is fluctuating a little in price, but bars are quoted at from £4. 12s. 6d. to £5. 2s. 6d.; hoops, £5 to £5. 7s. 6d.; sheets, £6 to £7. One of the best indications of reviving trade is the continued demand for railway material. The Colonies, as well as a number of foreign States, are becoming exceedingly good customers. Messrs. Steel, Peach, & Tozer are very busy on steel rails; so are Messrs. Charles Cammell and Co. At their Penistone works, the latter company are turning out railway material, it is said, at the rate of over 1000 tons per week; and at Workington the output of steel rails is enormous. Messrs. Thomas Turton & Sons are doing a large trade in railway springs, and the other local firms making railway material have very satisfactory

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orders on their books. The waggon builders in the locality are also well employed, and there is very general evidence of further railway development. The exports of railway material from Sheffield to distant parts last month reached £378,349, being an increase on the same month of the previous year of £168,676. Crucible cast steel castings are still in extensive request, and most of the well known engineers are well employed on heavy machinery and boilers. At the rolling mills and foundries work is plentiful, but in the armour plate mills there is no great activity. It is hoped, however, that Mr. Stanhope's statement in the House the other night means benefit to Sheffield. The promise made that the Government intends to protect our coaling stations and our naval and mercantile ports should result in some industry at the ordnance works which local firms, like Messrs. John Brown & Co., Messrs. Cammell & Co., and Messrs. Vickers, Sons, & Co., have erected. With improving trade there has been for the past few weeks a demand for plant of various kinds, a few firms extending their works, and putting down labour saving machinery. The tendency all round is to lessen the cost of production as much as possible; nevertheless, in some branches the workmen are beginning to inquire about an increase of wages, though some of them have only recently obtained regular work. Messrs. J. Sagar & Co., of Halifax, have recently supplied Portsmouth Dockyard with vertical boring machinery and sawing machinery, and have just received orders from the India Office for similar machinery for use at the Quetta Arsenal. The contemplated change in the Globe Steel Works of Messrs. Ibbotson Brothers has aroused little interest. The shareholders will make a profit out of the transfer of the concern to the London syndicate, receiving practically £87 per share of £100, of which £80 is paid up. Messrs. W. Jessop & Son's dividend of 6 per cent., as against 5 per cent. in the previous year, caused a good deal of satisfaction in local investing circles when it was declared, last Friday.

NORTH STAFFORDSHIRE, 14th March, 1888.

The Potteries.—As is usual at this season of the year American buyers are paying a visit to the district, and some satisfactory orders are being booked. Owing to the keen competition which prevails, however, prices are low, and the margin of profit very small. Most of the expensive and highly finished products of local manufacturers are consigned to the United States. The home trade is also improving to some extent, and those firms dealing in special lines report business to be improving. Mr. T. Twyford is building an extensive manufactory close to the main line of railway between Stoke and Etruria stations, and the work will shortly be completed. Fuel for manufacturing purposes is in fair request, and prices rule from 7s. to 8s. 6d. at the pits according to quality. Greatrow coal is extensively used for "biscuit" ware.

Miners' Federation.—The monthly meeting of the local federation was held at Tunstall on Monday last, Mr. Thomas Booth, president, in the chair. Mr. Enoch Edwards explained what had been done with regard to the case of the dismissal of a checkweighman by order of the stipendiary magistrate, the particulars of which were reported in *Industries*, and the steps he had taken to bring the matter under the notice of the Home Secretary through Mr. Fenwick, M.P. The question is to be raised at an early date before a national conference of miners. After considerable discussion on the Employers' Liability Act, the following resolution was unanimously passed: "That this Federation learns with satisfaction that active steps are being taken to make the Employers' Liability Act compulsory, to extend the time of giving notice; and pledges itself to assist in every legal way to bring about this change." The substitution of uncertain litigation and the consequent friction between employers and employed, for a system of mutual insurance by which relief to injured workmen or their relatives is assured, appears to be an object which ought not to commend itself to the intelligence of miners' delegates.

DERBY, 14th March, 1888.

Technical Education.—In his address at the recent distribution of prizes of the School of Art and Technical Institution, Derby, Sir Philip Cunliffe Owen said that he hoped the Corporation would take up the question of scientific and technical education as a matter which belonged exclusively to the ratepayers. The committee are taking steps to introduce instruction in the following subjects: (1) Dyeing, (2) the chemistry of colours as used in enamels and china painting, (3) photography, (4) wood carving and metal chasing. For this purpose the erection of a chemical laboratory is contemplated.

Butter Factory.—At a meeting of the Derbyshire Dairy Farmers' Association lately held at Derby, the scheme of Mr. Gilbert Murray was approved, for the erection of a central factory in this town for the manufacture of butter. Mr. Murray pointed out that the success of the Normandy farmers was probably due to their adoption of the factory system, the extensiveness of which may be inferred from the fact that a London firm pays £30,000 per annum to one of these factories.

LEICESTER, 14th March, 1888.

Wool, Spinning, and Yarn Trades.—There has not been any change of consequence in the wool market since our last report. Values are everywhere depressed; but the country dealers and growers are inclined to reserve their stocks rather than submit to any further reduction. Staplers are neither inclined to buy nor sell, and their dealings are on a limited scale. Spinners have small faith in the firmness of present quotations, and only purchase for their immediate needs. It will thus be seen that the local market for the raw material is in a very languid condition. Very few orders are being booked by spinners. They still have large stocks on hand, as the great bulk of yarn spun lately has been to keep their machinery going. Yarn merchants are not doing a very brisk business, and quotations are rather uncertain.

Boot and Shoe Trade.—This industry received a considerable check from the late severe weather. However, with the return of more genial weather, retail dealers are ordering with more confidence, and wholesale orders which were stopped and delivery delayed are now being proceeded with. It is very likely that there will be a considerable increase of trade between this time and Easter. The turnover of the year has not been quite up to the average.

Hosiery Trade.—Business has been of an unsatisfactory character lately, but at present there is a slightly improved demand for plain hosiery, in cashmeres and cottons. But the heavier woollen department is quiet. Fancy hosiers who produce specialties are fairly busy, and those who do the ordinary trade are tolerably actively employed. Altogether the present condition and the outlook may be considered as encouraging.

BARROW-IN-FURNESS, 14th March, 1888.

Mining Developments.—The demand for hematite iron ore, although very fully maintained, in consequence of the large consumption both in this district and other parts of the country, has not led to any marked increase in price; but as the freights for Spanish ore have increased, a corresponding improvement was shown in local hematite iron ore, and this has led to developments of mining enterprise in various neighbourhoods, with the result that at the present moment the presence of as much iron ore is known of in Furness and Cumberland as at any previous period in the history of the trade. With the view of increasing the output, and extending the working area of the Hodbarrow Mines, at Miltown, the Mining Company there have determined, when the necessary consent of the Board of Trade has been obtained, to build a sea wall at the margin of their royalty, at an estimated cost of £100,000. In the immediate neighbourhood of Hodbarrow there are a few other royalties which have not yet been worked, but which have been proved to be large deposits of exceeding good quality, and which in the early future will be developed, much to the benefit of the district; while from an industrial point of view will afford considerable employment, as well as largely increase the yield of iron ore throughout the district. In other parts of Cumberland, as well as in many parts of Furness, there are also movements being made for the extension of mining operations, which will result ultimately in the working of large deposits of metal which have been proved to exist. The trade in iron ore will depend much on the future of the pig iron trade, but it is satisfactory to note there will be no scarcity in the supply. 8s. 6d. to 11s. 6d. per ton is the present value of ordinary qualities of iron ore.

Iron and Steel.—There is a quiet tone in hematite pig iron, and business has lately been slow. Makers, however, are well sold forward, and have on hand orders which enable them to resist the present low prices at which hematite warrants are changing hands. The business doing in best brands of Bessemer in mixed parcels of Nos. 1, 2, and 3 is at 43s. 6d. to 44s. per ton net f.o.b. Stocks of iron are still very large.

MIDDLESBROUGH, 14th March, 1888.

Pig Iron.—The market is stronger than it has been for some time past, and there is a little more activity. The fluctuations of the Glasgow market generally affect it, but this time it has remained firm. No. 3 G.M. cannot be had under 31s. 6d. per ton on warrants, and makers will not accept that, as they expect better prices presently. Those whose brands have a reputation require a much higher price. In the meantime everything points to an improvement.

Shipments of Pig Iron.—Last month showed a decided increase in the shipments, and this month, so far as it has gone, maintains the improvement. As the navigation becomes more open and the weather more settled it is expected that shipments will be even more favourable. The shipments coastwise account for the bulk of the increase, thus showing that the home consumption is increasing.

Iron and Steel.—The finished iron trade still maintains its activity, and prices are unchanged. The annual report of the Tees Side Iron and Engine Works is typical of the state of trade in the Cleveland district. A profit has been made in the engineering and foundry departments, and a loss on the blast furnaces. Their rolling mills and ship yard are still closed. The entire profit on the year only amounted to £384. 1s. 7d. Bolckow, Vaughan, & Co.'s annual report shows the same hard struggle for a dividend. Workmen ought to see reason in this for very moderate wages if those who find the work are to subsist at all. The latter firm have been fortunate enough to secure an order for 30,000 tons of steel rails and sleepers for the Bengal Nagpur Railway, but it is reported to have been taken at a very low figure, £3. 17s. 6d. per ton is the average price for heavy sections. Steel plates are in as great demand as ever, and maintain their price at £6. 17s. 6d. per ton.

NEWCASTLE, 14th March, 1888.

Rope Works.—Rope manufacturers continue to book new orders, and wire rope for steamers' rigging and other purposes on shipboard are in particularly good demand. Messrs. Haggie Brothers, Gateshead, have some heavy contracts in hand just now for Yorkshire collieries; and the important rope works at Teams, Washington, and Willington Quay are kept extremely busy on orders of a similar kind.

Glass Works.—Brisk business is still the rule at pressed glass establishments, and plate glass works are also well provided with orders. The bottle works at Blaydon show a distinct improvement in the state of business, and at the Gateshead stained glass works the volume of work has also largely increased. The company have just booked an exceptionally large order for glass to be used in the ornamentation of a large hotel at Bournemouth.

Potteries.—In the pottery trade the demand both for home use and export is decidedly good, and as prices show an upward tendency, the outlook for the manufacturers is better than it has been for some time past.

Leather Works.—In the local leather trade there is just now no particular animation, home wants having been to a large extent supplied, and the demand on foreign account, which is chiefly confined to india-rubber goods, having somewhat fallen off of late. The principal india-rubber factory in the district, however, is kept busy on local contracts from engineering firms.

Marble Works.—The marble works of Messrs. Emley and Sons, South Shore Road, Gateshead, keep exceedingly busy, the fitting up of steamers' saloons, &c., constituting a large portion of the work in hand.

Saw Mills.—The increased requirements of shipbuilders have considerably stimulated business in the saw mills, and in most cases the machinery is now kept going regularly.

Engineering.—The engineering establishments are all very fully employed. The most important marine engines at present being fitted are those for the s.s. "Pallas," which are being constructed by Messrs. Raylton, Dixon, and Co. They are triple expansion, of about 3000 i.h.p., fitted up with all the latest improvements, including Weir's feed heater. The boilers are the largest yet constructed by Mr. George Clark, Southwick Engine Works, and are two in number, double ended, with twelve furnaces in all, and working at a pressure of 150lb. per *square inch*. The same engineering establishment has another large vessel, the "Ville de Belfort," awaiting the completion of the engines and boilers. The smaller engineering and boiler making establishments continue to be well employed.

Glass Making.—Although the window glass trade cannot be described as satisfactory, it is encouraging to find that one firm is experiencing a continually increasing demand for lead glazed rolled cathedral tinted glass. The same firm has just secured a large contract for a new wing and other extensions to the local infirmary.

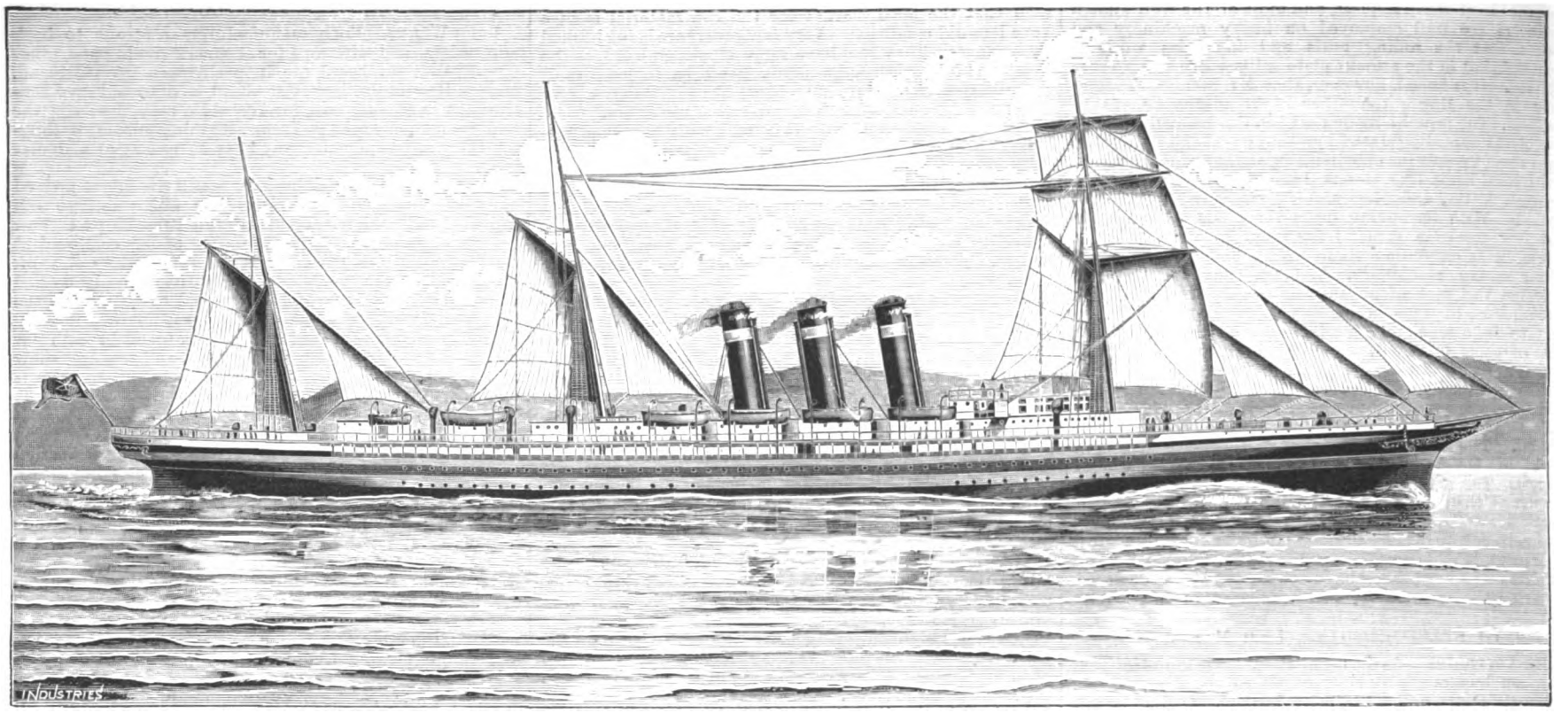
Coal Trade.—Gas coals are in good request, and prices are firm. All kinds of small coals are scarce, and are supplied at increased prices; any further advance will, however, be checked by the substitution of cheap unscreened for small, as low priced coals of the former description are plentiful and of fairly good quality. The demand for coke is good, and prices are steady. The prospects of patent fuel manufacturers continue to be encouraging. The coal shipments of last week show a continued improvement, the total for the week being 88,615 tons, as compared with 81,590 tons in the corresponding week of last year, and 77,500 tons in the previous week of this year; 69,515 tons were shipped coastwise, and 19,100 tons exported. The shipments of coke were 2450 tons, and of patent fuel 1740 tons, as compared with 350 tons and 450 tons respectively for the same period of 1887.

DUNDEE, 14th March, 1888.

Flax and Jute Trades.—The staple industries have undergone little change during the past fortnight. Business in both branches is quiet. The proposed changes in the American tariff, if carried into effect, will greatly benefit the heavier departments of the jute trade, and pending the settlement of the question, dealers are not disposed to enter into important forward contracts. In flax a fair business has been done at extremely low prices. Reports from the different Russian markets are somewhat conflicting, and current prices are difficult to strike. Flax is plentiful, and offers are freely made, but the exchange is uncertain. Flax yarns do not sell so readily as they did a few weeks ago, and prices, if anything, tend in the buyer's favour. In the linen department, manufacturers are well employed. The trade in sailcloth is quiet, but more business is being transacted on account of the makers determining to reduce their prices. The inquiry for all sizes of jute yarns is maintained, and quotations are firm. Buyers of jute goods do not come to terms very readily, and the tone of the market is consequently against sellers. There is a fairly satisfactory business being done in bagging and sacking at full rates; tarpaulin is also being asked for, and is a shade dearer. Manufacturers of jute carpetings are busy, more especially with the finer qualities.

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THE S.S. "CITY OF NEW YORK."



COAL, IRON, AND COGNATE INDUSTRIES.

The Board of Trade returns for February show a continued progress in the improvement of our shipping trade, and it is satisfactory to note that in this progress the industries under review have very largely participated. Our total imports for the month amounted to £29,532,776, and our total exports to £18,992,423; being an increase, as compared with the corresponding month of the previous year, of £1,018,782 or 3·6 per cent., and £1,737,290 or 10 per cent. respectively. The total exports of iron and steel for the month amounted to 280,128 tons, being an increase over February, 1887, of 4,851 tons, and over February, 1886, of 54,653 tons. One satisfactory feature of the returns is the increase of our exports of metals to countries other than the United States, *inter alia* the shipments of steel rails to the Argentine Republic and India having conspicuously increased. We have frequently called attention to the prospect of an entire closing of the United States metal market to all but native manufacturers. We append our monthly tabular statement, in a somewhat enlarged form:—

	Month of February.		Period of Two Months.	
	1888.	1887.	1888.	1887.
Pig and puddled	£114,429	£170,681	£226,470	£320,058
Bar, angle, &c.	137,927	98,033	270,610	201,572
Railroad	378,349	209,673	868,838	510,694
Cast and wrought	395,890	281,967	780,620	646,269
Hoops, sheets, &c.	346,114	203,338	619,689	446,258
Steel (unwrought)	109,755	207,960	217,965	334,244
Tin plates	430,782	319,932	820,916	595,647
Unwrought copper	211,894	73,234	433,058	149,551
Coals, &c.	756,505	651,235	1,509,316	1,397,577

Having regard to the above figures, there can be no doubt that our export trade for the first two months of 1888 has comparatively with the previous year been of a highly satisfactory character. The enormous increase in unwrought copper is of course attributable to the enhancement in value of that metal, due to the operations of the syndicate at present controlling the markets of the world. The falling off in our exports of crude iron and unwrought steel, which has been continuous for some months, is a factor which should not be lost sight of by British iron masters. If only our home industries had received a proportionate impetus to that which has left its mark upon the Board of Trade returns, there could remain no scepticism as to a real revival in trade. But unfortunately the reverse is the case. The activity in trade, and the higher prices which were heard of at the close of 1887, have proved but a fitful "flash in the pan," and from many quarters we hear of the same tale of disappointed hopes. Even our most optimist contemporary has at length been compelled to admit that a check has been experienced. Scotch pig iron warrants have reached an abnormally low level; the Middlesbrough market has been flat, and prices of Midland brands of pig have fallen to the lowest point which has yet been touched. In the case of finished iron and steel unremunerative prices prevail, although there exists some feeling of hope that an improvement may be felt in the spring and summer trade. We have frequently pointed out that hitherto prices have advanced at the wrong end, and it is to the finished iron trade we must look for the inception of any improvement which is to be of a permanent character. The continuation of winterly weather through the month of February proved of material value to those collieries producing a coal suitable for domestic consumption. As an index to the increased volume in this branch of trade, we may mention that the quantity of coals supplied by rail to the London market during January and February last reached a total of 1,352,966 tons, as compared with 1,257,410 tons during the corresponding period of 1887, being an increase of 95,556 tons. Prices, unfortunately for colliery proprietors, did not advance, the best kind of screened soft coals being sold in London for 22s. per ton, which, after deducting carriage, terminals, dues, merchant's profits, cost of agents, &c., leaves little more than 9s. as put into truck.

THE "CITY OF NEW YORK."

Yesterday there was launched, on the Clyde, the splendid twin-screw steamship "City of New York," the first of the two liners now being built by Messrs. James and George Thomson for the Inman and International Company. The Inman Company is well known to Atlantic travellers as providing in their floating "Cities" a safe and comfortable means of transit across the Atlantic, and, next to the Cunard, it is the oldest Atlantic steamship company. For some years, however, it retired from the struggle for pre-eminence, at least so far as speed is concerned; but now, after the re-construction of the company about a year ago, under the title of the Inman and International Company, it is coming to the front again by building two splendid steamers with the view of trying conclusions with the present "greyhounds" of the Atlantic. It is expected that the speed of these vessels will be at least as great as the fastest liners now afloat; but at the same time speed is by no means the first consideration which the directors of the company have kept before them, the two paramount considerations being the safety and comfort of the travelling public.

The general appearance of the ships is well indicated by the illustration which we are enabled to give at the head of this page, and which shows to advantage their smart yacht-like form, with three masts and three funnels, which will before long be well known to seamen on the Atlantic. The length of the "City of New York" is 560ft., the breadth 63¼ft., and the depth to upper deck 43¼ft. Above this upper deck, however, is a promenade deck, supported on stanchions, and affording a promenade which is uninterrupted for the whole length of the ship. The most important structural feature in these ships is the thoroughness of the system of water tight subdivision which has been adopted. There are fifteen main water tight compartments separated by steel bulkheads extending from the keel to the upper deck, or to a height of 16ft. above the water line. Two of these compartments could be knocked into one and flooded by the sea without rendering the vessel unseaworthy. Of these fifteen compartments three are devoted to the boilers, which are thus separated into three independent groups. Two other compartments are occupied by the two sets of triple expansion engines, which are also entirely independent, so that if any breakdown were to occur at any time to either of the engines or screw shafts, the ship could still proceed at about three-quarters full speed. The advantages of this duplication of the machinery are so obvious that it is surprising it has not been adopted before this in any of our large Atlantic liners, and there can be little doubt that the Inman and International Company will reap the reward of their enterprise in being the first to provide the additional security of twin screws.

The main saloon is constructed on a principle patented by the builders, which was first carried out in the National liner "America," recently sold to the Italian Government. The central part of the saloon is of a dome-like shape, and rises in a graceful arch to a height of 22ft. above the floor, thus giving an air of spaciousness which has never before been attained on shipboard. The drawing room and library are also spacious apartments, and will be fitted in a style of luxurious comfort. An important feature in these ships is the hydraulic system, which is being fitted by Messrs. Brown & Brothers, of Edinburgh, and which entirely takes the place of steam for such duties as steering, warping, heaving the anchors, loading and unloading cargo, hoisting ashes, &c. The rudder and steering gear is specially designed to be entirely below the water, so as to be efficiently protected in the event of the ships being employed as armed cruisers. The cargo will be worked by twelve hydraulic derricks, which will discharge and take in cargo with great dispatch and an absence of noise, and which will be appreciated by both passengers and officers. From the foregoing description it will be seen that the launch of the "City of New York" marks an important step in the continuous effort to overcome the dangers and discomforts of the stormy Atlantic voyage, and the performances of this new "greyhound" will no doubt create considerable interest during the coming season among all classes of the shipping community.

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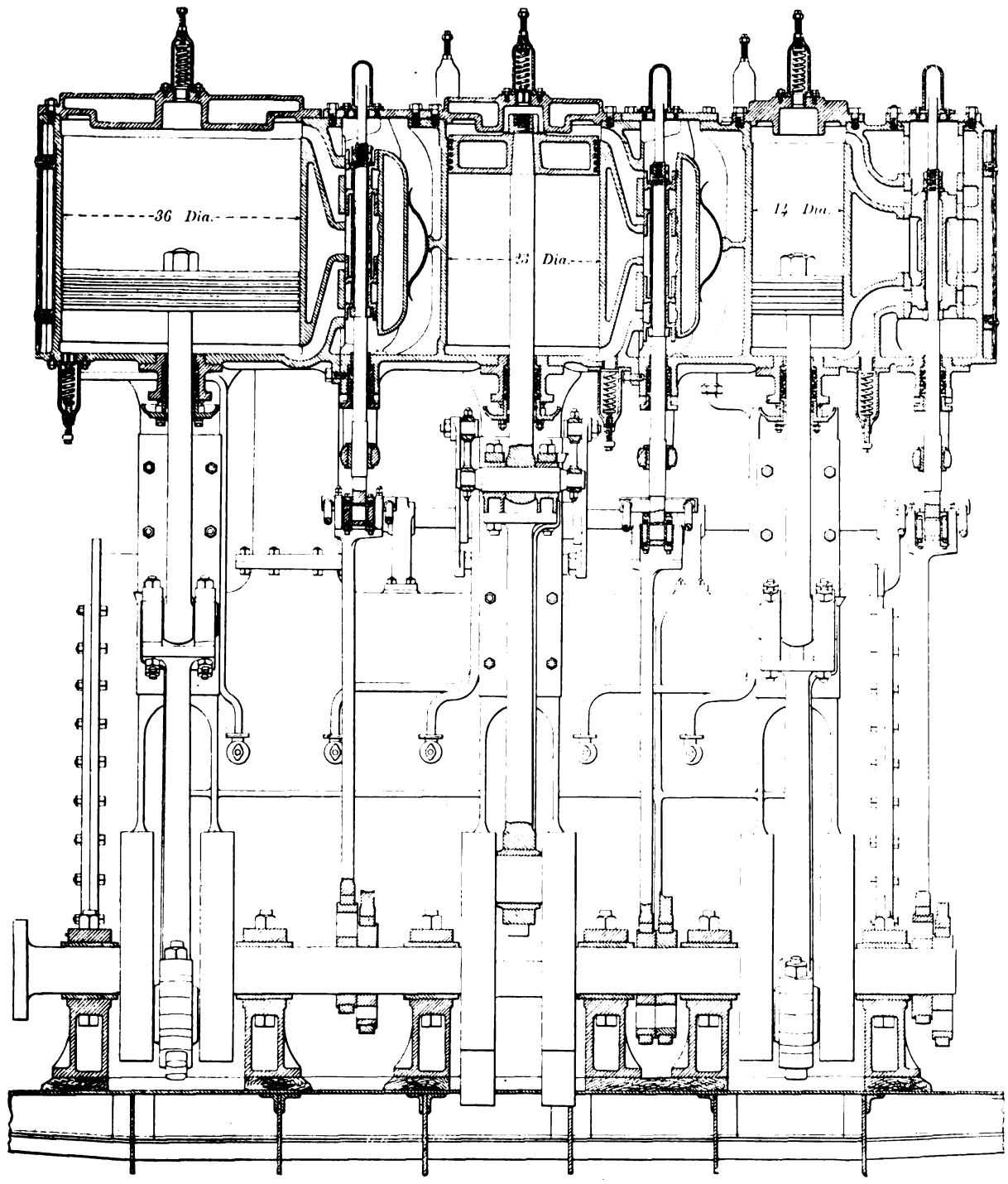
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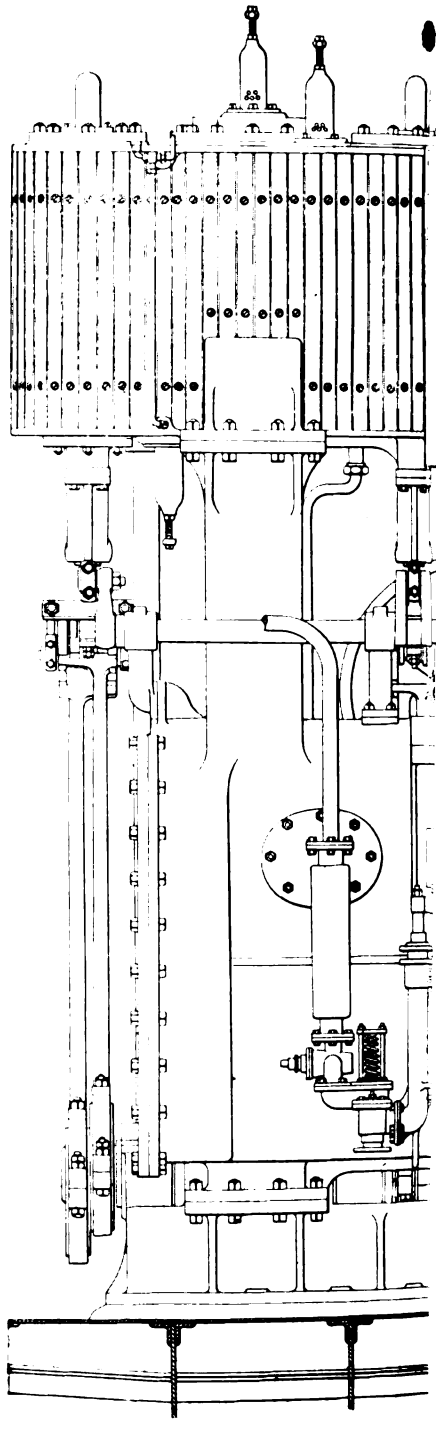
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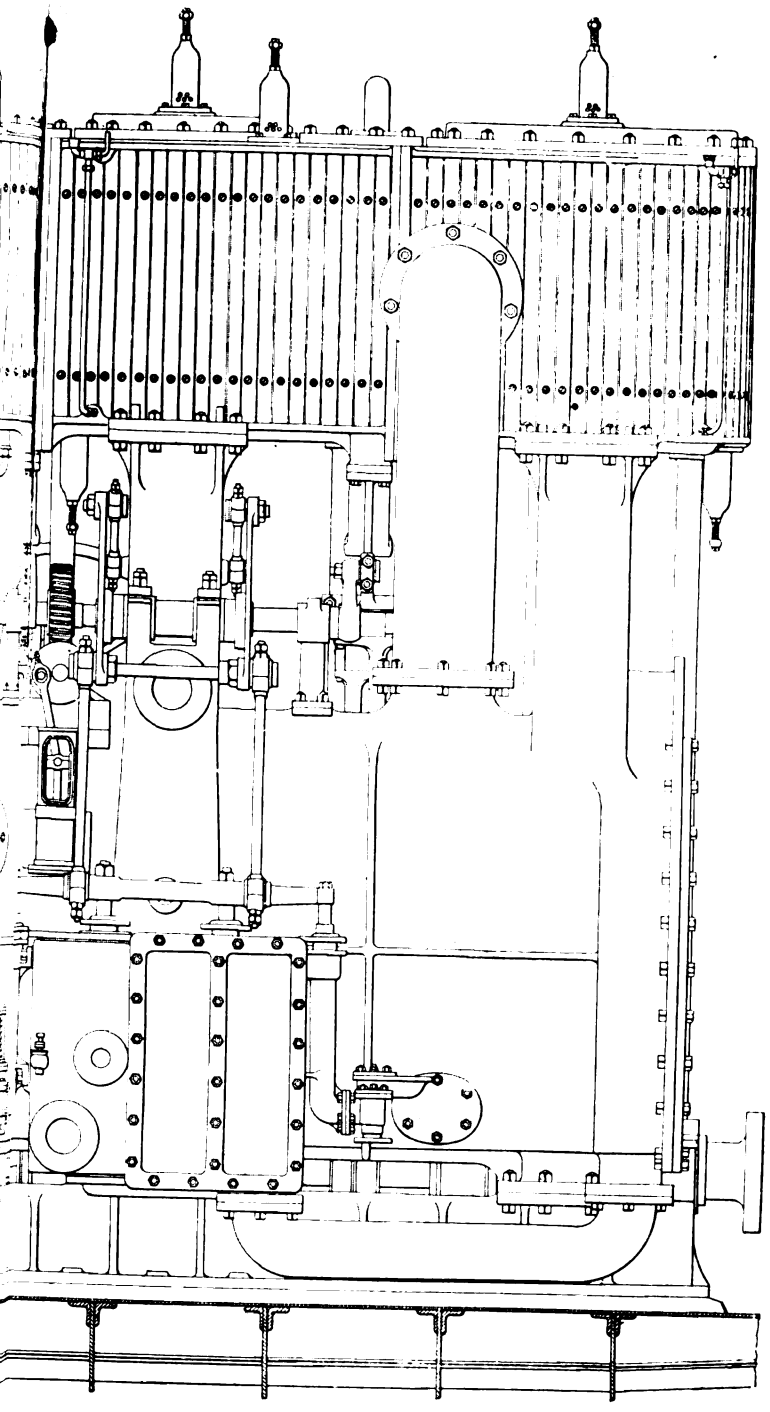
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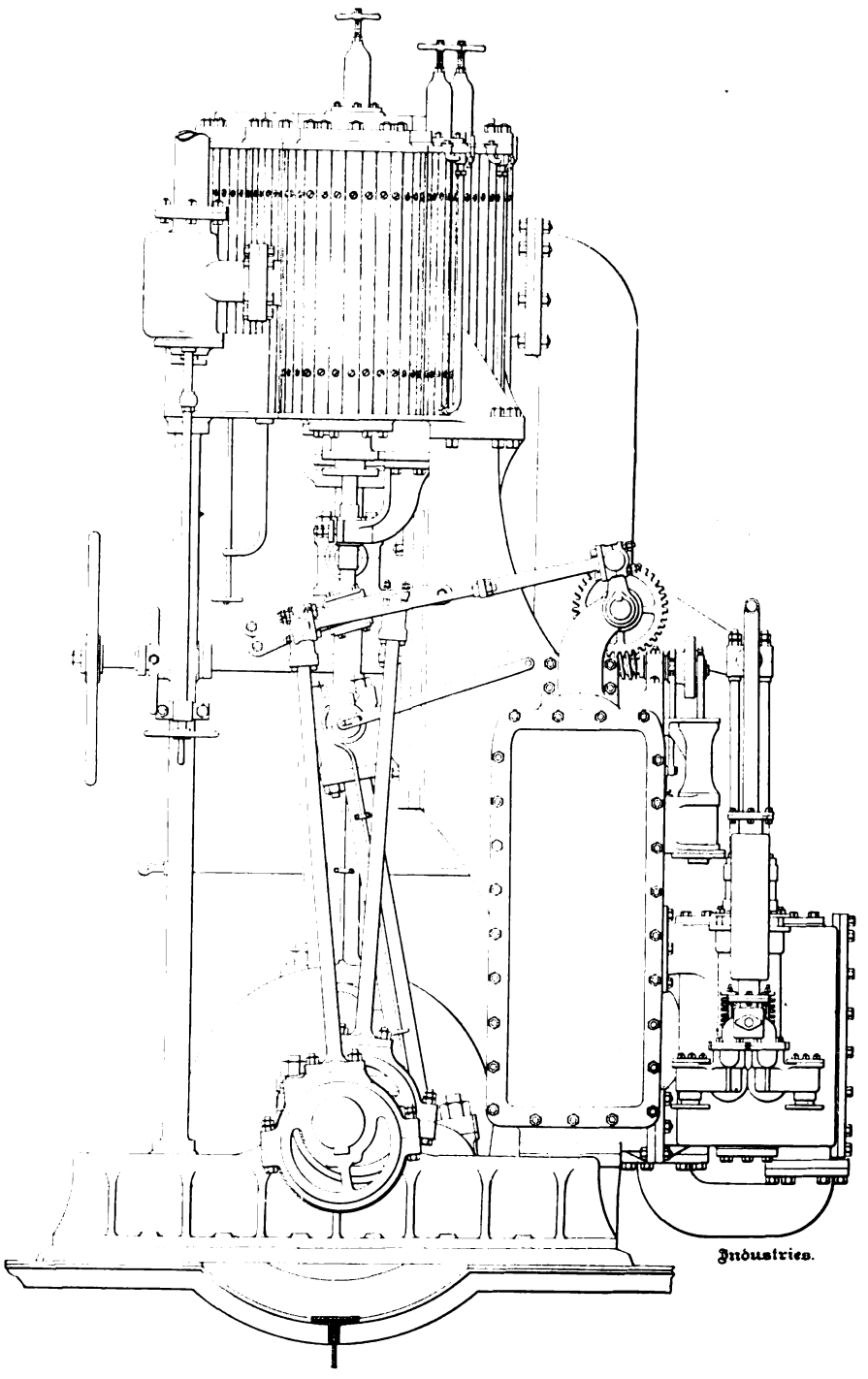
OF THE STEAM YACHT "THETIS."

lur & Houston, Engineers, Harbour Engine Works, Glasgow.

(For description see page 261.)



Back Elevation.



End Elevation.

OF FEET

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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With a Double-page Supplement showing the
TRIPLE EXPANSION ENGINES OF THE STEAM YACHT "THETIS."

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," *either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.*

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, Vols. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 16TH MARCH, 1888.

MR. GOSCHEN'S CONVERSION SCHEME.

LAST week was notably a financial week; announcements of the Navy Estimates, of the Army Estimates, and of the Conversion Scheme of Mr. Goschen, followed in almost bewilderingly rapid succession. The first Budget of Mr. Goschen so far infringed the canons of sound finance, that in spite of its offering a bold bid for popularity in the shape of a reduction of taxation, it fell short of any but qualified approval. It was thus necessary for him, in his financial proposals for the present year, to rehabilitate his reputation. Yet, in doing so, it would seem as though he had simply developed the policy which he adopted in his Budget last year. Then, it will be remembered, he deducted a sum of £2,000,000 from the amount set aside for the charge of the public debt, thereby reducing the amount which would have been available for redemption, from £7,000,000 to £5,000,000. This latter amount, however, Mr. Goschen intimated would suffice to redeem the whole present debt at par in fifty-seven years. The policy of reducing the annual charge for the National Debt has been again followed by Mr. Goschen; but instead of cutting off a portion of the Sinking Fund as formerly, he has adopted the sounder plan of reducing the rate of interest. Mr. Goschen's scheme involves, therefore, so far as appears at present, not any alteration in existing arrangements for the reduction of the principal sum, nor does it involve any addition to the principal sum; it produces alone the saving of ¼ per cent. in the interest of a portion of the debt for fourteen years, and a further saving of ¼ per cent. in the interest for a further period of twenty years. Since a part of the reduction does not come into practical operation until next financial year, there will not be any serious disturbance of the coming Budget; but the result will be that for thirty-five years we guarantee an interest of 2¾ to 2½ per cent. upon the stock proposed to be dealt with. The stock which the Conversion Scheme proposes to deal with primarily is the New Three per Cents, amounting at present to £166,000,000, and redeemable now at the pleasure of the Government. The reduction of interest upon this stock will effect an annual saving of £410,000 a year, from the beginning of the ensuing financial year, and a further saving of a similar amount from April, 1903. These sums represent the successive deductions of ¼ per cent., by which it is proposed to effect automatic reduction from 3 per cent. to 2½ per cent. But the complete proposal of Mr. Goschen involves much more extensive operations. In addition to the New Three per Cents, the bulk of the stock of the National Debt consists of £69,000,000 of stock known as Reduced Three per Cents, and £323,000,000 of Consols, also 3 per cent. These stocks are upon a different footing from the Threes. They are only redeemable at par upon a year's notice. In order to effect an immediate arrangement with these stock holders, Mr. Goschen proposes to allow them in cash, upon conversion, the ¼ per cent. to which they are entitled for the year in lieu of notice. Instead, therefore, of their receiving half yearly their 3 per cent., they will receive at once ¼ per cent. on condition of their stock being converted at par into the new Consols, bearing a dividend of 2¾ per cent. Should the conversion be carried completely into effect, there will be an immediate saving of £1,400,000, and an ultimate saving of £2,800,000 per annum. Mr. Goschen has adopted a method for which he advanced several precedents—that is, the method of regarding silence as consent; but he improves on the lesson of his predecessors by giving the national creditors very little time to reflect. To hesitate is to be lost. Fund holders must dissent before the 29th inst. against the conversion of the New Three per Cents, or if they are holders of Consols, or Reduced, they must apply for their ¼ per cent. before the 12th April. Mr. Goschen thus minimises as much as possible the time during which extraneous influences, such as European complications, could militate against the success of his scheme, and also sharply brings the fund holders to the point. As to his legal right to effect this transformation of the debt there can be no question, nor indeed can there be any question of its advisability from the point of view of national economy; the only question is, can he do it? Is there not a possibility of the fund holders refusing to convert, and of the Exchequer being unable to raise funds sufficient to pay them off at par. Mr. Goschen has expressed himself as extremely confident on this point. So sure is he that he said: "I say, weighing every word, that I have no fear of the success of my plan." There are indeed many reasons why he should succeed. The rate of interest on first class securities has been steadily tending downwards for several years. The price of Consols has been steadily going upwards; the rate of interest on good foreign loans has been subject to successive reductions during recent years; money is therefore so cheap that there is much force in Mr. Goschen's argument that the fund holders must take 2¾ per cent., for the best of all reasons, because they cannot do better. On the other hand, there is much of the wisdom of the serpent in Mr. Goschen's precipitancy. Trade is apparently reviving; with returning energy of demand there will come the floating of new industrial enterprises and the expansion of old; increased industry will demand increased capital, and money may ere long come to be dearer. All the more reason for the stock holder to reflect, and still more reason for Mr. Goschen to act promptly. The Chancellor of the Exchequer really possesses considerable powers of coercion. He can borrow, and does borrow, on Exchequer Bills at £1. 12s. 6d. per cent., and the amount which in case of need he might put upon the market is indefinite. Should he elect to perform a risky operation, he might transform temporarily a portion of the funded debt into floating debt in the anticipation that sooner or later the money holders would have to come to his terms. But such a financial expedient is really not necessary. Though a considerable number of dissentients would paralyse the scheme, they could not disturb either the national credit or the Exchequer, it would only postpone the complete realisation of the scheme of Conversion. There is another point; considerably over a hundred millions, spread over all the stocks, are held by the Government on behalf of State departments. That is to say, that of the seven hundred millions of which the debt is composed, only about six hundred are in the hands of the public. This means of course that the National Debt Commissioners have credit to borrow a hundred millions more than the present net debt. With the aid of the downward pressure of the money market,

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which so far cannot be said to have suffered serious check, and the strong financial reserve forces at the disposal of the Government, there can be little doubt that Mr. Goschen's scheme will secure a large measure of success. The likelihood of such a scheme being carried out at some time has long been present in the minds of financiers, so that the Conversion does not as a matter of fact disturb any financial calculations of moment, and is quite unlikely to cause any monetary dislocation whatever, while a relief, prospective though it is, of from £1,500,000 to nearly £3,000,000 a year to the overburdened tax payer, is to be cordially welcomed. Should the accumulation of capital go on during the next twenty years at a rate equal to the accumulations of the past twenty, the Chancellor of the Exchequer of the day may find himself in a position to test the truth of the adage, "John Bull can stand many things, but he cannot stand 2 per cent." While Mr. Goschen must be congratulated upon having apparently effected a considerable lightening of the burden of the public debt, there are incipient dangers in the policy he has consistently adopted in both his Budgets. A financially strong Government has two ways of dealing with its debt; it may devote itself to the reduction of the charge for the service of the debt to the lowest possible annual sum, or it may retain a high annual charge, paying the lowest interest and utilising the balance in redemption of debt. Mr. Goschen seems inclined to adopt the first method, which, rigidly adhered to, would have the effect of leaving the principal of the debt as it is, though reducing the burden of it. The second method is that which was followed by Mr. Gladstone and Sir Stafford Northcote during their periods of office at the Exchequer. From the banker's point of view, Mr. Goschen's plan is certainly the most convenient. They naturally desire a large homogeneous stock perfectly safe, which they may buy and sell at any moment, which is tolerably steady in price, and at the same time sufficiently susceptible to general financial movements to move upwards and downwards with other first class securities. It is essential for the banker that he should have his own money and that of his depositors invested promptly and promptly realisable. And this object the National Debt clearly enables him to obtain. The paying off of our National Debt would unquestionably result in a general rise in price of all first class securities—municipal stock and Foreign State loans especially. The general rise during the past ten years of our own stock, and that of many foreign nations, in first class credit, has among other causes undoubtedly been due to the encashment of the American Debt. This encashment has restricted the area of first class security, and thus raised the value of the restricted area. Although the interests of the bankers are not always the same as, and are often even opposed to, the public interest, the stability of commerce depends very largely upon the stability of banking arrangements. It is of little public importance whether this or that bank pays a dividend; but the stability of banking in general is important, and this depends largely upon the facility with which bankers obtain a moderate interest upon perfectly sound investments. The restriction of the area of first class security might have the effect of driving bankers to inferior securities merely that their money might be utilised. It is, therefore, a question of a balance of advantages. Is it better for the country to pay a tax of some £26,000,000 a year as an insurance for commercial stability, or to pay off the debt and allow commercial stabilty to look after itself? This has been done in America, and not with wholly satisfactory results, though these results are influenced by the unfortunately restricted terms upon which the American Debt was borrowed. The debt was contracted in great emergency, and now, though the Treasury could pay it off in a very few years, it is hampered in doing so by the periods for which the money was borrowed. The question arises in regard to Mr. Goschen's scheme: Does the automatic arrangement by which the interest is guaranteed at 2¾ per cent. for fourteen years, and at 2½ per cent. for twenty years, not afford the presumption that the new 2½ per cent. stock thus created is irredeemable until thirty-five years from now, or till 1923? If this is so, though it may present inducements now to the fund holder to convert his redeemable stock into irredeemable, it may carry with it the germs of future trouble. Who can predict the rate of interest at which money might be borrowed thirty-five years hence? Upon this point it would be well to have illumination, and also upon the method which Mr. Goschen proposes adopting in dealing with the Sinking Funds. Does he desire to keep the capital sum of the debt as it is, or is he prepared to advocate its rapid reduction?

THE FORTIFICATION OF OUR PORTS.

A few weeks ago we directed the attention of our readers to an address by Lord Brassey on the protection of trade, with reference to the defence of our foreign stations (see Vol. IV., page 142). The report of a committee appointed by the Secretary of State for War to consider with him the plans proposed for the fortification and armament of our military and home mercantile ports, and the relative importance and approximate cost of the works and armaments necessary for the adequate defence of these stations, has been recently issued, and a short notice of it will form a suitable supplement to that on Lord Brassey's address. We need not enter into the financial details included in the report, but will briefly note a few of the general arrangements which the Committee consider necessary.

The revision of armaments proposed for the military ports has, in each case, been worked out in detail by the Royal Artillery and Royal Engineers' Works Committee. The plans for the defence of the mercantile ports were originally projected in 1882, but considerable alterations have since been made in the proposals, and even now they have not been worked out in the same detail as in the case of the military ports. The Committee examined a considerable number of witnesses, including many of the most eminent naval and military authorities, and these were unanimous in pointing out the weakness of our present position, and in urging the imperative necessity of strengthening and adding to the existing defences, though with some natural divergence of opinion on minor questions. The Committee carefully considered all the circumstances connected with the defence of ports, and especially how far the co-operation of the fleet diminishes the necessity for fortifications, and they obtained in each case full information as to the facilities for submarine mining and for active torpedo defence, and they took into account all these when making their recommendations. These are divided into two parts, the first relating to military, and the second to commercial ports.

Among the so-called military ports three at once suggest themselves as far exceeding all others in importance. They are Portsmouth, Plymouth, and the ports included within the Thames and Medway defences. The Committee are of opinion that it is not too much to say that the destruction of our great dockyard at Portsmouth—and in a less degree of that of Plymouth—might be decisive of the issue of a great war; while the defence of the Thames and Medway is likewise of paramount importance, not only because in these rivers are situated the yards of Chatham, Sheerness, and Woolwich, but also because it is almost universally believed that an enemy descending upon England would immediately endeavour to strike a blow at London. If the Thames and Medway are not adequately defended facilities are afforded for such an enterprise, while Harwich also deserves very special attention as a possible base of operations for a sudden attack upon London. After carefully inquiring into the condition of each of these ports, the Committee have no hesitation in stating their conviction that deficiencies exist in the defences of each of them, which render our position dangerously insecure. The present defences although sufficient for their protection at the time they were erected are now insufficient, and the enormously increased range and penetration of modern guns, and the great strength of iron clads, now render partial—and in some cases very extensive—re-construction essential, and necessitate an armament equal to modern requirements. The Committee place as next in importance the defence of Malta and Gibraltar, as upon the maintenance of these two fortresses depends our position in the Mediterranean; and here too we must be prepared to face a possible attack of heavy ironclads, combined in the case of Malta with the attempt to land a large force. Both require very considerable additions and alterations of armament. The Committee have also considered the cases of Bermuda, Halifax, Cork, Pembroke, Portland, and Dover. The report being intended for publication, it has not been deemed prudent to enter into details of the deficiencies, or give descriptions of the works which are proposed for the purpose of making these good. The Committee, however, state that to carry out the works which they have suggested as urgent will involve an expenditure of not less than a million and a half; and they recommend that as little delay as possible should be allowed to intervene before commencing works, some of which, it must be remembered, will necessarily take a considerable time to complete.

With regard to the mercantile ports, beyond a small expenditure for surveys on the Tyne, and for submarine mining works at almost all the ports, no commencement has yet been made in works for defending these ports. The evidence given before the Committee disclosed a great variety of opinion as to the objects to be arrived at, and the extent to which they can be attained. The following, however, is a summary of the general conclusions at which the Committee have arrived: (1) If a defence is adopted for these ports sufficient to repel the kind of attack which, according to the evidence, is most to be apprehended—viz., that by armoured cruisers—and if it be adequately supplemented, according to the necessities of each case, by submarine mines or torpedo boats, the Committee are of opinion that these ports may be regarded as reasonably safe. The special importance of the Clyde, the Tyne, and the Mersey may, however, necessitate in these cases the addition of a heavier armament. (2) The danger most to be guarded against is not so much an attack on the ports themselves, as on the commerce converging upon them. (3) It is impossible to give absolute protection from bombardment to towns lying upon the seaboard, as the long range of existing guns will enable a comparatively small ship, at a distance of four or five miles, to bombard a town. (4) In some of these cases an active naval defence is the only one which can adequately protect the port. (5) Where mercantile ports are situated at some distance up a river, submarine mining defence will in general afford a very great protection. The Committee think it essential that, wherever this is adopted, the mine fields should be protected by quick-firing guns. They further give suggestions for a combination of the efforts of the local authorities with the regular forces of the army and navy, and they state that the evidence before them points unmistakeably to the necessity of an increase in (1) our regular Garrison Artillery, especially for colonial ports, (2) our Fortress Engineers, and (3) our Volunteer Artillery and Submarine Miners, according to the necessities of each port. The first two additions require further provision out of public funds; but the last, which for our home ports is the most essential of all, ought to be mainly produced by local effort. The Committee, therefore, cordially endorse the action which is now being taken by the War Office to encourage each port to be ready to meet, by voluntary effort, the special requirements for its own protection.

UNDERGROUND ELECTRIC LIGHT WIRES.

It will hardly be disputed that English engineers and electricians have yet a good deal to learn in the matter of distributing electricity, whether by overhead or underground mains; but the lesson taught them by Mr. W. Leggett, in our contemporary the New York *Electrical World*, will hardly prove a palatable one. This author, after briefly reviewing the first examples of underground electric conductors, which date back to 1816, refers to the great difference which exists between the mains used for direct incandescent supply and the cables used for arc lighting. Whereas, after some little trouble, it was found perfectly feasible in American towns to supply thousands of glow lamps by means of underground mains, all attempts to supply arc lights by underground cables have, according to Mr. Leggett, hitherto failed. The reason of failure is attributed primarily to the difficulty of insulating cables laid underground. Even if a large subway were constructed, and the cables were trained on insulators very much in the same manner as is now done overhead, Mr. Leggett thinks the leakage would be excessive, the reason being that the air in an underground conduit is necessarily moist. Moreover, very few localities could afford the expense of an underground subway large enough for this purpose. The estimated expense of such a subway 4ft. wide by 8ft. high for Chestnut-street, in Philadelphia, alone, is no less than £300,000, and the maintenance would also be considerable, because it would be necessary to supply the subway with forced ventilation. Owing to this almost prohibitive cost, American companies have universally adopted some sort of conduit system other than that of a subway, but with uniformly discouraging results. The Board of Commissioners of Electrical Surveys, at Brooklyn, after investigating the subject for a considerable time, came to the conclusion that: "With regard to electric light conductors this Board has found no device which would with certainty, in its opinion, enable the wires carrying arc light currents

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to be safely and successfully operated in the same conduit with telephone and telegraph conductors without disturbance or injury to the latter." In a later report, dated 15th December, 1887, they stated that the subject of underground conduits for arc currents is the one which presents the most numerous and novel difficulties. Mr. Leggett, after quoting further statements of this Board, gives a long list of cases in which arc light cables had been laid underground, and had within a short time either to be repaired or entirely taken up. The best results seem to have been obtained with lead covered cables, but if these were used in conduits where creosote was employed the effect was to oxidise the lead and destroy its protective property. It was also found that illuminating gas could not be kept from the conduits, and many explosions occurred from this cause. The reason of the failure is attributed to the high pressure employed on arc light circuits in America, the pressure seldom being under 2000 volts, but in many cases it reaches 3000 volts; whilst on the alternating current system, on which lead covered cables have hitherto proved least troublesome, the pressure carried is only about 1000 volts. The practical conclusion of Mr. Leggett's article is that corporations and town authorities should not insist upon electric arc light companies undergrounding their cables, as by doing so they ask the companies to perform what may almost be considered an impossibility in the present state of our knowledge. The picture painted by Mr. Leggett is exceedingly sombre, and we doubt very much whether, had the work been done in England, the results would have been the same. Excepting the experiments made with cables on a limited scale at Eastbourne and some other places, very little has been done in this direction on our side of the Atlantic, and it would be well to take notice of these failures. We trust that by having drawn attention to the matter, some of our electrical engineers may be induced to work out a system of underground high pressure distribution which will be free from the defects attributed to the various schemes which have been tried in America.

Letters to the Editor.

PROPOSED LEGISLATION FOR THE COMPULSORY INSPECTION OF STEAM BOILERS.

To the Editor of "Industries."

Sir,—My previous letters, which you have been good enough to publish, have been devoted to showing what the present Board of Trade inspection of steam boilers is like, and in so doing I have made the Assistant Secretary, Engineer Surveyor in Chief, and the Engineer Inspectors speak—as I have simply quoted their words verbatim. In so doing, I may now ask, have they shown themselves to have that grasp of the subject, or that competency which should cause us to hasten to entrust the care of all the boilers in the kingdom to them? Does any steam user feel satisfied that his interests would be served, or that any commensurate benefit would accrue from the enormous trouble and expense which would thereby be incurred?

Some of your correspondents, many of the public, and some writers for the press—whose opinions are formed upon what is popularly and generally known of the operations of the boiler insurance and inspecting societies—think that the passing of a Bill for the compulsory inspection of steam boilers, provided it could be carried out on similar lines, would be both feasible and beneficial. The scheme proposed by the Board of Trade of absorbing the existing associations and using them as delegate societies, and of deputing, for some time at least, its powers to them, has led to totally false and incorrect impressions of its real aims and objects being taken and held by a considerable number of those who have not examined and considered the provisions of the proposed Bill for themselves.

In order that something like a correct impression of the intentions of the Board of Trade may be formed, and of what inspection under the proposed Bill would be like, let us examine the Bill itself, and we shall find that under Section XIV., clause 1, it is provided that "if on complaint or otherwise the Board of Trade have reason to believe that any boiler is unfit for use, they may require the boiler to be surveyed by an inspector." Again in clause 2: "For the purposes of this section every inspector shall have all the powers conferred on the Court named in Section VI. of the Boiler Explosions Act, 1882, and any person who obstructs an inspector in the performance of his duties under this section shall be liable to the penalties imposed by that section for obstruction."

Upon referring to Section VI. of the Boiler Explosions Act, 1882, we find that the powers of the inspector will be those of a Court, as defined in the words of the Act—Section VI., clause 4: "The Court [inspector] shall have, for the purpose of 'its' [his] investigations, all the powers of a Court of Summary Jurisdiction then acting as a Court in the exercise of its ordinary jurisdiction, and shall, in addition, have the following power, viz.: (*a*) The Court [inspector], or any one appointed by it [him] may enter and inspect any place or building, the entry or inspection whereof appears to the Court [inspector] requisite for the said purpose. (*b*) It [he] may by summons under its [his] hand require the attendance of all such persons as it [he] thinks fit to call before it [him] and examine for the said purpose, and may for such purpose require answers or returns to such inquiries as it [he] thinks fit to make. (*c*) It [he] may require and enforce the production of all books, papers, and documents which it [he] considers important for the said purpose. (*d*) It [he] may administer an oath, and require any person examined to make and sign a declaration of the truth of the statements made by him on his examination." We have now before us, accurately defined, the proposed powers of the future Board of Trade engineer inspector, which will, no doubt, astonish the steam user who now becomes acquainted with them for the first time.

Let us ascertain where these tremendous and arbitary powers come into force, and under what conditions the unfortunate steam user may become subject to them. The proposed Bill states, in clause 14, "that if on complaint or otherwise the Board of Trade have reason to believe that any boiler is unfit for use, they may require the boiler to be surveyed by an inspector." From which it is evident that from an information lodged by a neighbour as to the condition of the boiler, which might be most unfounded or even malicious, an inspector with "the powers of a Court" would be sent to stop the working of the boiler, no matter what inconvenience or loss might be caused by the enforced stoppage, to inspect, examine persons, books, papers, documents, administer oaths, and possibly cause stoppage of the works for days. Again, in clause 6 of the proposed Bill, it is provided that "it shall not be lawful to use any boiler to which this Act applies unless it has been surveyed, and a certificate for it issued, as provided in this Act, is in force. The certificate shall state the period during which the *boiler may be safely used*, and shall cease to be in force at the end of that period or any earlier date at which it is cancelled under this Act."

From these clauses it is clear that upon the expiration of the certificate stating "the period during which the boiler may be safely used," a boiler would become unsafe in the eyes of the Board of Trade until the owner was again provided with a certificate. It follows, therefore, that these tremendous powers of the engineer inspector come into force, firstly, upon any complaint as to the condition of a boiler; and, secondly, whenever a boiler can be found that it is not certificated safe by the Board of Trade engineer inspector. Consequently, every owner of a steam boiler would on any of these occasions be open to the visit of an engineer inspector, provided with "all the powers of a Court of Summary Jurisdiction, when acting as a Court in the exercise of its ordinary jurisdiction, and shall have in addition" the powers already explained under clauses *a*, *b*, *c*, and *d*.

The certificates are only intended to be available for twelve months, and therefore at least once a year the steam user will be liable to the visit of an inspector with "the powers of a Court." Those firms who already have their boilers under periodical inspection know how difficult it is at all times to arrange their business so that their boilers may be thoroughly examined within each twelve months; and find it sufficiently irksome and inconvenient to stop their boilers when required by the inspecting companies having charge of their boilers. Under Government inspection convenience must be set aside, a certificate must be had and produced when required; boilers must be stopped, examined, and certified—that is, if the inspector is satisfied.

With the extremely peculiar views entertained by the Board of Trade as to the strength and safety of boilers, and their numberless deductions of percentage in strength, according to any slight deviations that may be found from their approved standard, it would certainly be curious to inquire how long a boiler would be allowed to work at the pressure for which it was originally intended and made. How long would it be allowed to work without being tested by hydraulic pressure? How often would it require to be entirely stripped of brick work and re-seated? Boilers in possession of the Government are, it is generally understood, tested by water pressure after every five hundred hours' working. Here is a standard! How would steam users relish testing every boiler once in each five hundred hours of working? Under such inspection the principal business of a steam user's life would appear to be looking after his boiler, being examined—on oath—by the inspector, producing books, papers, documents, and superintend the attendance of his workmen upon the inspector—a pleasant prospect! Take a case of a steam user in the midst of an important time contract, when the stoppage of his works for even an hour would be of the most serious consequence, finding that the certificate of the safety of his boiler had just expired down comes the inspector, Government and the Board of Trade must not be trifled with, certificate must be produced, otherwise work must be stopped instantly, and if any defect caught the inspector's attention, suspended until remedied. Complaint has sometimes been made as to the manner and bearing of the inspectors of the inspecting societies, and feelings of irritation expressed at the presumed dictatorial and too confidently expressed opinions given by their engineers, probably arising from a very great special experience, which causes them to take contradiction from imperfectly and often incorrectly informed sources, with some little impatience. But this can be remedied at the renewal of any policy by simply ceasing to pay the premium and severing the connection. The inspectors of the boiler insurance companies are practically servants of the insured, and can be dismissed at will; but what would be the manner and bearing of these very men, if they were upon any premises with the authority of the Board of Trade behind them, and "the powers of a Court with Summary Jurisdiction" in their hands and mouths?

Steam users would then find relations reversed, and the inspector the master certainly of the situation for the time being; and if complaint is now made, and irritation and annoyance felt, what would be the condition of affairs under the changed relations? Is it too much to say that such a condition of things could only possibly exist for a short term, as the strain would be too great to be borne, and the indignant body of steam users would rise and sweep the whole irritating, unnecessary, and wholly uncalled for fabric of rules, regulations, and restrictions away? The Englishman of to-day is a tame dog, and under the worst provocation only snaps and growls; but the engineer inspector might, it is thought, provoke him to bite.

Since my last letter, Mr. Provand has brought into the House of Commons a Bill to amend the law relating to and providing for the compulsory examination of steam boilers. Lord Stanley, who had charge of the Boiler Registry and Inspection of Boilers Bill in the House of Lords, has been moved from the Presidency of the Board of Trade to the Governor-Generalship of Canada. What effect this change may have upon the latter Bill, it is of course impossible to accurately predicate; it is possible, however, that Sir Michael Hicks-Beach, his successor, may not be so easily convinced of the necessity for such a piece of meddling, useless, and mischievous legislation, and consequently it may possibly be allowed to drop quietly out of sight for a time, until revived again at some more favourable juncture. Mr. Provand's Bill now will come before us, and its provisions will be looked forward to with anxiety. It is, however, of the greatest importance for steam users to clearly see and feel their position in the event of compulsory inspection being pressed forward, whether by Mr. Provand or the Board of Trade.

Once more let me repeat that no further legislation is required, the Boiler Explosions Act, 1882, is ample in its powers for all necessary purposes, and if its powers were put in force the numbers of explosions would be reduced to the lowest possible number. Let the whole of its provisions be put in force, and the Act tried for another term of years, and then if the results do not justify the course taken let further legislation be made; but when we find that the fear of an inquiry only—although it is clearly understood that no pecuniary or other loss is likely to accrue—is sufficient in four years to reduce the number of explosions 42 per cent., the result may be easily foretold.

When once steam users are properly informed on this subject of compulsory inspection, and grasp the results that will flow from their being subjected to it, their decision will be sharp, clear, and decisive. Even if during a period of indifference and inactivity such a measure is allowed to slip through Parliament, steam users will, under governmental treatment, soon recover from their somnolence and lassitude, and find energy to erase it from our statute book; but in the meantime what annoyance, what trouble, what loss, and what a great and serious check to industrial progress will have been suffered.

Yours, &c.,
Economiser.

Manchester, 10th March, 1888.

To the Editor of "Industries."

Sir,—Your correspondent "Economiser," who writes so intolerantly on the boiler inspection question, still appears to be quite ignorant of the fact that in discussions personalities are not arguments, and I again decline to be led away by his example, although, were I so minded, it would be impossible, as he has taken the convenient but unsatisfactory precaution of shielding himself under an anonymous signature.

For reasons best known to himself, your correspondent appears to have set me up as an advocate of Board of Trade inspection. I again repeat I am nothing of the kind. I simply believe that it would be a good thing if all steam boilers were periodically inspected, and as some owners, either through carelessness, poverty, or avarice, let their boilers work for many months, or even years, without any adequate examination, the only way to reach them is to make inspection compulsory. I do not care in the least who the inspection is made by if it is properly done, and the liberty of the boiler owner is not interfered with.

In quoting from the *Engineer*, your correspondent takes a solitary sentence and adapts it to his own use. I said the article in question corroborated my statement, that many worn out boilers are in use, and this I still maintain. Notwithstanding the Report of the Assistant Secretary of the Board of Trade—which I conclude your correspondent quotes, as it happens in this case to suit his own ideas—I am yet to be convinced that it would not be a gain to all concerned if only properly qualified men could be entrusted with the care of steam boilers; and I agree with the remark of "A. C." in your last issue, that "it would harm no one, would add to the longevity of the boiler, lessen the coal bill, increase public safety, and improve the status of the men." Notwithstanding the assertions of "Economiser" that "experts"—an unknown quantity—consider this idea an exploded one, how comes it that a Scottish boiler association is now initiating this very system of certificates? If your correspondent will take the trouble to look carefully through the columns of your contemporary of the issue I mentioned, he will find on page 150 an important communication on this very subject, in which the granting of certificates to boiler attendants is strongly urged. If the proposed Bill be bad in every respect, as your correspondent would wish us to believe, how comes it that the Blackburn Chamber of Commerce has declared in favour of it with some modification of clause 10? and how will he account for the action taken by the Associated Chambers of Commerce, as shown by the following newspaper report:—

"The third and concluding meeting of the annual session of the Associated Chambers of Commerce was held at the Hotel Metropole, on Thursday, the 23rd ult., Sir Bernhard Samuelson, M.P., presiding. The following resolution had been placed on the paper by the Oldham Chamber:

'That this Association is strongly opposed to the Boiler Registry and Inspection Bill, 1887 (introduced into the House of Lords by the President of the Board of Trade last session), which they consider unnecessary, as shown by the rapid diminution of accidents which have taken place during the past few years, and as only likely to further embarrass trade, already sufficiently harassed by Parliamentary enactments, and would call attention to the Boiler Explosions Act, 1882, the powers under which already conferred upon the Board of Trade, if put in force, are amply sufficient to act as a safeguard against accidents, and as a deterrent to carelessness on the part of owners of boilers.'

"This was strongly opposed, and eventually negatived in favour of an amendment to the effect that the meeting, without pledging itself to all the details, approved the principle of the measure referred to, as the Act of 1882 had not been a sufficient safeguard against avoidable accidents."

Yours, &c.,
M. Powis Bale.

London, E.C., March 12th, 1888.

Stoppage of Abercarn Tin Works.—A notice was posted on the 10th inst., at the Abercarn Tin Plate Works, intimating that the works (with the exception of a water mill) would remain closed until further notice. The works have been kept going on day to day contracts for some time. Hence only twelve hours' notice to cease work was required.

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THE NEW EXPLOSIVE "HELLHOFFITE."

The safe working of mineral property has for nearly twenty years been an anxious care to the Legislature, to specialists, and to the general public in this country, and at present there still remain unsolved two mining problems of the greatest importance. A perfectly efficient and safe miner's lamp has yet to be provided, and colliery managers are still far from unanimous in their approval of an effective and at the same time harmless substitute for gunpowder and dynamite as explosive forces. The lamp question has continuously been the object of scientific application, but it is only recently that inventive genius has engaged itself in the task of modifying the process of breaking down minerals by means of dangerous explosives. Progress in this work has been marked by the water cartridge, gelatinous cartridge, securite, tonite, a variety of mechanical coal getters, and other more or less practically useful productions. "Hellhoffite," which is one of the latest additions to the list, hails from the Continent, and is said to be a harmless explosive. Hellhoffite is a red and rather caustic liquid, and is formed by a combination of the nitro-products of tar oils with nitric acid. It may also be obtained as a solid, this state being arrived at through absorption of the liquid by "kieselguhr"—fossil earth.

The cartridges which contain the explosive are made, for light charges, of refined lead, and these may be driven into the blast holes under pressure, are capable of filling up unevenly drilled holes, and can sustain deformations without their contents being affected. The explosive is fired by means of strong caps, primed with fulminate of mercury, inserted into small lead tubes tightly screwed in the cartridges, and these need not be fitted on until just before firing. Numerous experiments have been made at various Continental mining centres under diverse conditions with this explosive, and have uniformly resulted in a clear demonstration of the great force it exerts, and of the perfect safety with which it may be used. From a tabulated statement contained in the final report of the Prussian Royal Commission on explosions in mines, it appears that a long series of experiments with hellhoffite were conducted in the drift of a mine, where in each case the percentage of fire damp varied. In one instance it amounted to 10 per cent., and when coal dust as fine as flour was strewed for a distance of 10m., no flame whatever appeared. According to the same authority, liquid hellhoffite is 70 per cent. more powerful than guhr-dynamite, and 30 per cent. more than liquid nitroglycerine; and in the opinion of the Imperial and Royal Mining Department of Pribram, it has over 38 per cent. more breaking power than Nobel's gelatine dynamite No. 1. The following is culled from an official report of the Royal Hungarian Mining Department of Schemnitz:—"A rail of the narrow gauge Schemnitz line was laid free upon a grass plot, and a 100-gramme hellhoffite cartridge so placed upon the rail—totally uncovered—as to be located between flange and foot. The cartridge being fired by an electric fuse, the whole foot of the rail was torn away for a length of 15cm., and hurled to a distance of over 50m., the surfaces of the fragments showing initial signs of fusion. A 105-gramme dynamite cartridge, placed in the same manner upon a similar rail, exploded when fired without showing any vestige of destruction." When we add that the products of combustion remaining after the explosion of the hellhoffite are only characterised by the smell of the burnt fuse, and are neither dangerous nor disagreeable; that the price of this explosive, including the filling of the cartridges and the packing, is less than that of dynamite; and that when used in a pit the tendency of its breaking power is rather to rift than to shatter, it is sufficiently clear that the explosive to which we now direct attention is one which will make its influence felt in the mining world.

ALLOYS AND THEIR PROPERTIES.

The first of a series of three lectures on "Alloys," was delivered by Professor Chandler Roberts-Austen, F.R.S., of the Mint, at the Society of Arts' Rooms, on Monday last. The lecture was devoted, for the most part, to a retrospective glance of the work which has been done in the past by the alchemist, and drew attention to the difference which exists between the ancient and modern uses of metals. Antimony was commonly employed by the Greeks in the arts, but now this metal is only used in alloys with other metals. There are very few chemical notices of the composition of the alloys used in earlier times; but we find in the writings of Reaumer, Gillert, Muschenbrock, and Achard several allusions to the mixing and making of metallic mixtures. Reaumer propounded a theory in which the hardening of steel was explained by the sulphur and salts, which he supposed existed between the molecules of the metal, not having had time enough to be taken up by the metal when it was suddenly cooled. Achard drew attention to the similarity in behaviour of the metals towards heat, and electricity. Matthiessen in 1860, from an examination of the electrical resistance of the metals when pure and when alloyed with one another, came to the conclusion that alloys contained the metals in an allotropic condition, or in such a form as to be practically different from those used in preparing the alloy. There are three methods of general use employed for making alloys, viz.: (1) Fusion; (2) pressure; (3) electro-deposition. It is very essential that the metals used should themselves be as pure as possible, as traces of foreign metals present considerably modify the properties of the alloys. Tin, for example, is a soft and ductile metal; but when it contains a trace of arsenic it becomes brittle, or if there is a larger quantity of arsenic present it forms a crystalline mass resembling zinc. With a drop of mercury the tin becomes so brittle that it can be readily broken by the fingers. Alloys may be divided into two classes, according as heat is evolved or absorbed in their formation. The alloys of aluminum and copper, lead and tin, gold and tin, arsenic and antimony, and bismuth and lead, are all formed with the evolution of a considerable quantity of heat; while an alloy of tin, bismuth, and lead in equivalent proportions, when mixed with mercury so as to form an amalgam, absorbs heat to such an extent that it may be used to freeze water. When the metals are alloyed together, first by fusion, and then powdered and mixed with mercury, the cold produced is not so great as when the powdered, unalloyed metals are rubbed with the mercury. The formation of alloys by pressure was first studied by M. Walter Spring. He found that powdered metals, when welded together by simple pressure, became converted into a compact mass; and if the pressure was still further increased, the alloy formed flowed into the crevices of the mould. Powdered lead, under a pressure of 13 tons per square inch, becomes a compact lump, and under a pressure of 33 tons per square inch becomes fluid, and flows into the interstices of the machine.

Similar phenomena are observed in the case of tin when subjected to great pressure. Alloys can be produced in the same way; powdered bismuth, lead, and tin, when mixed in suitable proportions and compressed, form an alloy which melts at a lower melting point than that of the most fusible metal of the three. No heat is experienced when pressure is applied in this way, as the compression is allowed to take place very gradually. Some alloys of metals are known which only exist in the liquid state, so that on cooling the homogeneous liquid separates the metals contained in it in a more or less pure condition Lead and zinc form a solution which almost entirely separates its metals on cooling. A mixture of copper, antimony, and lead, in definite proportions, separates on cooling "regulus of venus," an alloy of antimony and copper $SbCu_2$, which was well known to the alchemists, and lead containing a small quantity of the same alloy. Dr. Ball, who has recently examined these changes, considers that the regulus of venus is dissolved in the lead, and being more soluble in the hot lead than when cold, the regulus separates out on cooling the alloy, leaving a cold saturated solution of the regulus behind, which then solidifies as regulus. Many alloys resemble metals in being capable of occluding gases, and Devray has shown that an alloy of rhodium and lead if treated with nitric acid gives after the bulk of the lead has been dissolved, a crystalline alloy of rhodium and lead, and a black residue which, when heated *in vacuo*, explodes and forms a brilliantly crystalline compound, which is soluble in *aqua regia*, whereas, before the explosion, it is insoluble in that solvent. Guthrie showed that the most fusible alloys of metals were not those which contained the constituent metals in molecular proportions.

RING v. MULE SPINNING IN INDIA.

A paper was read on the above subject by Mr. James Cocker, late of Bombay, at the Manchester Technical School, on the 12th inst. In his paper, the author pointed out that in the present days of competition it was absolutely essential that a mill manager should carefully attend to small details, and be able, by organisation, to bring out the fullest possible efforts of his work people. In commencing to compare the ring frame and the mule as competitive machines in the Indian market, he said that he was inclined to give the mule the first place for several reasons. The quality of the cotton they had to use, the current rate of exchange, the high price per spindle of rings with the accessories, and the cheap adult labour in India, all contributed to make the mule a cheaper instrument of production than the ring frame. He instituted a comparison between two machines, both spinning the same class of yarn, one fitted with 16,200 ring spindles, and the other with 19,610 mule spindles. In each case the rate of wages paid were the current rates in Bombay, and the comparison came out as follows, having regard to the fact that a ring frame of 270 spindles required a piecer for each side. For the whole of the labour required for the 16,200 ring spindles the cost per month was 1890 rupees, while for the 19,610 mule spindles the cost was 1216 rupees. Taking the production of the ring spindles at 6·9oz. per spindle for twelve hours, the production for twenty-eight days (which is the month on which wages are paid) is 195,608lb. The mule spindle produces 5·7oz. for the same working hours each day, equal to 196,608lb. per month. The cost per lb. was 1·85 pice in the case of the ring, and 1·19 pice in the case of the mule, an advantage to the latter of ·66 pice per lb. Comparing next the cost per spindle delivered in Bombay, the ring frames cost 8¼ rupees per spindle, and the mules 4·75 rupees per spindle, or a total cost of 133,650 and 93,147 rupees respectively. Making the usual allowance of one rupee per spindle for the extra floor space occupied by the mules, the latter cost 109,347, or 24,302 rupees less than the ring. Again it was necessary in spinning on the ring frame that a finer roving should be used. In spinning 20's for the China market, for instance, a 2·86 hank roving sufficed on the mule, while on the ring frame a 3·25 was wanted. The extra cost of this on the yarn produced was 150 rupees per month. Again the waste was greater on the ring than the mule, being respectively 3·93 and 1·48 per cent. The reason of this could, the author said, be demonstrated by a simple experiment—where 20's yarn with 15·86 turns per inch, and testing 46lb. was being spun a 6/0 traveller would be required. If the frame were stopped, the yarn marked close to the rollers, the frame re-started, and the number of revolutions of the rollers noted, it would be easy to ascertain the length which should be found on the spool. If the yarn were drawn off and measured from the rollers to a given mark, it would be found that there was ·75in. more yarn than the rollers were calculated to deliver. The same experiment with the mule would show that 1·73in. less than the calculated length was on the cop. If the same drag was put on the yarn in the mule as in the ring frame, and Surat cotton was used, the same waste would be made. The average margin between the manufactured article and the raw cotton for the past eighteen months was 4d. per pound. Allowing ½ per cent. for the lessened waste in reeling ring spun yarn, the excess of waste of ring over mule yarn was brought down to 2 per cent., equal to 733 rupees per month on the given quantity produced, to which should be added 150 rupees for the extra hank roving, making a total of 883 rupees or 8·1 pice per pound. A comparison comes out thus: Ring yarn, with common labour, 1·85 pice; extra fine roving, ·12; interest on the higher cost per spindle, ·1; extra waste made, ·71; a total cost per pound of yarn of 2·78 pice, against 1·19 pice per pound of mule yarn. The difference in favour of the latter was thus 1·58 pice per pound. In a brief discussion which followed it was generally agreed that the comparison, although possibly fair for India, did not represent the actual facts in this country, a proposition to which Mr. Cocker assented.

Books Received.

Practical Education. By Charles G. Leland. London: Whittaker & Co.

Spons' Engineers' Price Book: giving Tables for Estimating Cost of Material and Labour on Current Prices. London: E. & F. N. Spon.

Electrical Instrument Making for Amateurs: A Practical Hand Book. By S. R. Bottone. London: Whittaker and Co.

Reviews.

Transactions of the American Society of Mechanical Engineers. Vol. VIII.

This volume, which contains a record of the transactions of the fourteenth meeting at New York in November, 1886, and of the fifteenth at Washington, of the American Society of Mechanical Engineers, maintains the character of the volumes which preceded it for the value and originality of its contents. New societies, and especially those in new countries, seem to get out of the official and rather dry routine of older institutions, and while not in any way allowing the quality of their transactions to deteriorate, are able to present them in a more agreeable form to their members. At the very beginning of this volume we meet with an item which is rather apt to startle orthodox readers. It is a list of the members who have died since the institution of the Society. Their names appear immediately after the names of the present members, and they are to a certain extent still considered as belonging to the Society. The idea is good. Too often when a man dies he is forgotten, whatever his services may have been. In some Continental regiments it used to be the custom to keep on the lists the names of soldiers who had highly distinguished themselves, and they were called at the daily roll-call. Our societies might at least

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record in their yearly volumes the names of some of their deceased members, who in their day have taken a prominent part in their proceedings.

The papers in the volume under consideration are very varied in their character, and somewhat unequal in value; but, as a collection, they reach a high standard and are well worthy of study. The first paper is a report of a committee on Standard Pipe and Pipe Threads, and it embodies a part of a paper by the late Robert Briggs, C.E., on "American Practice in Warming Buildings by Steam," printed in Vol. LXXI., Part I. of the Proceedings of the Institution of Civil Engineers of Great Britain, and which contains comprehensive information regarding the subject of standard pipe and pipe threads, as applied in American practice. While the Society did not endorse the Briggs' standard, still the opinions of the members were all strongly in favour of it.

The next paper, by Professor Reuleaux, of Berlin, honorary member of the Society, on "Friction on Toothed Gearing," will be read with especial interest by all of a mathematical turn of mind. Professor Thurston's paper on "The Friction of Non-Condensing Engines" enters on a subject which is well worthy of attention, that is, the efficiency of steam engines considered as machines, and we shall present to our readers the results of such investigations as may from time to time be made. In a paper on "The Strength of Shafting Subjected to both Twisting and Bending," Professor Lanza discusses Grashop's formula, and gives the result of some experiments he has made on the subject. While Mr. Benjamin Baker, of the Forth Bridge, contributes some useful notes on the working stress of iron and steel. The paper by Mr. William Cowles, on "Fire Boats," contains a large amount of information concerning the various types of floating fire engines which have been designed and built in America and England. Mr. George J. Alden summarises the investigations on the effects of the reciprocating parts of high speed engines, and gives tables and formulæ for calculating these. Mr. Kent's paper asks the question, Is Water Gas an Economical Fuel? and answers it in the negative. Mr. Oberlin Smith discusses the intrinsic value of special tools, and points out the necessity for large sums being written off yearly for their depreciation, as a change in the market might seriously reduce their value.

The next paper, by Mr. W. E. Partridge, on "Capital's Need for High Priced Labour," is intended to show that the labour troubles of employers, both in England and America, are largely due to a wrong theory in regard to wages, which stated in its simplest form is this: the less the price paid for labour, the less will the product cost; and he adds that this theory is so deeply rooted in the minds of both the labourer and the capitalist, that it has passed unquestioned from the early days of manufacturing to the present. The opinions expressed by Mr. Partridge, and by those who took part in the discussion, are worthy of very serious consideration both by capitalists and labourers; and we must confess we would like to hear of a few such subjects being discussed in our engineering institutions, as we are afraid by attending too closely to technical matters, they are apt to overlook those of more importance.

One of the most important papers in the volume is that by Professor Thurston on "The Systematic Testing of Turbine Water Wheels in the United States," and is based upon statistics and information from scattered sources, but principally gathered through the assistance of Mr. James B. Francis and of Mr. Clemens Herschel, and is interesting and valuable not only as a history, but also as a record of systematic experimental work. Mr. L. H. Rutherford brings a considerable amount of mathematics to answer the question—Should a piston packing ring be of the same thickness at every point? but we suspect that observation and practice will be more depended upon than the results of mathematics. The paper on "The Education of Intuition in Machine Designing," by Mr. John T. Hawkins, and the discussion upon it, opens up many questions connected with the teaching of engineering which deserve more attention than they usually receive. The writer concludes with Gibbon's remark that "we have two educations, one from teachers and the other we give ourselves," and he says what he wishes to contend for is, that the teachers should give us more of those things which we are obliged to buy, beg, borrow, steal, or dig out in some way for ourselves, and which, in machine construction, constitute the main requisites.

The next three papers are all of great value in the science of practical thermodynamics, all by Mr. Charles E. Emery: The first, on "The development of the compound engine, and the probable limit of steam pressure in marine engines and boilers;" the second, on "Cylinder condensation and the reduction of the same by the use of the compound engine;" and the third, on "The comparative value of steam and hot water for transmitting heat and power." Our space will not even in the meantime allow us to give a synopsis of these, but we may give some of their results on a future occasion. In the meantime we commend them to the attention of our readers.

Mr. Samuel Webber returns to a subject to which he has long given attention, viz., "The comparative value of different kinds of belting," and gives the results of a considerable number of tests. There are other valuable papers on the "Needs of the Navy," on "Coast Defence," on "Steam and Power," and other subjects, all of an interesting nature, which, with topical discussions, convey a considerable amount of useful information in a lively form.

The President's Address comes at the end instead of the beginning of the volume, he being prevented by a long and serious illness from attending the meetings at the beginning of the session. Any address by Mr. Sellars is certain to be worth reading, and this one contains much that is deserving of attention, especially when he treats of the training and education of engineers; and he insists that the system of education which will teach the student to think and reason, without depending on fixed rules, will in the end be of the greatest practical benefit; and he notices some of the discussions which have taken place in this country. Altogether the volume before us sustains the high reputation of its predecessors, and bears evidence of the increasing prosperity of the American Society of Mechanical Engineers.

TECHNICAL EDUCATION AND FOREIGN COMPETITION. By Swire Smith, Member of the Royal Commission on Technical Instruction. London. 1887.

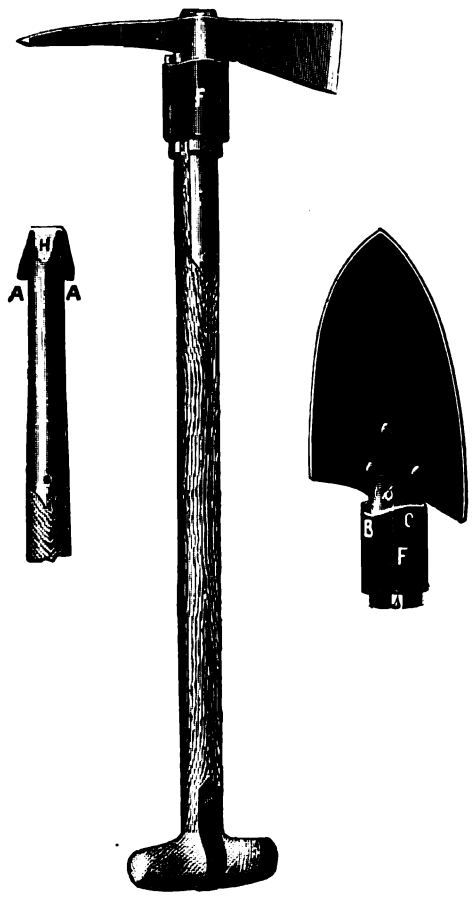
One of the most useful objects of the recently founded National Association for the Promotion of Technical Education is the preparation, in a popular form, of information to be obtained from reports of commissions, consular reports, and from various other sources, such as articles in reviews, so that correct information may be diffused throughout the country, and opportunities given for the discussion of the question from different points of view, and for the ventilation of opposing opinions. On the effect of technical education on the present state of our industries the most varied opinions are held and expressed, and it is only by free discussion that the truth is likely to be arrived at. Some writers and speakers seem to think that all the talk about the necessity for improved technical education is pure humbug; while others go to the opposite extreme, and look upon improved educational arrangements as the most pressing necessity of the present day. In this, as in all other questions, the truth is likely to be found between these two extremes. Sir Frederick Bramwell is not likely to be accused of any want of sympathy with technical education; but recently, in an address on "The Worth of Technical Education," he expressed opinions which ought to be carefully weighed by all who are studying the present economic condition of affairs. He said that our manufacturers would probably find that technical education had not restored to them the position which they had formerly held in regard to foreign competitors; that not only was this adjunct necessary to economical production, but that industry, thrift, liberty of labour, and the conscientious discharge of duty were still more important, and that without these we should never succeed in the race, whoever it might be against. An enormous amount of girder iron was now introduced into English buildings. That came to the London market almost entirely from Belguim. We ought not to have allowed the Belgians to introduce a single ounce of it. We had capital, raw material, coal of an unparalleled quality, and were not without inventors and inventive skill; the country was permeated by railways, a coasting service of the most complete description, and the most magnificent ocean fleet in the world. Yet we had allowed ourselves to be beaten in our own market; and however much the lack of technical education had had to do with that, it was not the sole cause—it was not 50 per cent. of the causes. He did not believe it was 10 per cent.; and those who expected such a condition of things to be put right again by technical education, would find that they had made a grievous error, and that other defects must also be remedied. Professor Huxley has also, in his recent speeches and papers, pointed out that unless we take care all our present methods of technical education are merely quicker ways of going to ruin, unless we at the same time take steps to secure the stability of the social structure.

The first paper issued by the National Association for the Promotion of Technical Education is that named at the head of this notice, and it is a very moderate statement of experience and observation, and attracted a considerable amount of attention at the time it first appeared in the *Westminster Review*. From his position as a member of the Commission on Technical Education, Mr. Swire Smith had every opportunity of ascertaining facts, and the inferences he draws from these seem to be fully justified. He gives a short sketch of the industrial growth of Britain, and contrasts present with past conditions. He points out that the old system produced infinitely more skilful men than the modern one—some of their products being the despair of modern imitation; but aided by science and invention in utilising the forces of nature, the manufacturers of England were able to flood the markets with the cheap products of organised mechanical industry, while our rivals, clinging to past conditions, holding on to past methods, worked their fingers to the bone in vain efforts to earn a living. But the commercial prosperity of England, promoting as it did the industrial advancement of the world, soon began to be felt in other countries. Foreigners came over and bought English machinery; they employed English architects for the erection of their factories; English foremen for directing them. They adopted our methods of manufacture and organisation, and they copied from us every good thing we could teach them. They learned our strong points, and did not fail to take careful note of our weak ones; and as a result, finding it impossible to compete with us in machinery, they turned their attention to the cultivation of their men—already more highly educated than our own. Their supply of labour was practically unlimited, millions of men being eager for employment at low wages.

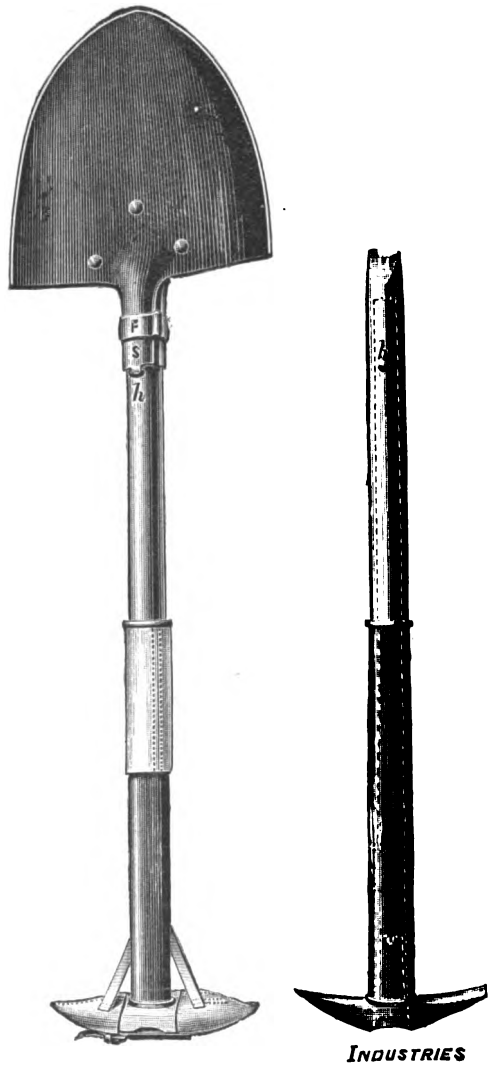
As far back as the Exhibition of 1851 the fact was clearly demonstrated that we were lamentably behind our foreign rivals in the application of art to manufactured productions, and this was what set the Prince Consort and others to organise the Science and Art Department at South Kensington, and local bodies to institute schools of design and mechanics' institutes. But there were two great difficulties which impeded the success of the movement; apprentices were invited to study design who had never learned a stroke of drawing, and in many instances could neither read nor write; on the other hand manufacturers, blinded by their prosperity without art, viewed with perfect indifference and apathy the movement for the artistic training of their men, and only in exceptional cases supported it, and the result is that we are much behind our Continental neighbours both in scientific and art training. Mr. Swire Smith remarks, that what is chiefly remarkable in all this existence of national ignorance of art or science is the fact, that for many years the great bulk of the industrial classes, both employers and employed, could not be made to believe that they were one penny the worse of it. Our insular pride and prejudice encouraged the fallacy that we commanded the machinery, the capital, the skill, and the knowledge, and therefore that success was assured, and could not but be enduring. Soon, however, effective foreign competition gradually and almost imperceptibly began. The inventions of England were no longer England's monopoly; they were distributed over the world, and every new foreign factory that was built combined the latest English improvements with the equipments of our most modern machines. Moreover our rivals were often able to shut out our products by high protective duties, although to a certain extent this policy gave a stimulus to the export of machinery, factory and workshop appliances, and raw and semi-raw materials from England. The results, however, were often disastrous to the manufacturers. But for us the serious part of the question was not simply that we have lost our trade in staple cheap goods with foreign manufacturing countries, but our enterprising Continental rivals beat us in their own countries in common goods by their tariffs; but they also beat us abroad in some classes of superior goods by their skill, taste, and commercial aptitude—the qualities which they have so assiduously taught in their schools, and which have been so grossly neglected in ours. These facts were strongly impressed upon the Commissioners on Technical Education, of which Mr. Swire Smith was one. They visited the schools, conversed with the professors and students, and on returning to England they visited competing establishments, and tested the foreign evidence face to face with all the facts in our own country. They obtained undoubted evidence proving that, in so far as economy of production is concerned, English manufacturers, despite the higher wages and shorter hours of English compared with those of foreign workmen, have nothing to fear. In respect to machinery, organisation, spirit, and energy, Mr. Smith does not think the Commissioners were blinded by undue partiality in giving the foremost place to English employers and operatives, although in respect of these points the rapid progress of our German rivals during recent years shows unmistakeably that there must be neither rest nor sleep if we are to maintain our ground. The best machinery everywhere is English, in some of the weaving factories even the yarn is English. The superiority of the foreign establishments is not in machinery, but in the men; not in natural faculties, but in training. Mr. Smith enters into various questions connected with tariffs, and discusses the educational arrangements which are necessary in order to enable us to hold our own. These, however, our space will not allow us to describe at present; but we trust that Mr. Smith's pamphlet will be widely and carefully read, and that the National Association for the Promotion of Technical and Commercial Education will continue to place before the public such information as will enable them to form exact opinions on the subjects which are now attracting so much attention.

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COMBINED PICK AND SPADE.



FIGS. 1, 2, AND 3.



FIGS. 4 AND 5.

COMBINED PICK AND SPADE.

THE illustrations which we give herewith show a new combined pick and spade, invented by Major W. C. Underwood, of the 4th Hussars. Figs. 1, 2, and 3 represent the cavalry type, and Figs. 4 and 5 the infantry pattern. In the cavalry type, a wooden shaft is employed, having at one extremity a steel head H, with side projections A A, the head being inserted into the socket of the pickaxe or shovel. The fastening is by means of a ferrule F, provided with two grooves to allow the projections A to pass. When right home the ferrule is turned, and its sloping edges B C engage with the projections on the head of the shaft, thus making it fast in the sleeve S. The weight of the tool, with leather frogs and cases, is 4lb., and the shaft may be used for tethering the horse. The shaft of the infantry tool (Figs. 4 and 5) is a light hollow steel tube, which forms a scabbard for the bayonet, and at one end of which is a solid welded steel pick. This serves as a handle when the spade is fixed to the other end H, in which case protection is given to the hands by the leather covering by which the shaft is suspended from the soldier's belt. The spade is attached by means of an oval ferrule F, which, sliding over the tapered sleeve S, forces tags into the holes *h*. The spade can, by straps attached to its leather cover, be hung from the chest buttons of the tunic, and, owing to its having an oblique face and being made of steel, has been found capable of resisting rifle bullets at ranges over 200 yards. The total weight of this tool, with leathers, is 2lb. 7oz. In addition to the military uses to which these instruments can be put, the inventor, who recently exhibited them at the Royal United Service Institution, points out that the cavalry pattern would be valuable for emigrants or explorers, and the infantry pattern for gamekeepers, a steel rod being substituted for the bayonet in the latter case.

THE largest gas engine ever manufactured in the Wear district has been on view for some time at Messrs. Rideal gh, Fairman, & Co's., of Sunderland. The engine indicates 27 h.p., and is intended to work four lifts in the Sunderland Co-operative Societys' warehouse. The space occupied is only 6ft. sq. by 10ft. high.

ON THE COST OF CENTRAL STATION LIGHTING.

BY R. E. CROMPTON.

AN article under the above heading appeared in *Industries*, page 598, Vol. III., and it professed to deal with the comparative costs of distributing electricity by the three kinds of transformers now available, viz.: (1) accumulators used as transformers; (2) what Sir William Thomson calls "step down" dynamos used as transformers; (3) the well known alternating transformer system as used on the Grosvenor Gallery installation, and also by Westinghouse and others. In that article, a great deal was said as to the great advantages, in point of cheapness, of the system I have placed third in order; and I will now proceed to show how the conclusions arrived at in that article may be considerably modified in favour of the accumulator transformer system, if the latter be treated in a somewhat different manner to that proposed by the writer of the article. I think he put this system in a false position by going too far in the direction of reducing current and increasing the e.m.f. No one will doubt that in a large number, in fact in the majority of cases, the generating station can be placed at a distance not exceeding one mile from the nearest part of the district requiring electricity for lighting or motive power purposes, and I propose to show that in these cases when battery transformers, or what I shall briefly call the B.T. system, is used, the cost of the plant will only slightly, if at all, exceed that for an equivalent supply from alternating transformers, which for convenience I shall call the A.T. system. I prefer not to compare what might be done, but what has been actually and successfully done in the way of transforming by batteries with what has been done by alternating transformers.

At Vienna, the system proposed by M. Monnier, and successfully carried out by myself, consists of charging from a central station, groups of batteries of accumulators, charged continuously in series. From each group four circuits are led off so as to cut down the e.m.f. from 400 volts to 100 volts to suit the lamps used. This system has now been in use continuously for six months, and there has been no hitch or trouble whatever in working the plant. It is almost needless here to remark that the troubles connected with the boilers about which so much has been written, have had nothing whatever to do with the electrical plant. No difficulty has been experienced in charging continuously at the high pressure necessary, and although no special precautions were taken with the inside wiring of the opera, and other places supplied, no danger or difficulty has arisen from the use of this high pressure. We may therefore consider it proved that a system of supply which uses a charging current at a potential sufficient to fully charge four batteries arrangod in series each at 100 volts, and which supplies at times of average maximum demand for electricity, two-thirds of the current direct from the dynamos without any loss whatever, and one-third only from the accumulators, can be worked successfully and economically, and with a far greater margin of security against temporary stoppages of the light than could possibly be the case with either alternating or direct current transformers without storage.

It remains now to compare the cost of the B.T. system when applied to an installation of the dimensions proposed in the article, with the figures given as the cost of the installation by alternating current transformers. Taking the items in the order previously given, I shall consider first the cost of motive and dynamo power. As I have said, the dynamos supply two-thirds of the maximum net output of 600 kilo.-watts, and as in this case there will be no loss of current, but only of e.m.f., in the regulating appliances, which may be safely taken at 12 per cent., we require 448 kilo.-watts at the terminals of the batteries, or, adding the 10 per cent. loss in the mains, 500 kilo.-watts in the generating station. If I add to this the 20 per cent. of extra motive and dynamo power the writer of the previous article proposes to allow as reserve, we must provide for 600 kilo.-watts, equal to 1000 i.h.p. Such a plant may conveniently consist of six sets of combined engines and dynamos, each of 100 kilo.-watts, or 166 i.h.p.

£12 per i.h.p., the sum allowed in the former article, appears to me an excessive estimate for engines and boilers only, and as it tells equally on both sides of the comparison, I propose to reduce it in both cases to £8. 12s. per i.h.p., for which sum I believe more than one contractor of repute could be found ready to supply and fix the boilers, steam and exhaust pipes, feed apparatus, triple expansion engines, ready to be coupled on to the dynamos. I adopt the figures given as the cost of the dynamos, and from the two I work out the cost of the motive power to £8,700, and the dynamo power £4,800. For the A.T. system I adopt the figures formerly given, viz., 1450 i.h.p., which at £8. 12s. comes to £12,500, and for the dynamos and exciters £5,540. For purposes of comparison, a sum ought to be added representing the cost of site and buildings in both cases, and as stated in the article, the cost of this would be nearly in proportion to the space occupied by the machinery. I propose to add on this account £8,000 to the B.T. system and £11,000 to the A.T. system. Next as to cost of charging mains. As I read the article, these mains in the case of the B.T. system will extend only from the generating station to the accumulator stations in the district. If we take the length of this main at one mile exterior to the district, and 240 yards inside it, or 2000 yards in all, the total length of circuit being 4000 yards, the current 1200 ampères, and a loss allowed of 10 per cent. or 40 volts, its resistance must be 0·04 ohm. A double conductor, having a collective area of about 2·55 sq. in., weighing about 45 tons, and costing at £80 a ton, £3,650, will be sufficient. This can be laid, supported on earthenware or porcelain insulators, in a brickwork-in-cement culvert, for £1,500, or, say, £5,150 in all. In the case of the A.T. system, the mains, for purposes of comparison, must be laid under ground, and as in this case the charging mains are practically co-extensive with the charging as well as the distributing mains of the B.T. system, it will be convenient to consider the cost of the street work as common to both. The cost of the cheapest and most trustworthy method of laying distributing mains under flag footways, and under ordinary street crossings, varies in London from 14s. a yard of double main, if the section is as small as would be laid for carrying 40 ampères, to 16s. per yard, if conductors having ¼ sq. in. of section of copper are used.

Before proceeding further, it is necessary to consider what length of house frontage will be probably required for a supply of 10,000 60-watt lamps burning simultaneously. I believe recent experience in London and elsewhere has shown that the ampère at 100 volts, *i.e.*, 100 watts per yard of useful frontage of houses supplied, is a good figure to use. For the 6000 ampère or 600 kilo.-watts we supply 6000 yards of useful frontage, and this on the supposition that every house takes the light. But it is not unreasonable to say that for years to come 50 per cent. in excess of this frontage must be supplied with mains, or 9000 yards actually facing the houses, to which we must add at least 35 per cent. for crossings and other portions of the road traversed by the mains, which do not face what I call useful frontage. This makes

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ON THE COST OF CENTRAL STATION LIGHTING.

COST OF GENERATING AND DISTRIBUTING PLANT FOR 10,000 60-WATT GLOW LAMPS, BURNING SIMULTANEOUSLY.

With Secondary Batteries.

	£	s.	d.
Motive power, six 166 i.h.p. sets = 996 i.h.p., at £8. 12s.	8,700	0	0
Dynamos	4,800	0	0
Building to suit above	8,000	0	0
Charging main, 45 tons at £80	3,650	0	0
Laying ditto in culvert	1,500	0	0
Distributing mains, 12,000 yards at 16s. per yard	9,600	0	0
Service boxes, 450 at £2	900	0	0
Batteries, four sets of 50 cells each	8,640	0	0
Regulating gear	1,000	0	0
	£48,790	0	0

With Alternate Current Transformers.

	£	s.	d.
1450 i.h.p., at £8. 12s. per i.h.p.	12,500	0	0
Dynamos and exciters	5,540	0	0
Building to suit above	11,000	0	0
Charging main	2,400	0	0
Distributing main, 12,000 yards at 14s. per yard	8,400	0	0
Service boxes, 450 at £2	900	0	0
Regulating gear	500	0	0
Transformers, assuming one large one for two houses, 300 at £25 (including fixing) =	7,500	0	0
	£48,740	0	0

12,000 yards in all. From the figures I have before given, these 12,000 yards of distributing mains for the B.T. system, at ¼in. section of conductor, would cost £9,600; and those for the A.T., at the smallest useful section, would cost £8,400. To the latter figure must be added an item of £2,400 as the cost of one mile of main outside the area of supply. Before leaving the subject of the distributing mains, it will be convenient here to consider the question of the cost of the house connections. When underground conductors are used, it is necessary to provide one surface box with connections for every two houses. Now, as the whole of these must be put down in the first instance at the time the mains are laid, we must estimate for their supply for both systems. In London the house fronts vary from 24ft. to 60ft., and taking the rather high average of 30ft., or 10 yards, we would require a surface box for every 20 yards, or 450 boxes for the 9000 yards of useful frontage. Pricing these at £2 for each surface box fixed, we must add £900 to both estimates.

The battery transformers have to supply 200 kilo.-watts per hour during the hours of maximum supply. A great deal hangs on this most important question of the duration of the hours of maximum supply, but in London it is found not to extend beyond three hours per day in winter. If we supply four batteries of accumulators which will have a total capacity of 1000 kilo.-watts, we shall provide for five hours of extreme demand, which is a condition of things extremely unlikely to occur, even in times of fog. We require thus four batteries, each having a capacity of 250 kilo.-watts and capable of being discharged at fair efficiency, at a rate of not less than 650 kilo.-watts. Such accumulators can be obtained either in England or on the Continent from at least three different makers, and can be fixed and set to work for the sum of £8,640. In one of these cases, the makers guarantee that to meet a breakdown of the charging plant or of the charging mains, a demand at the rate of 250 kilo.-watts can be supplied by each battery without injuring it in any way, but of course for a comparatively limited period. This would provide against any panic or annoyance to the users of the light caused by a temporary stoppage of the charging current, even if it occurred at the period of maximum demand. In all such cases as this which I am now estimating, when ample allowance has been made for spare machinery, and when the charging mains can be laid and insulated in two parallel sections, such stoppages are unlikely to extend beyond a few minutes, so that in this point the B.T. system offers enormous advantages over its rivals.

The cost of the alternating transformers appears to have been largely under estimated in the former articles. The writer there stated that a maximum supply of 10,000 lamps would be obtained from such a small number as 150 transformers. Most people will admit that such distribution is extremely unlikely to occur in London, whatever might be the case in New York or some of the Continental towns. When I was above considering the distributing mains I showed that 9000 yards of mains fronting the houses would be required in order to obtain 10,000 lamps lighted simultaneously, and I suppose that these mains would front 900 houses, of which only 600 would take the light. It follows that, if every consumer has his own transformer fixed, 600 must be provided, and at the lowest estimate this could not be done, including the fixing of them, at a less charge than £20 per house, or £12,000 for the whole. Even if we suppose that one transformer could be provided for every two houses, we cannot estimate the total cost at less than £7,500; and in order to avoid possible criticism on this ground, I propose to enter this lower figure in my comparative statement; but it will be very interesting to hear the opinion of the advocates of the A.T. system on this point, as it very vitally affects its first cost. The statement I have thus arrived at shows that the cost of 10,000 60-watt lamps supplied simultaneously will be approximately the same, viz., £49,000, for both systems, a result which differs very widely from the figures given in the previous article. I leave the figures to speak for themselves, and shall have more to say on the matter after I have heard a few of the criticisms which I may reasonably expect from those who believe in the A.T. system.

STATISTICS OF FIRE TELEGRAPHY.

AT the Society of Telegraph Engineers and Electricians a paper on the above subject was read by R. von Fischer Treuenfeld, F.R.G.S., Member. The title of the paper was "The Present State of Fire Telegraphy;" but as this title might induce our readers to think that the author dealt with technical and scientific improvements in the apparatus used, we have taken the liberty of altering the title to that given above. The paper was by no means technical or scientific, it was entirely statistical, but nevertheless of great practical value, and likely to direct public attention to a much needed improvement. Why this paper should have been read before the Society of Telegraph Engineers and Electricians is, however, difficult to understand; it would have been far more suitable for the Statistical Society. The author referred to his having, eleven years ago, brought the subject of fire telegraphy before the Society and the British public, when he showed by statistics that a considerable reduction in the percentage of "serious fires" could be attained by the adoption of a system of fire telegraphs, and especially of street call points. As early as October, 1861, Messrs. Siemens Brothers had proposed to introduce a system of the kind into Manchester; but it was not carried out, owing chiefly to the fear of the Town Council that false alarms would be frequent. The same fear delayed the introduction of street call points in London until 1880; but subsequent experience has shown that though much inconvenience is caused by false alarms, this is greatly overbalanced by the advantages of the system in giving early notice of fires to the fire brigade stations, and thereby reducing the proportion of fires of serious dimensions. The author has collected statistics referring to British, American, and Continental towns, and found that where the system of fire telegraphy is fully developed the ratio of serious fires is only about 4 per cent. of the total number, while in towns totally unprovided with such a system the percentage rises as high as 29. By a "serious fire" is to be understood one for the extinction of which more than two engines or reels of hose are required; but this standard is not always adhered to, so that it is impossible to make the statistics strictly comparable throughout. It was pointed out in the paper that the periodical decrease in the percentages of serious fires must be attributed in part to the increased efficiency of the fire brigades, as well as to the extension of systems of fire telegraphy. The author considered that though the number of alarm points has generally increased in British towns, we are still in this respect very much behind the towns of America and the Continent. The statistics do not give any direct evidence that the extended use of fire telegraphy lessens the loss of life through fires, for through the action of other causes, such as the crowding together of factories and warehouses, the proportion of lives lost to the total number of fires shows a general tendency to increase.

Mr. Sharpe considered that factories and warehouses should have automatic fire alarms, but that the slowness of action and want of reliability of those hitherto used had prevented their general introduction, and also the fact that they required the use of closed battery circuits, with a consequent waste. He referred to a system described in the *Electrical Review* for 1st March which he asserted met these difficulties.—Mr. E. B. Bright was in favour of using automatic alarms, and created considerable amusement by stating that when he had tried to persuade the insurance companies to take them up he had been informed by an insurance manager that the companies did not want to abolish big fires, as whenever these occurred they brought so much new business.—Mr. Higgins confirmed Mr. Bright's experience of the attitude of the insurance companies, and complained of the apathy of the public on the subject. He stated that he had introduced a very efficient and inexpensive system, but had only succeeded in getting six subscribers in three years.—Mr. H. E. Hall, who spoke on behalf of the insurance companies, said that though certainly if fire extinguishing arrangements could be so perfected as to make the public consider insurance a waste of money, the companies themselves would be extinguished; still they did not want big fires. What they would like if they could choose, would be a fire from time to time in outlying districts like Hampstead to stimulate business, and an absence of fires in the City, not involving absence of premiums. He considered unreliable automatic alarms a source of danger, as tending to produce a false sense of security, and also that having sprinklers and other amateur fire extinguishing apparatus in houses often prevented an early alarm being given, as the inhabitants thought they could manage the fire themselves. He thought one reason for the diminution of the proportion of serious fires was that the districts consisting of private houses and small shops where there would not in general be serious fires, was always extending, while the City, where the fires generally were serious, necessarily remained stationary in area.—Captain Shaw had not yet found any reliable system of automatic fire alarms, though large numbers had been submitted to him. He considered the establishment of street call points a great benefit, in spite of the trouble given to the brigade by false alarms. During the past year they had received 826 good calls, and 375 false ones, arising from various causes, carts running against the posts and other accidents, calls due to malice or love of mischief, or from some one seeing smoke coming from a chimney, and thinking that it was due to a fire. He thought it would be very desirable if some means could be devised by which the giving of an alarm from a public call point should involve the production of a noise sufficient to rouse the neighbourhood within a radius of a hundred yards, which he thought would be effective in preventing malicious tampering with the instruments. He considered bells objectionable, as being so liable to be rung accidentally, and would prefer for public and private alarms some telephonic or other system by which details of the fire could be given.

As examples of the statistics upon which the above conclusions are based, we give below a table of London fire statistics, and also one giving the fire statistics of Amsterdam, a town which possesses an exceptionally complete system of fire telegraphs.

LONDON FIRE STATISTICS.

Year.	Number of points at which fire alarms can be raised.	Proportion of alarm points to inhabitants.	Percentage of serious fires.	Lives lost per 100 fires.
1876	160	1 to 17,531	11	2·14
1877	162	1 „ 18,144	10	1·89
1878	163	1 „ 18,857	10	1·51
1879	170	1 „ 18,871	9	1·86
1880	218	1 „ 15,333	9	1·76
1881	233	1 „ 14,923	8	2·01
1882	271	1 „ 13,322	9	1·87
1883	407	1 „ 9,203	9	1·82
1884	470	1 „ 8,256	9	1·83
1885	510	1 „ 7,871	7	2·07
1886	603	1 „ 6,880	7	2·28

Average = 1·91

AMSTERDAM FIRE STATISTICS.

Year.	Number of points at which fire alarms can be raised.	Proportion of alarm points to inhabitants.	Percentage of serious fires.	Lives lost per 100 fires.
1875	161	1 to 1,751	5·5	0·91
1876	172	1 „ 1,668	3·4	—
1877	178	1 „ 1,629	3·8	0·31
1878	179	1 „ 1,653	3·7	0·25
1879	184	1 „ 1,641	2·5	0·21
1880	198	1 „ 1,561	3·0	0·74
1881	211	1 „ 1,498	2·9	0·36
1882	220	1 „ 1,483	2·4	—
1883	225	1 „ 1,458	2·8	—
1884	235	1 „ 1,490	3·7	0·32
1885	249	1 „ 1,491	4·8	1·52
1886	256	1 „ 1,432	3·7	0·34

Average = 0·43

A NEW COMMERCIAL APPLICATION OF OXYGEN.*

THE want of some simple method of obtaining a powerful source of heat under perfect control is an experience which all who have charge of machinery and chemical plant must have felt more or less frequently. Up to the present time the only practical methods have been either the use of a basket of live coke or a blowpipe connected to the nearest gas supply. Neither of these methods is satisfactory in many cases, and, to overcome the difficulty, I have devised some special forms of blowpipes

* Paper read before the Liverpool Section of the Society of Chemical Industry, by Mr. Thomas Fletcher, F.C.S., on the 7th inst.

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which can be used with the ordinary coal gas supply and compressed oxygen made by Brin's process. These blowpipes are essentially different from the usual form, and also from the well known mixing jet, the latter requiring both gas and oxygen to be equally compressed, which at once excludes it as an emergency arrangement for repairs. It is pretty well known that air gas produced from gasoline vapour, when used with an air blast in a blowpipe, is peculiarly liable to be extinguished; the speed of combustion is sufficiently slow to enable the flame to be blown out, or away from the unburnt vapour, with the greatest ease, probably owing to the fact that the gasoline is not diffused through the air as a true gas, but as a vapour, which requires further heating and considerable expansion before it will burn. On this point a rather pretty experiment will be given, showing you the particles of vapour in the so-called air gas, burning separately, the flames of the separate suspended beads of gasoline vapour being distinctly visible as independent centres of combustion. When we apply an oxygen blast to gasoline vapour this brittleness or want of persistence disappears; but owing to the air mixed with the vapour, the temperature obtainable is far lower than that from permanent combustible gases, and up to the present time high temperatures have not been obtained with blowpipes using the light petroleums, owing to the necessary mixture of air to obtain the vapour. It must not be forgotten that when gasoline or benzoline vapour is used, it has one special point in its favour for some classes of work in the fact that the products of combustion are quite free from sulphur, which in many ways is a great source of trouble in laboratory work. The use of a petroleum or spirit spray, if it were practicable, would overcome the difficulty of the admixture of air; but the spray formed by an oxygen blast is of a most unpleasantly uncertain and explosive nature, so much so that after my own experience I can only give a strong caution as to the excessive care required to prevent disastrous accidents. A spray burner may start and work satisfactorily, and then suddenly, without any apparent cause, the whole apparatus may be shattered into fragments. When we burn a permanent gas, such as hydrogen or coal gas, in a blowpipe with an air blast, the flame will bear a heavy air pressure on the jet, giving a correspondingly high temperature flame. If we take the same permanent gas, and use it with a jet of oxygen instead of air, the persistence of the flame is again greatly increased, the speed of traverse of flame backwards is so great that the amount of combustion which may be going on in a given space is almost unlimited, and enormously high temperatures can therefore be obtained with the greatest ease, the absence of nitrogen in the flame, of course, greatly assisting the result by reducing the loss of heat, and we gain also by the smaller area of flame containing a given number of available units of heat.

In the construction of powerful blowpipes for compressed oxygen, and coal gas at ordinary pressures, the form of the jet is a very important matter. The centre jet, instead of being formed with a single hole (except in the very smallest sizes), should be flat on the end, and drilled with a circle of very fine holes, each large enough to pass from 3 cub. ft. to 4 cub. ft. of oxygen per hour at a heavy pressure. The gas outlet which surrounds this jet should be an annular space about $\frac{1}{16}$in. wide surrounding the jet, and should project $\frac{3}{8}$in. beyond the tip of the jet, this projection being the same for all sizes and powers. Such an arrangement is useless for a gas and air blowpipe, as it extinguishes itself instantly, and considerable experimenting has been necessary to arrive at the details now given. With me I have three sizes of these blowpipes, requiring respectively about 7, 20, and 40 cub. ft. of oxygen per hour; and with a small bottle of compressed oxygen, which can readily be carried under the arm, I will now give some idea of their power. The quantity of oxygen required for each has not been measured by myself, but has been estimated from a bottle supplied by the Brin Oxygen Company, which I was informed contained 20 cub. ft., and which has supplied the largest blowpipe at full power for half an hour continuously. The smallest of these blowpipes will fuse the end of a $\frac{3}{16}$in. wrought iron rod; the next size will do the same with a $\frac{1}{2}$in. wrought iron rod, or will braze copper pipes $\frac{1}{2}$in. thick about as quickly as a tinman can soft solder light sheet tinned iron. The largest size will fuse a hole through a 4in. wrought iron steam pipe, and will braze, and probably also weld, heavy flanges and couplings on work of the same size. Larger blowpipes can be easily made on the same lines, and it is now both possible and easy to braze and make repairs in parts of complicated machines without removal in any place into which a man's hand can be got. The heat is so local and so quickly obtained that, with the assistance of wet cloths, polished work or wood lagging can be preserved without injury within two or three inches from a place where a heavy brazing repair is being done. Breakdowns in copper pipes or vessels can be made good and work re-started in a few minutes which under ordinary conditions would necessitate several days' stoppage. Using the same blowpipe and bottle of oxygen, I will show, with a block of lime, an emergency light which will often be found useful; amongst other things it will enable you to get by photography a permanent record of any accident or unusual state of things in places where no natural light can be obtained, and where magnesium would fail owing to the dense fumes evolved. This light is, of course, anything but silent; but as we are now considering only works emergencies, the noise is not of any great consequence. Turning now to the laboratory, as many members will know, I have identified myself for many years with apparatus for the production of high temperatures for experimental purposes, and the cheap production of oxygen has advanced our powers in this direction very considerably. When any new application of a power is discovered, my own instinctive feeling turns at once to its application in the chemical laboratory, that source from whence a very large proportion of our commercial knowledge and power has originally sprung. It is not only necessary that a new power shall be known in the laboratory; the most important point from a practical point of view is that it shall be easily and quickly applied to useful research by those whose time is limited, and the elements of time and personal trouble must be eliminated as much as possible.

My first attempts to utilise compressed oxygen for laboratory gas furnaces proved total failures, owing to the intensely local heat evolved, which entailed the cutting and destruction of every crucible used. The direct application of the heat to the contents is in many cases out of the question, and after some experimenting I found that the desired result could be obtained by mixing air with the oxygen blast, so as to increase the size of the flame, and spread the heat more evenly over the surface of the object to be heated. The form used for this purpose is similar to the well known injector blow pipe, the air jet being, for a small laboratory furnace, $\frac{1}{4}$in. bore and open at both ends, and behind this is a small oxygen jet pointing directly along it. When the oxygen blast is turned on it carries along with it about four or five times its bulk of air. Having got so far, I was again blocked by the fact that no known casing suitable for gas furnaces would stand the heat obtained, even for a few minutes. The only kind of casings which can be satisfactorily used for laboratory gas furnaces are composed of a mixture of very refractory clay and ground cork or sawdust; when these are fired in a kiln, the woody matter is burnt out, and a porous material is left, which offers a most extraordinary resistance to the passage of high temperatures through it. It is, as is very well known, an easy matter to fuse cast iron in a crucible in a casing of this material only 1in. thick, before the outside of the casing has time even to become slightly warm to the hand. The objection to this mixture is that the salts contained in the wood or cork are not burnt out, and they remain acting as a flux on the refractory clay, reducing its resistance to fusion to a very serious extent. This difficulty has, however, with the assistance of the Morgan Crucible Company, been at last overcome, and as the increase of power in our guns leads to improvement in armour plates, so has the increase in power of our laboratory furnace burners led to an improvement in the resisting power of the crucible casings which have to withstand their destructive power. By the discovery of a very refractory clay, which has practically the same contraction as the porous mixture, it is now possible to line the furnace casings with a thin layer, which offers an extraordinary resistance both to fusion and also to the action of fluxes. That these casings are only in their preliminary stage, and not at their most perfect point, goes practically without saying, and only a few have been made up to the present time. One difficulty not yet perfectly overcome is the tendency of the refractory lining of the lid to tear loose, owing to the thinness and the slight hold available; this is, however, only a question of detail which will shortly be overcome.

With the injector furnace, which is undoubtedly of great value for chemical research, I have for some years been held in check by the fusibility of the casings, and this has of necessity put a very definite limit to the power of the burners which could be employed. As this limit is now, or very shortly will be, greatly extended, there is an opportunity for further experiments on the air and gas burners for ordinary use, irrespective of the new power we have now at command. Using the combined air and oxygen burner with one of the new casings, it may be shown that any power, from the lowest to the highest, can be obtained with the greatest ease, and without attention, as one of the small oxygen bottles will work this furnace at full power for about 2½ or 3 hours, and at lower powers for a correspondingly longer period. I have already expressed an unfavourable opinion as to the use of gasoline or benzoline vapour for use in open blowpipes, but this objection does not exist with furnaces where the mixture is blown on to a surface at a high temperature, which insures perfect combustion and persistence of the flame. The only working objection to the oxygen blast in gasoline or benzoline vapour furnaces at present is that a supply of air must be blown through the generator to produce the combustible vapour.

Whilst experimenting, it is the nature of chemists to consider the expense after the money is all gone; in fact, if this were not fortunately the case, very little original work would be done, and to follow this old established rule, now all my oxygen is gone we will consider the expense. In the first place, owing to the great concentration of the heat, the loss in use is exceedingly small; the nitrogen, which in an ordinary blowpipe flame is a source of great waste, is partly or entirely absent, and as a consequence the coal gas consumed is in practice only about one-sixth of that required to do the same work if an air blast is used. The oxygen, if made on a large scale, can be produced by Brin's process at a cost varying from 2s. to 7s. per 1000 cub. ft., depending on the quantity made. In the steel bottles the compressed gas is now sold at from 2d. to 3d. per cub. ft., which is, of course, a high price for work on anything like a commercial scale; but if we keep a few small bottles of compressed oxygen ready for emergencies, their value may, in some cases, be more than a thousand times their cost, and the expense becomes, therefore, a minor consideration.

It may be well to mention, whilst dealing with this subject, that compressed liquid nitrous oxide has been used for small blowpipes for platinum working; but it is not only very much more costly than compressed oxygen, but it is also not so satisfactory. With the oxygen, repairs of platinum vessels in the laboratory become a very easy matter, and the ordinary forms of blowpipes can be used for this purpose, provided a small jet is used and the outer cap is kept about $\frac{3}{8}$in. in advance of the jet. This is necessary to obtain a rough flame for general heating, a fine pointed flame being liable to cause perforation of the vessel instead of producing a broad welding surface. If the compressed oxygen is to be at all freely or generally used, the price charged must be greatly reduced, and, judging from the first cost of the gas, I certainly can see no reason why so high a price should be charged, as the bottles last practically for ever, and the cost of compressing must be very small.

In the discussion which followed this paper the Secretary stated that having regard to the ease with which Mr. Fletcher could fuse a hole through an iron plate by means of the large blowpipe shown, a burglar proof safe no longer existed, as a chilled iron or steel plate could be perforated almost as quickly as a carpenter could make a similar aperture through a wooden door. This was, he said, a very serious matter indeed for bankers and others having charge of valuable property, and would require the immediate attention of safe makers, as it was well known that the professional burglar was ready to utilise the latest applications of science to further the ends he had in view. That Mr. Fletcher's inventions have been made use of in this way could be seen any day in the detectives' museum at Scotland Yard.

Since the above paper was read, we have had an opportunity of witnessing at Mr. Fletcher's works several experiments as carried out with the large size blowpipe referred to in his paper, and we may briefly state that the apprehensions expressed during the discussion which followed the reading of the paper are not in any sense imaginary or exaggerated. Ordinary coal gas and oxygen were used for the blowpipe, the oxygen being manufactured by Brin's process, and supplied in steel bottles of cylindrical form, measuring about 2ft. in length by 5in. in diameter, the ends being hemispherical. These bottles when fully charged are said to contain 20 cub. ft. of oxygen at atmospheric pressure. One experiment was intended to show the effect of the blowpipe flame upon a ¼in. iron plate, and the result was almost similar to that of a chemical plumber's small blowpipe upon a sheet of lead of equal thickness, for in 30sec. a hole was fused through the plate, and by continuing the action of the blowpipe a straight slot was fused in the plate at the rate of 1¾in. per minute. From these results it may be easily imagined that an operator having burglarious intentions would, if provided with Mr. Fletcher's blowpipe and the necessary supply of gas and tubing—which could easily be arranged in a portable form—subject our best safe makers' work to a much more severe test than they have hitherto anticipated. There is fortunately, however, an industrial side in connection with this blowpipe, and we would recommend boiler makers and copper smiths to make themselves acquainted with its powers, as we have no doubt that by its use some repair work could be carried out in a fraction of the time that is now required.

THE RECOVERY OF SULPHUR FROM ALKALI WASTE.

On Monday, the 5th inst., at a meeting of the Society of Chemical Industry, held at Burlington House, Mr. A. M. Chance read a paper upon "The Recovery of Sulphur from Alkali Waste, by means of Lime Kiln Gases." In 1837, Mr. Gossage began researches on this subject, followed later on by Schaffner in Germany, Mond in England, and Mactear in Scotland, without results of more than limited practical application, although the more recent process of Schaffner and Helbig gave promise of more substantial effects. In July, 1882, Mr. C. F. Claus took out a patent mainly for the purification of coal gas, which he (Mr. Chance) thought might be applied to recover sulphur from the sulphuretted hydrogen liberated from vat waste by means of carbonic acid, so he made terms with the controllers of this, and several other of Claus' patents. In the process under which was produced the sulphur upon the table before them, a regulated mixture of sulphuretted hydrogen and air passed under the perforated bottom of a circular kiln, lined with fire brick, first through a bed of broken fire brick and then through a layer of oxide of iron. The steam and sulphur vapour produced passes along the outlet pipe into a small brick chamber, and thence into a large brick subliming chamber The heat of the reaction soon becomes sufficiently great to cause part of the sulphur vapour to condense at the bottom of the first chamber, and much of it passes into the second one, where it is deposited as dry flowers of sulphur. With too much air some sulphurous acid would be formed; with too little air some sulphuretted hydrogen would pass off. In the perfect and constant adjustment of the oxygen required by the hydrogen to form vapour of water, is the main key to the success of the process, and the difficulty was to effect this with an ever varying quantity of sulphuretted hydrogen. This difficulty, after three years of experimenting, was overcome in 1886. In decomposing vat waste by lime kiln gases, the sulphuretted hydrogen varies in strength according to the strength of the carbonic acid gas itself, and to the various stages of decomposition of the waste. The sulphuretted hydrogen varies from 1 to 35 per cent. in an irregular manner. The first condition of success was to obtain lime kiln gases containing as constant a percentage of carbonic acid as possible, although from the best worked lime kilns the escaping gases never consist on an average of more than 30 per cent. of carbonic acid, which is accompanied by 70 per cent. of gas, chiefly the nitrogen of the air. A mixture of alkali waste and water, which has been preferably passed through a sieve, is introduced into a series of vessels connected by pipes, and furnished with inlet and outlet ways, and through some or all of such vessels the lime kiln gases are pumped. In the first vessel the carbonic acid is absorbed by any free lime present, with the production of carbonate of lime, and by the sulphide of calcium with the production, in the presence of water, of carbonate of lime and sulphuretted hydrogen. The latter meets with alkali waste in the next vessel, and is absorbed with the production of sulphydrate of calcium, CaH_2S_2. By

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this twofold absorption, the gases issuing for a time from the last vessel contain neither carbonic acid nor sulphuretted hydrogen; they are allowed to escape after passing through a purifier containing lime or oxide of iron. Thus inert diluent gases, chiefly nitrogen, are allowed to escape. When the gases in a certain vessel contain much sulphuretted hydrogen, because of the carbonic acid acting on the calcium sulphydrate, a workman closes the outlet from the last vessel, and opens another outlet from the intermediate vessel from which the sulphuretted hydrogen is issuing in sufficient strength. The reaction is:

$$CO_2+CaH_2S_2+H_2O=CaCO_3+2H_2S.$$

The gases now contain sufficient sulphuretted hydrogen for profitable treatment and are conducted to a gas holder, whence they can be utilised for making sulphur or sulphuric acid. When the gases become poor in sulphuretted hydrogen the outlet is closed, and having emptied the first vessel or vessels, and filled another or others with a fresh mixture of alkali waste and water, operations are resumed, and so on continuously. The decomposition of the waste is so complete that the water filtered from the residue does not darken a solution of a lead salt. The residue is muddy carbonate of lime, which may be used in black ash furnaces in place of limestone, and also contains bicarbonate and other salts of soda. From 2½ to 3 tons of soda may be saved for every 100 tons of alkali produced. The carbonate of lime may also be used for cement making. The dirty water remaining behind is used with fresh vat waste. The apparatus at the Oldbury works consists of a series of tall cylindrical vessels (seven is a convenient number) suitably furnished with pipes and connections. They are in charge of a man who has to turn the various taps at the right times. The gases are delivered from a lime kiln by means of pipes and powerful carbonic acid pumps. A set of seven cylinders 15ft. high by 6ft. in diameter should suffice to treat the waste from 300 tons of sulphate of soda per week; but there is an advantage in a double set of cylinders, to keep up a constant flow of strong sulphuretted hydrogen. At Oldbury, since November last, vitriol has been regularly made by burning the sulphuretted hydrogen gases in a kiln connected with a complete set of chambers furnished with a Glover's tower and a Gay-Lussac absorbing column. For some weeks past 40 tons per week of sulphuric acid, computed as dry acid SO_3, have been made at the works by burning sulphuretted hydrogen. The acid is free from arsenic, contains but a trace of iron, and is nearly colourless. From first to last, with the exception of fuel to generate steam for pumping carbonic acid, no coal is used. The current cost of working the process is therefore reduced to that of obtaining and pumping carbonic acid from one or more lime kilns.

Sir Frederick Abel, F.R.S., said that he had visited the Oldbury works, and that the process seemed to be a thoroughly practical one.—Mr. J. C. Stevenson, M.P., remarked that after twice visiting the works he had persuaded his partners to take up the process and set up plant at their works.—The Government Alkali Works Inspector stated that the duty of the man who had charge of the taps was simple, as he had to test whether the gas in any vessel was sufficiently rich in sulphuretted hydrogen, merely by the aid of a Bunsen's burner, and noting whether it would or would not burn. He should like to know how much sulphur was collected in proportion to the sulphuretted hydrogen employed.—Mr. Gossage remarked that his father was the discoverer of the decomposition of sulphide of calcium by carbonic acid. Whenever sulphide of sodium can be readily made, there will be no more alkali waste.—Mr. Brock thought that the process decomposed alkali waste profitably, and his company was putting down a plant which would decompose 700 tons of alkali waste per week.—Mr. Alhusen intended shortly to erect a plant at Newcastle to deal with 1000 tons of waste per week.—Mr. F. S. Newall said that some years ago his firm erected kilns just like the one described by Mr. Chance, but did not succeed in recovering sulphur in the dry state.—Professor Dewar, the president of the Society, who occupied the chair, congratulated Mr. Chance on his successful perseverance after having spent £15,000 on failures.

Notes.

THE JUBILEE SHOT.

Considerable expectation centres round the so-called "jubilee" shot which will be fired at Shoeburyness before long. It takes its somewhat fanciful name from the fact that last year it was proposed to fire the new breech loading 9-inch for range, and to try the extreme elevation of 40°. To meet the strain of so great an elevation with a muzzle velocity of over 2000ft.-sec., a suitable carriage was a matter of some difficulty. This, however, has now been surmounted. In anticipation, the range for 40° has been calculated on the following data: Calibre, 9·17in.; weight of projectile, 380lb.; head struck with a radius of two calibres and a muzzle velocity of 2260ft.-sec., though it is said the actual velocity will be greater than this. The following is the result:—

	Niven's method.		Slacci's method.
Range	17,835yds.		17,730yds.
Height of vertex	5,075yds.		5,005yds.
Angle of descent	55° 20′		54° 30′
Final velocity	1,037·5f.s.		1,030·7f.s.

A popular idea of this extraordinary trajectory may be formed by conceiving the gun to be placed at Chamounix, when the projectile would fly far over the summit of Mont Blanc and fall in Italy.

PUBLIC WORKS IN RUSSIA.

In his report on the trade of the district of Taganrog during 1887, Consul Wagstaff states that so far the project of uniting the rivers Volga and Don has remained in abeyance; but as the district of Rostoff and Taganrog have now been definitely annexed to the Don Cossack country, hopes are entertained that the scheme will be realised. The canal would be fifty-three miles long, and it is proposed that vessels allowed to pass through it shall not exceed 210ft. in length, 42ft. in breadth, and 7ft. draught, with a displacement of 500 tons. The construction of a harbour for coasting craft at Taganrog will be commenced this spring. A branch railway to Novorossisk has nearly been completed.

A NEW ANTI-CORROSIVE PAINT.

The smoothness of steel plates, combined with the corroding quality of the material, are leading paint manufacturers to try every possible means for insuring the proper protection of the hulls of vessels and large structures built of mild steel. Some time ago we referred to a proposal of Messrs. M. Holzapfel & Co., of Newcastle-on-Tyne, to rough roll steel plates, in order to provide an adhesive quality; and now we learn that the same firm have, after careful experiments with Chinese soapstone, as a substitute for the metallic pigments usually employed in paints, patented a quick-drying soapstone composition for the inside of steel and iron steamers, ships, bridges, and other structures. Soapstone has for centuries been used in China and Japan for preserving structures built of soft stone, otherwise liable to deterioration by atmospheric influences. When ground it is remarkable for the exceptionable fineness of its grain, and being lighter than metallic pigments, mixed as a paint covers a larger surface than zinc white, red lead, or oxide of iron. In Messrs. M. Holzapfel & Co.'s new composition, soapstone, finely ground, is present in a large proportion, mixed with a quick-drying varnish of great tenacity and hardness. When applied to iron or steel, this paint has large covering capacity, and presents an enamel-like surface of a bright red colour.

THE HEATING OF WIRES BY ELECTRIC CURRENTS.

The extended use of fuses in electric light installations has rendered the question as to the heating of wires by electric currents one of considerable practical importance, and the results of a long series of experiments made in this connection by Mr. W. H. Preece, F.R.S., were recently submitted by him to the Royal Society. The experiments were taken for three temperatures: First, the melting point of shellac, which is 77°C.; second, the point of self luminosity, which for all substances may be taken as 525°C.; third, the fusing point, which is different for the different metals. Mr. Preece experimented with wires varying in thickness from 4 to 40 mils., and comprising the following materials: Copper, aluminium, platinum, German silver, platinoid, iron, tin, lead, and an alloy of tin and lead. For wires varying in diameter between 10 and 40 mils., the current which produces a certain temperature is for each wire given by the product of a constant, and the diameter to the power of $\frac{3}{2}$. For smaller wires than 10 mils. this formula does, however, not hold good, and the current is more nearly proportionate to the diameter. In order to eliminate errors due to the cooling effect of the terminals, the samples experimented upon were 6in. long, being clamped between terminals upon a dry wooden stand; but a second series of experiments was also made for wires stretched between terminals 1¼in. apart, so as to determine the fusing point of short wires such as are used in commercial cut-outs. Mr. Preece arrives at the conclusion that the best metal to use for thin wires is platinum, and for stouter wires, tin. Platinum fuses like wax without explosion or scattering of molten particles, and tin in moderately stout wires behaves in a similar manner. Mr. Preece doubts, however, whether large wires should be used at all for fuses, because, owing to radiation, the surface keeps cool and solid, while the centre is liquefied. The wire then bursts with an explosion, and incandescent particles are scattered in all directions with considerable energy.

KEEP'S TESTS FOR FOUNDRY IRON.

A paper of more than usual interest is announced to be read at the next meeting of the South Staffordshire Institute of Iron and Steel Works Managers, to be held at Dudley, on the 24th inst. The title of the paper is "Keep's tests for foundry iron—a proposed standard series of tests for pig iron for foundry purposes." Mr. W. J. Keep, the author of the paper, is superintendent of the Michigan Stove Company, Detroit, Michigan, U.S.A. At these works 70 tons of iron is daily used for stove plates, and as the result of a good many years' experience, systematical tests have been devised which give every satisfaction, and which have recently been adopted by a number of American firms engaged in the sale or use of foundry pig. Mr. Keep's paper has been revised, and will be communicated by Mr. Thomas Turner, Assoc.R.S.M., lecturer on metallurgy at Mason College, who has himself devoted considerable attention to foundry iron; and it is anticipated that, even where these tests are not adopted, considerable interest will be taken in the new methods of testing introduced by Mr. Keep.

EXPLOSIVES.

In the current number of the Proceedings of the R.A. Institution, a further instalment is given of the valuable "Dictionary of Explosives," in process of compilation by Major J. P. Cundill, one of H.M. Inspectors of Explosives. This instalment deals with nitro-compounds containing nitro-glycerine, and forms the fourth class or division into which he has divided his subject. Before detailing in alphabetical order, and explaining the numerous compounds that come under this head, he has made a few introductory remarks of value; *inter alia*, he gives an interesting sketch of the progress of the manufacture and commercial use of dynamite. Nitro-glycerine was discovered by A. Sobrero, in the laboratory of Pelouze, in 1847; but for many years no practical use was made of it, except to a very limited extent, as a medicine, until between 1860 and 1863 Alfred Nobel, a Swedish engineer, established factories on the Continent for its manufacture on a commercial scale as a blasting agent, and a further step was made in its development when he discovered that by means of the initial explosion of a detonator, he could elicit its enormous energy. But during the next few years a series of disastrous accidents, due to liquid nitro-glycerine, led to public reprobation of the compound, and Sweden, Belgium, and England totally prohibited its use. Nobel, however, continued his investigations, and in 1867 he patented an invention which placed dynamite among recognised articles of commerce in this country. He caused the nitro-glycerine to be absorbed in porous unexplosive substances—such as charcoal—whereby it became insensible to shocks, and could be burned over a fire without exploding, while if fired by a detonator its full power would be developed. "Dynamite" is now used as the genuine title for a vast number of nitro-glycerine explosives, known under various distinguishing or fancy names.

THE DOTY LIGHT.

The *Times* states that a very useful and cheap self generating light for illuminating workshops and for enabling outdoor operations to be carried on at night has just been perfected by Captain Doty, who will be remembered as having solved the problem of employing mineral oils in lighthouse illumination. The Doty light, which is self contained and portable, consists of a galvanised iron cylinder 2ft. high and 18in. diam., which contains a supply of paraffin or other mineral oil. Pressure is brought on the top of the oil by means of an air pump attached to the cylinder, and the oil is thus forced up a tube which reaches nearly to the bottom of the oil supply. This tube is placed outside the top of the cylinder in a spiral form, and the end is continued downwards, so that the orifice of the tube is in the centre of the vertical coil, and constitutes the burner. The lamp is lighted by first heating the coil by a small oil flame to the temperature necessary for the vaporisation of the oil. When this point is reached, which is in three or four minutes, the oil is turned on, and upon entering the coil is at once vaporised and burnt as a gas, giving a brilliant flame some 3ft. high. As the flame originates at the bottom of the coil and passes up through its centre it keeps the coil hot, and the conversion of the oil into gas goes on continuously. The working air pressure is from 10lb. to 15lb. per square inch, and a 500 c.p. light, it is said, will burn for thirteen hours with one charge of oil, and at a cost of less than 6d. per hour. The air pressure requires renewing about every two and a half hours. A demonstration of the Doty light took place on the 8th inst. at Messrs. F. Braby & Co.'s works at Deptford, when two of the lights were shown to amply illuminate a store 200ft. long by 40ft. wide. It was found possible to read a newspaper at a distance of 130ft. from one of the lights, and the demonstration was in every way a success.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

2nd March, 1888.

3183. Stanley, D. A. — Air compressor.
3186. Maltby-Newton, C. — Gas engine.
3206. Bernhardt, G. — Spinning machines.
3211. Skinner, H. A. — Double acting pumps.
3212. Briggs, I. — Spinning frames.
3216. Oldroyd, J. W. — Steam boilers.
3226. Davy, C. — Bloom shearing machines.
3232. Thompson, W. P. — Dyeing fabrics (*Doulceron and Van Meerbeeck*).
3233. Myers, F. — Type writing machines.
3237. Williams, S. de la G. — Lime kilns.
3248. Jones, C. W. — Spinning machinery.

3rd March, 1888.

3253. Nussey & Haskard — Warp knitting machines.
3261. Woollason, W. — Threshing machines.
3265. Moorhouse, W. H. — Jacquard mechanism for looms.
3266. Dorman, W. H. — Circular knitting machines.
3270. Winder, R. — Type composing machines.
3285. Oliver, T. — Winding yarn.
3288-9-90-91-92. Burkhardt and Jackson — Forming hollow spheroidal bodies from metal tubes.
3296. Thompson, W. H., and others — Pulverising machine.
3311. Davis & Howard — Sewing machines.
3313. Bollmann, L. — Sewing machines.
3314. Skaife, W. — Riveted joints.
3326. Breeden & Breeden — Screw cutting lathes.

5th March, 1888.

3337. Windrath & Hausmann — Looms.
3339. Evans & Hall — Generating steam.
3340. Bottomley & Townsend — Pickers for looms.
3342. Fairweather, W. — Copying press (*Schwing*).
3345. Holt & Gould — Potato digging machines.
3346. Fisher, H. A. — Twist lace machines.
3349. Wilkinson, F. — Carding engines.
3353. Fry & Fry — Paddle wheels.
3356. Low, R. — Spinning machinery.
3359. Law, E. F. — Type writers.
3367. Wise, W. L. — Centrifugal machines (*Burmeister & Maskin-og-Skibsbyggeri*).
3368. Turnill, A. C. — Thrashing and seed rubbing machine.
3370. Richardson, W. — Grinding the teeth of the "cards" employed in carding engines.
3381. Rogers, H. — Axle boxes.
3383. Krell, O. — Gun carriages.
3384. Mudd, T. — Steam hammers.
3388. Poore & Storey — Vessels constructed to travel under water.

6th March, 1888.

3397. Page, W. A. — Road sweeping and collecting machine.
3406. Walker, A. B. — Two wheeled road carriages.
3409. Holgate, J. B. — Apparatus for conveying granular substances.
3410. Hall, J. F. — Manufacture of iron or steel.
3414. Thompson, W. — Shedding motions of looms.
3419. Brown, G. — Kilns for burning bricks.
3420. Eves, J. V. — Flyer spinning of fibres.
3425. Frisbee, G. — Crushing mills.
3427. McGhee & Burt — Gas motor engines.
3429. Lawrie, J. G. — Corrugated furnaces.
3432. Gutman, J. — Sewing machines.
3439. Pearson, M. H., & others — Punching and eyeletting machines.
3445. Röell, C. F. A. — Pleating fabrics.
3447. Gillies, D. — Axle for mortar mills.
3449. Justice, P. M. — Railway switches (*Isbell*).
3450. Paul, E. — Pumps.
3452. Catchpole, A. — Generating steam.
3454. Murrie, J. — Condensers for steam engines.
3457. Shepherd, J. W., & ors. — Winding yarn.
3465. Watson, T. — Damping yarns in looms.
3473. Wawn, C. — Travelling cranes.
3474. Edwards, E. — Starting apparatus for carriages (*Feenel*).

7th March, 1888.

3479. Ashworth, H. — Mules.
3481. Latouche, J. A. C. de — Mounting and working guns.
3488. Orr & Brown — Pointing and closing the ends of metal tubes.
3489. Dawson, D. R. — Sewing machines.
3490. Mycock, W. — Dyeing apparatus.
3491. Bradbury, J. — Weighing machines.
3503. Watkin, H. S. S. — Firing guns.
3508. Thompson, W. P. — Cable coasters (*Van Zandt*).
3518. Murrie, J. — Pumping engines.
3531. Taylor, W. H., & others — Loom temples.
3541. Pastor, F. — Forging bolt heads.
3542. Watson, C. T. — Machines for printing cards.
3544. Bischoff, M. — Cutting screw threads.
3545. Greenway, G. H. — Sand washing and elevating machine.
3546. Rollason & Hamilton — Gas engines.

8th March, 1888.

18031. Hignette, J. J. — Grinding mill. (Ante-dated 18th October, 1887. Under International Convention.)
3554. Smith, D. — Moulding and folding sheet metal.
3556. Taylor, J. — Consuming smoke.
3559. Mycock, J. — Dyeing machines.
3561. Sharples, G. B. — Smoke consuming apparatus.
3569. Wilson, J. W. — Steering ships.
3570. Philip, J. R. — Centrifugal machines.
3573. Bamford & Wild — Manufacture of velvets.
3576. Gibson, J. — High speed gearing.
3577. Clegg, G., & others — Twisting yarn.
3582. Dealy, T. — Motors.
3583. Holroyd & Wilson — Kilns for heating pottery.
3585. Longbottom, W. — Picking motion for looms.
3586. Longbottom, W. — Shuttle boxes for looms.
3587. Burtscheidt, G. — Weaving pile fabrics.
3597. Britain, W. — Centrifugal pumps.
3606. Cooper, R., & others — Dyeing fibrous substances.
3609. Johnson, J. Y. — Water meters (*La Société Fritz Perret et Cie*).

ELECTRICITY.

2nd March, 1888.

3215. Oldroyd J. W. — Electric incandescent lamps.
3223. Kingsland, W. — Secondary batteries.
3230. Allsop, F. C. — Electrical tramways.
3235. Miot, G. — Dynamo-electric machines.
3246. Walker, F. — Electrical lamp.

3rd March, 1888.

3286. Addenbrooke, G. L. — Electrical measuring instruments.
3303. Leigh, H. H. — Registering the consumption of electric energy (*Clerc*).
3312. Tyer, E. — Voltaic batteries.
3328. Langdon-Davies, C. — Commutators.

5th March, 1888.

18030. Lebiez & Verchère — Thermo-electric batteries. (Ante-dated 8th November, 1887. Under International Convention.)
3369. Watt, A. — Zinc ores.

6th March, 1888.

3456. Winnall, W. H. — Electric bells.

7th March, 1888.

3483. Schmidt, F. T. — Electrical switches.
3498. Parker, T. — Dynamo-electric machines.
3504. Oldfield, J. — Multiple electric communication.
3515. Collet, H. — Telephonic apparatus.
3517. Disher, R. — Primary batteries.
3535. Fitch, W. B. — Electric conductors.

8th March, 1888.

3550. Thompson, N. G. — Electrical battery.
3571. Laurie, T. — Telephonic transmitters.
3590. Statter, J. G — Electrical transformers.
3593. Walker, R. — Electric batteries.
3614. Ferranti, S. Z. de — Dynamo-electrical machines.
3618. Saunders & Brown — Fire alarm telegraphs.

CHEMISTRY.

2nd March, 1888.

3179. Bowen, E. — By-products of gas manufactures.
3182. Chance & Chance — Sulphuretted hydrogen.
3193. Thatcher, E. — Brewers' "finings."
3218. Gossage & Mathieson — Sulphide of sodium.
3228. Bunn, P. C. — Extracting gold.

3rd March, 1888.

3310. Byrom, W. A. — Making charcoal from peat.
3317. Schmidt, V. — Metallic alloy.

5th March, 1888.

3374. Hessel, C. — Zinc white.
3378. Lebedeff & Hughes — Treatment of metallic ores.

6th March, 1888.

3428. Green, H. — Treating ammoniacal liquor.
3476. Von Ehrenwalten and Fabricius — Production of gas.

7th March, 1888.

3495. McDougall, A. — Manufacture of gas.
3510. Manbrè, E. — Making alcohol.
3530. Brins Oxygen Company and Goble — Carbonated oxygen water.
3547. Brin, L. Q. — Aluminium bronze.
3548. Brin, L. Q. — Plating iron with aluminium.
3549. Brin, L. Q. — Alloys of aluminium.

8th March, 1888.

3579. Geary, G. J. — Sulphide of zinc (*Keiller*).
3601. Cunningham, A. B. — Sodium and potassium.
3602. Cunningham, A. B. — Aluminium.
3613. Jones, F. F. — Sulphate of iron.

MISCELLANEOUS.

2nd March, 1888.

3180. Birch, W. — Stretching fabrics.
3187. Rose, W. — Chain cable.
3188. Hartnell, W. — Treating sheets of iron after tinning.
3192. Dyson, R. — Supporting rails in their chairs.
3195. Emmett, H. — Door places for hoists.
3198. Norcliffe & Jessop — Steaming seal skin fabrics.
3201. Orr & Brown — Producing patterns upon metal.
3202. Temple, W. — Drying bricks.
3203. Jones, J. — Forging & re-sharpening chisels.
3204. Mitchell, A. — Shuttle for weaving (*Dolbey*).
3220. Taylor, E. K. — Tricycles.
3221. Palmer, T. N. — Mitreing printers' rules (*Golding*).
3222. Parkes & McWatt — Cut nails.
3224. Parker, C. E. S. — Couplings for carriages.
3225. Shearme & Morris — Measuring liquids.
3227. Smith & Smith — Locks and bolts.
3231. Boult, A. J. — Packing cases (*Lancha*).
3238. Hopkinson & Hopkinson — Stop cocks.
3240. Pearce, H. T. — Horseshoes.
3242. Varley, J. J. — Stoppering bottles.
3243. Herrmann, M. — Lamp glasses.
3249. Stokes, W. — Gulley traps.

3rd March, 1888.

3254. Graham, H. J. — Bottles.
3255. Wheatley, W. T. — Cement.
3256. Hobson, A. H. — Treatment of bones.
3262. Ogg, J. — Dressing stone.
3263. Rylands, D. — Bottles.
3267. Billington & Newton — Lubricators.
3271. Davies & Fraser — Stuffing boxes.
3275. Leather, J. P. — Regulating the pressure of gas.
3281. Roeckner, C. H., and others — Refining paper pulp.
3282. Buckton, H. — Regulating the pressure of water in mains.
3287. Fairclough, G. — Lubricator.
3293. Loftus & Angier — Signal lamps for ships.
3294. Hawkins & Stacey — Hydrocarbon lamps.
3297. Clayton & Gresham — Warming railway carriages by steam.
3299. Kelly, W. P. — Lubrication.
3302. Reynolds & Hibbard — Lamp.
3306. Carter & Aynsley — Spring hinges.
3309. Corcoran, P. — Dressing stone.
3316. Stark, W. F. — Manufacture of candles.
3318. Bayer & Lease — Tricycles.
3319. Héroux, J. — Gas extinguisher.
3320. Surprenant, L. — Nut lock.
3323. Palmer, T. N. — Mitreing printers' rules (*Golding*)
3327. Griffiths, A. H. — Lamps.

5th March, 1888.

3329. Walsh, J. — An improved lens.
3347. Matthews, S. — Water gauges for steam boilers.
3373. Warner, W. J. — Dry gas meters.
3382. Redfern, G. F. — Fixing railway rails to sleepers (*Coblyn*).

6th March, 1888.

3391. Vinton, J. H. — Ratchet drills.
3394. Harrison, W. M. — Fire extinguishers.
3395. Whittaker, R. — Clip for holding rolled material.
3405. Low, W. — Drying fibres.
3407. MacLeod, A. C. — Projectiles.
3408. Redwood, E. G. — Wood finishers.
3411. Haill, J. — Brake.
3415. Wilson, R. — Couplings for rolling stock.
3423. Burtonshaw, T. — Tar burners.
3430. Carroll, J. — Oil lamps.
3436. Deane & Winfield — Stopping bottles.
3460. Japiot, J. — Trimming the heels of boots.
3464. Haddan, H. J. — Split pulleys (*Zerbe*).
3466. Johnson, J. Y. — Lubricator (*Société Million Guiet et Cie.*).
3467. Hammond, L. G. — Hinge.
3468. Boynton & Johnson — Spools for spinning machines.
3477. Walton, F. — Flexible metallic tubing.

7th March, 1888.

3496. Higginson, A. — Pulleys.
3501. Brookbanks, J. — Composition for ships' bottoms.
3507. Marriott, J. F. — Stoppered bottles.
3513. Rigby, W. — Dressing stone.
3516. Brothers, C. — Ventilators.
3520. Hey, J. G., and others — Manufacturing solid india-rubber cords, tyres, & packing.
3522. Lea, R. H. — Velocipedes.
3526. Robertson, J. — Carriage draw bar attachments.
3529. Mayrhofer & Kurka — Apparatus for cleaning boots.
3532. Kraemer, H. — Ventilators.
3533. Dronier, P. — Magnesium lamps.
3536. Crastin & De Pass — Gas burners.
3537. Ferguson, J. — Lamps.
3538. Seagrave & Olivier — Carburation of gas.

8th March, 1888.

3552. Hunt, W. H. — Bottles.
3553. Ward, J. R. — Automatic sprinklers.
3558. Shaw, S. — Shaft guard.
3565. Hiller, H. — Safety plugs for steam generators.
3566. Dempster & Dempster — Feeding retorts with coal.
3578. Thompson, W. P. — Nut locks (*Albert*).
3581. Fraser, W. — Water gauges for steam boilers.
3584. Taylor, J. — Extracting oil from fish.
3591. Bower, J. — Safety lamps.
3604. Keller & Guérin — Producing designs upon vitrified surfaces.
3607. Ivall, J. — Elliptic springs for carriages.
3608. Burgess, H. J. — Ball valves.
3612. Doty, H. H. — Burning hydrocarbon for signalling purposes.
3616. Wilding, S. P. — Utilising high explosives in warfare (*Emmens*).
3619. Ryan, F. J. — Cocks and taps.

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COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

10th March, 1888.

220. Normanville, S. A. de. Liquid meters.
3372. Hoster, A. Breech loading fire arms.
4208. Carpenter, J. J. Steam engines.
4511. Ridealgh, C. Gas engines.
4778. Maxim, H. S. Quick-firing guns.
4988. Boult, A. J. Sewing machines (*Whitney*).
5200. Anderson, J. L. Smoothing textile fabrics.
5375. Jones, D. Sewing machines.
5449. Jeffries, G. A self acting motor.
5915. Hacking, W. H. Shedding motions for looms.
6208. Sutcliffe & O'Brien... Apparatus for drying cotton.
6516. Payton, W. Valve gear.
6526. Sugden & Colburn..... Yarn beaming machines.
6527. Sugden & Colburn..... Warp beaming machines.
6545. Harris & Shuttlewood Pelerine machines.
6569. East, J. E. Annealing iron sheets.
6574. Barnard, E. N. Generation of steam.
6592. Whittaker & Bury..... Looms.
6601. Anderson, A. Sewing machines (*Singer Manufacturing Co.*).
6629. Johnson, J. Y. Hydrostatic disappearing turret (*Souriau*).
6658. Read, R., & others ..... Making sheet metal articles.
6743. Tydeman, B. Dredger.
6750. Jones, O. Production of sand moulds (*Tasker*).
6752. Warsop, T. Weighing machines.
6778. Mewburn, J. C. Breaking flax (*Gavelle*).
6784. Appleby & Robinson... Blast pipes.
6810. Brown, A. B. Hydraulic unloading apparatus for ships.
6880. Kittle & Adgate. Knitting machines.
7222. Ellis & Wilkinson..... Ejector mechanism for breech loading small arms.
7224. Beyer, A. Knitting machines.
7267. Adgate & Kittle..... Manufacture of knitted fabrics.
7605. Lawson & Dear ..... Driving the bobbins of spinning frames.
7675. Johnson & Phillips ... Anchors.
9399. Dickson, J. Ejector for drop-down fire arms.
9647. Glembowieski, A. Rotary engines.
11881. Winkler, F. G. Sifting machinery.
16832. Turner, B. Hydraulic lifts.
17119. Paterson, A. Shaping metal tubes.
660. Briggs, J. W. Rotary pumps and engines (*Barber*).
1450. Smith, C. H. Wool scouring machine.
1655. Lake, H. H. Rotary printing machines (*Société Paul Auguste-Godchaux & Cie*).
1674. Buckley, W. Linings for steam engines.
1799. Richardson, A. S. Sewing machinery.
1824. Boult, A. J. Steam generators (*Stehlik*).
1959. Thomlinson, W. Flues of regenerative chambers.

ELECTRICITY.

10th March, 1888.

4369. Jolin, P. Measuring electric currents.
4635. Baker & Bryan ..... Telephonic and telegraphic call apparatus.
5140. Quarterman, W. H. Galvanic batteries.
5193. Grindle, G. A. Distribution of electricity.
6267. Cockburn & Thomas ... Electric switches.
6590. Scott & Paris ..... Magneto-electric cut-out.
6621. Andrews, J. D. F. Electromotors.
6933. Nicoll, D. Insulation of electrical conductors.
7548. Gott, J. Submarine cables.
9515. Worms & Balé. Tanning by electricity.
13148. Ross & Franzen ..... Producing rectilinear or rotary motion by electricity.
13447. Lineff & Bayley..... Electric railways.
155. Boult, A. J. Electrical turnstiles (*Ehrling*).

CHEMISTRY.

10th March, 1888.

4371. Delhaye, A. Caustic soda and potash.
5753. Mathieson & Hawliczek ..... Carbonate of soda.
6632. Wise, W. L. Phosphates (*Solvay*).
7087. Watson, W. R. Sugar (*Young*).
13839. Salamon, A. G. Treatment of benzoyl sulphonic imide (commonly known as saccharine).

MISCELLANEOUS.

10th March, 1888.

3929. Ibbotson, A. B. Lock nuts.
4346. Radcliffe, J. H. Fire extinguishing apparatus.
5369. Harverson, W. W. Lamps.
5600. Dauber, J. Ice machines.
5647. Gray, A. Extinguisher for oil lamps.
5840. Newton, A. V. Explosive projectiles (*Nobel*).
6266. Shoenberger, J. L. Couplings for railway vehicles.
6357. Harris & Shaw ..... Parallel vices.
6383. Bosshardt, F. Levels and clinometers (*Hahn*).
6556. Brewer, G. Lamps (*Hivet*).
6616. Marguerie, L. C. A. ... Vitreometallic material suitable for glazing in place of glass.
6644. Wall, J. Signal lamp.
6653. Storey, W. F. Cinder sifter.
6713. Parry, E. H. Fusible safety plugs for furnace tubes.
6774. Lyle, J. Hydrocarbon fuel.
6884. Chapman, F. Nail (*Stokes*).
7019. Burdon, J. Locks.
7131. Dixon, R. G. Horseshoes.
7132. Michel, J. Speed indicator for vessels.
7611. Johnson & Phillips ... Grapnel rope couplings.
9283. Coward, J. Ring frame bobbins.
10023. Tapp, W. Water softening apparatus.
14669. Brierley, W. Lubricator.
16501. Wacks, L. Artificial fuel.
16779. Stanynought, H. Safe locks.
511. Howorth, J. Circulating air.
1313. Redfern, W. Valves (*Howard*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(*To the 3rd December, 1887, inclusive*).

Year 1883.

5521. Péchard, J. E. Sewing machines.
5522. Alexander, E. P. Abrading threads of railway and tramway wheels (*McIntyre*).
5523. Hillman, W. Velocipedes.
5525. Typke, P. G. W., & ano. Substitute for bisulphide of carbon.
5527. Reynolds, J. H. Ventilators and chimney cowls (*Robinson*).
5528. Dickinson, B. Propelling and steering ships.
5535. Johnson, J. H. Telegraphic relays and repeaters (*Maloney & another*).
5538. Thompson, W. B. Compound marine engines.
5542. Boult, A. J. Illuminating and heating gas (*Hanlon & another*).
5546. De Castleberg, J. A. B. Lathes (*Piquerez*).
5550. Kidd, J. H. Manure.
5551. McNair, W. L. Reverberatory gas furnaces.
5553. Pitt, S. Treatment of mixed fabrics (*Robert*).
5554. Lake, H. H. Fabrics covered with xylonite, &c. (*Edson*).
5559. Wood, G. Lamps.
5560. Wilkinson, W. Traction engines.
5564. Clark, A. M. Reduction of iron ores (*Thiéblemont*).
5569. Adie, P. Velocipedes.
5577. Cowan, A. B. Coke.
5581. Dehaître, F. Finishing textile fabrics.
5584. Haddan, H. J. Electric igniting apparatus (*Witte*).
5587. Wigham, J. R. Working audible fog signals.
5592. Dufriche-Miroude, E.. File wheel for grinding cards.
5594. Campbell, J. Wool washing machines.
5602. Clark, A. M. Working, &c., railway switches (*Railway Speciality Manufacturing Company*).
5605. Weldon, W. Soda.
5610. Lloyd, W. J. Tricycles.
5612. Settle, E. R. Tricycles.
5613. Wise, W. L. Velocipedes (*Von Palstring*).
5619. Boult, A. J. Telegraph and telephone wires (*Gray*).
5622. Jensen, P. Articles of wood pulp (*Andersson*).

Year 1882.

5628. Hornsby, W., & another Steam and motive power engines.
5671. Ekman, C. D. Colouring matters.
5727. Taylor, G Raising, &c., railway waggons.
5743. Clark, A. M. Wind motors (*Dumont*).
5760. Johnson, J. H. Bricks, &c. (*Darrigan*).
5763. Jensen, P. Protecting ships against shot (*Von Stockhausen*).

Year 1881.

5216. Liardet, J. E., & ano... Hydraulic motors.

Year 1880.

4932. Lyte, F. M. Treatment of ores.
4963. Howard, J., & another. Ploughs.
4968. Macay, J. F. N. Dissolving and filtering in chemical processes.
4975. Mitchell, J. Washing machines (*Storey*).
4996. Walker, J. Cocks and taps.
5001. Hedderwick, P. D. Printing, &c., newspapers.
5007. Readman, J. Mariners' compasses.
5025. Sutcliffe, R. Cleaning flues of steam boilers.
5041. Dobson, B. A., & another Spinning and doubling.

Year 1879.

4901. Hearson, C. E. Gas governors.

Year 1878.

4919. Clark, J. L., & another. Artificial breakwaters.

Year 1877.

4537. Levick, G., & another... Rails for tramways, &c.

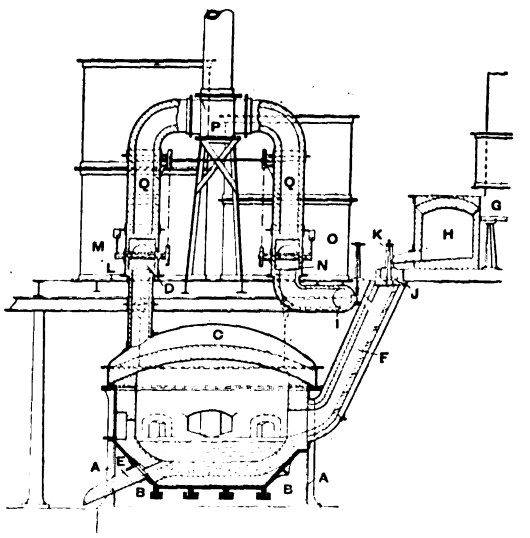
ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Boiler Furnaces.—*J. Platt, Sheffield.*—This invention is applicable to various types of furnace, but more particularly to the furnaces of Cornish boilers. An air box is formed in the brick work of the fire bridge, or is constructed of fire clay or metal faced with brick. An opening is made in the box for the admission of a pipe to the rear of the bridge. At the bottom of the bridge below the fire bars is another pipe whose mouth comes through the front of the bridge. This pipe is carried for some distance on the bottom of the flue tube, and its direction is then reversed towards the bridge, where it is connected with the opening in the air box. In the bottom of the flue tube underneath the fire bars are a number of plates lying horizontally above the mouth of the pipe in the bottom of the bridge, and protecting it from being choked up with ashes. These plates are provided with longitudinal ribs on the under side, and extend from the front of the bridge to the front of the boiler, thus forming air spaces which may be provided with valves for the regulation of the admission of air. When the boiler is at work the plates below the grate bars become heated by the cinders falling on them, and the air admitted into the spaces below the ash plate becomes heated in its passage towards the mouth of the air pipe in the bottom of the fire bridge; in passing through this pipe the air is further heated as it approaches the air box, whence it is discharged through the orifices in the cover bricks at the top of the fire bridge. In its heated and rarefied state it intermingles with the gases and other products, thereby contributing to a more perfect combustion. The inventor makes two claims for the parts constituting the air box and its pipes for the purposes described.—No. 5676. April 19th, 1887. 8*d.*

Manufacture of Steel.—*B. H. Thwaite, Liverpool, and J. Noble, Middlesbrough.*—This invention introduces certain improvements into the process described in Patent No. 11972 of 1886, granted to B. H. Thwaite. The molten metal from the blast furnace is run direct to a receiver. After a sufficient quantity is accumulated, it is tapped into the ladle, which runs on rails on an upper floor. This upper floor is built at such a height above the open hearth furnace as to be level with the upper end of a Thwaite vertical pneumatic converter placed on the centre of the furnace roof. Open hearth recuperator vessels are placed on this upper floor. The melted pig is run from the ladle into the Thwaite converter, in its course through which it is partially converted by the air blast. The bath of the open hearth furnace is made shallow, so that a large surface of metal is exposed. When phosphoric pig iron is employed, a preliminary basic open hearth and inclined furnace is substituted for the basic cupola. The inclined hearth furnace has several levels, on which the pig iron can be rapidly charged and melted. A finely ground limestone is there added to the metal, in order to increase the basic character of the slag. A recuperative arrangement is provided in this inclined furnace for the removal of the phosphoric element; and a second furnace of silicious material

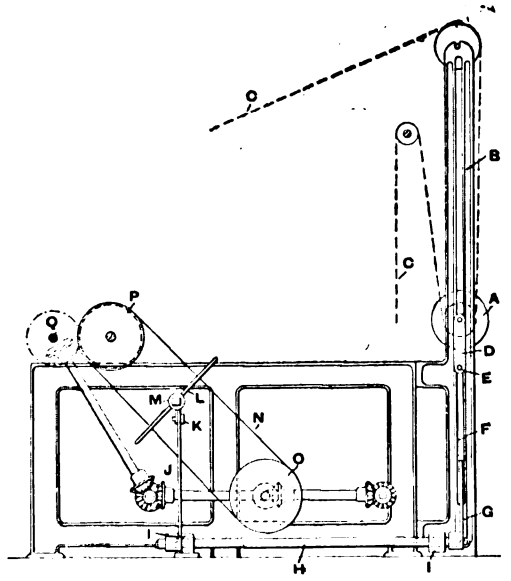


afterwards receives the metal in its pure state. The inventors specify several arrangements of plant for carrying out this process, one of which is illustrated in vertical section in the accompanying diagram. The furnace is made circular in plan; its under side is surrounded by a casing A, enclosing an air space B. This air space is connected with another at C, which in its turn is connected to the air reversing valve D, so that the heat radiated from the side of the furnace is utilised by being re-added to the internal heat of the furnace. The tapping spout is shown at E, the Thwaite converter at F, the cupola at G, and the receiver at H. The upper part of the converter communicates with the gas supply flue I, so that it can be heated to a high temperature before the metal is tapped from the receiver H. The air to support the combustion of the gaseous fuel in the converter passes through the metal ingress J, which can be entirely covered with a fire clay plug K. The reversing valve arrangement is placed on the upper floor; L is the air valve connected to the air recuperator vessel M, and the gas valve N communicates with the gas recuperator O. The valves are connected to the chimney flue junction P by means of the lined flues Q. The inventors make five claims for the process and the plant described.—No. 16497. December 1st, 1887. 1*s.* 1*d.*

Hot Air Engines.—*R. L. Howard, E. Howard, & R. S. Lloyd, London.*—In some hot air engines, such as the Ryder engine, Patent No. 3404 of 1875, the lower part of the heater is exposed to the direct heat of the fire, and consequently wears out much sooner than the upper part. According to this invention, the lower part is made of cheaper cast iron, and is bolted on to the rest of the heater. The removal of the worn out parts is thus facilitated. In another modification, the door of the fire box is made sufficiently large to effect the removal of the entire heater. The door is placed in the front, and the smoke outlet at the back is constructed in such a manner as to act as a hand hole for reaching the parts to be detached. An annular baffler is arranged underneath the annular bottom of the heater, in order to protect the heater from the direct heat. The inventors make two claims for making the heater in two parts and for the annular baffler.—No. 4692. March 29th, 1887. 8*d.*

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Sizing, Drying, and Warping Machines.—*E. Brook, Huddersfield, and J. Vickerman, Mirfield, Yorkshire.*—In the ordinary machines for combining the three processes of sizing, drying, and warping, the increasing diameter of the coil of threads wound in the warping mill tends to increase the tension on the threads as they come from the letting off rollers in the drying machine. The object of this invention is to provide an automatic regulator of the tension. The accompanying figure illustrates an end elevation of one of the two modifications of the improved apparatus. The essential feature is the application of a loosely mounted rising and falling roller A, and the frame work B for guiding its motions. Its position is dependent on the tension of the threads C, which in their passage from the sizing machine to the warping mill are caused to pass under and support the roller in the manner shown in the figure. The spindle D is connected by the arms and cross bar E and rod F to a lever arm G which projects from a rocking shaft H. Another arm J fixed to the rocking shaft is linked to the belt shipper L, which works on a guide rod M. The belt N passes partly round



a pair of slightly conical pulleys O P. The small end of one pulley is arranged opposite the large end of the other, so that as the belt is shifted from the large end of the driving pulley towards the large end of the driven pulley by the increased tension in the threads, the warping mill is caused to run somewhat slower. When one section has been wound on the warping mill and another section is commenced, the tension on the threads C is least, and the mill may not take the threads up as fast as they are let off from the drying machine. This defect is immediately rectified by the roller falling by the action of gravity. Afterwards the roller in its descent drags the belt shipper and belt towards the large end of the driving pulley, as described. In the second modification the object is attained simply by the use of a weighted roller which is suspended by the threads. This method is only applicable where there is very little variation of tension. The inventors make two claims, one for each modification.—No. 4591. March 28th, 1887. 8*d.*

Magazine Guns.—*A. J. Boult, London.* (*M. Hartley, New York.*)—This invention relates to the Martini-Henry type of arms, in which a breech block pivoted at its rear end in the frame swings downwards and backward to open the breech. In the Patent No. 9796 of 1887 the present inventor described a gun in which the breech block was made in two parts, both swinging on the same pivot, with a passage between them for conducting the cartridges from the magazine in the rear stock to the chamber. According to this invention, the breech block is made in a single piece, with a longitudinal opening through it, which forms a continuation of the magazine tube, and serves to conduct the cartridges to the chamber. Four claims are made. —No. 17384. December 17th, 1887. 8*d.*

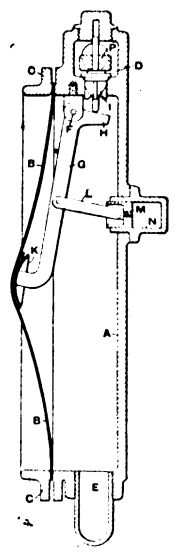
Wood Working Machinery.—*A. Kerr & R. Kerr, Glengarnock, Ayr.*—The wood to be operated on is fastened between two adjustable sockets, which can slide along slots in the table of the machine. Two side standards are connected at the top by a bridge frame, which is grooved vertically to hold a sliding piece which carries the tool. The tool holder is vertically adjustable by means of a screw, so as to adapt it to various work. Two feet attached to a transverse bar on the tool holder slide over the surface of templates fixed to the side of the table. The shape of the template causes the tool holder to slide up and down in the groove in the bridge frame, while gravity effects its descent. The course pursued by the knife is thus determined and the figure cut from the wood can be varied indefinitely by the employment of templates of different shapes. Three claims are made.—No. 15626. November 15th, 1887. 6*d.*

Carding Engines.—*W. Knowles, Bolton.*—The revolving flats are constructed, according to this invention, so as to clean and improve the fibre more effectually. The endless lattice of revolving flats is divided into two entirely different sections. The first section is mounted on pulleys and guided over the bend in the usual manner, and is formed of flats of coarse open filleting. When these flats are passing the under side of the bottom pulley, near the taker in, they are guided in a parallel line to facilitate the stripping performed by a revolving brush or filleted roller. The removed strippings are cleared from the revolving brush by another one, which delivers them to the taker in. The strippings are then subjected to the usual operation performed by the taker in, and the dirt is driven by its centrifugal force into the fly space. Any imperfections which are not thus arrested will be caught again by the first section of the flats, and the process will be repeated until all the dirt has been deposited in the fly space. The second section of the flats is constructed and mounted in the usual way, and is divided on the upper side of the carding cylinder by a plate which extends across the cylinder from side to side. A filleting of fine wire is fixed on the flats, and is calculated to act on the previously purified fleece in a more effective manner. The first set of flats may be driven at a greater speed than the finishing flats. The inventor makes three claims for this arrangement of flats.—No. 5416. April 14th, 1887. 8*d.*

Wood Planing Machines.—*T. N. Robinson, Rochdale.*—This invention is more particularly applicable to hand planing machines, in which a horizontal cutter block is supported between a pair of bearings. It may also be applied to machines which are provided with a self acting feed. The aim is to readily adapt such machines to cut straight, curved, or circular mouldings without interfering with its ordinary uses. An adjustable table is fitted in guides on one end of the machine, and in the end of the cutter spindle a hole is bored, preferably of taper form. The hole has a screw thread at one end, and any number of different sized spindles may be fitted into it. These small auxiliary spindles carry cutter blocks on which moulding cutters are secured. In some cases the wood to be operated on is placed below, and in other cases above, the cutter spindle. In the former case an adjustable fence is fixed to the table, together with the necessary spring rollers for steadying the timber. A hole in the table permits it to be raised above the small cutter spindle for cutting mouldings with a fly cutter. In this case a piece of hard wood is fitted into the hole in order to form a support for the cutter. When the machine has been set in motion the table is gradually lowered until the cutter has cut through the plug of wood, and projects far enough through it to cut the desired moulding. The inventor makes two claims for the combination of the ordinary surfacing cutters with the overhanging moulding or fly cutters, and with the adjustable slotted table and filling up piece as described.—No. 5100. April 6th, 1887. 8*d.*

Mangle Racks for Platen Printing Machines.—*T. Coulthard & J. Bradshaw, Preston.*—This invention relates to that class of reciprocating toothed racks called mangle racks, in which the axis of motion of the driving pinion is fixed. Arrangements are made by which the rack when shifting from side to side at the end of its traverse may be caused to move bodily at right angles to the line of its path. The rack is mounted so that it can slide upon two or more transverse guide rods, which are arranged at suitable distances from each other, and fixed to the plate upon which the rack is carried. This arrangement permits of a considerable acceleration of the reciprocating movement of the racks. The inventors claim the combination of reciprocating toothed racks with transverse slides or guide rods arranged as described.—No. 5057. April 5th, 1887. 8*d.*

Gas Engines.—*C. G. Beechy, Liverpool.*—The accompanying figure illustrates the inventor's design for a gas bag for regulating the supply of gas to the engine. The objects aimed at in this arrangement are to prevent fluctuation of the pressure of the gas in the mains, and to automatically close the inlet valve in the event of the bursting of the bag. One side of the cast iron case A is provided with a flexible diaphragm B, which is secured in its place by the ring C. The gas enters at D, and proceeds to the engine through the opening E. A lever G, wholly inside the box, is pivoted at the point F, and its lower end is formed so as to press against the diaphragm. The tail H actuates the entry valve I, and a lever L attached to the middle of G is connected with the piston M, which works in the cylinder N. The weight P is placed on the valve I, and is made sufficiently



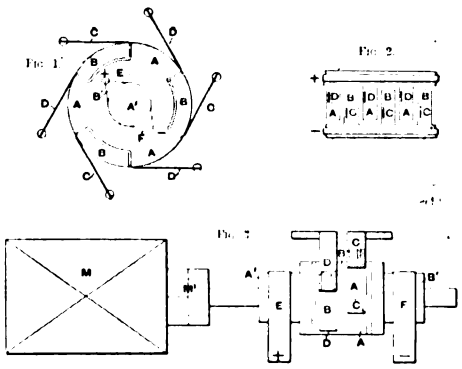
heavy to overcome the weight of the lever G when the pressure of the diaphragm is released. When the engine starts, the box will be full of gas, the diaphragm will be forced outwards, the inlet valve I closed, and the lower end of the lever G will press against the diaphragm, as shown in the figure. The engine then draws the gas through the outlet E, and the diaphragm retracts and carries with it the end of the lever G. The tail H is caused to open the gas inlet valve I, and more gas enters the box. The dash pot N prevents the lever G from returning quickly, so that the diaphragm on again becoming distended by the entry of the gas, parts from the lever for a time. The counteracting actions of the diaphragm, dash pot, and the pressure of the entering gas reduces the fluctuation of the supply to a minimum, and the pressure in the main is hardly disturbed at all. In the event of the gas bag bursting, or of the engine stopping while the gas cock is open, the inlet valve will automatically close by the weight P overcoming the power of the lever G. The inventor makes three claims for the arrangement and construction of the gas bag, as described above.—No. 4160. March 19th, 1887. 8*d.*

Portable Boiler and Centrifugal Pump.—*Tangyes, Limited, Birmingham, and T. Jefferies, Handsworth, Staffordshire.*—The object of this invention is to combine a portable boiler with a centrifugal pump and engine, in such a manner that a complete balance shall be effected, and that the pump shall be kept free from the dust due to the firing of the furnace. A frame of wrought iron is connected to the fire box and extends from side to side between the pairs of wheels. The engine bed of cast iron is secured on this base; at one side is placed the steam engine and on the other the centrifugal pump, and the spindle of the pump is coupled to the crank shaft of the engine. The pump is so arranged that it can be turned in several directions to meet the varied requirements of the suction and delivery pipes, and when the pump is not in use, the coupling can be unloosed and the engine can be employed for other work. A fly wheel is placed on the outer side of the shaft in a convenient position for being surrounded with a driving belt. The inventors make one claim for the arrangement.—No. 32220. March 2nd, 1887. 6*d.*

Welding the Ends of Tubes.—*J. P. Kennedy & E. S. T. Kennedy, New York.*—By the machine here invented the end of the tube to be closed is heated to a working heat, and afterwards fed forward and rotated whilst it is subjected to the swaging action of a pair of conical dies. After a conical end is formed, it is re-heated and slid upon a mandrel with a hemispherical end. A die with a concave rounded recess descends upon the end supported on the mandrel, and the tube end is welded and swaged upon itself without seam or joint. The inventors make eighteen claims for the process, the machine, and the tube as an article of manufacture.—No. 11673. August 27th, 1887. 8*d.*

ELECTRICITY.

Electrical Transformer.—*M. Immisch, London.*—In converting alternating currents into continuous ones the inventor employs a primary conductor, through which the alternating current passes, and which is surrounded by a number of secondary conductors, in which induction takes place. The inner end of each secondary conductor is connected to a brush, and the outer end of each to another brush, and each of these brushes rests on a hub connected to a separate series of commutator segments, the two series being arranged alternately in a



circular form, so as to fit each other. The brushes thus serve to convey the alternating currents induced in the secondary conductors to the commutator segments. By reference to the accompanying diagrams this arrangement will be better understood. Fig. 1 is an elevation showing the commutator segments, brushes, and collectors; Fig. 2 is a plan view of the same, opened out; and Fig. 3 is a plan view of the general arrangement. The commutator is formed in this case of three segments in the two series A and B. The brushes C and D are similarly divided into two series. A^1 is the hub common to all the A segments, and a brush or stirrup E rests on it; while B^1 is common to the B segments, and supports the stirrup F. The commutator is applied directly to the spindle of the motor M. Part of the alternating current is led to the motor through its own commutator M^1, and as the commutator of the transformer is mounted on its spindle, the movement of the motor will be transmitted to it. The alternating current passes through the primary wire of an induction coil, and thus induces a current in the secondary wires, the ends of which are connected either to the brushes A and B or to the brushes E and F. The secondary wires of the induction coil may all be connected to a switch, so as to enable them to be placed more or less in parallel for the purpose of varying the current. A suitable switch is also provided for putting the transformer in and out of action. In the case where the induced current is led to the brushes E and F, the continuous current will be taken off by the brushes A and B, and *vice versa*. Instead of mounting the transformer directly upon the motor spindle, it may be driven from its spindle by suitable gearing at a different speed from the motor, and all that is necessary is that the number of impulses per unit of time in the motor shall correspond with the number of changes in the commutator. The inventor makes one claim for the construction of this transformer.—No. 831. January 19th, 1887. 8*d.*

Electric Switch.—*B. Egger, Vienna.*—This switch is intended for use in combination with electric conductors and incandescent lamp holders. A hand lever and a contact lever are placed upon one axis, so that they may be easily turned. When the circuit is interrupted, they are pressed against stop pins, which are placed in a definite angular position by a spring already under tension. On turning the hand lever in one direction, it will pass into a position in line with the contact lever, which continues to bear against the stop pin. The spring is under the greatest tension in this straight position, and is ready for the succeeding operation. When this dead point is exceeded by the further movement of the lever, and when the angle between the two levers has become less than 180°, the spring contracts and moves the contact lever away from the stop pin to another pin, which has a contact spring attached to it, and the circuit is thus closed. The same operations take place during the

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return movement for the purpose of breaking the circuit. The sudden and exact making and breaking takes place whether the movement of the hand lever is slow or rapid. If the switch is a large one, it is arranged that a rod which can slide to and fro shall act upon a lever by means of an arm slotted laterally, and impart to it the required motion. The inventor makes one claim for the construction of the switch, as described.—No. 5092. April 5th, 1887. 8*d.*

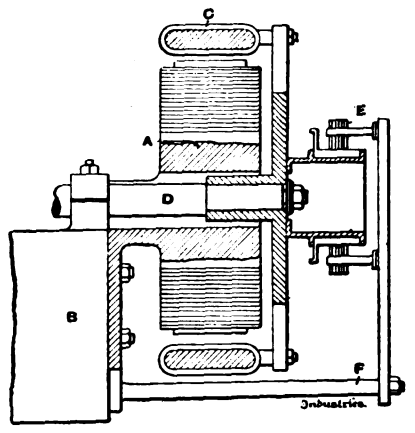
INDICATING THE SPEED OF SHAFTS.—*J. S. Gisborne, London.*—The object of this invention is to indicate on the bridge of a ship the direction and speed of revolution of the engine shaft, by means of an electric connection. A small spindle is mounted horizontally on suitable frame work, close to the main shaft of the engines. At either end of the spindle is fixed a double ended lever, carrying a friction roller at one end and an electrical contact piece at the other. The friction rollers are intended to gear with an eccentric placed on the engine shaft. A pawl is fitted at the end of each lever; one of them causes one of the levers to be depressed when the shaft revolves in one direction, and the other causes the second lever to be raised during the opposite direction of revolution. Each of the contacts completes an electrical circuit, and the consequent current is transmitted to the bridge, where there are registering and recording instruments of any approved form. Five claims are made.—No. 17575. December 21st, 1887. 8*d.*

GENERATING ELECTRICITY FROM HEAT.—*P. M. Justice, London. (E. G. Acheson, Pittsburgh, Pennsylvania.)*—This invention is based upon the discovery that if a magnetic whirl is produced about an electric conductor which is traversed by currents of heat, an electric current will be generated in the conductor at each making and destroying of the magnetic whirl. In order to make use of this discovery in a practical manner for the generation of electricity, the inventor arranges a hollow cylindrical core wound with a series of convolutions of insulated wire. The terminals are connected to the primary circuit, which supplies the intermittent current. Through the core and coil is passed the conductor or conductors which form the converting or generating coil. The terminals of this second coil are connected to the working circuit, and suitable means are applied for inducing a current of heat in one part of it. It is found most convenient to have two magnetic whirls round the conductor, with the directions of the lines of force in opposition; by placing the source of heat between the whirls so that the heat shall pass from a central point in opposite directions, the lines of force of the whirls will be such as to convert the heat into electric currents in the same direction. There are several other ways mentioned in the specification of carrying out this discovery, but the above sufficiently indicates the nature of the invention. Six claims are made for this method of converting heat into electricity.—No. 17837. December 28th, 1887. 8*d.*

DYNAMOS.—*J. Hopkinson, London, and E. Hopkinson, Manchester.*—This invention relates more particularly to that class of dynamos in which there is more than one electric field. The object is to secure abundant room for the copper conductor of the armature, and to avoid as far as possible any undue variation of the magnetism as the armature revolves. The best form of machine for this purpose is that in which the lines of magnetic force are parallel to the axis of rotation of the armature. The armature consists of a series of bobbins having iron cores composed of thin plates placed tangentially to their direction of motion. The cores have preferably polar extensions for rendering the field easier to produce. The bobbins rest on the outside of a wheel, whose radiating arms fit between the cores of the armature. The bobbins are bound in by rings which slip over their ends. The outer ends of the magnets are attached to cast iron rings, and the wrought iron cores are let some distance into the cast iron. However, the magnets may sometimes be fitted with cast iron pole pieces, and in this case the wrought iron is let into the cast iron. To obviate the danger of accidents from the high speed of revolution, a number of guards are placed at a small distance from the binding rings. As soon as these rings begin to stretch they come in contact with the guards, which immediately act as a brake. The rings are secured by screws to snugs on the wheels of the armature, and the plates of the armature cores may be secured together by bolts, provided that these are placed in such a manner that they shall not close electrical circuits around the lines of force. The inventors make eight claims for this improved dynamo.—No. 4322. March 22nd, 1887. 11*d.*

GENERATION AND DISTRIBUTION OF ELECTRICITY.—*R. Dick and R. Kennedy, Glasgow.*—By these improvements a main constant current is transformed locally into a secondary current of any desired strength in a secondary circuit in which the translating devices are placed, and a constant electromotive force is obtained at the terminals of the secondary circuit while there is a variable current along its length. A combination of a dynamo with an electromotor is made use of to produce this effect. The motor field magnets and the dynamo field magnets form the frame work of the machine; the motor armature and commutator are fixed at one end of a longitudinal shaft, and the generator armature and commutator are secured to its other end. The main conductor is coiled in series along the upper field magnets of both the motor and generator, and is also wound in series along the lower field magnets of the same; thence it passes to the terminal end of the brushes on the commutator of the motor, and the circuit is completed from the terminal on the opposite brushes of this commutator. A thick secondary circuit wire is connected to the terminal of the brushes on the commutator of the dynamo, and is coiled in series between the coils of primary wire and in the same direction round both the lower field magnets of the generator and motor. It is also coiled in series round the upper field magnets of the same over the coils of the primary wire and then passes to the translating devices in the consumption circuit. The main constant current passes through the few series coils of wire on the motor field magnets and the separate exciting coils on the generator field magnets, and thence through the terminals of the brushes on the motor armature and back again to the main supply circuit. The number of turns of wire in this motor circuit is just sufficient to maintain a given speed on the motor shaft with the minimum secondary current; and the number of turns of wire in the separate exciting coils on the generator field magnets is just sufficient to maintain a constant given electromotive force in the secondary circuit. The secondary circuit passes from the generator armature through the series coils of thick wire on the generator and the separate exciting coils of the motor, and thence through the translating device and back to the other terminal on the dynamo armature. The inventors make one claim for the method of winding, connecting, and exciting the two fields, as described.—No. 3225. March 2nd, 1887. 8*d.*

COMBINED ENGINES AND DYNAMOS.—*C. D. Abel, London. (Siemens & Halske, Berlin.)*—In the arrangements hitherto employed for driving dynamos directly from motor engines, the dynamos have always been constructed complete in themselves, and the axis of the revolving armature has been placed in line with the engine shaft and coupled to it by a rigid or flexible coupling. This arrangement necessitates the placing in line of the two shafts with numerous bearings, and any want of accuracy in adjustment leads to detrimental action as well as to an increase in the cost of installation. The object of the present invention is to obviate these defects. The dynamo is constructed in such a manner that some parts of it form part of the motor engine. The framing carrying the field magnets is fixed to a convenient part of the framing of the engine, and the revolving armature is mounted on an overhanging end of the engine shaft in the same way that the fly wheels and pulleys



are mounted in other work. The commutator brushes are carried by a bracket fixed either to the framing of the field magnets or to the engine frame. This invention may be carried into effect in combination with machines of various types. In the accompanying diagram the engine is coupled with a dynamo which was described in Patent No. 1738 of 1887. The internal field magnets A are fixed to the framing B of the motor engine, while the armature C is carried by the shaft D of the engine, and the commutator brushes E by a bracket F fixed on the engine frame. The inventors make two claims for the combination of a dynamo with a motor engine in such a manner that the revolving armature is carried by the engine shaft while the field magnets are carried directly or indirectly by the framing of the engine.—No. 4546. March 26th, 1887. 8*d.*

CHEMISTRY.

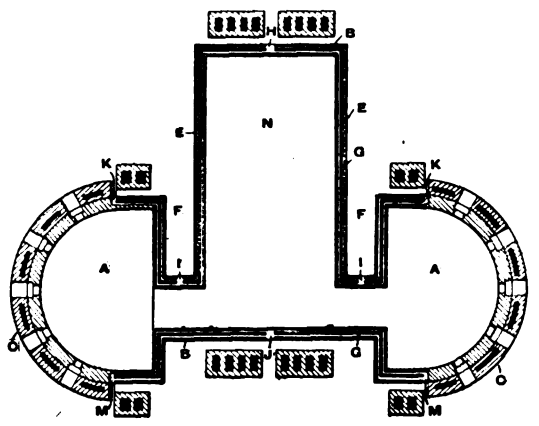
ELECTRO-DEPOSITION OF COBALT.—*S. P. Thompson, London.*—The solution used in the deposition of cobalt consists of the sulphate or chloride, or of the double sulphate or chloride of cobalt and ammonium, to which has been added either sulphate or chloride or other salt of magnesium. The anodes may be either carbon or cobalt, but preferably the latter. The best current density is from 1 ampère to 4 ampères per square foot of depositing surface; but a somewhat stronger current may be used at the beginning of the action, in order to secure a more rapid striking of the film on the surface. The pieces to receive the deposit should be scrupulously cleansed, and prepared in the same way as is usual in the deposit of nickel. The inventor makes two claims for the employment of magnesium salts in the deposition of cobalt.—No. 4472. March 25th, 1887. 6*d.*

SEPARATING PRECIOUS METALS FROM ORE.—*C. E. Tripler, New York.*—This apparatus is designed for extracting the metal by an improved process of amalgamation. The crushed ore is fed in the usual way from a hopper into a broad vertical tube. At a point near the upper end of this tube the vapour of mercury enters from a specially constructed retort. The quantity of vapour supplied is controlled and regulated by a tap, and a gauge is provided for ascertaining the amount used. The powdered ore in falling down the vertical tube becomes mixed with the mercury, and the resulting mass is afterwards led into a vessel which has a finely perforated bottom. A series of vibrating bars stir the liquid, and cause a more intimate mixture of the mercury and the ore. In a lower vessel the mixture passes over several amalgamating plates, and then the process is partly repeated by sending the material through a second perforated vessel and over another series of plates. The resulting amalgam is drawn off at the conclusion of each process into one of several collecting troughs. The inventor makes seven claims for this apparatus.—No. 16027. November 22nd, 1887. 8*d.*

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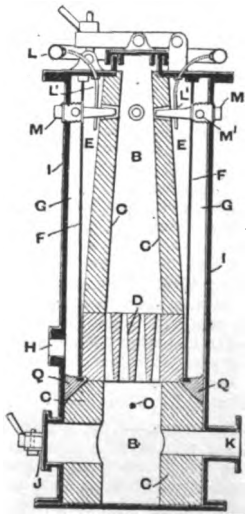
CEMENT.—*G. F. H. Clark & R. I. Clark, London.*—This cement is intended for fastening wood, linoleum, or other covering to iron or steel decks, or to wood flooring. The following ingredients together constitute the composition of this cement: fusel oil, amber, shellac, pigments, and rubber. In the process of making the cement the fusel oil is heated to a temperature of about 150°F., and the amber or other fossil gum in the form of powder is added gradually during the continued stirring of the solvent. The shellac and rubber are then dissolved, and finally the pigments. It is sometimes advantageous to add a small quantity of boiled linseed oil immediately after the solution of the amber. This product, in addition to its use as above described, may be also employed for treating felt so as to render it hard and water proof. One claim is made.—No. 5152. April 6th, 1887. 6*d.*

REGENERATIVE GAS FURNACE.—*D. Rylands & R. Potter, Barnsley.*—The annexed figure represents a sectional plan of the improved furnace as specially applied to the manufacture of glass. The chief compartments are those for melting, shown at N, and for working out, shown at A. The spaces F which lie between the two different compartments are made wide, so that the air can approach them. The free contact of the atmosphere with the walls of the furnace preserves them for a longer time. The sides E, the ends B, and the stop pieces in the walls are made of fire bricks, perforated with holes G running horizontally. A forced draught of air enters through the openings I J, blows



through the perforations, and leaves the walls E and B at the holes H K M. The stop pieces previously mentioned extend across the passages connecting A and N, and the perforations G run through them. The escaping blast is led to the air regenerators in the usual way. The blast may be arranged to pass through the blocks which constitute the working out ends C, in which case the air enters at J, and is made to pass through the blocks in C, and then escape at K. The furnace may be either fed from the crown of the melting portion N, or over suitable holes made in the sides E. The inventors make four claims for this improved furnace.—No. 2920. February 25th, 1887. 8*d.*

MANUFACTURE OF GAS FOR GAS ENGINES.—*F. Windham, London.*—Improvements are here introduced into the construction of gas generators, in which an incandescent grate or filter and combustion chamber are employed as described in Patent No. 3697 of 1886, granted to the same patentee. The accompanying figure represents a vertical section of the producer. Liquid hydrocarbon is introduced into this apparatus, and the heat of its own combustion serves to vaporise it and make it ready for use in the gas engine. The combustion chamber is indicated by the letter B; its walls C are made of fire brick, and a grate D is situated at its lower end. The vaporising chamber E has a surrounding wall F of iron, and an exterior chamber G is formed between the outside case I and the wall F. The air used in combustion is heated and regenerated in this chamber G, into which it is admitted through the opening H. A cleaning door is fixed at J and a delivery pipe at K. The petroleum is led from the main L through the pipes L^1 into the vaporising

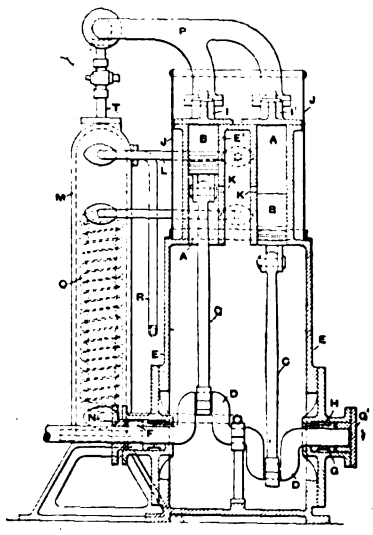


chamber E, and the heated air from G passes through the holes M^1 in the nozzles M into the combustion chamber. A certain amount of water is admitted to the space below the filter D through the opening O. In order to start the producer a fire is lit in the chamber B and the doors are closed; a supply of air is delivered at H and passes through M. The vaporised fuel which has been admitted into E passes through the recess in the wall C, and meets the stream of air issuing from the nozzles and immediately fires. The walls C and the filter D rapidly become incandescent, and the fire on D is allowed to burn out gradually. The gases resulting from the combustion are delivered through K under pressure. The water admitted through O also vaporises as the gases proceed past it, and the resulting steam mixes with the gases on their progress to the engine. The inventor makes six claims for the combination of evaporating chamber and the

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mixing nozzles, for the use of the air heating chamber G, for the introduction of the jet of water through O, and for the combination of the incandescent grate and walls of the chamber with the foregoing appliances.—No. 1132. January 25th, 1887. 8*d.*

Refrigerating Apparatus.—*H. J. West, London.*—This invention relates to that class of ice making and refrigerating machines in which the cooling effect is produced by the alternate compression and expansion of a liquefiable gas, such as ammonia. The particular object in view in the construction of this machine is the removal of the heat of compression. The arrangements and plant will be understood by reference to the accompanying diagram, which represents a sectional elevation of a pair of compression pumps. The pumps A are enclosed, together with the cranks and shaft, in the air tight box E. One end of the crank shaft revolves in the bearing G, which is air tight, and provided with the channels H for lubricating purposes, while the other end passes through a stuffing box, and is connected with the outside driving gear. The delivery and suction valve boxes I I¹ are placed on the upper ends of the working cylinders, and both valve boxes and cylinders are surrounded by the jacket J, in which cooling water circulates. The upward prolongation E¹ of the case E is connected with the interior of the cylinders A by the passages K, and also with the vessel M, by means of the pipe L. The lower part of M



communicates with the lower part of E through the pipe N. The vessel M contains a coil O, through which cold water circulates. A lubricating liquid not attacked by ammonia occupies the space within the vessel M to a level slightly above the passages K, and the working parts of the pumps are also immersed in lubricating liquid. The liquid is cooled in the vessel M and falls to the bottom, whence it passes through N into the bottom of the case E. The lubricating liquid, being above the level of L, enters the cylinders A alternately, and is forced up with the compressed gas into the delivery pipe P. The object gained by this action is the cooling effect on the compressed gas, and the complete prevention of leakage of the gas. The oil falls down the pipe T into the vessel M, and thus returns to its old position. The cooling effect of the vessel J and coil O causes the oil to give up the heat abstracted from the gas. The inventor makes three claims for the application to machines in which the refrigerating effect is produced by alternate compression and expansion, of the means of cooling the lubricating material which has been heated by the compression of the gas.—No. 3964. March 16th, 1887. 8*d.*

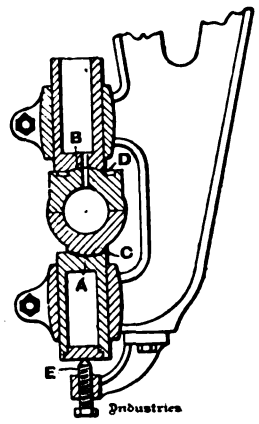
Grinding the Rollers of Paper Machines.—*I. Gallowitsch, Vienna, and W. Seel, Warsaw.*—The cylinders or rollers are rotated in their frames in the same direction and in contact with each other, but with different circumferential velocities, and oil and emery are applied to them. The appliances for imparting the desired rotation to the cylinders consist of a shaft carrying two pulleys of different diameters, and two other pulleys of equal diameter keyed upon the ends of the opposite journals of the cylinders. The shaft is supported in bearings mounted upon pieces of wood fastened to the frames by bolts. The pulley on the journal of the bottom roller is connected with one of the pulleys on the shaft; while the pulley on the journal of the top roller is connected with the other pulley on the shaft by means of belts. The different speeds of the cylinders are thus obtained. The inventors make one claim for this method of grinding the rollers.—No. 8645. June 15th, 1887. 8*d.*

Button Making Machines.—*J. C. Schott, Providence, Rhode Island.*—This invention relates to a machine for making the common cloth buttons which are composed of front and back parts. A die is provided, which is in part expansible, so as to compensate for the different thicknesses of cloth, and to relieve the cloth from the damaging strain. The button parts are forced into the expansible die or ring to be united. The supporting and operating mechanism of the reciprocating plunger which drives the punch is also improved by a specially constructed swinging yoke, and by the use of a cam lever for engaging the head of the plunger. Two vertical posts are mounted on the base plate, and one of them is formed with a recessed head. The swinging yoke is pivoted at one end to the head of one of the posts, and its other end locks with its free end in the recess of the other post. A sleeve depends from the yoke, and the spring pressed plunger reciprocates in the sleeve. The inventor makes nine claims for the various parts and combinations.—No. 17531. December 20th, 1887. 8*d.*

Artificial Stone.—*L. Preussner, Berlin.*—The inventor mixes burnt magnesia and concentrated muriatic acid together in a proportion of from 1000 to 1500grm. of the acid to 1500grm. of the magnesia according to the amount of carbonic acid contained in the magnesia. This fluid paste is poured into hard india-rubber moulds to harden. The product resembles smooth and bright marble or enamel, and is not cracked by subsequent attacks of water and carbonic acid. The inventor makes one claim for this process.—No. 4689. March 29th, 1887. 4*d.*

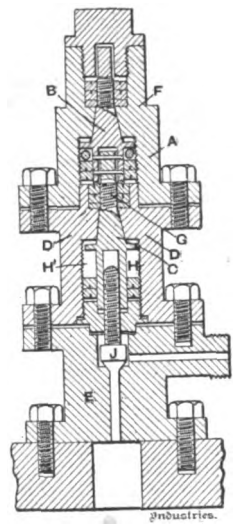
GERMAN PATENT ABSTRACTS.

Plummer Blocks.—*Escher Wyss & Co., Ravensberg.*—This invention relates to a modification of Sellers' plummer block. The adjustment in the vertical direction is effected by the



screw E, which lifts the spindles A B. The plummer block is connected to these spindles by two ball joints D and C, which are eccentrically arranged in A and B. By turning the spindles A and B, an adjustment in the horizontal direction is effected, while the plummer block retains the flexibility peculiar to Sellers' arrangement.—No. 41597. April 20th, 1887.

Liquid Carbonic Acid.—*Fleischer & Mühlich, Frankfurt-am-Main.*—This invention relates to a cut-off valve for liquid carbonic acid. J is the cut-off valve carefully fitted into the



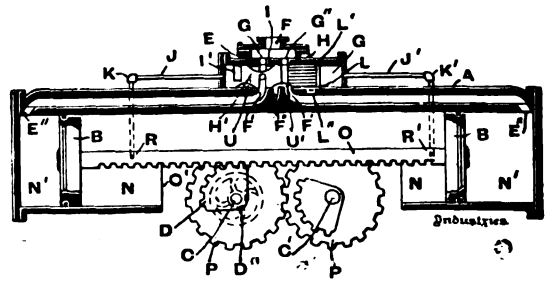
valve casing E, and carrying a screw, the nut of which is cut into the piece C, which is provided with a ground cone fitted into D. H is a stuffing box arrangement, and G represents metallic packing. The same arrangement is made in A, B being the cone coupled to C, and F the metallic packing. By turning B, C is actuated and the cut-off valve J is opened or closed. Any gas escaping through C is arrested by B, thereby preventing waste.—No. 42114. January 18th, 1887.

UNITED STATES PATENT ABSTRACTS.

Electric Battery.—*H. Walter, Cincinnati.*—This battery is intended for open circuit work, and consists of a wide mouthed jar, which is hermetically sealed by its stopper. The negative electrode is composed of finely crushed carbon, which is packed into the space between the outer jar and an inner bag of suitable fabric. A piece of solid carbon is attached to the stopper, and carries the current to the wire in the usual way. The fine carbon is packed closely round the solid piece, in order to insure as great efficiency as possible. The positive electrode is contained within the cylindrical bag, and is provided at its lower end with a collar, which rests on the bottom of the jar. It is immaterial to this invention what energising fluid is made use of. The inventor makes three claims for this battery.—No. 378121, dated 21st February, 1888.

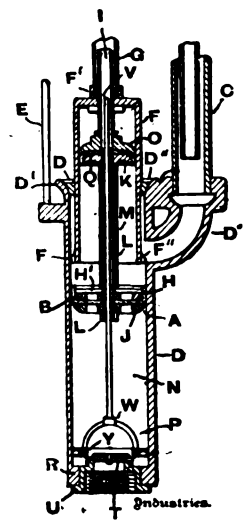
Refining Cotton Seed Oil.—*G. W. Scollay, New York.*—The object of this invention is to produce a refined cotton seed oil and a paint as the result of a single operation. A chloride of a metal not ultimately injurious to the oil as an article of food is mixed with the impure oil, and a small amount of alkali such as caustic soda is added to this mixture. After allowing these ingredients to intermingle thoroughly, the two products are separated from one another, and the refined oil is allowed to run off. It is found that the chloride of iron is the most efficient salt for employment in this process, as it accelerates the process of refining, and it does not injure the oil as a food substance. The inventor makes two claims for this improved process.—No. 378113, dated 21st February, 1888.

Steam Engine.—*F. A. Cresswell, Strongstown, Pennsylvania.*—This invention involves a new method of converting the reciprocating motion of the piston rod into the rotary motion of the driving shaft. The cylinder is double ended, and the two parts of the piston B are connected by a rod O, which has a toothed rack on its lower side. The middle part of the cylinder is left open, so as to allow the two similar segmental wheels D to gear with the rack on the piston rod. The wheels D are



mounted on the two similar shafts C C¹, as are also the two wheels P, which gear into one another. It will be seen by reference to the diagram that the two segments D revolve in opposite directions, and are only in gear alternately during the two different directions of motion of the rack. The shaft C¹ is only a short one, while C serves to transmit the energy to its destination. By this arrangement there are practically no dead points in the revolution of the shaft. A modification of the valve gear is also included in this invention. There are the usual steam ports F¹, exhaust port F², and steam chest G. The circular valve is provided with the steam space H¹, the exhaust ports U U¹, and the steam ports I¹ I². One end of the valve carries a toothed portion L¹, which gears with a straight rack shown in section at L². The seat of the valve has two openings G¹ G² in it for the admission of the steam from the chest F. The pipes J J¹ enter the valve chamber one at each end, and their other extremities are in the side of the cylinder as shown. When the piston B arrives at the end of its stroke, the steam is admitted by these pipes into the valve chamber, and the position of the valve is changed accordingly. A rotary motion is imparted to the valve by means of the rack L², so as to enable the steam to enter and exhaust through the recesses in the valve. The inventor makes five claims for the combination of the segment pieces in transmitting the motion, with the double ended cylinder, and with the valve gear.—No. 378041, dated 14th February, 1888.

Force Pump.—*B. C. Vanduzen, Ohio.*—The accompanying illustration shows the improvements introduced by this invention into the construction of a force pump. The lift out and drop valve P is made with an annular portion Y. Outer flanges and projections hold an annular spring which presses against the walls D. The circular legs and arch W are connected with



the annular portion as shown. The valve spindle of this drop valve moves in the raised valve seat I, which forms an annular sand chamber with the cylinder D. The rest of the pump is arranged according to previous designs. The inventor makes six claims for the drop valve as described, and for its raised seat I.—No. 377054, dated 31st January, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

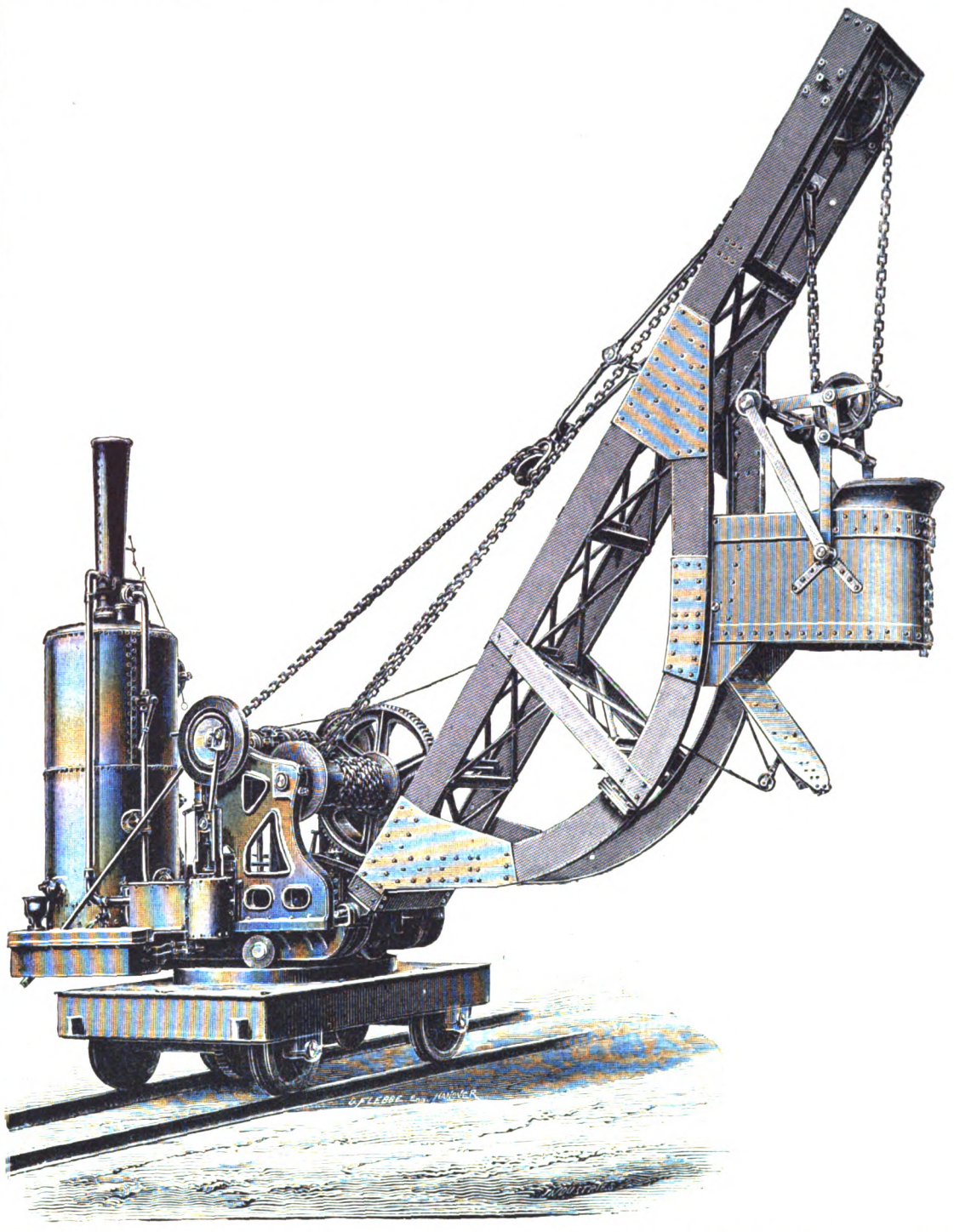
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GARVIE'S IMPROVED EXCAVATOR.

THE above illustration shows a simple form of excavator which has been designed by Mr. James Garvie, of 172, Fenchurch-street, London, and which is being manufactured by the Southgate Engineering Company, Limited, at their works at New Southgate. The principal feature in this excavator is the shape of the jib, and the readiness with which the excavator can be transformed into an ordinary steam locomotive crane or *vice versa*, by simply changing the jib. Thus any contractor who has work in hand, including only a small amount of excavation, need not go to the expense of purchasing any of the costly and somewhat cumbrous excavators or steam navvies, which have hitherto been the only machines in the market. It suffices in these cases to replace the ordinary jib of the steam crane by the special excavator jib shown in our illustration. By having these two jibs the contractor's efforts are greatly accelerated. When the machine is required to work as a steam crane the ordinary jib is used; but when excavating has to be done the ordinary jib is removed and replaced by the excavator jib, the change only occupying about an hour. Another advantage is that by this arrangement the ordinary gauge of rails may be used, whereas the "giant" excavators require a special gauge. The special excavator jib is formed by curved channel irons added to the under side of the beams, and secured to them by strong gusset plates, in the manner shown in the illustration. This lower part acts as a guide for the excavating bucket. In ordinary mechanical excavators the bucket is guided by a radiating arm attached to the machine, but in this excavator the bucket is fitted with four rollers which slide on the flanges of the curved guide. The lower part of the guide is horizontal and the upper part vertical. When working the excavator the bucket is lowered to the bottom, and the excavator brought up to the face of the cutting. The bucket is then lifted, and its lip cuts off a portion of the material operated upon, and by the time the bucket reaches the top it is filled. Attached to the bucket is a triangular frame, one angle being the pivoting angle of the bucket, the other carrying the chain block or sheave, and the third is provided with a pair of small guide rollers. The latter come into action when the bucket passes the curved part of the guide, running on the edges of it, and acting as a fulcrum for the bucket in turning from the horizontal to the vertical position.

When the bucket has reached its highest position it is relieved by the derrick chain, which draws the jib about 8in. back. The bucket is then turned round and emptied into waggons alongside or behind the excavator in the ordinary manner. The catch of the door is released by means of a cord pulled by the driver, the door being arranged to open at an angle of 60°, in which position it forms a shoot for the material discharged into the waggons. After discharging, the excavator is ready for another cut. The ordinary travelling motion of a locomotive crane is employed for bringing the excavator up to its work. The excavator is held down to the rails by screw jacks in the same manner as in the steam navvy, and balance weights are attached if required. It will be readily understood that the supplemental part of the jib, forming the guide, can be fixed to the existing jib of any ordinary locomotive steam crane. We are informed by the makers that an ordinary 4-ton locomotive crane, with the special gear attached to it, will excavate nearly as much earth as an ordinary steam navvy. It is not to be supposed that this excavator will take the place of the steam navvies now in use, which are very suitable for heavy excavations; but it should prove useful in cases where only small quantities of earth work have to be dealt with, and where economy in first cost is of importance.

GARVIE'S IMPROVED EXCAVATOR.



THE MANCHESTER ROYAL JUBILEE EXHIBITION.

TEXTILE MACHINERY *(continued from page 183)*.—The machines used in the preparation of thread or doubled yarn form a special class. Before twisting the required number of strands together, it is usual to wind them from the cop or bobbins on which they are spun on to a bobbin resembling those used in a warping machine. This bobbin is driven by the frictional contact of its surface with a revolving drum, and the machine is fitted with a detector mechanism, which arrests the motion of the bobbin on the breakage or failure of any of the ends which are being wound on it. There were several machines of this class exhibited, which were chiefly constructed with a drop wire arrangement, similar to that described on the warping machine. The machine exhibited by Messrs. John Horrocks & Son, of Manchester, may be taken as a typical one. In this the yarn passes through an eye at the upper end of the detector wire, which it sustains during the operation of winding. The wires are fixed in an oscillating box, which has a small projection formed at the back. The bobbin is held in a frame, and is kept in contact with the drum by means of a prop, which presses against the projection in the oscillating box. When the detector wire falls owing to a failure of the yarn, its lower end comes in contact with a constantly revolving wiper, by which means the box is oscillated. The support of the bobbin being thus removed, the latter falls away from the drum, and its motion is immediately arrested by a brake. During recent years there has been a tendency to obviate the use of yarn bobbins, and in order to do this the traverse of the guide, by means of which the yarn is conveyed to the bobbin, had to be considerably accelerated. Instead, therefore, of laying the yarn in regular coils, the guide traverses the whole width of the bobbin at a very rapid rate. The spools so formed may be handled very roughly without any of the yarn ravelling off at the ends, and the saving in bobbins is very considerable. To attain this object a cam course was at first employed, by which the guide bar was traversed, Messrs. Dobson & Barlow, of Bolton, exhibiting a machine of this type. Mr. Samuel Brooks, of Manchester, also exhibited a machine in which guides were dispensed with, and the drums driving the bobbins were made in two parts, fixed on the shaft in such a manner as to leave a groove between them. This groove forms a cam course, and as the yarn passes round a rod, and through the groove to the bobbin, it receives the necessary traverse. It is, however, impossible in both these machines to effect a change in the lift of the bobbin—*i.e.*, the distance between the inside of the flanges—without changing the cams. Mr. Joseph Stubbs, of Manchester, exhibited a machine in which the guide rail derives its motion from a quadrant lever, the upper end of which is provided with a slot and the lower end with a segmental mangle wheel, by which the motion of the lever is reversed. The lever works on a stud suitably held, and has a reciprocating motion. A pin is passed through the slot in the quadrant lever, and also through a similar slot in a double ended lever, pivoted at its centre. The position of the pin may be altered to suit any lift, and is fastened in the required position by a nut. The upper end of the lever is attached in a suitable manner to the guide bar, which is thus actuated as required. By varying the speed of the pinion engaging with the mangle wheel, the speed of the traverse of the guide may be accelerated or diminished. After the yarn has been wound in the manner described, it is put on to the doubling machines, this being the general term applied to machines for twisting two or more ends of yarn together. The machines exhibited by Mr. S. Brooks and Messrs. Howard & Bullough illustrated two modes of doubling, known respectively as the Scotch and English systems. In the Scotch system the yarn is passed through a trough of water between a pair of brass rollers, while in the English system it is carried under a glass rod, which may or may not be immersed in water. The difference is very slight, and is probably attributable to the fact, that in Scotland most of the material pro-

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THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery.

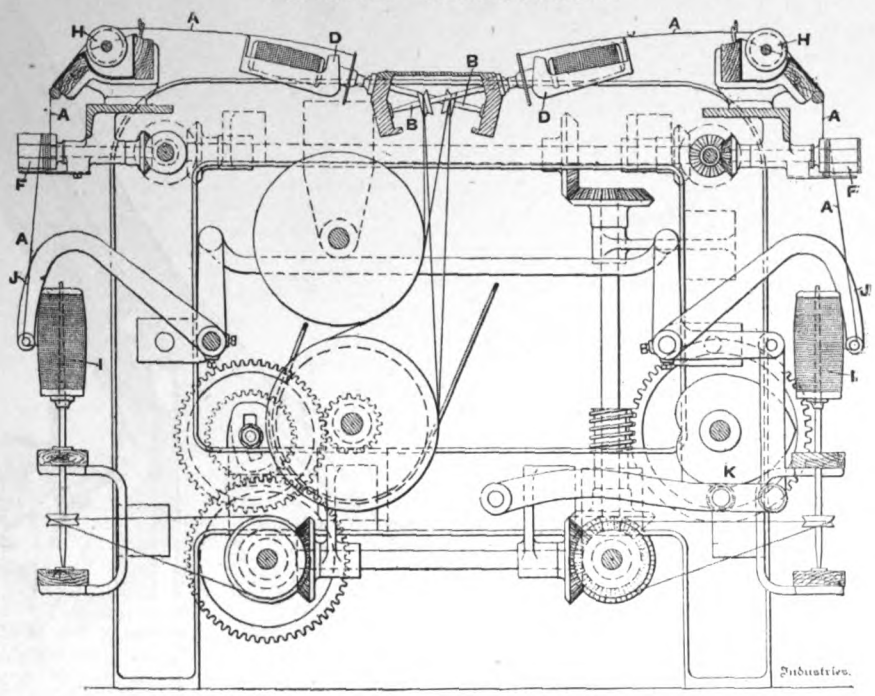


Fig. 63.

duced is intended for sewing thread, while in England it is used for weaving, lace, hosiery, and other purposes. The doubling machines are similar in every respect to the ring spinning frames previously described, except that the spindles are heavier, and the machines generally are stronger in construction.

One of the novelties of the late Exhibition was shown by Messrs. Shepherd & Ayrton, of Manchester, and was described as a twin twisting machine. The object of this machine is to put into the yarn or roving *two* twists for every revolution of the spindle, the accomplishment of which would enable more work to be obtained with a

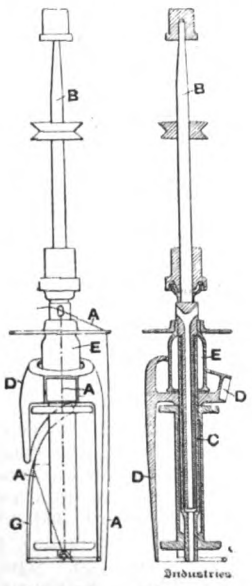


Fig. 64. Fig. 65.

slower speed of the spindles. The construction of the spindle is shown in side elevation and section in Figs. 64 and 65, and the general arrangement of the machine in Fig. 63. The spindle B is mounted as shown in Fig. 63, being borne by a collar and footstep, and revolved by a band passing over a warve in the usual way. A loose tube C, to which is attached a frame D, is mounted on the spinde, and D is so made that it is heavy at one side, and is consequently unable to rotate with the spindle. The latter is tubular, holes being formed at the end of the tube as shown in Fig. 65. A cup E with a steel disc attached is secured to B, and a bobbin is placed on the spindle upon which the untwisted yarn is wound. The course of the thread A is indicated in Fig. 64, and is as follows: Passing from the bobbin over the curved part G of the frame D, it travels along the outside of the latter until it reaches the end, when by means of a guide eye, placed as shown, it is taken up the tube in the spindle as indicated by the dotted line in Fig. 64. As soon as the end of the tube is reached the yarn issues by one of the holes shown, traverses over the edge of the disc, and thence over the roller H to a rotating roll F, which is hexagonal in form, and around which it is taken several times. From F the twisted thread is conducted over a guide fixed in the arm J to a bobbin I, mounted on a vertical spindle rotated by a band from a tin roller. The necessary traverse of the arm J is obtained from the cam K in the manner shown in Fig. 63. The rotation of the spindle gives one twist to the yarn as it is travelling from the bobbin to the tube in the spindle, so that when it reaches the holes by which it leaves the tube, one turn has been put in. Being held by the draw roller F at the delivery end, the revolution of B puts a second twist into the yarn after leaving the spindle and before going on the roller F. It is premature to do more than describe the mechanism at the present time, as the machine is still untried in actual work, or at any rate has not been tried on a scale which enables an opinion to be given of its actual merits, but it is sufficiently novel to be worth notice.

After thread is formed by twisting two ends of yarn it is, if intended for sewing cotton, "cabled"—that is, three strands of the double yarn are twisted together; and if for lace yarns it is "gassed," in this way having the "oose" or projecting fibres removed from its surface. After being produced as six-cord sewing cotton it is necessary to wind the thread on to small spools or reels ready for the market. The only machine shown for this purpose was Weild's patent, which is also made by Messrs. Shepherd & Ayrton. This machine is well known, but it may be of interest if the cycle of operations performed by it be described. The necessary changes are produced by the arrangement of suitable cams, and the machine is perhaps one of the most ingenious automatic machines extant. The frame shown had eight heads, that is to say, that number of reels were wound at one time. The heads are provided with two short spindles, one of which passes inside the spool, while the other grips it so as to turn it. The spools are placed in troughs, and assuming that the spindles are open, a spool falls forward on to a plate, which is in such a position that when the spindles close they accurately grip the spool. The thread is wound from bobbins held in a suitable creel, and is always fixed at its free end, so that the commencement of the rotation of the spool begins to wind on the thread. As soon as the spindles close on the spool they are automatically started and winding begins, the thread being passed over a steel guide which is fixed on a longitudinal rod. This rod is traversed at a speed accurately corresponding to the pitch of the thread when wound on the spool, and its length of traverse is increased in each direction at each stroke, so as to compensate for the greater length of the spool arising from the bevel given to it. As soon as the requisite length is wound the winding ceases, and a hooked knife descends and cuts a nick in one head of the spool, into which the end of the thread is subsequently drawn. The last named operation is effected by a hook which pulls down the thread into the nick and over a knife edge fixed for the purpose, thus cutting it and freeing the spool, which is then released by an automatic movement of the spindles. As the end is cut, it is held until a new spool is gripped, when the cycle of operations described is re-commenced. By this machine spools of any size of cotton, containing any defined number of yards, can be wound without necessitating on the part of the attendant any further care than that necessary to replenish the spools and bobbins.

The gassing frame is arranged with a number of gas burners of the Bunsen type fixed in swivels screwed into a pipe suitably placed, and which can be moved from under the yarn when a bobbin is raised for piecing. The bobbin is driven by frictional contact with a revolving drum, mounted on a longitudinal shaft suitably driven. At each side of the gas light is a stand, into which pins are fastened so as to be vertically adjustable. Brass grooved bowls revolve on these pins, the yarn on its passage from the bobbin in the creel to that on the drum being passed over these grooves several times. In order to obtain the best effect, the yarn is taken over the top of the first groove in the back runner, under that in the front runner, round the latter, under the second groove in the back bowl, and so on as many times as desired. It thus passes through the flame several times, and better gassing is obtained. The speed at which the yarn travels is carefully arranged to allow of the effective removal of any loose fibre, while preventing the yarn being burned down by the heat of the flame. The only machine of this class exhibited was shown by Mr. Joseph Stubbs, of Manchester.

(To be continued.)

ECONOMY TRIALS OF A NON-CONDENSING STEAM ENGINE.

At the ordinary meeting of the Institution of Civil Engineers, held on the 13th inst., a paper was read on the above subject by Mr. P. W. Willans, M.Inst.C.E., in which he described a series of economy trials, non-condensing, made with one of his "central valve" triple expansion engines, with one crank, having three cylinders in line. By removing one or both of the upper pistons, the engine could be easily changed into a compound, or into a single, engine at pleasure. Distinct groups of trials were thus carried out, under conditions very favourable to a satisfactory comparison of results. No jackets were used, and no addition had therefore to be made to the figures given for feed water consumption on that account. Most of the trials were conducted by the author; but check trials were made by Mr. MacFarlane Gray, Professor Kennedy, Mr. Druitt Halpin, Professor Unwin, and Mr. Wilson Hartnell. The work theoretically due from a given quantity of steam at a given pressure, exhausting into the atmosphere, was first considered. By a formula deduced from the $\phi\,\Phi$ diagram of Mr. MacFarlane Gray, which agreed in results with the less simple formulæ of Rankine and Clausius, the pounds weight of steam of various pressures required theoretically per i.h.p. hour were ascertained. A description was then given of the main series of trials, all at four hundred revolutions per minute, of the appliances used, and of the means taken to insure accuracy. A few of the results are embodied in the accompanying table. The missing quantity of feed water at cut-off, which, in the simple trials, rose from 11·7 per cent. at 40lb. absolute pressure to nearly 30 per cent. at 110lb.—and at 90lb. was 24·8 per cent.—was at 90lb. only 5 per cent. in the compound trials. In the latter, at 160lb., it increased to 17 per cent.; but on repeating the trial with triple expansion, it fell to 5·46 per cent., or to 4·43 per cent. in another trial not included in the table. On the other hand, from the greater loss in passages, &c., the compound engine must always give a smaller diagram, considered with reference to the steam present at cut-off, than a simple engine, and a triple a smaller diagram than a compound engine. Nevertheless, even at 80lb. absolute pressure, the compound engine had considerable advantage, not only from lessened initial condensation, but from smaller loss from clearances, and from reducing both the amount of leakage and the loss resulting from it. These gains became more apparent with increasing wear. The greater surface in a compound engine had not the injurious effect sometimes attributed to it, and the author showed how much less the theoretical diagram was reduced, by the two small areas taken out of it, in a compound engine than by the single large area abstracted in a simple engine. The trials completely confirmed the view that the compound engine owed its superiority to reduced range of temperature. At the unavoidably restricted pressures of the triple trials, the losses due to the new set of passages, &c., almost neutralised the saving in initial condensation; but with increased pressure, say to 200lb. absolute, there would evidently be considerable economy. The figures of these trials showed that the loss of pressure due to passages was far greater with high than with low pressure steam, and that pipes and passages should be proportioned with reference to the weight of steam passing, and not for a particular velocity merely. The author described a series of calorimetric tests upon a large scale (usually with over 2 tons of water), the results of which were stated to be very consistent. After comparing the rates of initial condensation in cases where the density of steam, the area of exposed surface, and the range of temperature were all variables, with other cases (1) where the density was constant, and (2) where the surface was constant, the author concluded that, at four hundred revolutions per minute, the amount of initial condensation depended chiefly on the range of temperature in the cylinder, and not upon the density of the steam, or upon the extent of surface; and that its cause was probably the alternate heating and cooling of a small body of water retained in the cylinder. The effect of water, intentionally introduced into the air cushion cylinder, corroborated the author's views, and he

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ECONOMY TRIALS OF A NON-CONDENSING STEAM ENGINE.

Intended mean admission pressure.....lb.	40	90		110		130	150		160		170
Simple, compound, or triple.....	S.	S.	C.	S.	C.	C.	C.	T.	C.	T.	T.
Actual mean admission pressure .....lb.	40·88	92·65	87·54	106·3	109·3	130·6	149·9	151·9	158·5	158·1	172·5
Percentage ratio of actual mean pressure, referred to l.p. piston, to theoretical mean pressure.....	98·2	100	91·3	100·7	94·8	94·2	94·6	84·54	95·9	85·3	85·2
Indicated horse power.....	16·51	31·61	29·14	33·5	33·0	36·31	38·59	35·69	39 55	35·56	38·45
Feed water actually used per i.h.p. hour:—											
Simple .....lb.	42·76	26·89	—	26·0	—	—	—	—	—	—	—
Compound ..... „	—	—	24·16	—	21·37	20·35	19·45	—	19·19	—	—
Triple ..... „	—	—	—	—	—	—	—	19·68	—	19·19	18·45
Steam required theoretically per i.h.p. hour .....lb.	34·67	19·24	19·86	17·9	17·65	16 25	15·23	15·16	14·87	14·9	14·36
Percentage efficiency	81·1	71·5	82·2	68·8	82·5	80·0	78·3	77·0	77·4	77·6	77·8
Percentage of feed water missing at cut-off in h.h.p. cylinder.....	—	—	—	—	—	—	—	5·33	—	6·84	5·01
Ditto h.p. cylinder.....	—	—	5·0	—	9·5	11·7	15·1	14·84	17·0	12·06	15·33
Ditto l.p. cylinder.....	11·7	24·8	15·2	29·56	16·25	19·1	20·6	22·12	21·3	22·11	24·21
Percentage of feed water missing at end of stroke in l.p. cylinder	10·4	18 83	14·25	21·53	16·59	17·55	20·69	18·01	19·55	18·81	19·25

showed how small a quantity of water retained in the cylinder would account for the effects observed. At lower speeds surface might have more influence. The favourable economical effect of high rotative speed, *per se*, was very apparent. In a trial with a compound engine, with 130lb. absolute pressure, the missing quantity, at cut-off, rose from 11·7 per cent. at 405 revolutions to 29·66 per cent. at 130 revolutions, the consumption of feed water increasing from 20·35lb. to 23·67lb. This saving of 14 per cent. was due solely to increase of speed. Similar trials had been made with a simple engine. In one simple trial at slow speed the missing quantity rose to 44·5 per cent. of the whole feed water. The author compared a series of compound trials, at different powers, with 130lb. absolute pressure, and various ratios of expansion, with a series giving approximately the same powers at a constant ratio of expansion, but with varying pressures, being practically a trial of automatic expansion against throttling. Starting with 40 i.h.p., 130lb. absolute pressure, four expansions, and a consumption of 20·75lb. of water, the plan of varying the expansion, as compared with throttling, showed a gain of about 7 per cent. at 30 i.h.p., but of a very small percentage when below half power. If the engine had an ordinary slide valve, the greater friction, added to irregular motion, would probably neutralise the saving; while if the engine were one in which initial condensation assumed more usual proportions, the gain would be probably on the side of variable pressure. Even as it was, the diagrams showed that the missing quantity became enormously large as the expansion increased. Judging only by the feed water accounted for by the indicator, the automatic engine appeared greatly the more economical; but actual measurement of the feed water disproved this. The position of the automatic engine was, however, relatively more favourable when simple than when compound. In conclusion, the author referred to a trial with a condensing engine, at 170lb. absolute pressure, in which the feed water used was 15·1lb., a result evidently capable of further improvement, and to an efficiency trial of a combined central valve engine and Siemens dynamo, made for the Admiralty, at various powers. At the highest power the ratio of external electrical h.p. to indicated h.p. in the engine was 82·3 per cent. Taking the thermo-dynamic efficiency of the engine at 80 per cent., that of the combined apparatus would be nearly 66 per cent.

IMPROVED COMMUNICATION BETWEEN BIRMINGHAM AND THE SEA

We have already, on page 257 of our last volume, drawn attention to a scheme for improving the Worcester and Birmingham Canal, and thereby enabling vessels of 250 tons burden to reach the Midland district. Since the inception of this project two others have been developed, one of which proposes to open up communication between Birmingham and London by an extension and alteration of existing waterways. These are the Grand Junction Canal, the Oxford, Warwick, and Napton Canal, and the Warwick and Birmingham Canal. Mr. Hickman, M.P., the chairman of the committee for improving the water communication between London and Birmingham, points out that these canals are fortunately independent of railway control, and he recommends (1) that the locks on the Grand Junction Canal should be made double, and those on the Oxford, Warwick, and Napton Canal, and the Warwick and Birmingham Canal should be increased to four times their present size—160ft. long by 14ft. 6in. wide—with not less than 7ft. of water over the sills instead of 4ft. 6in. as at present; (2) that the total number of locks should be reduced from one hundred and fifty-four to ninety by the substitution of deep or compound locks in place of the existing flights of shallow locks; (3) that the improved canal should have a minimum top width of 45ft., a minimum bottom width of 21ft., and a minimum depth of 8ft., with side walling on the towing path side extending to a depth of 3ft. below top water level in places where the canal will have a less top water width than 50ft., and where it is proposed to raise the level of the water above that of the existing canal; (4) that the passage way through and under numerous bridges should be widened, deepened, and heightened, and that the line of the canal should be improved by doing away with 132 awkward bends and by making forty-four deviations, which would lessen the distance now traversed by two miles. By these means would be rendered possible the passage of cargo carrying tugs drawing three ordinary canal boats, and carrying altogether 120 tons of cargo, and each of such fleets could pass at one lockage; or in place of this, two Thames barges carrying 140 tons, or one steamer carrying 140 tons, might pass the locks. The present canals have a carrying capacity of about 750,000 tons per annum, and it is estimated that the improved canal would have a capacity about 2½ times as great, *i.e.*, about 2,000,000 tons. A considerable reduction would be made in the time of transit—which is estimated at about fifteen hours. The cost of haulage would at the same time be reduced from about 3s. 8d. to about 1s. 10d. per ton. These reductions, in conjunction with the improved carrying capacity of the canal, would allow great relief to be given in the matter of tolls. It is estimated that Class A goods, which at present cost 15s. per ton by rail from London to Birmingham, or 12s. 6d. in 10-ton lots, would be carried on the canal for 6s. per ton, including collection in Birmingham and delivery alongside ship, in addition to haulage and tolls. The improvements would also probably result in a great extension of the South Staffordshire coal trade, since the rate for carriage to London would be about 4s., as against the present railway rate of 6s. 9d. per ton. The cost of the alterations is put down at about £1,250,000. It is proposed to acquire the existing canals either by payment of a sum down or by renting them at a charge based upon the present value and annual net income. The existing tolls would of course be lowered; it is proposed to reduce the rate on Class A goods from 3s. 2d. to 2s., and on coals and raw materials from Staffordshire to London to 1s. per ton, and from the Warwickshire coal field to 10d. per ton. These reductions would, it is estimated, involve a loss of about £7,500 per annum, while the extra cost of maintaining the larger and busier canal is placed at £12,500 per annum. The interest on £1,250,000 at 4 per cent. being added to this, it will be seen that a total of £70,000 per annum would be required to meet expenditure and pay a satisfactory dividend. For this extra amount the committee confidently look to the greatly increased traffic which would immediately begin to result. The report and surveys regarding this system were made by Mr. Martin, C.E., who has subsequently proposed a modification of the scheme. According to this, a new canal would be made which would commence by a junction with the Warwick and Birmingham Canal about eight miles from Birmingham, and proceed for about eleven miles in a south-easterly direction, making a junction with the Oxford Canal near Coventry. The last named would require enlarging as far as Brannston, where it would join the first considered improved route by a union with the Grand Junction Canal. This alternative route would involve an additional outlay of £300,000; but it would reduce the total number of locks to seventy-three, and would furthermore shorten the journey by three or four hours, thereby considerably decreasing the cost of transit. It would in addition directly connect the Warwickshire coal field to Birmingham, and reduce the cost of coals in that town by about 1s. per ton.

It may be taken for granted that some such scheme will before long be carried out, and the London route is the one for special reasons most likely to be adopted; firstly, because of the moderate cost of the proposed works; secondly, because so much of the present traffic goes to the Thames; and thirdly, on account of the regular and abundant supply of out and ingoing steam vessels with which the Midland district would be brought into direct connection. It is understood that the committee appointed by the Birmingham Corporation to consider the whole question of water communication, have determined to strongly recommend the adoption of this route, while a route *viâ* the Trent to Hull as an alternative has also been suggested.

THE PROTECTION OF INVENTIONS AND DESIGNS IN INDIA.

A Bill amending the law relating to inventions and designs has been published in the *Gazette of India*, together with the Report of the Select Committee to which the Bill was referred. Several important departures from the existing law and practice will follow upon the passing of the Bill, which it is contemplated will become law without alteration, and come into force on the 1st of July, 1888. The provisions of the Bill stipulate that the applicant for an exclusive privilege must furnish such drawings or photographs of the invention as may be required, and in exceptional cases a model. The application may be referred for inquiry and report to any person whom the Governor-General in Council may think fit. If this person is not in the employ of the Government, the applicant will have to pay such a fee as the Governor-General may determine, and this fee, or a sufficient sum to cover it, must be deposited by the applicant before the reference is made. In the event of the non-payment within the specified time of the renewal fees, which will come into force under the new law, an extension of the time up to three months may be obtained on payment of a fine, as provided by the British Act of 1883. No amelioration of the practice under which at least five copies of the specifications and drawings are required is provided, and it may possibly be ordered that an additional set of copies shall be filed. All applications will be numbered and dated consecutively on the date of application. A patent, or, as it is called in the new Bill, "an exclusive privilege," may be prolonged for a term not exceeding seven or, in exceptional cases, fourteen years. The Government is bound equally with a private individual not to use a protected invention without consent; but if terms are not arranged between the officers of the Government and the owner of the invention, any department in the Imperial service may use it on such terms as may be settled by the Governor in Council. When an English patent has been applied for, protection for the same invention may be had by the inventor if the Indian application is made within twelve months. In other cases, the privilege will be invalid if the invention has been published in India or in the United Kingdom, unless that publication is in fraud of the inventor, or results from the use by the inventor or his agent for a period of less than one year. The duration of the protected period for a registered design is five years. The fourth schedule to the Bill sets forth the fees payable in respect of an exclusive privilege. The fees on application are Rs.10; on filing the specification, Rs.30; before the expiration of the fourth, fifth, sixth, seventh, and eighth years respectively, Rs.50; at the end of each subsequent year up to the thirteenth, Rs.100.

TOBACCO CULTURE IN ENGLAND.

Those who are taking an interest in the cultivation of tobacco in England, a subject to which we have on former occasions directed the attention of our readers, are not likely to receive much encouragement in their efforts from a perusal of the reply which was given by the Chancellor of the Exchequer to a deputation from the British Tobacco Growers' Association, which recently waited upon him. As we have mentioned in our previous notice, in order that it might be tried whether the growing of tobacco in the United Kingdom may not be carried on for the purpose of utilising to a certain extent the prevailing agricultural depression, leave was given, under certain conditions, for the working of experiments, and the recent agricultural returns show that more than eighteen acres were planted with tobacco. The conditions, however, were too onerous to allow of an adequate return, and the object of the visit of the deputation to the Chancellor of the Exchequer was to ask that the Society they represented should be granted a license to grow and sell tobacco throughout the United Kingdom for a payment of £25 per acre per annum for five years, for the purpose of making experiments as to the cultivation, manufacture, and marketable value of British tobacco. Lord Walsingham informed the Chancellor of the Exchequer that on a piece of land he had grown the equivalent of 800lb. of tobacco to the acre, and he was of opinion that the weed could be successfully cultivated and prove an important outlet to surplus labour, provided a substantial reduction of taxation was granted. The Chancellor of the Exchequer, as in duty bound, has always a sharp look out for proposals which are likely to affect the revenue, and in the presence of the deputation he calculated that 800lb. of tobacco at 3s. meant £120 per acre, and to grant the request which was made to him would mean a sacrifice to the revenue of about £100 on every 800lb. grown in Britain. Widespread success in the cultivation of tobacco, with a duty of £25 per acre, would be a very serious matter for the revenue, which derived from the tax on imported tobacco in the financial year ending March, 1887, the large sum of £9,367,185. This was obtained by duties varying from

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THE FORTH BRIDGE.

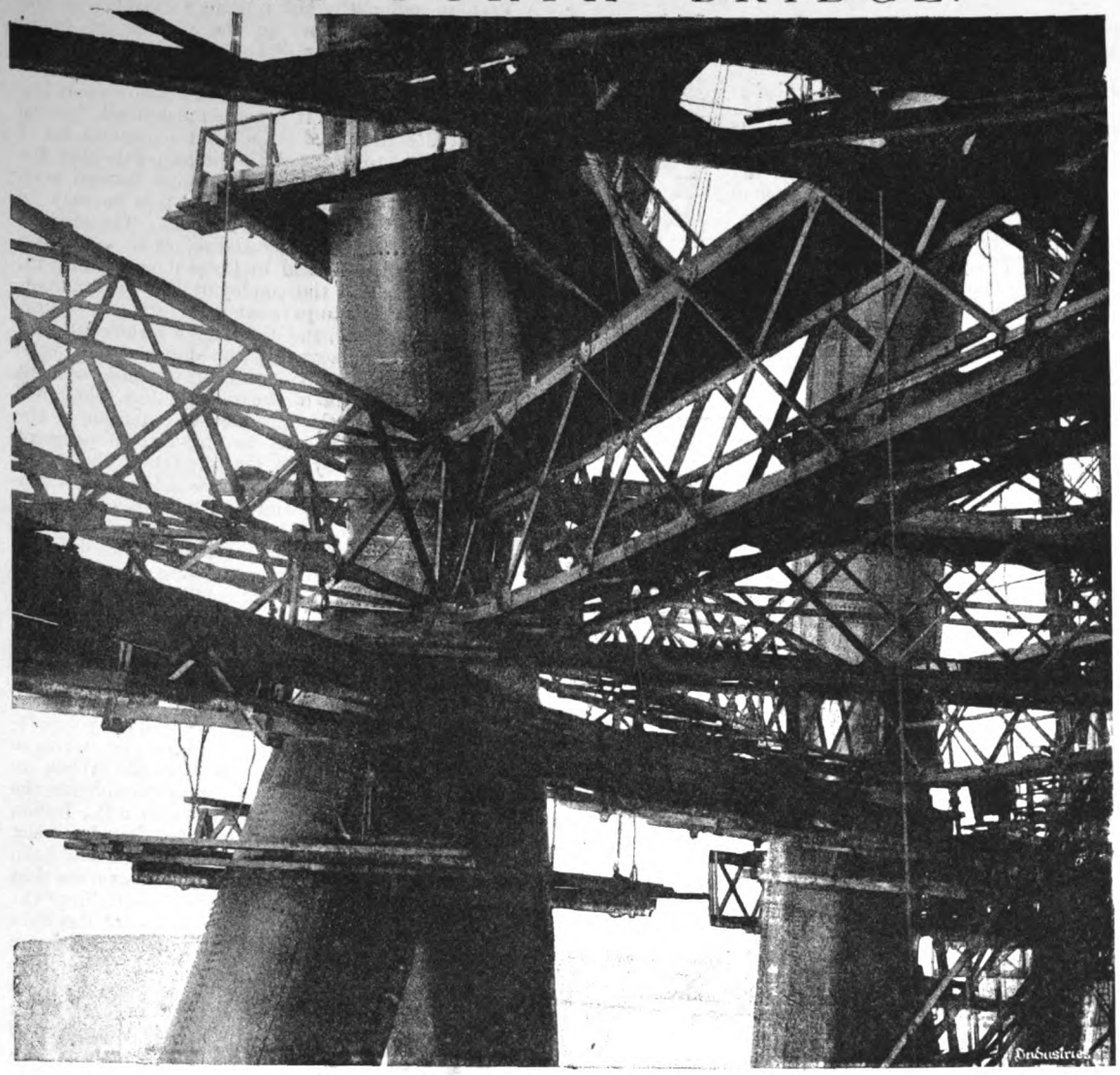


FIG. 1.—INTERSECTION OF DIAGONAL TUBES.

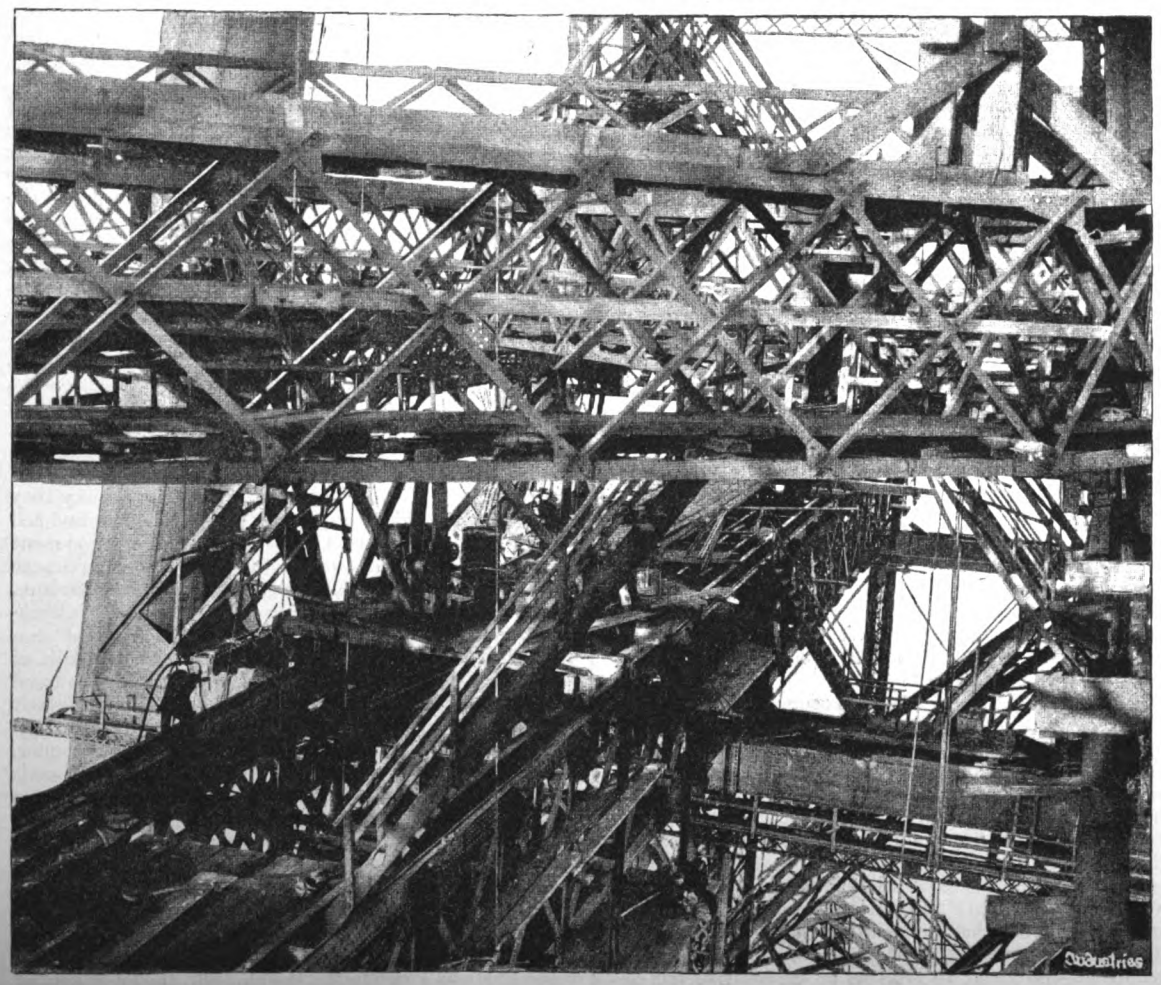


FIG. 2.—INTERNAL VIADUCT, WITH HORIZONTAL AND DIAGONAL BRACINGS.

3s. 6d. on unmanufactured to 4s. 10d. on manufactured tobacco, and 5s. 6d. on cigars. Mr. Goschen pointed out that if they were to have acreage duties in various parts of England, it would be extremely difficult to avoid very great risks, and he did not see how the difficulty could be got over, nor could he hold out any hope of a reduction of duty. Looking at the great importance of maintaining a sum which was equivalent to about 4d. in the pound on the Income Tax, which the duty on tobacco represented, he thought the deputation would feel that it was his duty to do nothing which would threaten the revenue. We sympathise with the opinions of the Chancellor of the Exchequer, and we feel that there are sundry breakfast table duties, amounting to about £5,000,000, to be got rid of before we can think of reducing the sum derived from a luxury like tobacco. We further confess that so long as we have a system of indirect taxation, it is difficult to see how the matter could be arranged, and few, we imagine, would be inclined to resort to a direct taxation of incomes, which would relieve luxuries of the greater part of their burdens, and press unduly on those who could not afford such luxuries.

THE FORTH BRIDGE.

As work at the Forth Bridge progresses, the magnitude of the undertaking becomes more and more impressively manifest. Cantilever bridges are not novelties; but the huge scale upon which this one is built brings into play difficulties which do not exist in smaller constructions on the same principle. At every point interesting questions arise, not only in matters of detail, but even in the general system of construction. Thus, before the erection of the cantilever bays was begun, the question arose as to the desirability of carrying up to the whole height of the bays a horizontal lifting platform, similar but lighter than that used in the construction of the main piers. It was decided to adopt the lifting platform principle up to about one-half the height of the cantilever bays, and to construct the top member, with the relative ties, struts, and bracings, by an overhang from above. The top member, which consists of steel lattice girders, is therefore built out from the top junction without support for about 160ft., or half the length of the first bay. At this point it meets the first vertical tie, which is temporarily employed as a support until the other half of the bay is built, when the top member will be united to the bottom member by diagonal struts and ties. The building outwards and downwards of so enormous masses of metal involves careful adjustment of weights and strains. Our illustration (Fig. 5) on page 296 is a view of the Fife pier, and here the system of overhang is displayed to advantage. A comparison of our view of this pier, which we gave some time ago (see *Industries*, Vol. III., page 450), with our present illustration, will enable our readers to observe the progress made in the construction. This pier is rather further advanced than the other ones, and possesses the further advantage from an illustrative standpoint that it offers more eligible points of view than either the Inchgarvie or South Queensferry Pier.

The two steel girders of which the top member is composed are permanently connected by means of horizontal diagonal bracings; but in addition they are temporarily connected by a broad platform upon which a crane runs. This crane has two jibs, of which one is used for carrying the riveting machines, and the other for hoisting and lowering material. This crane in effect builds its own foundation as it advances. Our illustration (Fig. 5) shows the main pier practically completed, and the construction of the cantilever bays carried on to the point at which the second diagonal strut branches upwards from the bottom member. The top member is carried out to the point at which the first vertical tie will meet it. The diagonal ties are shown stretching downwards from the top junction, each of them having its constructive platform and joining the diagonal struts, which are built upwards from below, and intersect the diagonal ties at a point somewhat above the level of the internal viaduct. The internal viaduct is also observable in our illustration (Fig. 5) stretching across the pier, having been erected on either side to a point beyond and below the intersection of strut one and tie one.

The internal viaduct is also built in the same manner. It is provided at either end with a two-jibbed crane, which raises material on one side from a jetty, and on the other from barges in the Forth. The crane travels along the viaduct as the work progresses, building its own foundation as it advances. The chief feature in the method of construction, viz., that the structure is its own scaffolding, each part carrying with it as it is put in position the means of further advance, is well illustrated by these examples. The riveting rings, painters' stagings, and temporary ties will be recognised among other instructive details. The method of overhang, the adoption of which was fortunately impossible in the earlier stages of construction, might have been attended with great danger.

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A mass of steel weighing hundreds of tons, and projected from a point 360ft. high, like a gigantic arm, outwards over an arm of the sea, strikes the imagination so much that it might well have been impossible to find workmen reckless enough to risk their lives in carrying out such a work. The gradual progress of the work from water level upwards has so far trained the vast number of workmen employed on the bridge to work at high altitudes, that they have become accustomed to the nature of the work, and do not shrink from risks which seem to them enormous only at a distance, and which diminish when approached. Thus the system of overhang, fearful as it is to the uninitiated, has been so far accomplished with very few accidents. When the bottom member and top member approach each other, the diagonal ties and struts will unite them together. These diagonal ties, built downwards from above, as described (see Fig. 5), will be converted into ties proper by bringing hydraulic pressure to bear upon them, so as to compensate for the slight depression inevitably due to the length and weight of the top and bottom members. The required tension will be easily obtained by cutting the tie when complete and drawing the ends together by means of hydraulic pressure. Within the past few days, and since our views were taken, the first ties of the northernmost bays on both north and south main piers have thus been connected to the top and bottom members in these bays. During the progress of the structure, the rivets at all the junctions are only partially inserted, and screw bolts are largely used for the purpose of enabling the correction of any depression without causing an excessive strain in the structure as a whole. We have been favoured by the engineers of the bridge—Sir John Fowler and Mr. Benjamin Baker—with the accompanying illustrations of details, which are exceedingly interesting, though the maze of angle irons, girders, and columns is apt to render them confusing at a first glance. If studied, however, with reference to the larger views, which illustrate the positions of these details in the structure, they will become more intelligible.

Intersection of Diagonal Tubes.—Fig. 1 represents the intersection of the diagonal tubes of the main pier at Queen's Ferry, west side. The point of intersection in the main piers will be found in Fig. 5, and the details of them are the same both in the north and in the south piers. The point of intersection in the diagonal tubes is also the junction of the horizontal bracings.

Internal Viaduct, with Horizontal and Diagonal Bracings.—The view shown in Fig. 2, though at first sight a confused mass of girders, will be readily understood by a little study. It represents the internal viaduct at the point where it passes through the main pier on the Queensferry or south side of the Forth. The view is taken from a point above the viaduct in bay one, and at about the level of the horizontal diagonal bracing shown in the illustration. The viaduct, which is intended for a double line of rails, consists of four lattice girders resting upon strong plate girders connected to the main columns of the piers, and to the struts of the cantilever bays. The tube to the left is the south-west tube of the Queensferry main pier. The girder passing across the upper portion of the illustration is the horizontal diagonal bracing of the first tie. It is connected at the extreme right to the south-eastern tube of the pier. The diagonal girders which brace the sides of the structure together beneath the level of the viaduct are seen crossing each other, and the vertical columns which aid in the support of the horizontal plate girders upon which the viaduct rests are seen springing from their intersections. The photograph from which Fig. 5 was reproduced was taken by Mr. Philip Phillips; the others (Figs. 1, 2, 3, and 4) were taken by Mr. E. G. Carey, Assoc.M.Inst.C.E. The bridge, in spite of the inclemency of the weather during a great part of the winter, has made extremely rapid progress.

Crossing of Tie One and Strut One, and Temporary Vertical Column.—Fig. 3 shows the method of passing the strut tube through the open girder which forms the tie. The vertical column, which is temporarily used to support the top member, will, in the permanent structure, not be carried further than this crossing, as it will become unnecessary for the support of the top member as soon as the diagonal struts and ties are in position.

Junction of Strut Two and Tie One with Bottom Member.—Fig. 4 represents the junction of strut two, a steel tube of 8ft. diam., and tie one, an open lattice girder, with the bottom member at the N.E. corner of the Queensferry pier. The first ten plates of the strut are alone in position, and a short length has yet to be added to the tie, projecting downwards, to effect a connection between the bottom and top member. As has been explained before, the top member has been built downwards by means of a moving platform, which is fixed at the lowest end, and construction carried on simultaneously a few feet below and a few feet above the platform. The crane, which moves along the tube of the lower member, erects its own travelling way, always in advance of itself, in the shape of the permanent structure.

THE FORTH BRIDGE.

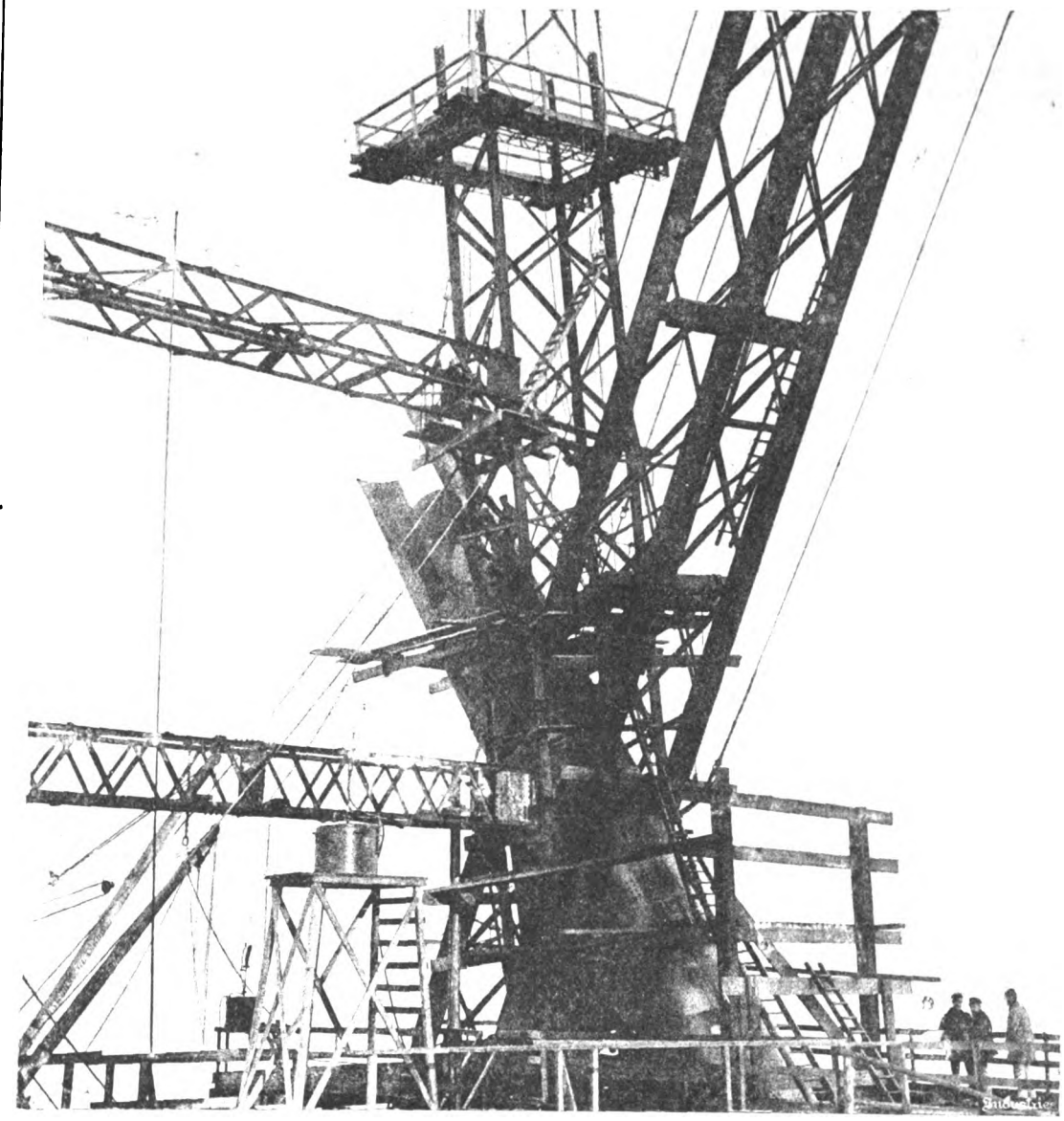


FIG. 3.—CROSSING OF TIE ONE AND STRUT ONE, AND TEMPORARY VERTICAL COLUMN.

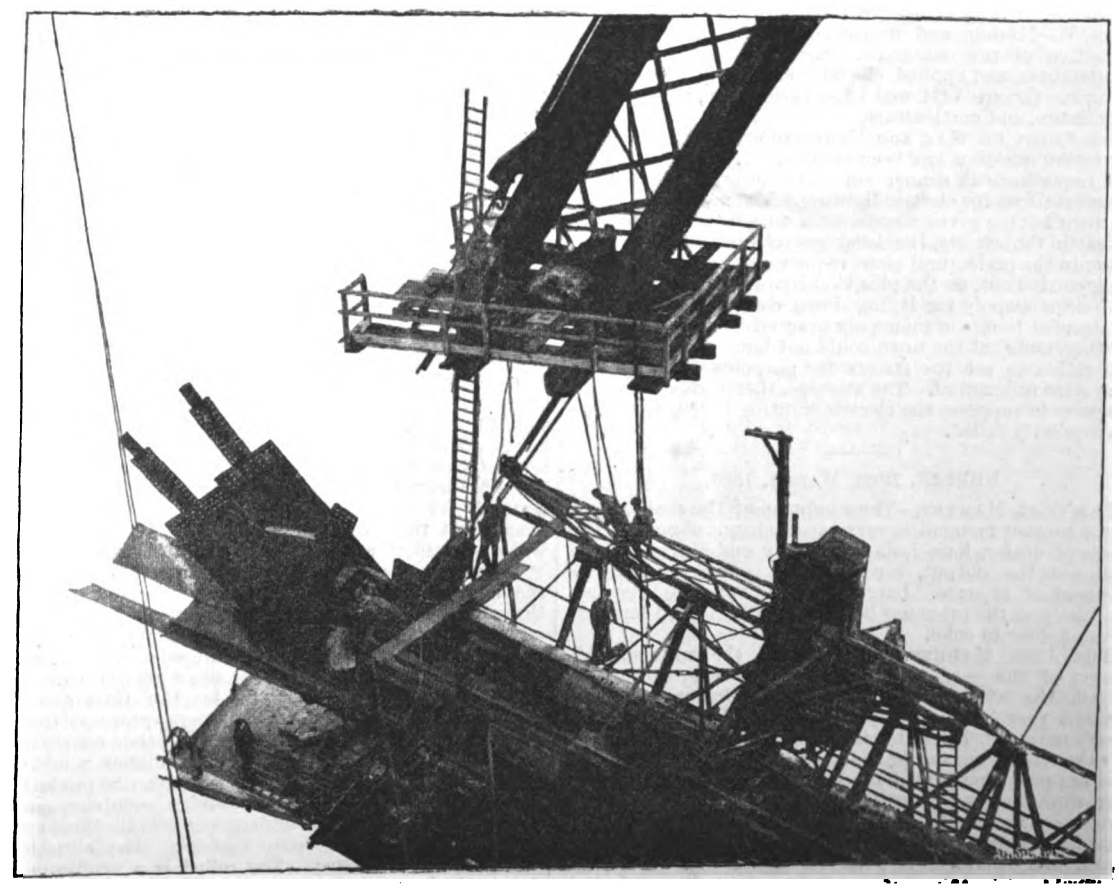


FIG. 4.—JUNCTION OF STRUT TWO AND TIE ONE WITH BOTTOM MEMBER, QUEENSFERRY, N.E.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 20TH MARCH, 1888.

THE IRON MARKET.—Since my last report affairs have taken a turn for the better in the iron trade, and on all sides there is talk of rising prices. Already some advances have been announced. Founders' prices are 1s. 6d. a ton higher. In the Haute-Marne efforts are being made to advance the prices of heavy castings by 8s. a ton. Such a rise would be fully justified, for founders have been working at a loss for some time past, and the raw material costs from 1s. 6d. to 2s. a ton more than it did a month ago. From the Loire et Centre we learn that bars and joists are this week quoted 1s. 7d. a ton higher. That a general advance in finished iron will take place cannot be doubted, for in this case too the prices of the raw materials, pig iron and coke, are constantly increasing. Excepting wire, wire rods, and wire nails, which are less sought after, business is more active for all classes of goods. The weather has again become very cold, a circumstance that will delay the expansion of trade in building iron. But it is now clear that the situation is strong, and that we are approaching a busy season. In the midst of all these indications of revival the Paris merchants persist in their headstrong course of "bearing" the market. With every influence against them, however, the issue of this deplorable conflict between manufacturers and the middlemen is not doubtful. The latest information is to the effect that the Longwy pig iron syndicate has announced a rise of 1s. 7d. a ton for forge pig, the quotation now being 41s. 6d. It is further reported that no iron can now be bought for delivery at an earlier date than June.

THE METAL MARKET.—The official quotations for copper show an advance of £2 a ton in the course of the week just past; but the movement is merely a speculative one, and of genuine business there is but little. Consumers are buying up old metal, which is to be had at very low rates, the syndicate not being able to get possession of this stock. Tin continues to arrive in larger quantities, and stocks accumulate. It is surprising that under such circumstances the markets remain firm. The market for lead is very animated, consumers being apparently afraid of a "corner" like what has been so successfully accomplished in the case of copper. Spelter is neglected, and slightly weaker in price.

THE EXHIBITION OF 1889.—M. Berger has issued a notice to the effect that the applications for space in Groups II., III., IV., V., and VI. have been sufficiently numerous to render it unnecessary to further extend the time. The success of the French Section is, he said, now assured. The space allotted in the main building to French exhibitors in Groups III., IV., and V., up to the 1st March, amounted to 64,850 square metres, while the covered space reserved for these groups in the galleries to be built in the Champ-de-Mars is 61,950 square metres. The following classification into groups has been adopted for the official catalogues. One separate catalogue will be published for each group: Group I.—Works of art. Group II.—Education, and apparatus and materials used in connection with the arts. Group III.—Furniture and accessories. Group IV.—Textiles, clothing and accessories. Group V.—Mining, and industries connected with the production of raw materials. Group VI.—Engineering, manufactures, and applied electricity. Group VII.—Food products. Groups VIII. and IX.—Agriculture, viticulture, pisciculture, and horticulture.

THE RIGHT OF WAY FOR UNDERGROUND CABLES.—An interesting question has been raised at St. Etienne, which is of importance in connection with the establishment of central stations for electric lighting. The municipality of the town having given a concession to a company to lay cables in the streets, the local gas company brought an action in the prefectural court to prevent this arrangement being carried out, on the plea that it was an infringement of their monopoly for laying down conduits. The Court has decided that the monopoly granted was only for gas lighting, and that the town could not bind itself to grant sole rights to use the streets for purposes which at the time were unheard of. The attempt, therefore, of the gas company to suppress the electric lighting in this town has consequently failed.

BERLIN, 19TH MARCH, 1888.

THE COAL MARKET.—The condition of the coal market at the present moment is very satisfactory. Stocks in the hands of dealers have been completely sold out, and at the collieries the output, especially of better qualities, is disposed of at once. Large coal is in very good request, especially as the price has been lowered. A good business is being done in coke.

THE IRON MARKET.—In spite of the unfavourable season of the year, the iron market is very active. In Silesia the whole production of puddled iron for the present year has been disposed of, as well as part of next year's output. The rolled iron syndicate has raised prices for the second quarter of the year 2s. 6d. per ton, owing to the improved tone of the market. Foundries and engineering works are well supplied with orders at remunerative prices. The wire nail trade is very active, and the syndicate has succeeded in raising the prices to a remunerative level, and this rise also affects favourably other wire products. The sales bureau of the wire nail syndicate is already in working order, and a uniform method of packing wire nails in packets containing 1000 nails finds much favour with dealers. Other syndicates are in course of arrangement. A committee has been formed to settle the details of a syndicate of chain makers. Spring makers are taking similar steps, and a syndicate of drawn wire makers is also being negotiated.

SEWING MACHINES.—German sewing machine makers are now getting up a petition to Government praying for an increase in import duty on this class of goods. It is somewhat surprising that the makers should wish for an increase of duty, seeing that German made sewing machines are largely exported; but it appears that the movement is directed more especially against the Singer Company, who have of late years cut the ground from under the German manufacturers' feet by allowing purchasers to pay for their machines by monthly instalments extending over a long period. Should the import duty on sewing machines be increased, it is probable that the Singer Company will not be beaten out of the field, but will meet the changed condition of the market by establishing a manufactory in Germany.

CHEMICALS.—The united chemical works in Leopoldshall have decided to manufacture potash on a large scale. Until some time ago the methods in use for making chloride of potassium into potash were not very successful; but Messrs. Borsche & Brünjes have introduced a new process, according to which chloride of potassium can by a wet method easily be made into potash by the use of carbolic acid and ammonia. This process has now been tried for a year, and the results obtained are said to be very satisfactory. The by-products of chloride of magnesium produced in the manufacture of chloride of potassium have, until recently, not been utilised, but were allowed to pollute the rivers into which they were conducted. A new process has, however, now been introduced, under which these by-products will be manufactured into hydrochloric acid.

ELECTRIC LIGHTING.—The larger hotels in Berlin are beginning to introduce electric lighting to a greater extent than has hitherto been the case. The new hotel "Thiergarten," which was erected last year, has now been fitted throughout with glow lamps, the current being supplied from the central station in the Mauerstrasse. This is the first hotel in this town which relies solely upon electricity, no gas or other illuminant being used as reserve. This circumstance is significant, as showing how great is the confidence of the public in electric lighting. In the new restaurant Gambrinus, gas has also been completely discarded in favour of electricity. The electric light installation in the Continental Hotel, which comprises 1000 glow lamps, has recently been completed. The work was carried out by the Allgemeine Elektricitäts Gesellschaft on their own account, the customer only paying for the current used, but not for the cost of putting up the installation.

VIENNA, 19TH MARCH, 1888.

THE COAL MARKET.—Business in all qualities of coal remains very active, and, with the re-opening of navigation on the Elbe, exports by water are again taking place. The total quantity of coal sent out from the Vienna Northern Railway Station during February amounted to 95,000 tons, leaving about 49,000 tons in stock. This traffic benefits almost exclusively the coal mines in the northern portions of the empire, whilst in the south, and especially in Styria, the condition of coal mining is exceedingly unsatisfactory. These mines are not able to compete with those in the north, and many miners are emigrating to America for lack of work.

THE IRON MARKET.—At the present moment it is difficult to estimate the tendency of the iron market, because traffic has been interrupted in many places, with the result of disorganising business. In Galicia, for instance, railway traffic has been completely paralysed, and not a single train could leave Lemberg during several days in the beginning of this month. In Bohemia there were also serious blocks from snow, whilst in the southern provinces the roads are almost impassable on account of the thaw. The markets have not yet recovered from the dull tone which was produced by the death of the German Emperor, and business at the present moment is by no means brisk. The Chamber of Commerce of Lower Austria has resolved to approach the Minister of Commerce with a request that more consideration should be given to the home industry when tenders are invited for the supply of material for the State railways and other Government works. At the general assembly at which this question was discussed, it was pointed out that Austrian producers of railway material are placed in Hungarian markets on the same footing as if they were foreigners, and are therefore at a disadvantage as compared with England and other nations who can produce more cheaply. They are thus beginning to lose the Hungarian market, and to make up for this now wish to secure a greater share of the home market as far as work for the Government is concerned. The Chamber of Commerce proposes that the Government should nominate a Commission, consisting of producers and consumers, which Commission would draw up a list of all those articles which can be produced in Austria equally as good as in foreign countries, and the Government should then undertake to obtain these articles exclusively from Austrian makers. The situation in Hungary is satisfactory. The rolled iron syndicate have raised the base price by 8s., and a slight increase has also taken place in the price of rolled iron tubes. In ship plates there has been a good demand from Roumania, Servia, and Bulgaria, with a consequent hardening in the rates. Pig iron is slightly weaker.

TEXTILES.—The usual spring revival in the textile trades is now beginning to show itself. Cotton prints and zephyrs are in good request, also the better qualities of cretonnes and shirtings. Unbleached cotton goods are still neglected. Linen goods from Reichenberg and Brünn have during the past week been extensively dealt in, and woollen goods are also active. In silks, the market is fairly animated, and in this connection it is interesting to note that the production of cocoons is constantly increasing. Some years ago it was only the south of Tyrol which produced cocoons, but at present considerable quantities are produced in other districts. The harvest last year was 1422 tons of cocoons in the south of Tyrol, 1194 tons in Gradisca, 139 tons in Istria and Dalmatia, and 72 tons in Hungary. The various agricultural associations are assisting this industry to a considerable extent, and this year's harvest will probably exceed the figures given above.

AUSTRIAN TRADE ABROAD.—The Austrian Export Association are making strenuous efforts to open up new markets abroad. The latest development of this Association is a depôt in Greece, erected with the specific object of competing against German importations of machine tools and hardware. The Association are also exporting to Greece considerable quantities of glass and toilet articles. Some time ago an Austro-Hungarian Chamber of Commerce was established in Paris, with a view to facilitate export business to France, and the results have been so far encouraging that a similar chamber for London is now in contemplation.

BRUSSELS, 20TH MARCH, 1888.

THE COAL MARKET.—Both industrial and household coals are very firm, and the contracts for 334,000 tons of coal which are to be made by the State railways on 3rd April, will have a favourable effect on the situation. The Prussian State railways have reduced the tariff for coal from the Ruhr and Wurm districts towards stations on the Belgian Grand Central, and this will enable the German collieries to regain the ground they have lost in Belgium. Although there is still a scarcity of waggons in the Mons district, business is active, and the continued cold causes a brisk demand for household coal. The weather has also caused stocks of nuts and household coal in the Liège district to be greatly reduced. Industrial coal has risen in price, and stocks are low. One of the large collieries in the Charleroi district has contracted to supply small steam coal for the Baltic.

THE METAL MARKET.—Plate makers have decided upon a rise of 4s. per ton, and a similar increase will probably take place in girders and building iron, owing to the strong demand in this line. Foundry pig continues very firm, and so far the imports of English pig have had no influence on the prices of Luxemburg pig. English pig cannot be sold under the rates ruling for our own; but even without a reduction this source of supply has eased the situation for consumers. Contracts will be made to-morrow for three hundred iron coal waggons, one hundred and thirty-five coke waggons, and sixty-five closed goods waggons. The Providence and Monceau works and Cockerill are turning out remarkably good frame plates. Thy-le-Château is busy with light steel rails and girders for America. The Seraing works will perhaps be forced to close for a time, owing to the rise of the river Meuse. Cockerill's will undertake work for the metallurgical company Dniesprovienne, in which the directors of the former company have taken a considerable interest. Railway waggon works are very busy, especially those of the Centre, and orders are being received from Switzerland and a few from Italy. Pig iron makers who have received for trial specimens of ore from the Haute-Moselle, are so satisfied with the results that they have bought largely, and 25,000 tons of this ore will shortly arrive in the Charleroi district. The makers have also the option of buying 100,000 tons in addition to the above. The ore produces 35 to 40 per cent. of iron, and some kinds can be smelted without the addition of flux, whilst the price delivered by water at Charleroi is only 5s. 10d. per ton for the best qualities. The red minette from the Esch district, which is similar, on the other hand costs 7s. 5d. at Charleroi.

FLAX AND YARN MARKETS.—Although, owing to the depreciation of the rouble, very favourable offers have been made at Ghent for Russian flax, there has been but little business. In home grown flax prices are unchanged, although the demand has diminished. Yarns are not much in request, and prices are giving way. Linen is also in a less satisfactory condition.

ELECTRIC LIGHTING OF THE EXHIBITION.— On the 25th inst. the Executive Committee will make final arrangements for giving out the work for the electric lighting of the buildings and gardens of the Exhibition. Offers have been made by many electricians to supply various apparatus free of charge, both for arc and incandescent lighting; but other offers were on the basis of payment per lamp-hour, the average price asked being from 2d. to 3d. for a 10 to 12 ampère arc, and of 3d. to 35d. per 16-candle power glow lamp. For the arc lighting offers have been received from the following: The Thomson-Houston Company, (engineer, M. Admirallie), seventy-five 2000 nominal candle power lamps, with an 80 h.p. steam engine; Messrs. Bouckaert & Co., of Brussels, four lamps of 25 ampères, six of 16 ampères, forty-two of 10 ampères, and sixteen of 6 ampères; M. Dulait, of Charleroi, twenty-five lamps of

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15 ampères, four of 24 ampères, and six of 4 ampères, all at 35 volts; Messrs. Jaspar, of Liège, twenty lamps of 12 and 6 ampères; the Gülcher Electric Light Company, lamps of 10 ampères, &c. For incandescent lighting the following have made offers: M. Dulait, 200 lamps; M. Khotinsky, 500 lamps; M. Bury, 500 lamps; l'Industrielle, 750 lamps; and Mr. Bernstein, 150 lamps of 30 c.p. to 50 c.p. In the machinery section there will be three rows of 10 ampère arc lamps, seventeen in each row, and one row of 16 ampère lamps will be placed in two rows on either side. The 10 ampère lamps are hung at a height of 30ft., and the 16 ampère lamps at a height of 42ft., the object of the latter being to illuminate the side galleries, which are 20ft. above the floor. There is a 10 ampère arc lamp provided for every 1900 sq. ft. of floor space. M. Pieper, of Liège, has already obtained a concession for lighting the aquarium, the casino, and the German breweries. He will also work the electric tramway.

DÜSSELDORF, 19TH MARCH, 1888.

THE COAL MARKET.—Great activity continues to be a distinguishing feature of the coal trade. The wintry weather has occasioned a renewed demand for house coal, and the revival of industry causes an unusual degree of activity in the market for steam coal and blast furnace coke. Prices have an upward tendency, and seem likely to remain firm for some time to come. The first contracts for the year for locomotive coal were tendered for the other day, when the offers received showed an advance of from 2s. to 3s. per 10-ton truck load on last year's prices. The tenders ranged from 5s. 9d. to 6s. 1d. a ton for locomotive coal, and 6s. 9d. to 7s. 6d. for gas coal. Coke was offered at prices varying from 9s. to 10s., and briquettes at from 7s. to 8s. a ton. The Customs returns for January give the exports of coal in that month as 739,173 (753,958) tons, those of coke as 72,232 (63,235) tons, and those of briquettes as 12,571 (12,817) tons; total, 823,971 (829,447) tons, the quantities within brackets being those for last year. It will be observed that the trade in coke shows an expanding tendency.

THE IRON MARKET.—The general aspect of the iron market has not greatly changed since my last report. Business is on the whole quieter in pig iron, the production of the blast furnaces being all sold forward to the end of June. Still, there is a steady demand, and prices remain very firm. Forge pig is most sought after. The market is fairly active for spiegel, despite the fact that no orders now arrive for the United States. There has been a better inquiry this week for Bessemer pig, and prices are a little harder. The export trade in crude iron is lifeless, while the imports of foreign iron increase—effects wholly due to the high level to which the syndicates have raised prices. It is contended by advocates of that artificial system of regulating trade that this objection does not hold, since many, if not most of those who work for the foreign market, have their own blast furnaces; but the greatly increased prices in the home market have occasioned a corresponding rise in the prices of iron ore and coke, so that manufacturers are unable to produce at the same cost as formerly. The market for finished iron and steel is fairly animated, but there is languor in some branches of the trade. Bars exhibit increasing dulness, and joists are in less demand. The latter circumstance is probably due for the most part to the inclement weather, which delays the resumption of building operations. There is still a brisk demand for plates, and many manufacturers have booked enough orders to keep them employed for several months to come. Business in sheets is somewhat dull, and there is increasing dulness in the wire trade. United States' orders are few and unimportant. There is a steady business in wire nails. During the week a good deal of buying has taken place on Belgian account. Home prices are as follow: Bars, something above the base prices of £6. 2s. 6d. and £6. 5s.; angles, £6. 12s. 6d.; hoops, £6. 17s. 6d. to £7; steel billets, £6. 15s.; wire nails, £8. 5s. per ton.

GERMAN TRADE WITH ITALY.—The German newspaper press is urging manufacturers to take immediate and energetic steps to turn to account the opportunity afforded by the war of tariffs between France and Italy. It is pointed out that English traders will seek to increase their hold both in the French and the Italian markets. Judging from the activity of German agents in Italy at the present time, manufacturers scarcely need the stimulus of these admonitions. The prospect for German trade in this direction is very encouraging.

LILLE, 20TH MARCH, 1888.

TEXTILE MANUFACTURES.—The week has passed without bringing any event which the most sanguine could construe into an indication of improving trade. The linen trade has been slightly more active than it was last week, but no improvement has taken place in prices. The woollen trade remains lifeless, and there are no indications of immediate revival. The return of cold weather has given an impetus to the hosiery branch of the trade; but in all other directions there is almost absolute stagnation. This protracted calm is giving rise to disturbing apprehensions, both among manufacturers and the persons in their employ. The market for raw materials is somewhat firmer. South American combed wool is quoted 4·70 francs to 4·90 francs; Australian, 5·50 francs to 5·75 francs per kilo. Noils, which had receded a little, have recovered to 3 francs and 3·15 francs for South American, and to 3·30 francs and 3·70 francs for Australian. Business in cotton goods is very quiet. A report from Lyons describes the silk trade as depressed by the new retaliatory tariff directed against Italy. The silk goods, velvet, and ribbon industry is largely dependent upon Italy for the raw material, and it will take years to establish a trade in the same commodities with Spain, Portugal, China, and Japan.

FLAX AND YARN MARKET.—The market is fairly animated for home grown flax, but prices show a tendency to weakness. Russian has been less largely dealt in. Tows have been in strong demand for export; but the home market is calm, and prices are in favour of buyers. The situation has not materially changed for yarns. There is some life in the export trade, but the requirements for home consumption are for the moment not great. In some instances spinners have shown a disposition to take lower prices. There is still a good demand for jute yarns. Hemp is in better request, and prices are very firm. Raw cotton has receded in price 1s. 6d. in consequence of forced realisation on the part of some New York speculators for the rise; but this has had no visible effect on the market for cotton yarns. Spinners having booked plenty of orders, are not disposed to make concessions.

THE IRON MARKET.—The iron market is unchanged in its principal features. Though business is less animated than it was a fortnight ago, there is a steady current of orders sufficient to keep the books well filled. Prices remain unaltered at £5. 4s. for bars; but an advance of 4s. is expected as soon as the forge masters of the Nord and the Centre have settled the question of zones, for which purpose there is to be a meeting this week at Paris. The strikes at the Providence works and the Manbenge blast furnaces continue. The founders of the Valenciennes district have agreed on the principal bases of the syndicate, but the details remain to be discussed. Engineering works are busy. M. Walrond is erecting a small steel works at Louvroil for M. G. Dumont.

THE BUILDING TRADE.—It is significant of vigorous industrial life in this locality that in the arrondissement of Lille alone there are upwards of 1600 building contractors, employing in all about 25,000 hands.

MILAN, 19TH MARCH, 1888.

RAILWAYS.—Mr. Baccarini has compiled some interesting statistics with reference to the Italian railways. During the last seven years 1660 miles have been constructed by Government, and 194 miles by private enterprise, making a total of 1854 miles. The cost of construction amounts to about £11,500 per mile, but nearly all the lines are single track. At a recent meeting of the shareholders of the South Adriatic Railway Company, a motion was put and unanimously carried authorising the directors to issue 6000 new shares of £20 each, the capital of £120,000 thus raised to be applied to the extension of the system. The Mediterranean Railway Company have laid before the government inspector for his approval and sanction a project for the construction of part of the circular line which is to surround Milan. It is probable that the proposal will receive the royal assent with but slight modifications. The part to be taken in hand at once is 3¼ miles long. The new line between Cuneo and Mondovi in Piedmont was opened for traffic last month.

SHIPPING SUBSIDY.—For some years past the Peninsular and Oriental Steamship Company have had a contract with the Government for a weekly service between Venice and Brindisi, and for this they received a subsidy of £20,000 per annum. This contract had already been twice renewed and was again about to be renewed when the Peninsular and Oriental Company made representations to the Government that owing to the competition of the North German Lloyd they did not care to continue the service to Venice unless the subsidy were raised to £50,000 per annum for a weekly, or £34,000 for a fortnightly, service. The Italian General Navigation Company took advantage of this hitch in the negotiations by offering to run a weekly service between Venice and Brindisi for £40,000, and a fortnightly service for £20,000 per annum. A commission of nine members was appointed by the Government to investigate the respective offers of the rival companies, and seven have decided in favour of the Italian company, whilst two recommended the contract to be given to the Peninsular and Oriental Company. It is therefore probable that the Government will accept the offer of the Italian General Navigation Company.

MADRID, 19TH MARCH, 1888.

COTTON MILLS.—A few years ago the cotton spinning industry here was in a most flourishing condition, and dividends of 30 per cent. were sometimes paid. As a consequence, numerous new mills were erected, until considerable over-production took place, and the situation is now very bad. An agreement has been come to among the most influential mill owners to raise prices 10 per cent., and if this fails to make business sufficiently remunerative, it is proposed to reduce the production by one-half.

PETROLEUM.—Among the financial proposals laid before the Cortes is one for an increase of the already very high duties on petroleum. The object is to increase the Custom House receipts; but it ought to produce the opposite effect if some enterprising British company, acquainted with the Scotch shale oil industry, were to establish works in the north of Spain. I am of opinion that if shale oil can be produced in Scotland, and hold its own against petroleum imported free of duty, it would be possible to produce it in Asturias at an enormous profit, as the duty on refined petroleum entering Spain is over 140 per cent. One disadvantage, however, lies in the fact that our legislation is perpetually undergoing alteration, so that next year it might happen that the duties would be decreased. It would therefore be inadvisable to make the experiment if the cost of plant is heavy; but some Scotch works which is at present doing bad business might find it profitable to transfer its plant to this country.

CHROME STEEL.—The Trubia Ordnance Works are turning out chrome steel of such reliable quality that all the tools used there are now made from it. This department is under the charge of Captain Cubillo, a member of the Iron and Steel Institute, who has devoted great attention to the manufacture of steel.

NEW YORK, 10TH MARCH, 1888.

THE COAL MARKET.—The anthracite coal market has got back to its condition before the strike. Most of the Reading collieries are again at work. The total output shows a considerable increase.

THE IRON AND STEEL MARKETS.—There have been no new developments in the pig iron market during the past week. Prices are not lower, but the feeling is weak. There is no scarcity of iron, and attempts are being made to get orders for future delivery at present prices. The furnaces are not working to anything like their full capacity. It is stated that there are large orders waiting for a lower market, but the rumour is very indefinite. In manufactured iron business is falling off, and very few mills are running at much more than half their capacity. Western offers are made for such large quantities, and at such favourable prices, that there is nothing in the business here. Generally the iron market is in a worse condition now than at any time during the winter, and it compares very unfavourably with the state of trade a year ago. Although there is an immense quantity of iron being used, all the orders which are placed are for small lots, and none of the mills have a large amount of business ahead. The steel rail market is quiet. The mills are running moderately full, but the contracts are not very large. The time of year is favourable for an increasing demand, and prices remain firm. One order of 5000 tons for an Eastern railroad is reported at £8. 2s. 6d. per ton.

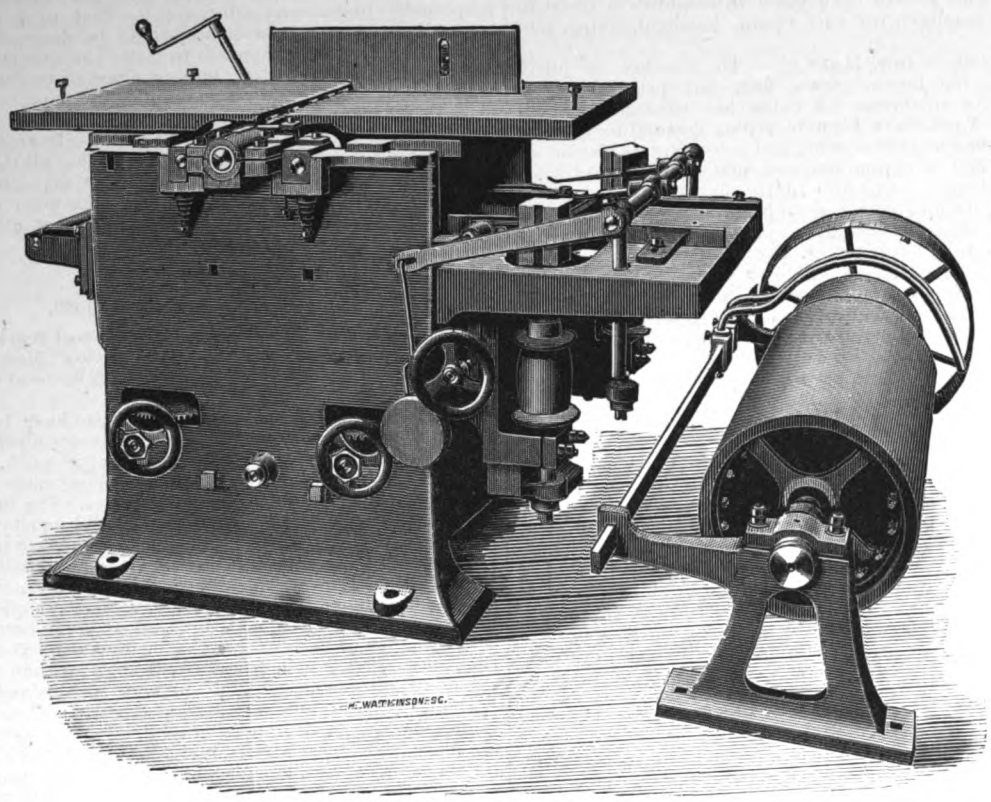
THE METAL MARKET.—Copper is rather firmer, but with little change in price. During the last week about 2,000,000lb. have been sold at 16 cents per lb. for March, and 16·20 cents to 16·30 cents for April delivery. There is no confirmation of the rumour that the Calumet and Hecla have sold their output to the syndicate. In the tin market purchases amounting to 210 tons have been made at prices varying from 36 cents per lb. for March, to 31·60 cents for May delivery. The market has improved somewhat, and speculative buying to the amount of about 600 tons on the metal exchange has caused an advance of 5·15 cents per lb. for spot, and 5·17 cents for April delivery.

THE TARIFF.—If it were believed that the present Congress would make any serious attempts to change the tariff, the Bill of Mills, the chairman of the Ways and Means Committee, would be sufficient to excite manufacturers in almost every branch of trade. The proposed new tariff is mainly free list. Some of the changes in the Bill are indicated below: Iron in pigs, spiegel iron, reduced from $6·72 to $6 per ton; iron and steel rails (not over 25lb. per yard), from $17-$20 to $14 per ton; flat rails (punched), from $17·92 to $15; rails or bars (over 25lb. per yard) $16·68 to $11 per ton; tin plates, from 1c. per lb. to free; wools, &c. (unmanufactured) range from 2½-36c. per lb. to free. There does not seem to be any possibility of the Bill passing the Lower House in anything like its present shape, and it is extremely doubtful if any general Tariff Bill will be passed during the present session.

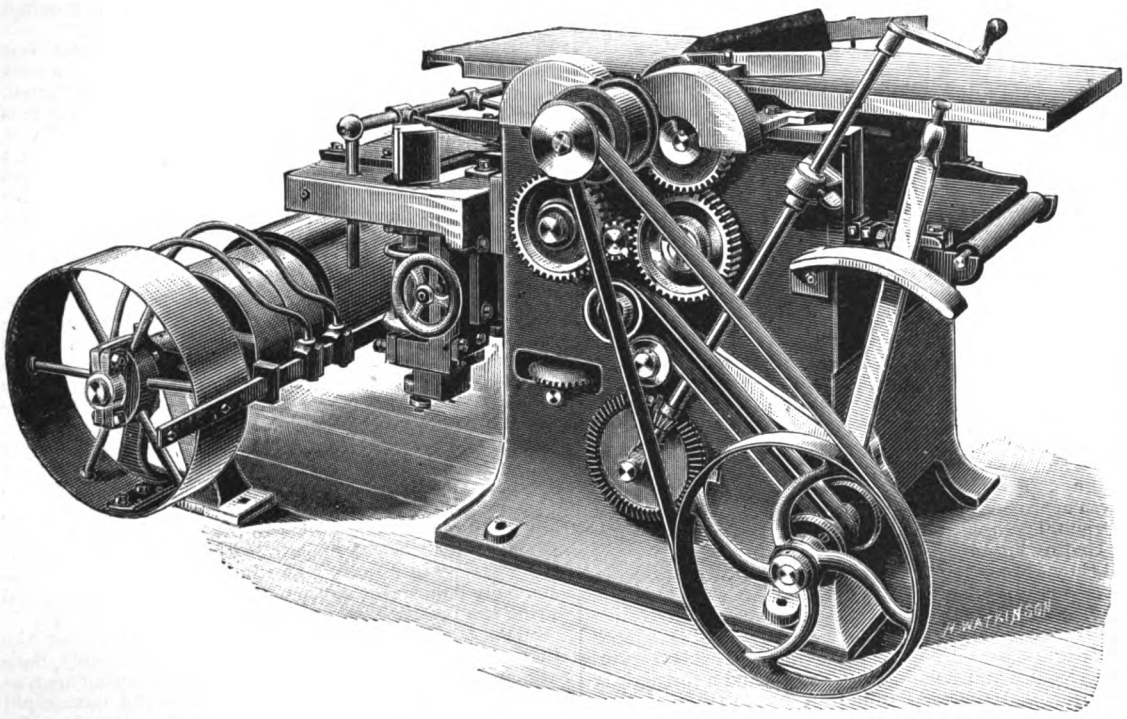
SHIPBUILDING.—The boats used for ferries over the Hudson River at New York, by the Pennsylvania Railroad, are all being equipped with steam steering gear, as the crowded condition of the river makes the more rapid handling of the boats a necessity.—A twin screw boat for the United States lighthouse service is nearing completion in Baltimore. The hull is of steel, and of novel construction. The forward part of the steamer is of ordinary shape, but abaft dead flat; the ship being practically a double one. The keel separates into two parts, and each screw shaft goes through its own stern post. The boat is 180ft. over all, 29ft. beam, and is of 11ft. depth of hold. The engines are compound, with 15in. and 28in. cylinders diam., by 27in. stroke.—The contract for a new steel steamship, 300ft. long, 46ft. beam, has been given to Messrs. Cramps by the Clyde Steamship Company for their southern trade. Triple expansion engines, with all the latest improvements, are to be fitted. The steel turned out by the Pacific Rolling Mill Company of San Francisco, and used in the construction of a vessel for the Government, has been found by the inspectors to more than fulfil the requirements. The breaking of beams, which took place early in the year, and caused considerable comment among officials, has been shown to be caused by improper treatment of the beams after leaving the mill. Tests made of four samples from each heat give an average of 61,000lb. tensile strength and 30·5 per cent. elongation in 8in. for angles; hull rivets, 53,308lb. and 31·5 per cent.; boiler rivets, 61,220lb. and 29·3 per cent.; and the cast steel used for stem, stern post, and ram gear, 66,870lb. and 19 per cent. elongation.

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IMPROVED WOOD PLANING MACHINE.



FRONT VIEW OF MACHINE.



BACK VIEW OF MACHINE.

IMPROVED WOOD PLANING MACHINE.

THE accompanying illustrations show an improved wood planing machine constructed by Messrs. John Sutcliffe and Son, wood working machine makers, Jail Lane, Halifax. This machine is provided with a top table for planing wood, which may be in twisted condition, to a true plane surface. The body of the machine is cast in one piece, and carries a horizontal steel spindle fitted with three knives and two steel feed rollers. One of the knives may be removed, and a moulded cutter put into its place for moulding and planing the board at the same time. The roller which forces the wood under the knives is fluted, while the other one behind the spindle is smooth, so that no marks are perceptible on the wood after having passed through the machine. The table is also provided with two carrier rollers arranged under the two feed rollers in such a manner that they just protrude above the table. By these means the friction between the wood under operation and the table is obviated. Wood which may be in a twisted condition is first planed on the top table to a true plane, and then passed face downwards on to the lower table, where it is planed to the required thickness. This lower table is also fitted with two vertical spindles, which plane, mould, or tongue and groove the sides of the board, according to the shape of the cutters fixed to the spindles. The depth of the cut is regulated by raising or lowering the tables, which are arranged to take a cut up to $\frac{5}{8}$in. in depth. By means of the fence shown on the top table, rabbets, chamfers, or stop chamfers may be produced. The feed motion of the bottom table is very powerful, being capable of working with a cut $\frac{3}{8}$in. deep without any slipping of the gear wheels driving it. A rule is fitted to the side of the machine, over which a pointer on the table moves, showing the exact thickness to which the wood is being planed. We understand that the machine will plane any thickness from $\frac{1}{16}$in. to $7\frac{1}{2}$in., either hard or soft wood, and that it is made from 12in. to 30in. in width. It will be seen from our illustrations that the machine is very compact, and suitable for its intended purpose.

RING SPINNING MACHINERY.*

AFTER giving a general outline of the machine as made at present, the author gave a brief history of the ring frame, defining it as a machine of which a stationary annular ring is an essential feature, in which case no earlier date than 1828 can be assigned to it. In that year a patent was granted in the United States to one J. Thorp, who invented a ring which was in two pieces, and a groove was thus formed in which a solid hoop was placed. The yarn was conducted between the two rings, and was drawn round the periphery of the hoop by the pull of the spindle. In the next year a patent was taken out in the United States by Messrs. Addison & Stevens, in which the first mention is made of a traveller. The first patent in this country was granted to Messrs. Sharp & Roberts in 1834. The spindle was borne by the bolster and footstep, the warve or whirl being placed between the two. The copping rail carried the ring, which was fastened on to the top of the rail. The traveller was formed from flat wire coiled round a rod, and cut into short lengths for the purpose. The spindle carried a bobbin which rested on a braid or disc on the spindle, and was positively driven by means of a pin in the braid which engaged with a hole or slot in the flange of the bobbin. All the essential features of the modern ring frame are found in this machine, the roller stand being inclined, the bobbin positively driven, and the ring and traveller identical in principle with those now used. The next patent in point of time granted in this country was that of Charles de Bergue, which was granted in 1836, being identical in principle with that of J. Thorp. The invention of John George Bodmer in 1837 was next referred to. Sketches of the traveller used were shown. The lower ring was attached to the rail by bolts, and served as a support for the traveller. An upper ring or cover was employed, and kept in position by a button. The revolution of the spindle pulled round the traveller, as in the preceding patents. It was somewhat remarkable that in the specification of this patent Bodmer appears to have stated some deductions which are very much akin to the speculations of some modern inventors. He states that at first, when the spindle was revolving slowly, the eye in the traveller would be close up to the spindle, while with the increase of speed the centrifugal force created would cause the traveller to fly outwards. It was on the balance of the forces of tangential and centrifugal impulses thus given to the traveller that Bodmer relied for the efficient winding of the yarn on the spool. He laid down as a rule that the weight of the "flyer" depended entirely on the work to be done and the counts to be spun, thus showing that even at this early day there was a very clear apprehension of the principles underlying this process. The next patent of which notice was taken was that of John Platt and Thomas Palmer, which bears the date of 1847, this being the first time in which an attempt was made to spin on the bare spindle cops similar to mule cops. The spindle was of the ordinary type of mule spindle, and it had surrounding it the ring attached to the copping rail, to which the usual vertical movement is given. The specification states that the patentees had discovered that by giving the rail the necessary traverse by means of a cam of the requisite shape, "pin" cops could be very readily spun on this machine. After this date little use was made of the ring frame until in the year 1866 Messrs. J. & P. Coates and Messrs. Clark & Co., both of Paisley, and both having mills in America, introduced into this country short sample ring frames for the purpose of twisting sewing cottons, and in February, 1867, Messrs. J. & P. Coates ordered from Messrs. P. & J. McGregor, of Manchester, eight sample frames of 238 spindles each for twisting purposes. In May of the same year Messrs. Clark ordered from the same firm a sample frame, and during that and immediately succeeding years many repeat orders were executed by Messrs. McGregor. Messrs. Wm. Higgins & Sons, of Salford, also made machines on the American pattern for the same firms and for the United States. In June, 1867, Messrs. McGregor made for Messrs. Knowles, of Burnley, a ring spinning frame, all those previously referred to being for twisting, and in October, 1869, they made for Messrs. John Dugdale & Brothers, of Lowerhouse, near Burnley, fourteen frames of 364 spindles each. The author is not aware of any earlier actual use in this country on a large scale of ring frames either for spinning or doubling. At the latter end of 1872 Mr. James Blakey, a representative of Mr. Brooks, paid a visit to the United States, and there investigated closely the use which was being made of the machine, the result being that Mr. Brooks began to manufacture the machine with energy. In 1870, Mr. J. H. Sawyer, of Lowell, Mass., patented the spindle bearing his name, and which was introduced into this country under the name of the "Booth-Sawyer." The main principle of the spindle was the devising of a means by which the top bearing was carried up inside the bobbin, thus sustaining it at a higher point than had been before possible. Special provision is made for lubrication of the bolster and footsteps, and both are supplied with covers. The Booth-Sawyer spindle is beyond doubt an efficient spindle, and constituted a very great advance on the spindles previously used. The introduction of the Rabbeth spindle into this country by Messrs. Howard & Bullough about the year 1874 led to its wide adoption, and the practical supercession of the Sawyer. The principle of the Rabbeth is that of the Sawyer so far as the position of the upper bearing is concerned, but it has the further merit of being entirely self contained. The latter feature was not new in the annals of British invention, as in a patent granted to David Cheetham in 1857 a self contained spindle was included. In addition to this, in a silk mill at Renfrew, occupied by a Mr. Gavin Pollock, a self contained spindle made with a brass bolster had been working for a great number of years prior to 1857; but this use was not generally known. In 1836 a patent was granted to Mr. William Wright, in which this principle of a self contained spindle is foreshadowed, the driving warve being at the lower end of a hood fitted on to the spindle. The first form of the Rabbeth spindle had the bobbin entirely above the bearing, as the specimen exhibited will show. The first patent taken in America by Mr. Rabbeth was dated the 2nd April, 1867; but on the 18th of December, 1860, Mr. E. M. Steeve patented in the same country a spindle which is almost identical with the Rabbeth spindle.

* Abstract of a paper read by Mr. Joseph Nasmith, before the Manchester Association of Engineers, on 10th March, 1888.

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Various modifications of the Rabbeth spindle have been made, including the Dobson-Marsh, which provides for a readier means of oiling by taking off a cap at the lower end of the spindle, and thus allowing the dirty oil to run away—this necessitating pumping out in the Rabbeth. In all essential features the Rabbeth may be taken as the best type of self contained spindle, in which the spindle proper is sustained by rigid bearings, and one of its chief merits is that it can be readily adjusted so as to be quite true with the ring. As a matter of fact this was practically the only advance noticeable in the Rabbeth spindle over its predecessors, and was not perceived even by its inventor until after spindles made under his first patent had been working some time. During the past few years, however, a new type has been introduced, to which the designation of the "top" spindle was given, and which was, while held in a long bearing at the top of the bolster, free to move at its foot until it found its position of steadiness. It was found, however, that the changes of position when the balance was disturbed were so abrupt that it was necessary to restrain the movement to a certain extent. Several types of this class of spindle were described, and it was noted that the adoption of spindles with elastic bearings had been followed by a shortening of the driving sleeve and a lowering of the top bearing. In the patent of William Wright, previously referred to, provision for an elastic bearing at the bolster was made, the collar of the bolster being grooved and a leather washer fitted, the outer periphery of the washer fitting a hole formed in the rail. The author subsequently dealt in detail with the machine and considered some of its principles. In conclusion, he pointed out that the success of the machine depended on the accurate construction attained by modern machine tools, and that it was as a twisting rather than as a spinning machine that its use was renewed. In answer to a question, the author said that with preparation machinery not more than sixty-five ring spindles per h.p. could be safely counted upon, and in some cases the number was less.

SHIPBUILDING NOTES.

Messrs. Short Brothers, of Pallion Shipbuilding Yard, Sunderland, launched on the 15th instant the steel screw steamer "Rio Tinto," which has been built to the order of Mr. John Tully, of Sunderland. The vessel, which is built of Siemens-Martin steel, is classed 100 A1 under special survey on Lloyd's Register, and is constructed with a cellular bottom throughout, divided for trimming purposes. There is a full poop aft for the accommodation of the officers, the saloon being handsomely panelled in Lincrusta-Walton, hurricane house amidships, with engineers' rooms in aft end, and topgallant forecastle for the accommodation of the crew; a fore and aft gangway between the deck erections, allowing a ready access in bad weather, &c. As the vessel will be principally engaged in the ore trade, suitable trunks are provided. All the latest appliances are fitted for rapid dispatch in loading and discharging cargo, including four steam wenches on the compound principle, supplied by Messrs. Wigham & Co., South Hylton; and having a multitubular donkey boiler of 150lb. per square inch working pressure. The "Rio Tinto" will be fitted with triple expansion engines of 180 n.h.p., with two steel boilers of large size, working at a pressure of 150lb. per square inch, by Mr. John Dickinson, Palmer's Hill Engine Works, Sunderland.

Messrs. Jos. L. Thompson & Sons, North Sands, Sunderland, launched on the 17th inst., the steel screw steamer "Birchfield," built to the order of Mr. Jos. Brown, of Liverpool. This vessel has a dead weight capacity of 3,500 tons, and is of the well-decked type, with raised quarter deck, hurricane house, and topgallant forecastle, built on the web frame principle, dispensing with hold beams. Six water tight bulkheads divide the vessel into seven compartments. The vessel is to be fitted with triple expansion engines of 220 n.h.p., by Mr. John Dickinson, of Palmer's Hill Works, and with two steel boilers of 150lb. per square inch. Direct steam windlass, steam winches, steam steering gear, and donkey boiler on deck are included in the vessel's equipment.

Messrs. W. R. Potter & Sons launched from their shipbuilding yard, at Queen's Dock, Liverpool, last week, a fine new sailing ship for the Calcutta trade. The "Seafarer" is a sister ship to the "Wayfarer," launched from the same yard about eighteen months ago, and is of the following dimensions: Length, 230ft.; beam, 41ft.; depth of hold, 24ft. 6in.; tonnage, net register, 2200 tons; dead weight capacity, 2500 tons. She is classed 100A at Lloyd's, and the framing and plates are in excess of the requirements of either Lloyd's or the Board of Trade. She is constructed of Siemens-Martin steel, manufactured by the Steel Company of Scotland, the Consett Company, and Messrs. Dorman, Long, & Co. She is fitted with Barfield's patent steam winch.

Messrs. William Simons & Co., of Renfrew, have received another order for one of their patent hopper dredgers, for harbour improvements in the East.

A New Pottery Kiln.—A new pottery kiln, fired by gaseous fuel, is in operation at the Wilderness Terra Cotta Works, Mitcheldean, Forest of Dean. This kiln, which has been constructed by Mr. Carr—from the designs of Mr. Thwaite, C.E., of Liverpool—has several new features. It is recuperative, and the heat radiated from side walls is also recovered. The kiln is so arranged that a perfectly uniform heat in the muffle can be obtained; but full fuel economy is only obtainable when there are two or more kilns. In that way the gaseous fuel produced from a Thwaite gas producer can be continuously consumed—first on one kiln and then on another. We understand that a second kiln is to be constructed, so that this economical advantage may be accomplished.

Notices of Meetings.

THIS WEEK.

Institution of Naval Architects.—Friday, 23rd March, noon and 7 p.m. Continuation of annual meeting. Papers to be read and discussed.

Balloon Society of Great Britain.—Friday, 23rd March, 8 p.m. Lecture on "Great Britain and the Colonies," with Notes of Personal Travel in Australia, by Mr. J. E. Cracknell, F.R.G.S.

NEXT WEEK.

Society of Arts.—Monday, 26th March, 8 p.m. Cantor lecture on "Alloys," by Professor Chandler Roberts-Austen, F.R.S. —Tuesday, 27th March, 8 p.m. Foreign and Colonial Section. Paper to be read on "The Panama Canal," by Mr. J. S. Jeans.

Institution of Civil Engineers.—Tuesday, 27th March, 8 p.m. Further discussion on paper on "Economy Trials of a Non-Condensing Steam Engine—Simple, Compound, and Triple," by Mr. P. W. Willans, M.Inst.C.E. Paper to be read (time permitting), on "Compressed Oil Gas, and its Applications," by Mr Arthur Ayres, M.Inst.C.E.

The Society of Architects.—Tuesday, 27th March, 7 p.m. Special general meeting.

Chemical Society.—Wednesday, 28th March, 8 p.m. Anniversary meeting. President's address. Election of office bearers.

Civil and Mechanical Engineers' Society.—Wednesday, 28th March, 7 p.m. Paper to be read on "The Development of Machinery in Relation to Hand Labour," by Mr. Ambrose A. Myall, Assoc.M.Inst.C.E.

PRICES CURRENT, 22nd March.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/10½	Cash
Scotch Warrants, m/n		39/1	"
Hematite Warrants, m/n		42/1½	"
Stocks in Stores. Scotch	960,518—Inc. for week,	3072	Tons
Middlesbro'	326,758—Dec. "	2572	"
Hematite	211,358—No change.		

Exclusive of stocks in makers' yards.
Market firmer, prices having an upward tendency.

	No. 1.		No. 3.	
Coltness	47/9	.....	42/-	f.o.b. Glasgow.
Gartsherrie	44/9	.....	41/3	" "
Dalmellington	39/9	.....	38/3	" Ardrossan
Eglinton	39/-	.....	37/3	" "
Glengarnock	44/-	.....	39/9	" "
*Derbyshire	—	.....	35/6	f.o.t. Works.
*Lincolnshire	—	.....	32/6	" "
*Lancashire	—	.....	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 17 6	.....	5 7 6	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 2 6	.....	5 12 6	Manch'r.
" Angles	5 12 6	.....	6 2 6	"
Crown Sheets	6 5 0	.....	6 10 0	"
" Hoops	5 5 0	.....	6 5 0	"
"Siemens-Martin" Steel Boiler Plates		.....	7 17 6	"
" Ship and Girder		.....	7 12 6	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£19	10	0	to	£19	15	0
Copper: British Cakes and Ingots	80	0	0	"			
" Chili Bars	80	5	0	"	80	7	6
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	0	0	"	15	2	6
" English Sheet	16	0	0	"	16	2	6
Tin: Straits	166	0	0	"	166	5	0
" Australian	167	0	0	"			
" English Ingots	159	0	0	"	160	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Chili quotations are slightly lower, and have during the past week ranged from £80. 5s. to £80. 7s. 6d. for spot parcels. Manufactured is without change. There is still an absence of demand for manufactured copper, and great slackness of trade in consequence thereof.

Tin.—Quotations for Straits very steady; sharp cash £166. 5s., delivery £142.

Lead.—Spanish is again easier, at £14. 5s. to £14. 7s. 6d.

Spelter is without change.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	10	0
" Ceylon	"	24	10	0
Cottonseed	"	20	15	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	18	10	0
Palm, Lagos	"	21	10	0
Rapeseed: English	"	24	0	0
Seal: Pale	"	23	10	0
" Brown	"	17	0	0
Sperm	"	41	10	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6⅜
" Spirit	"	0	0	7¼

CHEMICALS.

		£	s.	d.		£	s.	d
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	4	—	0	0	4½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6¼	—	0	1	6½
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	12	0	0	—	12	5	0
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	10	0	—	7	12	6
Bisulphide of Carbon	"	13	0	0	—	.....		
Borax	"	30	0	0	—	30	1	0
Benzole (90%)	gal.	0	3	6	—	.....		
" (50/90%)	"	0	2	4	—	.....		
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	.....		
" Prussiate (Yellow)	"	0	0	7¾	—	.....		
" Sulphate (Basis 90%)	ton	8	10	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—	.....		
" " " 60%)	"	5	15	0	—	.....		
" " (Cream, 60%)	"	5	13	9	—	.....		
" Crystals	"	2	10	0	—	2	12	6
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	8	0	—	6	10	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

Electric Lighting Contract.—The British Consul at Königsberg announces that the municipal authorities of that town are advertising for tenders for the construction and maintenance of the necessary works for lighting the streets with the electric light. A copy of the conditions, with a plan of the city, can be obtained from the chief cashier of the municipality on payment of two and a half marks, and tenders will be received until the 16th April next.

Delta Metal.—We understand that Mr. Dick has formed his business into a company, in order to enable him to better meet the greatly increased demand for his metal. Sir Edward Reed is the chairman, and Mr. Charles Cammell, of the Cyclops Works, Sheffield, is one of the directors of the company. Although the company was registered only last week, nearly all the capital at present required has been subscribed for by users of the Delta metal.

We regret to record the death of Mr. Robert Hadfield, of Sheffield, on the 21st inst. Mr. Hadfield was the founder and principal partner of the Hadfield Steel Foundry Company, Sheffield. He erected the present extensive works in Newhall Road, and there developed an extensive business in steel castings, and invented processes for the rapid making of steel, which embodied some of the best features of the Bessemer, the Siemens-Martin, and similar processes. His firm have attained considerable celebrity as makers of steel castings for a great variety of purposes.

Balloon Society of Great Britain.—At the weekly meeting of the Society held at St. James' Hall, Piccadilly, Mr. John Parnell read a paper on "Ancient Engraving," tracing the art from its rise in Italy and Germany in the fifteenth century, and through Europe up to the close of the eighteenth century. Among the etchings and engravings exhibited by the lecturer, were many by the great Italian painters and artists of the Dutch, French, and Flemish schools; mezzotint and line engravings by English engravers of the seventeenth and eighteenth centuries; Bertelli's designs for the Carnival of Venice, A.D. 1643; Hogruberg's view of Cambridge, A.D. 1572; Lafreri's print, A.D. 1560, of the Mithias Tablet; and Houbraken's print of William Cecil, Lord Burleigh. The following resolution was moved and carried during the meeting: "That the art of engraving has contributed largely to the culture and æsthetic taste of all civilised people, and has been the means of handing down from generation to generation representatives of customs, habits, facts, and events of vast importance to the human race."

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HOME INDUSTRIES.

MANCHESTER, 22ND MARCH, 1888.

THE ENGINEERING TRADES.—Stationary engine builders continue to be fairly well employed, but there is not any great accession of business. A large quantity of repair work is in hand, and a satisfactory trade is being done with foreign parts. Millwrights are only moderately busy, and in some cases are finding orders difficult to obtain. A continuance of the prosperity observable in the spinning trade is almost certain to result in the formation of new companies, and a busy time may consequently be expected by engine builders and millwrights. Boiler makers, without exception, continue to be fully employed, and there appears to be no prospect of any falling off in this department for many months to come. The locomotive trade has improved slightly, and there are indications of a decided advance in this branch of engineering. The railway carriage and waggon builders in the district are as a rule well occupied, and there are fewer complaints than for some time past. Machine tool makers are also finding a few more orders, but are not as yet fully supplied. Cotton machine makers are almost without exception very busy in all departments. Ring spinning machinery especially is freely ordered; but all classes of preparation machinery are in great demand. It is pleasing to note that the older concerns, such as Messrs. Platt Brothers and Co., of Oldham, are obtaining a full share of current business. Loom makers are still very busy, and orders are coming in freely, although it is hardly likely that the extension and building of sheds will take place at the same rate as has been the case during the last two years. The Union Manufacturing Company of Rochdale have ordered their engines for their new shed from Messrs. J. and W. McNaught, and the shafting from Messrs. T. Robinson and Son, Limited, of the same town. It is worthy of note that in this, as in many other weaving sheds recently erected, the whole of the shafting is of mild steel.

THE RIBBLE NAVIGATION WORKS.—The Local Government Board have issued a memorandum which is distinctly unfavourable to the acquisition of fresh powers of borrowing by the Preston Corporation. They point out that the present debt of the Corporation is £718,494, or twice the amount of the assessable value of the borough, and that if the additional powers are given this amount will be increased to £1,200,000. It is pointed out that the disposition of the sewage is not provided for, and a number of objections are made by the Board, which are in direct opposition to the extension of the present powers. This is a somewhat serious matter, and may result in the suspension of the dock and river works at present in operation.

A SPECIAL DRILLING MACHINE.—Messrs. Hetherington and Co. have just completed a special machine for drilling the mouthpieces of locomotive boilers. As these have to be drilled from the inside, there were considerable difficulties in arranging the drill spindle and feed arrangement. The spindle is held in a circular head stock, which is revolved by means of worm gear below the table; the driving is effected by a shaft also under the bed, and by a short vertical spindle passing up the centre of the head. Bevel wheels on the end of this spindle and the drill spindle give the necessary driving power. The latter is cut at its upper end with a quick threaded screw, on which a long nut with a hand wheel and a brake surface is formed. By applying the brake the nut is held, and the revolution of the spindle necessarily applies the full feed; but if less traverse is required, the brake is only partially applied, and the nut can thus slip a little as desired. The machine is an ingenious one, and is admirably constructed to surmount the practical difficulties of the work. It is made for the Lancashire and Yorkshire Railway Company, Horwich.

LONDON, 22ND MARCH, 1888.

THE MONEY MARKET.—Money is both abundant and cheap just now, and the Bank has recognised this by lowering the official rate. It is assumed that this step was taken to assist the Chancellor of the Exchequer in his Conversion Scheme, for unless money be cheap he cannot maintain over the heads of holders of new Threes the fear of redemption if they refuse to convert. But granting that the Bank was influenced by this consideration, there are abundant reasons for anticipating a continuance of cheap money. The situation, however, will be affected by the impending issue of several new foreign loans. The new Mexican Six Per Cent. Loan, to be issued to-morrow (Friday) at 79, was selling in anticipation on Tuesday at a premium of 1 per cent., so that there is evidently plenty of demand for such securities. The stock markets are distinctly duller this week, and foreign stocks are generally weaker. In spite of good traffic returns, home railway stocks are quiet, and the demand for railway debentures and Colonial securities for investment has abated. Part of the recent rise was unquestionably artificial, though at the same time there was no doubt a considerable amount of sound investment business. Copper shares are beginning to appear again in the market, and diamonds are becoming more susceptible to "bear" influences.

COMPANIES.—The following new companies have been registered since our last report: The St. James' and Pall Mall Electric Light Company, Limited, with a capital of £100,000; the Hull United Brewers, Limited, with a capital of £185,000; the Swaziland Gold Exploration Company, Limited, with a capital of £200,000; Daniel Higson, Limited, with a capital of £100,000, to carry on a brewery; the Victoria Mill Company, with a capital of £3,000, to purchase a cotton mill at Burnley; Anglo-Austrian Tin Company, Limited, with a capital of £90,000; Dunlop and Capon, Limited, with a capital of £50,000, to carry on the business of sawing, planing, moulding, and turning mills; Charles L. Baker & Co., Limited, with a capital of £25,000, to acquire a business of telegraphic, electric, surgical, and scientific apparatus; George Jackson & Co., Limited, with a capital of £30,000, to acquire a tobacco manufacturing business at Whitehaven; the Native Dog Creek Exploration and Mining Company, Limited (New South Wales), with a capital of £5,000; the Mechanical Supply Company, Limited, with a capital of £10,000; the Shaftesbury Automatic Safety Lamp Company, Limited, with a capital of £100,000; Explosives and Ammunition Manufacturing and Testing Works, Limited, with a capital of £10,000; Barrett & Elers, Limited, with a capital of £80,000, to carry on business as manufacturers of bottles, jars, and stoppers; the Patent Indestructible Face Cartridge Company, Limited, with a capital of £10,000; J. S. Warburton & Co., Limited, with a capital of £5,000, to purchase the business carried on at Britannia Iron Works, Preston; J. J. Broadbent & Co., Limited, with a capital of £50,000, to carry on business at Bradford and elsewhere as wool spinners; the Atlanta Gold and Silver Consolidated Mines, Limited, with a capital of £65,000; Sudbury Dairy Company, Limited, with a capital of £40,000; George Hoby & Co., Limited, with a capital of £50,000 to acquire the business of a blacking manufacturer; the British and Irish Gunpowder Manufacturing Company, Limited, with a capital of £50,000; Joseph Mason & Co., Limited, with a capital of £40,000, to take over the business of oil and colour merchants now carried on in Derby; Bradford and District Tramway Company, Limited, with a capital of £60,000; Seaham Chemical Works Company, Limited, with a capital of £20,000; the Dublin Brewery Company, Limited, with a capital of £100,000; Bogaerts' Engraving Company, Limited, with a capital of £30,000; and Canning Town Glass Company, Limited, with a capital of £10,000.

METALS.—An interesting table has been issued by Messrs. H. R. Merton & Co., London, showing the principal copper supplies of the world during the period 1879-87. With the exception of 1886, when the supplies were less than in the two preceding years, there has been a constant increase, and owing to the operations of the copper ring, this year will, no doubt, show a much larger advance. In 1879 the quantity was 151,963 tons, and in 1887 224,490 tons. The average price of the former was £57. 11s., and of the latter £42. 3s. The production of spelter in Europe and the United States rose from 23,239 tons in 1880 to 45,530 tons in 1887; the average price in the former case was £18. 7s., and in the latter £15. 4s.

THE CONDITION OF TRADE.—The Labour Correspondent of the Board of Trade has prepared the following memorandum on the state of the skilled labour market: "The revival which, since the beginning of the year, has been apparent in the shipbuilding trade and in all the branches of the iron and other trades connected therewith, still continues to improve the condition of the labour market of those industries very materially. At the same time it is to be observed that the proportion of unemployed, though relatively much less as compared with the past two years, is still considerable. The building trades are in a very depressed condition, consequent to a great extent on the severe weather of last month, which seems not only to have retarded the usual spring development of the trade, but also to have greatly increased the number of those out of work. The cabinet making and printing trades are good. The cotton and carpet trades are moderate. In the finished iron trades employment is more regular. In the coal trade the number of men actually unemployed is small, but many collieries are only employed about half time. Up to the time of making up the report fifteen trade unions had sent in returns as to unemployed members. With an aggregate membership of 143,879 there were out of work 10,209, as against 11,113 last month, a net decrease of 904, which is a reduction in the proportion from 8·3 to 7 per cent. Three societies state generally trade to be 'good,' one 'normal,' three 'moderate,' seven 'improving,' and one 'bad.' In the trades which have most benefited by the improved circumstances of the labour market, many voluntary advances of wages have been conceded."

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—In connection with the country meeting of the Society, which is to be held at Nottingham next July, prizes are offered for hay and straw presses worked by steam, horse, and hand power respectively, and for a press for old hay worked by hand power. Intending competitors and exhibitors must make their entries by the 31st inst.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 11th March, amounted to £1,120,533 on 15,850¼ miles, as compared with £1,111,826 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 141½ miles, or 0·8 per cent., and in the receipts of 0·7 per cent.

RUSSIAN CUSTOM HOUSE FINES.—The Foreign Office has issued a notice that as numerous complaints are received from commercial bodies in England of the infliction of heavy fines by the Russian Customs authorities, it is desirable to point out that in many cases fines which are incurred in accordance with the strict letter of the Russian Customs regulations are not enforced; but that, nevertheless, the exporter is charged in the account by dishonest clearing agents as though the fine had really been exacted. It is therefore advisable that in all cases agents should be called upon to produce the official receipts for fines stated by them to have been paid.

THE NAVY.—The gun trials of the new armour plated ship "Hero" have now been completed, and she is ready for sea. She has a displacement of 6200 tons, and her engines are of 6000 h.p.—The trials at Sheerness of the two 110-ton guns of the "Benbow" have proved perfectly satisfactory. Charges of 1000lb. of powder were used, with a projectile weighing 1800lb. The 6in. breech loading guns for the same ship have also been tested with satisfactory results.

BOILER EXPLOSIONS.—A circular has been issued by the Board of Trade to sanitary authorities throughout the country, calling attention to the conviction of the owner of a steam boiler for neglecting to comply with the provisions of the Boiler Explosions Act, 1882, by not sending to the Board of Trade a notice of an explosion which had occurred on his premises. The Board has reason to believe that many owners of steam boilers are still unacquainted with the requirements of the Act, and that consequently explosions sometimes occur which escape investigation. It is therefore suggested that the local sanitary authorities should distribute handbills calling attention to the conviction in question.

FOREIGN EXHIBITIONS.—A meeting was held at the Mansion House last Friday in connection with the formation of the British Section of the forthcoming Paris Exhibition. An executive council has been appointed under the presidency of the Lord Mayor, and preliminary arrangements are in progress.—In connection with the Barcelona Exhibition, the Society of Arts has undertaken to promote the interests of the Exhibition in this country, and to act as the intermediary between British exhibitors and the Executive of the Exhibition. The date for the receipt of applications from foreign exhibitors has already passed, but a request for an extension of the time has been made to the Spanish Executive. In the meantime, British manufacturers who wish to take part in the Exhibition, and have not already sent in applications for space, may apply to the Secretary of the Society of Arts.

GLASGOW, 22ND MARCH, 1888.

INTERNATIONAL EXHIBITION.—It has been arranged that the Prince and Princess of Wales shall open the Exhibition on Tuesday, the 8th May, and that this day shall be observed as a general holiday. The Women's Industries Section is to have a preliminary exhibition of women's work in the Corporation Galleries on Friday and Saturday, the 23rd and 24th inst.

GLASGOW PHILOSOPHICAL SOCIETY: "PREVENTABLE BANKRUPTCY."—An important paper upon this subject was read at a meeting of the Economic Science Section, by Mr. John Mann, jun., M.A.C.A. After describing the difficulties of acquiring accurate statistics of bankruptcy, owing to the frequency of private arrangements, Mr. Mann went on to speak of the effects of bankruptcy upon industry. He estimated the indirect tax upon the nation represented by the whole volume of insolvency at thirty millions per annum at least. The effects of continued trading at a ruinous loss during insolvency were described, and it was pointed out that in consequence of the paralysis to legitimate trading occasioned by it, the practice of selling off bankrupt stocks did not offer an advantage to the public commensurate with the losses entailed. The inevitable result of continued forcing of goods upon the market in this manner was the depression of prices and of trade, the trader who paid his way being compelled to sell his goods at the prices asked for by those who did not pay their way. As to the causes of bankruptcy, Mr. Mann considered that about one-half were causes which could be avoided, the other half being those resulting from general conditions beyond the control alike of individual traders and of Government. The preventable causes were set down as these: Excessive granting of credit, prevalence of rash speculation, defective bookkeeping, &c. The remedies suggested by the author of the paper were: Restriction of the limit of prescription, examination of the bankrupt's conduct by an independent official, as is the case in England, and greater publicity as to the position of a trader.

ENGINEERING.—Messrs. Dunsmuir & Jackson, Govan, have just fitted on board the s.s. "Tropic" a set of triple expansion engines, with cylinders respectively 20in., 33in., and 54in., having a stroke of 36in. The boilers are two in number, and have a working pressure of 160lb. At the trial trip the vessel, with 2600 tons dead weight, attained a mean speed of 10¾ knots. The engines indicated 990 h.p. —Messrs. Sharp, Stewart, & Co., of Glasgow, formerly of Manchester, have disposed of their injector business to the Patent Exhaust Injector Company, Limited, of St. Ann's Square, Manchester. This company have secured the services of the same workmen who served the former owners of the business, so that the manufacture of all classes of injectors will be carried on in the same efficient manner as hitherto.

GREENOCK.—An improvement, if only of a temporary character, seems to have come over the fortunes of the James Watt Dock, Greenock. The quays are now fairly well occupied, considerable cargoes of sugar and wood having been landed during the past few days. The activity which is still manifest in the sugar trade has

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restored vitality to what appeared to be a decaying industry, and has effected a vast improvement in the trade of the port.

EDINBURGH ELECTRIC LIGHTING.—A specification has been drawn out by Mr. Bryson for the lighting of the Free Library, which is now being erected in fulfilment of the arrangement by which Mr. Andrew Carnegie, of Pittsburg, U.S.A., offered a sum of £50,000 on condition of the Free Libraries Act being adopted by the City of Edinburgh. The specification provides for seventy 16 c.p. incandescent lamps, and twenty-two 1000 c.p. arc lamps. The annual cost, including depreciation, was estimated at £400. The matter was left with a committee to take estimates on the basis of Mr. Bryson's specification.

PLEURO-PNEUMONIA IN SCOTLAND.—A deputation has been received by Lord Cranbrook, President of the Privy Council, concerning the spread of cattle disease in Scotland. This question has become one of great economic importance, since the sum of £34,593 was expended last year in giving compensation under the Contagious Diseases (Animals) Act. It was urged that an inquiry should be made as to whether inoculation should be resorted to. Lord Cranbrook admitted that an indisputable case had been made out for careful inquiry. In the course of his reply, he mentioned that no case of foot and mouth disease had occurred in England for two years, thus affording evidence that slaughtering infected cattle was effectual in extirpating the disease.

(From our own Correspondents.)

LIVERPOOL, 21st MARCH, 1888.

THE MERSEY RAILWAY.—The tunnel from the James-street Station, under Lord-street and Church-street, is now almost bricked in as far as the Central Station, and the excavation is practically completed. The station is being made underneath the Central Station, and as the work is so very near to the surface of the ground at this point, it makes it exceedingly difficult, and the utmost caution has to be taken, on account of the traffic overhead. All the constructional iron work of this station is being made and erected by the Pearson & Knowles Coal and Iron Company, of Warrington.

A NEW EXPORT TRADE FROM THE MERSEY.—Owing to the partial failure of the potato crop in the eastern parts of the United States, an enormous quantity of potatoes have been shipped from the Mersey to supply the deficiency, and very extensive orders are reported on 'Change daily. Since the 2nd inst. about 6000 tons have been shipped to Boston, New York, Baltimore, and Philadelphia; most of these potatoes have been grown in Lancashire and Cheshire. An advance in prices is to be expected shortly.

SHEFFIELD, 21st MARCH, 1888.

THE HEAVY TRADES.—There is no great activity in the armour plate mills or in the gun shops, but for many descriptions of heavy material the demand is very extensive. Crucible cast steel castings are selling well. For almost all kinds of shipbuilding material there is a good market; the competition, however, is keen, and one or two makers have recently lowered their prices. Heavy machinery for foreign as well as home use is more eagerly inquired for, and the engineers are better off for orders than they were at the end of last year. The moulders at the foundries are well employed; while at the rolling mills the quantity of work is steadily increasing. There is a great deal of cutting of prices in steel, and quotations range from £4. 10s. to £4. 15s. and £5. 5s. for rolled billets. In railway material the trade development has been conspicuously steady; and it is worth noting that Messrs. Cammell & Co., Limited, who have paid particular attention to the steel rail departments of their concern, announced on Friday the payment of an interim dividend for the year, making a total altogether of 7½ per cent. Bessemer steel rails are just now in demand, not only for English lines, but Colonial and foreign railways, and it is anticipated that within the next two years there will be an enormous development of railway enterprise. Railway springs, tyres, and axles are being ordered largely, the latter selling at from £6. 15s. to £7 per ton. There is one phase of the steel trade, however, that is not altogether hopeful. Several Australian and other Colonial customers who find it difficult to obtain the quality of steel or the shaped article they require in England, are being suited in America; and it is worthy the consideration of the Sheffield manufacturer whether it would not be desirable to meet the wants of the Colonial customer.

LEEDS, 21st MARCH, 1888.

IRON AND STEEL.—For manufactured iron the call is increasing, and the output at the furnaces is greater than it was at the end of the first quarter of last year. Hydraulic and other machinery is yielding a vast amount of work, and in the locomotive building shops there is more employment. Messrs. Kitson and one or two other noted firms are busy on railway work, and for stationary engines there is a good demand. Bridge work, roofing, and colliery plant are also being extensively ordered, and plenty of heavy manufactured material is being sent abroad. There is a renewed demand for engineers' tools; indeed in most of the heavy branches of Leeds trade an improvement is noticeable.

COAL.—At the West Yorkshire pits the men are working five days a week.

TEXTILES.—There is still some inquiry for woollens, owing to the long winter; but most houses are now busy on summer goods, and there is no lack of employment.

BARROW-IN-FURNESS, 21st MARCH, 1888.

DECLINE IN THE IRON AND STEEL TRADES.—The report of the week in connection with the iron and steel trades of this district is not so satisfactory as of late. There is a weaker tone in the iron trade, and prices have declined to 42s. 6d. per ton for mixed Bessemer samples net f.o.b.; but makers will not, generally speaking, do business at this price. They are fortunately well off for orders, and are likely to be busy for some months on the contracts already in hand. They have also the advantage of a large consumption of pig iron by steel makers in the locality and elsewhere, who are using more iron than at any previous time in the history of the trade; and there is the further prospect of an improvement in the iron trade with the opening of spring and the placing of shipping orders. Steel manufacturers continue to be busy, and there is a good demand for rails; but prices have declined, as also have those of pig iron. Heavy sections of rails are quoted at £3. 19s. per ton net f.o.b. There is not much business doing in steel for shipbuilding material; but makers are well off for orders, and expect large contracts on local as well as on general account. Plates are quoted at £6. 19s. per ton net f.o.b., and angles at £6. 7s. 6d. Billets are in demand at £3. 18s. 6d., and slabs are quiet at £3. 18s. The shipbuilding trade is showing more activity in all departments, and one or two new orders are noted. Iron ore is in quieter demand at lower prices, viz., 8s. to 11s. per ton net at the mines.

JUTE.—Great activity is maintained in the jute trade of Barrow, and the mills are regularly employed.

THE TIMBER TRADE.—The timber trade of the port of Barrow has been very quiet for about two years; but a much better year is expected in 1888, as the general demand shows some indications of improvement, and local requirements will certainly increase.

SOUTH WALES, 21st MARCH, 1888.

NEW DOCK AND CANAL—There is a somewhat bold scheme being mooted by a powerful London syndicate to construct a dock at the mouth of the river Rumney, at Cardiff, with a ship canal, about two miles long, to be connected with it. Works would be erected on each side of the canal, and so bring business to the company. It is roughly estimated that the scheme would cost about £1,000,000; but as there is a large demand springing up for sites for industrial purposes, it is confidently maintained that its success is assured if only the opposition of the Bute Docks Company can be overcome.

SOUTH WALES INSTITUTE OF ENGINEERS.—A well attended meeting of this Institution was held on Thursday last, at Cardiff, under the presidency of Mr. Archibald Hood. The chief attention was devoted to electric safety lamps, the use of which is making rapid progress. Mr. Nicholson, of the New Electric Portable Electric Light and Power Syndicate Company, exhibited two lamps, which only weighed 4lb., and which would burn from ten to twelve hours, giving a light equal to one and a quarter candles. The front of this lamp is fitted with thick toughened glass, and if that is broken by any accident, the light is at once automatically extinguished. Mr. Swan, who will shortly have 2400 of his lamps in use in this district alone, stated that his lamp weighed about 7lb., but, of course, could be made lighter if desired, at the sacrifice of illuminating power.

AGRICULTURAL.—A local committee has been formed at Swansea, to make arrangements for the show of the Glamorganshire Society on the 1st and 2nd August, when a large number of special prizes will be offered for competition. A hide and skin market is to be established at Cardiff for the disposal of these commodities by public auction, on the plan which has been found so profitable by the trade in some Midland towns. The capital has been fixed at £3,000.

MIDDLESBROUGH, 21st MARCH, 1888.

PIG IRON.—The market still remains unchanged, and there is sufficient probability of a forward movement to prevent any fall. The average price amongst merchants is still 31s. 6d. per ton for No. 3 G.M.B. for early, and 31s. 9d. to 32s. for April-June delivery. Warrants are 31s. 4½d. to 31s. 6d. per ton (cash) for Connal's No. 3 G.M.B., and 42s. 6d. nominally for Connal's Nos. 1, 2, and 3 hematite. Makers of hematite East Coast brands are quoted 43s. 6d. per ton f.o.b. mixed numbers.

SHIPMENTS OF PIG IRON.—These are far from favourable. Those to Scotland and other parts of England remain about the same, but those to foreign ports have fallen off. Up to the 19th they have declined about 4000 tons over the current month as compared with the similar period in the previous month.

FINISHED IRON AND STEEL.—The revival in the wrought iron trade continues. The steel works are going steadily, especially in the plate departments. There is also a large turn out of rails and sleepers, but the former have fallen very much in price; £4. 17s. 6d. per ton ordinary sizes is the average lowest, but lower still in some cases has been accepted.

STEAM SHIPPING.—There is a more healthy freight market this year than there has been for many years back. Well managed, economically worked steamers have paid at the rate of 10 per cent. and upwards per annum on their original cost. Second hand boats, acquired at cheap prices during the past two years, have paid as high as 30 per cent. on the capital invested.

SUNDERLAND, 21st MARCH, 1888.

COMPOUND STEAM WINCHES.—Messrs. Wigham & Co., of the South Hylton Engine Works, have just completed their first four steam winches on the compound principle. The working pressure of the steam supplied to the high pressure cylinders is 150lb. per square inch, and the diameters of the cylinders are respectively 6¼in. and 9in. The exhaust steam passes to a condenser placed in the donkey stoke hole, and is utilised for feed water for the donkey boiler, as in the ordinary marine engines. There is also the advantage of no exhaust steam escaping on deck, to the discomfort of the cargo men. It is anticipated that these compound steam winches will come into general use, as they can be worked from the main boilers without the interposition of a reducing valve.

THE SHIPPING TRADE.—Owing to the stormy weather last week there was a considerable falling off in the arrivals and departures in the Wear. There was only one cargo of iron ore imported, and the coal shipped was only 68,247 tons, as against 88,615 tons in the previous week, and 75,499 tons in the corresponding week of last year. Of the whole quantity shipped, 49,326 tons were for home ports, and 18,921 tons exported. The other principal shipments were 23,000 dozen bottles, 2512 tons patent fuel, 200 tons coke, 30 tons hoop iron, besides glass and earthenware.

NEWCASTLE, 21st MARCH, 1888.

CHEMICALS.—At the beginning of the present month a new restrictive measure in connection with the manufacture of bleaching powder was put in force in the principal Tyne chemical works, reducing the aggregate output of commodities by about one-fourth. At the Jarrow Chemical Company's works, Felling, the weekly make was reduced from 120 tons to 90 tons, and in this instance, as well as at the other establishments, a large proportion of the operatives have been rendered idle. The manufacture of soda, an article for which there is an active demand just now, has increased considerably within the period indicated, the output of this commodity at the factory that has been especially referred to having in the fortnight ending March 10th reached the large figure of 1240 tons. This is the largest output ever attained at this factory in the time mentioned. The company are now about to put down plant for the establishment of a new process, viz., the recovery of sulphur from alkali waste, and measures are in contemplation for the carrying out of a similar project at the Newcastle Chemical Company's works, Gateshead. The demand for alkali is somewhat below the average, and at most of the works stocks are accumulating.

CEMENT.—The leading manufacturers of cement in the district have just now some heavy orders to execute, the commodity being mainly sought after by consumers on the other side of the Atlantic. There is, however, a lack of tonnage suitable for this kind of cargo, and the export trade at this moment is, therefore, not particularly brisk. The demand on home account remains good, and the factories are all very fully employed.

COPPER.—Business is still very brisk in the copper refining works, and present appearances indicate a continuance of this satisfactory state of matters.

LEAD.—The demand for sheet lead has somewhat improved, but in other respects there is little change to be noted at the lead manufactories.

THE COAL TRADE.—The recent bad weather, though it must have had a stimulating effect on the demand for house coals, has caused increased slackness at most of the steam coal collieries, the arrival of vessels wanting cargoes having been unusually small. The shipments of coal and coke from Tyne Dock, for the week ending March 17th, amounted to 75,359 tons, which quantity was less by over 14,000 tons than the aggregate shipments of the same commodities in the corresponding week of 1887.

BELFAST, 21st MARCH, 1888.

MONEY.—Consequent on Mr. Goschen's financial scheme, there has been more excitement on the Dublin Stock Exchange than has been witnessed for twenty years. On the 14th inst. Bank of Ireland Stock opened at 287, and closed at 294. Great Southern and Western Railway rose 3½, and other railways from 1 to 1½ per cent. The principal activity, however, was in Debenture Stocks, which were in great demand at improved quotations. During one week Bank of Ireland Stock has risen £25.

SHIPBUILDING.—Great activity is still the rule here, and some new orders have been booked within the last fortnight; rapid progress is being made with the vessels on the stocks. The Belfast Harbour Commissioners invite tenders for a new steel steam ferry, with fire engine.

LINEN TRADE.—Business is rather quiet. Coarse wefts are rather dull at late prices, but the higher numbers have a ready sale at slightly advanced rates. The stocks of tows in hand are small, and trade is flat. Brown goods are steady, with all the looms fully employed. The demand for cloth and finished linens continues steady at late prices. The demand for handkerchiefs is brisker, and the prices have advanced somewhat. Shirt makers are fully employed, and hold large orders for immediate and forward delivery.

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THE FORTH BRIDGE.

(For description see page 288.)

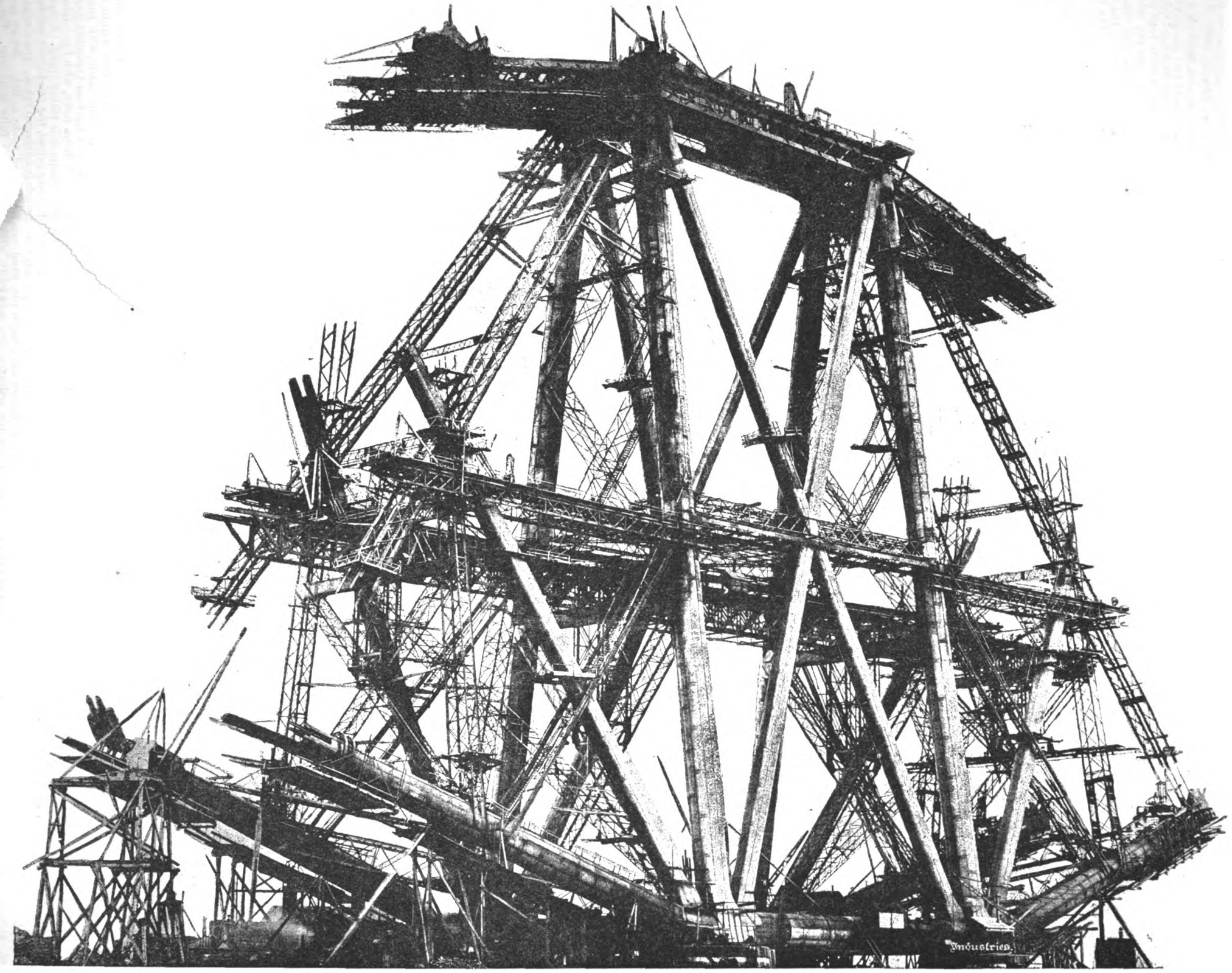


FIG. 5.—GENERAL VIEW OF THE FIFE OR NORTH MAIN PIER.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
„ „ "INDUS, LONDON."
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Telephone number: 684, MANCHESTER.
„ „ 2785, LONDON.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 23RD MARCH, 1888.

NAVAL ADMINISTRATION AND ORGANISATION.

IF the administration and organisation of the naval, military, and civil services do not improve, it will not be for the want of very candid criticism. Such men as Lord Randolph Churchill and Lord Charles Beresford do not hesitate to use the knowledge they gained when in office, when they find themselves in positions of greater freedom and less responsibility. The former must have made some of the occupants of comfortable Civil Service berths feel somewhat unhappy. It is, however, to the remarks of the latter, and the affairs to which they relate, that we wish in the meantime to direct the attention of our readers. In the recent debates on the Navy Estimates, with all the breezy frankness of a sailor, he let the public into some of the secrets of official life. He protested that it was not simply the small matter of the cutting off of £900 from the allowance for the Intelligence Department which caused him to resign, but rather the system which allowed the reduction to be made in the way it was done. He stated that before the present Board took office there was no shred of system of any sort for organisation for war, and he maintained that this statement was substantiated by the memorandum issued by the First Lord last year, and also in this year's memorandum in the paragraph dealing with the experimental trial of the system at Portsmouth. This, however, only referred to mobilisation, and he challenged the First Lord to produce any plan of campaign for home or abroad; any plan for the coaling of the fleet, for the protection of the mercantile marine, or any organisation for war—excepting that on paper—which the First Lord had himself described as being most defective. The Intelligence Department, which was the immediate cause of his rupture with the Board, was essentially a naval question, as was indeed everything connected with the organisation required for war, and the manner in which it was now managed was most unbusiness-like. With regard to the Estimates, there was no real Treasury or Parliamentary control over them, and he illustrated this by an incident in his own official career. He stated that one morning the Estimates were brought into his room by a clerk with a wet pen. "What is that?" Lord Charles asked. "The Estimates," the clerk replied. "What do you want me to do?" he further inquired. "I want you to sign them," was the reply. To that he rejoined "Certainly not," as he felt that if he signed them the public would assume that he had studied them, and that he was satisfied with them. As a matter of fact he had not read or studied them, and he was not at all sure that he was satisfied with them. The fact, however, that the clerk brought in the pen wet with ink showed that this was not the usual method of procedure. With regard to the information contained in the memorandum of the First Lord, he confirmed the opinion which is generally held by the public, but which is not often openly expressed, that it was all derived, not from the First Lord's own knowledge—for he could not, and did not know anything about it—but from the experts. Lord Charles concluded his speech by advocating a series of reforms, which may be briefly summed up as follows: That all the naval business should be under the direct control of the sea lords; that the Intelligence Department be made effective, with an admiral at its head; that both on the Board and in the Secretarial Department arrangements be made for an infusion of new blood, so that advantage might be taken of the latest and best experience; and, lastly, that there should be a more complete organisation for war.

Like a great many other enthusiasts, Lord Charles Beresford overshot his mark in some respects, as he sought to prove too much, and he proved himself a good example of the danger of appointing a naval man as head of the Admiralty. Some of his suggestions no doubt were excellent; but, as Lord George Hamilton pointed out, this special proposal was to be condemned both on theoretical grounds and from practical experience. He was of opinion that the House was not likely to sanction the principle of a naval officer being *ipso facto* a member of the Legislature because he was the head of a great spending department. Even if the House did accept the principle, he thought the result would be rather to introduce politics into the navy than to secure an addition of naval knowledge at the Admiralty. He was not certain that in France, for example, the system advocated had been altogether a source of stability. He had listened last year to a discussion in the French Chamber, when charges, graver than any that had ever been made in the House of Commons, were made against the administration of the French Navy. There was an absolute consensus of opinion on this subject, that the result of putting at the head of the Admiralty a naval expert was that he had rushed into expenditure on a number of projects that had not been sufficiently tested, and had seriously jeopardised the position of naval finance in France. The speakers who took part in the discussion of the Naval Estimates proved most distinctly that there is a danger of the Admiralty falling into the hands of experimentalists and faddists, and millions might be spent on alarms and scares. None of them had any general policy, but they were all of opinion that the navy will never be strong unless their views are carried out. But any unbiassed observer can see at once that these are one-sided views, and therefore we require at the head of the Admiralty a man of good sound common sense, who would be able to weigh carefully the importance which should be attached to any suggestion which may be made.

The First Lord of the Admiralty maintained that the Admiralty had now adopted a consistent policy, and that every year will make our navy stronger than it is or has been. This statement ought to be compared with that which we gave in our last issue —page 261. He stated on the 1st of March, 1887, that we had in commission sixteen ironclads, with an aggregate tonnage of 127,000; and in reserve, five, with an aggregate tonnage of 44,000. France had five war ships, of 79,000 aggregate tonnage, in commission, and six with 40,000 tonnage, in reserve. Italy had two in commission, and two in reserve, with a tonnage of 41,000. Russia had one ironclad in commission and four in reserve, the tonnage being 25,000. During the present year our first reserve, which could be put into commission in forty-eight hours, had a tonnage of 46,000, as against 14,000 in the case of France, and 13,000 in the case of Italy. Next year, by carrying out the programme laid before the House, we should pass out 53,000 tons. France, in the same time, would have 29,000, Italy 32,000, and Russia 26,000; and at the end of March, 1890, we should have 311,000 tons, against 184,000 in France, 100,000 in Italy, and 73,000 in Russia. He believed he was well within the mark when he said we were from 30 to 40 per cent. stronger

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than the next strongest Naval Power. Therefore we were justified in assuming that our relative superiority, in so far as fighting was concerned, was established, and that if we continued our programme, we would secure, year by year, a greater degree of superiority. If we were advancing cautiously, it was because there was great divergence of opinion among naval authorities as to what ought to be done. On the subject of the relative values of the navies of this country and the Continent, Mr. Fitzgerald stated he had the opinion of an expert, who had made the following estimate. Taking Britain at 100, then France would be 90, Italy 50, Germany 40, and Austria 31. We must leave the discussion of these figures for the present, but on the general question of sufficiency the First Lord remarked that the greatest danger was where the largest stream of commerce passed nearest the land, which would afford protection to hostile cruisers, and the policy of the Government was to husband their strength by having a large force in reserve, and it was opposed to the wholesale building of vessels, because they would all become obsolete at the same time.

Turning from the discussion of the Estimates themselves, we have much pleasure in observing the improvement in the form in which they are presented, and that the policy inaugurated last year by the Board of laying before Parliament fuller details relating to naval expenditure has been continued. In carrying out this object it is stated that the following are the salient points which the Board has endeavoured to meet: (1) To preserve, as far as possible, continuity of practice, in order to allow comparisons being made with the expenditure of the previous year; (2) to show the product anticipated from the expenditure, especially as regards dockyard work; (3) to exhibit the aggregate cost of each branch of the service, under whatever vote or department of State the provision may, in part or whole, be made; (4) by abolishing appendices, to bring the detailed appropriation of expenditure into direct connection with the votes, that it may be brought under the scrutiny of the Controller and the Auditor-General. If these arrangements be carried out, the public will for the first time have before it the total expenditure upon each branch of the Naval Service, and information as to the items of which it is composed. We have thus separate statements of the full cost of the *personnel* of the Fleet, including wages, provisions, medicines, half-pay, and pensions, and we find that the total cost of this department amounts to no less than £6,300,000, or one-half of the total estimated Naval Service. Similarly, we have estimates for shipbuilding, repairs, maintenance, &c., and we shall thus be able to ascertain, not merely the total cost of the dockyards, including establishment charges, as well as labour and stores, but of the proportion of these several charges to be set to the account of the individual ships under construction; and it will be possible to compare directly the cost of a ship built in a dockyard with that of a ship built by contract. The recent reforms in dockyard administration have had considerable effect on the cost of work done, and the First Lord is able to state that "the rapidity of construction shown in the advance of the ironclad 'Trafalgar' has rivalled, if not beaten, the best record in private shipbuilding yards," while the repairs of the "Northumberland" were estimated by the dockyard at £45,000, and they were actually effected for £22,000—and a long list of similar reductions is given. It would, however, have been more to the point if the Estimates had been made by independent parties, for it is a comparatively simple matter to make an apparent saving if the dockyard officials are not controlled in any way in the figures they put down in the Estimates. The figures quoted above for the "Northumberland" may only prove that the original estimate was far too high. There can be no doubt, however, that considerable economies have recently been effected in the method of doing work at the dockyards, and the First Lord, commenting on this part of the subject, said: "It is noteworthy that hardly any recent estimate, which after careful examination by the Controller's officers was reduced, has subsequently been exceeded in the yards; but that as a rule there have been substantial savings even upon the reduced amounts. This proves that the dockyard officials are now heartily co-operating with the central authorities, and are watching carefully the working out of estimates and the cutting down of unnecessary expenditure." As the *Times* remarked the other day, the word "now" in the foregoing sentence speaks volumes. In plain English it means that for years past the money of the British taxpayer has been scandalously wasted in Her Majesty's dockyards. That there is still room for economy is shown by some of the figures contained in the Estimates. For instance, at Sheerness the cost of superintendence to work done is nearly 15 per cent., whereas in the other yards it is only 10 per cent., and the sheathed protected cruisers, "Magicienne" and "Marathon," which are being built by the Fairfield Company, Glasgow, are put down at £140,000 each, while the corresponding estimate for the construction in one of the dockyards of the "Melpomene," a sister ship, is no less than £161,000.

While, therefore, giving credit for the improvement which has undoubtedly taken place, we would urge continued vigilance, so that neither the Dockyard nor the Admiralty authorities should be allowed to fall back into their ancient methods of doing work and keeping accounts. We would further urge the necessity of putting the Intelligence Department into a thoroughly efficient condition, and making it an adequate organisation for the contingency of actual war.

THE REGISTRATION OF ARCHITECTS, ENGINEERS, AND SURVEYORS.

One of the tendencies of the present day is without doubt an increasing belief in the efficiency of Acts of Parliament, and the edicts of Government Departments. Yet to those who know anything about Parliament or Government Departments, such a tendency is incomprehensible. The decisions of Parliament are not always guided by a full knowledge of the subjects under discussion, and, consequently, are wanting in that philosophic depth which should mark all wise legislation. The edicts of Government Departments are very often the whims of the permanent officials. As the *Times* remarked the other day, "People fancy that the Treasury means one or two responsible politicians at the head of affairs. To some extent it does; but to a great and most dangerous extent it means nothing more than a clerk at a desk, who, by initialling, reporting, and procrastinating, blocks half the business of the country, and breaks the heart of every man who has real public work to do and tries to do it." And yet people will go on invoking the aid of Parliament in things which they ought to be able to manage perfectly well by themselves, or at least with the aid of those associated with them. Government should not be allowed to interfere in the affairs of the people unless there was a very clear case that such interference was necessary for the protection of those who were too weak to protect themselves, or where a concern—such as, for instance, the Post Office—can be carried on efficiently, so that the whole nation may benefit. The aim of all wise legislation should be to encourage a voluntary co-operation which will habituate men to independent activities, instead of rendering them the slaves of fixed rules and regulations, and which, while strengthening their own consciousness of personal rights, will show them that those rights can only be enforced when they respect the just claims of others.

These thoughts have called forth expression owing to the receipt of a Bill which has been introduced into Parliament to arrange for the qualification and registration of architects, engineers, and surveyors, and its object is stated to be to enable persons requiring professional aid in architecture and engineering or surveying, to distinguish qualified from unqualified practitioners. This no doubt is a very worthy object; but in our opinion it does not require the passing of an Act of Parliament for its accomplishment, if the voluntary associations already in existence only took the steps they ought to take in order to raise the status of their members. The Bill which we are about to notice has for its short name "The Architects' Registration Bill," and this and its whole tenor show that it has been got up by architects for the benefit of architects, and that the engineers and surveyors who are mentioned are those general geniuses so well known in connection with building estates in the neighbourhood of London and other large towns, and of whom many representatives are to be found in country districts, who combine in one person the ability to survey the ground, plan the house, and lay out the drains. The Bill graciously says that "the Charters of the Royal Institute of British Architects, the Institution of Civil Engineers, the Royal Institute of Architects (Ireland), and the Surveyors' Institution are hereby confirmed, and are declared to be and shall be in full force and virtue, except so far as the same are by this Act altered, or as the same are inconsistent with this Act." The Council of the Institution of Civil Engineers must feel relieved by this information; but we doubt if the promoters of the Bill fully realise the powers conferred by the Charter of that Institution, or at least their extent as developed by the requirements of modern engineering. That document says that the Institution was formed "for the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in nature for the use and convenience of man, as a means of production and of traffic in States both for external and internal trade, as applied to the construction of roads, bridges, aqueducts, canals, river navigation, and docks for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns." The present membership of the Institution includes men who have had experience in every department of what is usually called civil engineering, and, in addition, mechanical, electrical, mining, chemical, and metallurgical engineers, as well as naval architects and shipbuilders. Are the promoters of the Bill prepared to take all these under their kind protection? Speaking of promoters, we naturally turn to the back of the Bill to find out who they are, and we see the names are Colonel Duncan, Captain Penton, Mr. Murphy, General Goldsworthy, and Colonel Makins. But we naturally ask, Under whose instigation are these men acting? Do they represent the opinions of the great body of engineers or of architects, or are they only the mouthpiece of a comparatively insignificant Society? Rumour has it that the Bill is really promoted by the Society of Architects. Now, we do not wish to say one word against that Society; but we must decline to recognise it as the *mouthpiece* either of the engineers or the architects of the country. If the Institution of Civil Engineers had united with the Royal Institute of British Architects in asking powers similar to those proposed in the Bill, the demand would have been worthy of serious consideration; but, so far as we can understand, these Institutions are at present simply ignoring the Bill as beneath their notice, although they may be reserving their strength till it appears whether there is any need for exercising it, and they may think that the very pretentiousness of the Bill will kill it.

We will not in the meantime occupy too much space with its consideration, but will simply give a brief outline of its scope. It ordains that a Council, which shall be styled "The General Council of Architectural, Civil Engineering and Surveying, Education, and Registration of the United Kingdom," shall be established, with branch Councils for England, Scotland, and Ireland. Five members of this Council are to be nominated by Her Majesty, five by the registered practitioners, and sixteen by various representative Institutions. A register is to be kept, and every person who at the date of the passing of the Act is a fellow, member, associate member, or professional associate of any of the bodies mentioned in a schedule attached to the Act, or who is an associate of the Royal Institute of British Architects, shall on payment of a fee not exceeding £3 be entitled to registration. The names in the schedule are worthy of note. Architects' associations of all sorts and sizes are mentioned, but some very important engineering institutions are altogether omitted. For instance, the claims of Scotland are recognised only in the Glasgow Institute of Architects, and the Glasgow Architectural Association. This latter Association is made up of young men who, as a rule, are too young for admission to the Institute of Architects. Whether it should be recognised or not is not now the question; but surely the promoters have heard of the Institution of Engineers and Shipbuilders in Scotland? The Scotch engineers have shown that they are not altogether to be despised. Having once been admitted to the register, members will be required to pay in advance an annual renewal fee of ten shillings. An unregistered person who takes or uses any of the names, titles, or descriptions mentioned in the Bill, shall be liable, on summary conviction, to a fine not exceeding £20, and on repetition of the offence, £50. We need not enter in the meantime into the details of the arrangements which are proposed for the admission of future engineers to the register, but will only remark that examinations are to be conducted by Institutions and Universities under the supervision of the Council. We shall, however, watch any further progress of the Bill with some interest, and

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observe the arguments its promoters bring forward in support of it. We would, however, remark that the Bill is a sign of the times which the existing Institutions should not by any means ignore; but, on the contrary, should so modify their arrangements as to make legislation unnecessary. On another occasion we hope to indicate the directions which, in our opinion, these modifications ought to take.

CANAL EXTENSION.

THERE are two recognised facts with regard to the incidence of water and railway carriage. As a rule, heavy goods may be more cheaply, but less expeditiously, conveyed by water than rail, and a healthy competition between the two modes of conveyance results in a fair tariff of rates. Amongst traders it is also recognised that in landlocked positions, where no such competition exists, the result of railway monopoly is to be found in the imposition of the highest "charge the traffic will bear," which is disastrous to industrial prosperity. At the present time considerably more than half the existing canal mileage is under railway control, and in many cases the acquisition of this property has been in excess of the rights granted to the companies by Parliament, and in distinct contravention of the recorded purposes of the original owners. A joint committee of the Houses of Lords and Commons, which sat in 1872 to consider this subject, reported: "That no inland navigation now in the hands of a public trust shall be transferred to, or placed under the control of, a railway company. That if the trustees of an inland navigation, or a canal company, apply to Parliament for power to compulsorily purchase a canal from a railway company, such purchase shall be favourably considered by Parliament, and that the utmost facilities shall be given for the amalgamation of adjoining canals with one another, or with adjoining navigation;" and in the Government Bill now before the House of Lords, there is a provision to prevent the future unauthorised application of railway funds to the acquirement of canals. The diverse ownership of different sections of the same canal is detrimental to securing easy through rates. No less than nine companies own the canals between Liverpool and London, while in the communication between North and South Staffordshire rates have to be obtained from and paid to three different companies. A result of the ownership of railways and canals in the same district by one company is that rates are not regulated to meet the exigencies of trade, but of the respective properties. They are so apportioned as to encourage the concentration of traffic on the length—railway or canal, as the case may be—from which the company in question receives the highest proportion of the through charge. A comparison between rates of carriage which prevail in those Continental countries where canal communication has been developed, with those exacted for the conveyance of goods to the seaboard from inland centres in this country, exhibits a startling difference, all in favour of our competitors. One example, culled from a pamphlet published by Mr. Samuel Lloyd on this subject—to which we shall have occasion to make further reference—will suffice. The Belgian iron masters of Liège and Seraing pay 2s. per ton for the conveyance to Antwerp, in craft carrying 300 tons or more, of their manufactured iron and steel for export; whereas the rate paid on English iron from Staffordshire to London is more than six times that amount, but, if framed on the basis of the Belgian tariff, would be only 3s. per ton. It is very evident that the tendency of such an impost in these days of fierce foreign competition and low prices must be to either annihilate the trade of the Midland counties or transfer it to seaboard localities. From the recent abortive legislative ventures in this connection, it is equally apparent that the only remedy for this state of things is to be found in the prompt development, by those interested, of competitive water communication with our principal export centres. Manchester has boldly led the way, and its Ship Canal scheme is in process of accomplishment. It now remains for Birmingham, situated in the very centre of England, with no important seaport less than one hundred miles distant, and which may be regarded as the Metropolis of the Midlands, to decide upon some feasible scheme for the reduction of those heavy transport rates which now handicap the trade of the Black Country and Mid-England generally, not only in competition with foreigners, but with other home centres, the more favourable situation of which allows of similar productions being placed on the seaboard at a nominal cost. More than a century has elapsed since the existing Birmingham Canal was cut through the South Staffordshire coal field and connected with the Wolverhampton Canal. During that period the trade of the district has passed through many vicissitudes until, to those behind the scenes, it is now abundantly manifest that the staple industries of colliery working and iron making are dwindling into comparative insignificance, and stand sorely in need of the removal of all drawbacks to their resuscitation; and particularly that of heavy railway charges on export goods. For something like two years this latter phase of the industrial situation has engrossed the attention of public opinion in Birmingham, and in April last the Ship Canal Inquiry Committee was appointed by the Town Council to inquire primarily into a scheme, to which the attention of the Council had been formally called, for an enlargement of the Birmingham and Worcester Canal to a sufficient capacity to carry seagoing vessels of 200 tons, in connection with improvements on the Gloucester and Berkeley Canal; and, finally, into the merits of any scheme for improving canal communication with London, Liverpool, or other ports.

THE PRODUCTION OF COAL IN 1887.

THE returns of the production of coal in the United Kingdom during 1887 have just been compiled at the Home Office, by the inspectors of mines, and advance copies have this week been sent out by the Board of Trade. It appears that the total production of coal in 1887 was 162,119,812 tons, as compared with 157,518,482 tons in 1886. There was thus an increased production in 1887 of over 4,500,000 tons. The chief item of increase appears in the South Wales district, where it amounts to 1,932,000 tons, and where the total output was 25,977,000 tons. The next largest increase was 1,111,000 tons in Scotland, where the output of coal in 1887 was 21,848,000 tons. Large, however, as was the output of coal in 1887, it was under that of the year 1883, when 163,737,000 tons were produced, so that the past year has not by any means witnessed the highest yield from our coal mines. The twenty coal fields into which the country is mapped show an increased production in fourteen and a decrease in six. The greatest falling off has occurred in the Northumberland coal field, and it is attributable to the serious strike which took place there in the early part of last year. This strike has reduced the production and consumption of Northumberland steam coal to the extent of 1,647,000 tons, and explains the very considerable increase of production in the coal fields of Scotland and South Wales, amounting together to over three millions of tons. There has also been a reduced production in Gloucestershire, Leicestershire, Somersetshire, and Worcestershire, and, to a smaller extent, in Cumberland. The output of the principal districts is shown in the following table:—

Statement showing the production of Coal in the principal coal producing districts in each of the years 1887 and 1886 (1=1000 tons):—

	1886.	1887.	Increase in 1887.
South Wales	24,045	25,977	1,932
Scotland	20,373	21,484	1,111
South Durham	20,112	21,003	891
Lancashire	20,574	20,768	194
Yorkshire	19,392	20,109	717
Staffordshire	12,438	12,853	415
Derbyshire	8,908	9,063	155

In Ireland there has been an increase of about 2000 tons in 1887, the output having been 107,000 tons in that year, against 105,000 tons in 1886.

The total number of persons employed about the coal mines of the United Kingdom in 1887 was 526,277, as compared with 519,970 in the previous year. Of the number employed in 1887, 428,540 were employed above ground, and 97,737 under ground. The number of employés in each principal district, with the quantity of coal produced and the average annual production per employé, is shown in the following tabular statement, from which it appears that Staffordshire stands first, North Durham second, South Durham third, and East Scotland fourth:—

	Tons Raised.	Employés.	Tons Raised per Employé.
Great Northern Coal Field:			
South Durham	21,003,629	55,445	378
North Durham	7,854,492	20,463	383
Northumberland	5,658,940	25,705	220
Cumberland	1,796,594	6,889	260
Totals and average	36,313,655	108,502	334
Welsh Coal Field:			
Glamorganshire	17,410,000	62,059	280
Monmouthshire	6,796,306	21,329	323
Carmarthenshire	556,835	2,200	253
Totals and average	24,763,141	85,588	283
Scotch Coal Field:			
East Scotland	15,268,186	42,196	363
West "	6,216,790	18,868	345
Totals and average	21,484,976	61,064	353
Lancashire Coal Field:			
North & East Lancashire	9,786,927	31,466	315
West Lancashire	10,981,491	33,887	333
Totals and average	20,768,418	65,353	320
Yorkshire	20,104,713	66,904	305
Derbyshire	9,063,407	29,737	312
South Staffordshire	8,173,901	19,377	430
North "	4,679,000	15,503	312

The increase in the quantity of coal produced in the United Kingdom during the last twenty years has been 59,584,000 tons, an increase equal to more than the total production of the whole of Continental Europe at the present time, excepting Germany. The greatest increase has occurred in the South Wales district, if we reckon Monmouthshire and Glamorganshire as one coal field. Here the development in the twenty years has exceeded 12,000,000 tons; or, in other words, has all but doubled. The next most important development has occurred in the Yorkshire coal field, where the increase has been over 10,250,000 tons; and the third place falls to the Durham and Northumberland, or Great Northern coal field. Particulars of each district are appended:—

Statement showing the quantities of Coal raised in the United Kingdom, and in each district thereof, in 1886 and in 1887 (1=1000 tons):—

District.	Production of Coal In 1886. Tons.		In 1887. Tons.	Increase In 1887. Tons.	Decrease In 1887. Tons.
Durham & Northumberland	25,194	34,515	9,321		
Cumberland	1,490	1,796	306		
Yorkshire	9,715	20,109	10,394		
Derbyshire	4,750	9,063	4,313		
Notts	1,600	5,596	3,996		
Leicestershire	866	1,099	233		
Warwickshire	775	1,456	681		
Staffordshire & Worcestershire	12,298	13,698	1,400		
Lancashire	12,320	20,768	8,448		
Cheshire	895	733			162
Shropshire	1,221	771			450
Gloucestershire, &c.	1,851	1,261			590
Monmouthshire	4,445	6,796	2,351		
South Wales	9,376	19,179	9,803		
North Wales	2,082	2,780	698		
Scotland	12,625	21,484	8,859		
Ireland	124	107			17
Totals	101,627	161,211	60,803		1,219
Deduct Decrease			1,219		
Net Increase in 1887			59,584		

BASIC STEEL FOR BOILERS.

A CERTAIN amount of suspicion pervades the minds of engineers in general with regard to the use of basic steel for boilers, and perhaps there is sufficient justification for this feeling of distrust, as accounts are reported of the erratic behaviour of basic steel plates in boilers and in other situations. The Committee of Lloyd's Register, some time ago, forbade the use of basic steel for shipbuilding; though they now sanction the application of it for ships and marine boilers, where it is made by methods of which they approve. For example, we reported a short time ago that the Glasgow Iron Company's steel was approved by Lloyd's Committee. The basic steel made by the Bessemer process seems to be that which is chiefly at fault. Much more uniform results are generally being obtained by the basic Siemens or basic open hearth process. In another column we give some particulars of a law suit raised by the Snedshill Iron Company, who supplied basic Bessemer steel plates to a firm in Staffordshire for boiler making purposes, and it may be interesting to refer to one or two of the points raised. The boiler makers requested that some of the plates should flange and weld; but they seem to have been quite unsuitable for any such manipulation, and the steel makers had, according to the ruling of the judge, to deduct from the invoice, not only the value of the particular plates in question, but the cost of removing and replacing the defective plates which had been worked up and put into boilers. This ruling appears rather severe upon the steel makers, since some may consider that the boiler makers should have been held responsible for putting imperfect material into the finished boilers. They apparently had it entirely in their own hands to use the plates in question or put in other plates. The plates which failed were those in the cross tubes, which the boiler makers had only been able to complete by dint of "patching and mending" the flanges and welds. Regarding plates for the shells and fire boxes of the boilers, no complaint had been made until after proceedings had been taken, so that the judge would allow no claim with respect to defects in these, although some direct evidence of imperfections in these was given, but more particularly with regard to the analysis of the steel. One contention relating to the analysis, put forward by the steel makers, is worthy of notice, viz., that ·24 of oxygen could not co-exist in the steel with ·11 of phosphorus and ·51 of manganese. Mr. Tucker, who made the analysis, considered that such a result is quite possible in steel. If, for instance, sufficient free lime is not present in the converter during the "after blow," the "blow" will oxidise the steel instead of removing the phosphorus; and if sufficient time be not given to the manganese, which is put in after blowing, to enter into combination with the oxygen in the charge before casting, the latter

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element will remain combined with the steel as oxide of iron. Another explanation of an apparently anomalous analysis such as the above lies in the possibility of the ingots being so honeycombed that oxidation may penetrate very far below the surface during the heating at the rolling mill furnaces; so that notwithstanding the fact that the scale was removed before taking drillings for analysis, the oxide present internally would affect the result seriously, and yet not have been in chemical combination with the charge of steel in the converter. Mr. Tucker stated that he found the steel "red short," which was probably due to an excess of oxygen and sulphur—·071 per cent.—to some degree. As regards "cold shortness," which another witness mentioned, it may be accounted for by the excess of phosphorus—·11 per cent. It was stated by Mr. Smith-Casson that the analysis was made from a fire box plate, and he further remarked that he "would never put basic Bessemer steel plates into boilers." This statement should give serious concern to makers of basic Bessemer steel, and we hope that persistent efforts will be made to bring about improvements in its manufacture, and corresponding improvements in its uniformity, and in that way increase the confidence of steel users generally.

Letters to the Editor.

THE COST OF CENTRAL STATION LIGHTING.

To the Editor of "Industries."

Sir,—In making a few remarks on Mr. Crompton's article in your last issue, I should like to premise that I do so without any feelings of enmity to the secondary battery. It has been immensely improved lately, and is still improving, and I should not be in the least surprised to find positive plates put in this year still working well in 1891, or even '92; further, I should consider any isolated installation incomplete without a storage battery. When it comes to central station working, however, I cannot help thinking that they must give way to the A.T. system, to use Mr. Crompton's notation. The figures for engines, dynamos, and buildings I will not presume to criticise, as Mr. Crompton knows a great deal more on the subject than I do. As to the cost for mains, however, his figures seem rather open to question. Does he really maintain that the respective cost of distributing mains at 2000 volts and at 100 volts is only in the proportion of 16 to 14? For the alternating leads it is proposed to lay a conductor to carry 40 ampères. To have the equivalent on the B.T. system at 100 volts means a conductor to carry 800 ampères, instead of which only one of ½ sq. in. section is allowed for in the estimate. The difference in cost of charging mains is much fairer, and probably nearer the mark, though rather favourable to the B.T.

When we come to the transformers themselves, I must confess I am unable to follow Mr. Crompton. What grounds has he for saying that 150 transformers are much too few for 10,000 lights? In his estimate he has: "Transformers, one large one for two houses; three hundred at £25, including fixing, £75,000. This being for 1450 h.p., is only 5 h.p. per transformer, which, so far from being a large size, is a fairly small one. If the houses in the district are all so small as to require a maximum of only twenty-five lamps each, one transformer would be quite enough for each group of four houses, and a 10 h.p. transformer would not occupy more room than an ordinary gas meter." Besides this, Mr. Crompton assumes that all the houses are small, whereas in the paper he is criticising the estimate of 150 is based on houses of different size, some of several hundred lights to make up for the very small ones. In conclusion, I may say that, in common no doubt with many others, I am looking forward with great interest to the paper which Mr. Crompton has promised on the subject at the Society of Arts and at the Society of Telegraph Engineers.

Yours, &c.,
London, 20th March, 1888. C. W. S. Crawley.

To the Editor of "Industries."

Sir,—I have read with much interest the article by Mr. Crompton upon the above subject, in which he criticises the statements and estimates made by the writer of the article which appeared in your issue of 2nd December, 1887. Mr. Crompton, in comparing the relative costs of two similar undertakings carried out upon the different systems of electrical distribution, called by him the B.T. and the A.T., or battery transformer and alternating transformer method respectively, has endeavoured to show that with regard to first cost the two systems are practically identical; and if I were to admit this, I would like to ask him whether he considers the cost of *maintenance* would be also identical—that is to say, whether he can keep storage cells in order for the same sum as will be sufficient to allow for depreciation upon the transformers employed. I do not believe he would make that assertion. In glancing over his estimate upon the A.T. system, I notice he has allowed £7,500 for transformers. Considering that the maximum output is to be 10,000 lamps of 60 watts each, and allowing for 5 per cent. loss in conversion (an excessive amount), the total e.h.p. required in transformers will not exceed 900, and this at his figure gives about £8. 6s. 8d. as the cost of transformers for each e.h.p. Now, this is altogether wrong. Taking it all round, the Gaulard-Gibbs transformers, as now made, do not cost more than £3 per e.h.p., and the sum therefore that would be expended on this item would not exceed £2,700. This alone makes a reduction of £4,800 in his estimate. There are many other figures in the article that require amendment, and, if you will allow me, I will try to deal fully with the matter next week, not having yet had leisure to go into the necessary calculations.

As regards the intrinsic merits of the two schemes, I grant that the possibility of storage gives an advantage to the B.T. system; but I contend that, though that method of distribution looks very pretty and appears very feasible *on paper*, yet as a commercial undertaking, and one calculated to compete successfully with gas for large towns, it is not to be compared with the transformer system employing alternating currents.

The result of the last two years has been to show that the system which will meet public and domestic requirements, that will break down existing gas monopolies, that will go right ahead in the teeth of opposition, that will be reliable, effective, easily understood, cheap to erect, and inexpensive to work and maintain, is the system that will be adopted in towns both large and small. How is it that, in the United States, the battery transformer system, though ably promoted and exploited, has made no way, whilst the comparatively new method of electrical distribution by alternating current transformers, beautiful in theory, and beautifully simple in actual working, has carried everything before it? The answer is not far to seek.

Yours, &c.,
J. Kenneth D. Mackenzie.
London, 20th March, 1888.

UNDERGROUND ELECTRIC LIGHT WIRES.

To the Editor of "Industries."

Sir,—In your article on underground electric light wires of last week, you refer to work carried out in America, where lead covered cables seem to have produced the best results and given least trouble. I desire to call your attention to the work in Philadelphia under the direction of Mr. D. R. Walker, the superintendent of the electrical department of that city. I had an opportunity of seeing this work in detail last year, and reference has been made to it at the recent convention in Pittsburg. The lead covered cables there referred to are the "Waring cables," and one important example of the success of these cables is the following: A three-wire clover leaf anti-induction cable, 1500ft. long, was placed in a conduit, and on the two outer wires the alternating current was put, working a 20-light converter placed in the chief's office. This telephone was connected with the third wire, and there was not a trace of interference on it when the alternating current was on. The wires in this cable are each separated by lead. This experiment disposes of the argument of the Brooklyn Commission, who say that electric light and telephone circuits cannot be worked side by side. The Long Distance Telephone Company, operating between New York and Philadelphia, are using three miles of this same cable as terminal sections to their line, and generally these cables are used to prevent induction where there is a large number of electrical currents near, or, as in the case above referred to, where different currents are used in the same cable. At such an important time as this, when a reliable underground conductor is being looked for, I think you will consider it only fair that the name of the "cables" referred to should be made known to the public.

Yours, &c.,
Frank Brewer, Assoc.M.Inst.C.E.
London, 20th March, 1888.

ALLOYS AND THEIR PROPERTIES.

In our last week's issue we gave an abstract of Professor Roberts-Austen's first lecture on this subject before the Society of Arts, and we now give an abstract of his second lecture. The lecturer began by dealing with the evidence afforded by the passage of an electric current through alloys. He took first the case of a molten alloy, and quoted the experiments of Obach and Haga, who had shown that when a current was passed through amalgams and through certain fusible alloys, there was no separation of the constituent metals. He then described his own experiments on alloys of lead and gold, and lead and silver, in which he employed an intense current of no less than 300 ampères. These experiments also showed that even with a very strong current there was no separation of the constituent metals, the experiments going far to show that molten alloys conduct like metals, and do not act electrolytically. Then arose the question: "Are there any metallic alloys or quasi-compounds of metals which can be in the slightest degree electrolysed by the passage of an exceedingly intense electric current?" He then dealt at some length with the experiments of Matthiessen on the electrical conductivity of solid alloys, the most interesting results of which he considered to be the evidence they afforded that the constituent metals of certain alloys could exist in allotropic states. He then proceeded to deal with the evidence as to the existence of metals in an unalloyed condition in allotropic forms, referring to the allotropic copper of Schützenberg and lead of Bolley, and turned to the evidence that in slow cooling gold and silver might be made to pass through allotropic states, illustrating his remarks more especially by reference to the beautiful experiments of Van Riemsdijk on super-fused gold and silver. The behaviour of these metals was compared with that of cooling sulphur, which, as Gernez has shown, may be made to crystallise in either the octahedral or the prismatic form, according to whether the germ which starts crystallisation belongs to the one or the other of these forms, and he referred to evidence of the same kind in the case of alloys of tin and antimony afforded by experiments by Jussien on alloys of lead and antimony. He then described the results of his own experiments, which formed the subject of a paper which he had read before the Royal Society on Thursday last. These experiments dealt with certain mechanical properties of metals considered in connection with Mendeléef's law of periodicity. He quoted numerous instances to show that the influence of "traces" of metallic and other impurity on metals was in some cases very extraordinary, and referring more especially to the case of gold, he gave evidence in favour of his conclusion that the influence exerted by the particular element on the tenacity and extensibility of metals bore a direct relation to the volume of the atom possessed by the added element—that the greater the atomic volume, the greater was the decrease in tensile strength. When this atomic volume of the impurity was less than that of gold, the tendency was for the tensile strength to increase. Evidence was given at much length to show that the influence of such impurities was directly under the control of Mendeléef's law. The lecturer stated that if his view as to the influence of the atom volume should prove to be correct, many obscure points in metallurgy would be satisfactorily explained.

Legal Proceedings.

The Snedshill Iron Company v. David Wood & Sons.

This case, which is of much interest to boiler makers and engineers, and worthy of the attention of steel makers generally, was heard on the 10th inst. at Shrewsbury Assizes, before Justice Smith, without a jury. The case arose out of a dispute about the quality of some basic Bessemer steel plates which the Snedshill Iron Company, Oakengates, supplied to Messrs. David Wood & Sons, boiler makers, Cradley Heath, Staffordshire, and for payment of which the Snedshill Company sued. It was shown that the defendants in November, 1886, obtained from the plaintiffs a set of plates for a boiler, which was in due course finished satisfactorily. For other boilers, the defendants then ordered in December further supplies of plates from the plaintiffs, stating that they were to be the same as last supplied, and "for high pressure boilers," at the same time stating on the order that certain plates with the letters "F. W." attached were for flanging and welding. These particular plates it appeared were for the cross tubes of vertical boilers; but when Messrs. Wood received them they found them unsuitable, inasmuch as they could not weld the steel nor flange it—the welds were imperfect, and the flanges tore open in turning down. In order, however, to finish the work they had in hand, they had to do their best towards making sound work in the tubes; but when the hydraulic tests were applied to the boilers they failed at the flanges and in the welds of the tubes in so much that the latter had to be removed and new ones put in. Meantime the defendants lodged a formal complaint respecting the steel for the tubes, and sent one of them to the plaintiffs to show the defects. The plaintiffs sent a representative to see the remainder at the defendants' works, and he admitted—according to the defendants' statement—the unsuitability of the steel for welding. The defendants wrote the plaintiffs intimating that they were returning the defective steel, but did not do so. All this occurred in the latter part of 1886 and beginning of 1887. Meantime, the plaintiffs had received no payment for any part of the steel which was supplied to the second order, and ultimately issued a writ against the defendants for the whole amount of the invoice, viz., £68. 14s. The defendants, considering themselves entitled to consequential damages, deducted £38 from the above amount for loss of material and workmanship, and for the loss sustained by removing the defective tubes, and paid the remainder (£30) into Court as sufficient to cover the plaintiff company's claim.

In opening the case for the plaintiffs, Mr. Spearman practically admitted the unsuitability of the plates supplied for the tubes, but submitted that no other claim of the defendants could be allowed. There had been no complaints about other plates until proceedings were taken. Mr. Jelf, acting for the defendants, advanced a counter claim for the losses above mentioned, and asked for damages sustained by the defendants in the loss of business by the sale of the boilers which had turned out defective in the tubes, and which had been seriously complained of by the purchasers. He also stated his intention to show by the analysis of the steel, and by the evidence of technical experts which he would call—viz., Mr. A. E. Tucker, of Smethwick; Mr. Thomas Turner, assistant manager of the Corngreaves Steel Works, Birmingham; and Mr. R. Smith-Casson, manager of Round Oak Works, Dudley—that many of the plates, other than tube plates, were unsuitable for boiler work, and that therefore the defendants were entitled to damages in respect of the dangerous position in which they were placed, viz., that of being called upon at any time within the next six years for damages which might be caused by the failure of any of the three boilers made from the plates supplied by the plaintiffs. His Lordship demurred to this latter claim, and said it was highly improbable that he could award any damages of that kind.

Mr. A. D. Ellis, general manager of the Snedshill Iron Company, was first called, and stated the facts concerning the orders and the correspondence. In cross-examination by Mr. Jelf he stated that some of the chief partners of the Snedshill Iron Company were also partners in the Lilleshall Iron Company, and that the Snedshill Iron Company purchase the whole of their steel, for rolling into plates, from the Lilleshall Company, who manufacture it by the Bessemer process. It was shown later in the proceedings, that the process carried on by the Lilleshall Company is not the ordinary Bessemer, but the basic Bessemer process. In his examination of Mr. Ellis, Mr. Jelf endeavoured to elicit from him an admission that the basic process was even yet on its trial as compared with the ordinary Siemens and Bessemer processes, that the results were very irregular and unreliable, and that much of the work done in steel making at Lilleshall had been experimental. To all of these inquiries Mr. Ellis replied with a direct negative, and as his Lordship interposed, and stated that any defects of the process, even if it had any, would not affect the question at

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issue, as it was only necessary to adduce evidence respecting the particular plates in question. Mr. Jelf thereupon handed to Mr. Ellis an analysis of one of the plates as follows, viz.:—

Carbon	·11 per cent.	
Silicon	Nil	
Phosphorus	·11 per cent.	
Sulphur	·071 „ „	
Manganese	·51 „ „	
Oxygen	·24 „ „	= ·8 per cent. oxide of iron

pointing out that it was not from a tube plate but from part of a fire box, and asked Mr. Ellis to give his opinion as to the suitability of such steel for boilers. Mr. Ellis, however, disputed the accuracy of the analysis, and stated that ·24 per cent. of oxygen could not co-exist in a steel made by the basic process with ·11 per cent. of phosphorus and ·51 per cent. of manganese. He further stated that if it had contained ·24 per cent. of oxygen they could never have rolled it, as it would have gone to pieces in the rolls. He considered it probable that the analyst had allowed some of the surface scale to get amongst the drillings—hence the apparent excess of oxygen.

Mr. W. H. Wood, a partner in the defendants' firm, detailed the matter of the correspondence, and the difficulties they met with in trying to weld and flange the steel cross tubes. He also stated that after completing the boilers they found them so unsatisfactory that they had to remove the cross tubes and replace them by new ones—costing in all about £20.

Mr. A. E. Tucker proved making the analysis above mentioned from a piece of steel in Court, and which Mr. R. Smith-Casson said was cut from a plate he procured in defendants' works. Mr. Tucker considered the steel would deteriorate rapidly, owing to its composition. He found it "red short," and thought that in parts where subject to the action of the fire its "life" would not be more than five years.—Mr. R. Smith-Casson stated that he had seen several plates, besides tube plates, in defendants' works, and all were defective in the same way. He had tested one of the plates, and found the steel "cold short." He considered it quite unsuitable for boilers, and under extreme heat would be dangerous. He would never put basic Bessemer steel plates into a boiler.—At this stage his Lordship suggested that this indirect evidence was unnecessary. There was no brand or mark on the piece of plate submitted to show that it was from any plate supplied by the defendants; besides, he did not see that he could admit any evidence regarding plates that had not been complained of before the action was commenced. The plates had been supplied in 1886, and the analysis and tests had been made in March, 1888. In the correspondence he could find no complaint of any plates except tube plates, and for these plates which were defective he would strike off £8. 12s. 6d. from the plaintiff company's claim, and would allow the counter claim of £20 for the cost of replacing the defective plates in the finished boilers. He could allow no claim of defendants for damages in respect of plates which had been worked up into boilers satisfactorily, no matter what doubt might be cast upon their quality by the analysis. Defendants having paid £30 into Court, the judgment was for £10. 1s. 6d., the defendants to receive costs on the counter claim.

THE PROTECTION OF BUILDINGS FROM LIGHTNING.

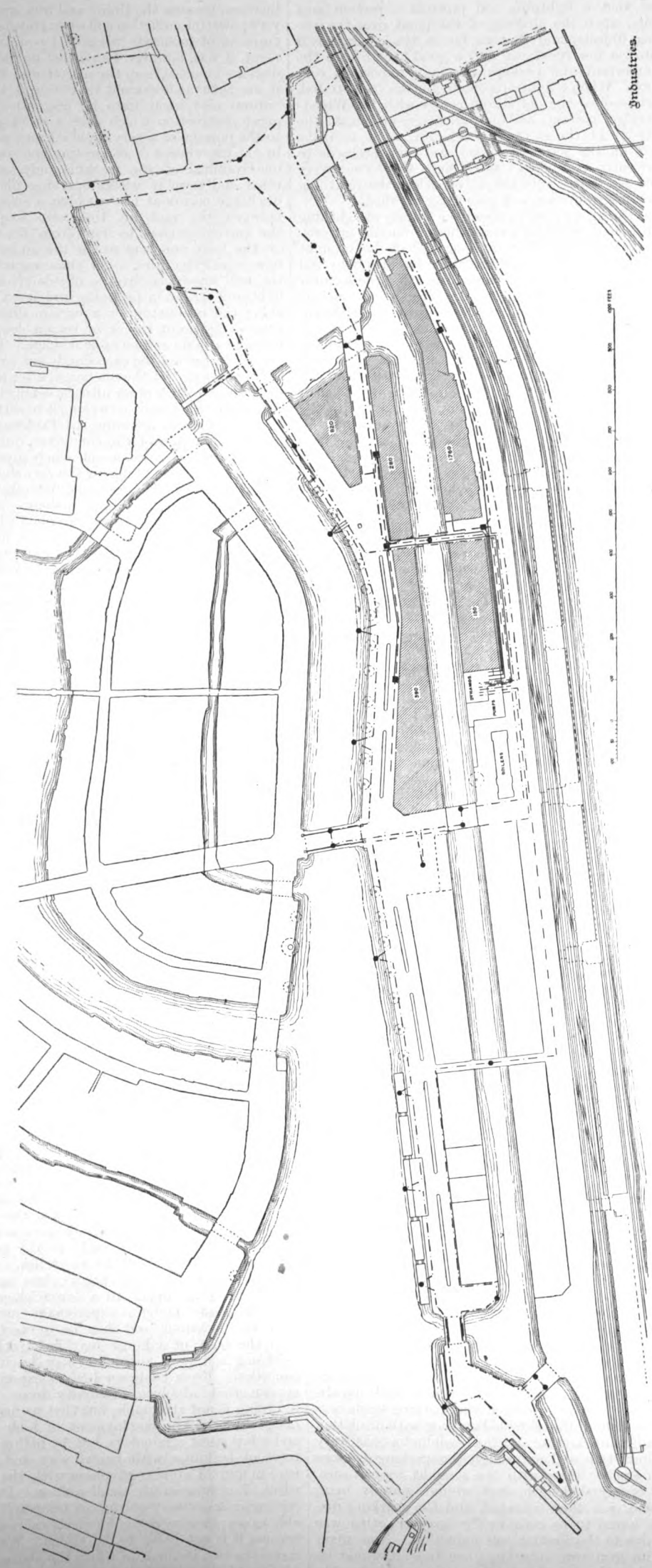
The commercial applications of dynamic electricity have of late years so engrossed the minds of scientists and engineers, that certain phenomena which we were in the habit of regarding as pertaining to static electricity have been somewhat neglected. The most important amongst these are undoubtedly those associated with atmospheric electricity. Private persons find it more profitable to concentrate their attention to the artificial production of electric currents and their use for commercial purposes than to the safety appliances to be provided if we would ward off the danger of an occasional electric current as supplied by the heavens, and thus the question of lightning rods and conductors and their best arrangement has been left to be dealt with by commissions and learned societies. Notwithstanding the labour of the Lightning Rod Commission some years ago, the principles which should guide the architect in devising lightning conductors are still only vaguely understood, and rival systems have apparently equal claims for adoption. The protection of buildings from lightning has not yet been developed into an exact science, and the opinions of experts on the subject differ as widely as ever. In Germany the Berlin Society of Electricians have from time to time formulated certain useful rules to be adopted in the arrangement of lightning protectors, and an experimental station has been established in Upper Silesia. As recently as the 4th of January last, the Berlin Society of Engineers discussed the question whether lightning conductors should or should not be connected with the water and gas mains. In a paper by Herr Oesten on the subject, it was stated that out of the 20,000 houses which in Berlin are connected with the water supply, the mains in fifteen or twenty houses are daily under repair, and may for such purpose be disconnected from the street mains. If then the water pipes are relied upon as the only earth connection, these fifteen or twenty houses would for the time be in an exceptionally dangerous position. It would thus appear necessary to provide either a separate earth connection, or to make the connection with the water mains so that it will not be interrupted by repairs in the house service. In these, as in all previous investigations of the subject, it has been assumed that a lightning rod protects a certain area depending upon the altitude of the point over the surrounding objects, and that as far as the conductor is concerned, a low resistance and a good "earth" are the most important and perhaps the only important consideration. When a lightning conductor has to be tested, the electrician of the old school comes with his Wheatstone bridge, battery, and galvanometer, and tests the conductivity of the rod and conductor, so as to make sure that all the joints are good, and then proceeds to test the earth resistance. If he finds the former very high and the latter very low, he considers the lightning protector in good order, and goes away satisfied.

These elementary notions about the efficacy of lightning conductors have received a rude shock from the investigations of Professor Oliver J. Lodge, which he brought before the Society of Arts in the Mann lectures delivered on the 10th and 17th of the present month. The lecturer wisely determined to discard all preconceived notions which are current regarding the nature of lightning strokes, and to start his investigations on a perfectly new experimental basis. In his experiments he did not use the method adopted by Franklin, who, as is well known, flew a kite and obtained electric sparks from the clouds; but he used a Voss induction machine and Leyden jars, by which means the element of danger in the experiments was obviated, whilst at the same time the phenomena were under better control. The arrangement of the apparatus may be thus briefly described: The terminals of the Voss machine were connected with the inner coatings of two Leyden jars standing upon the table, whilst their outer coatings were connected with two metal rods supported on glass stands. The ends of these rods, which terminated in knobs, could be approached more or less, and thus the sparking distance could be varied. The potential on the two outer coatings when the charge is slowly accumulating must evidently be equal; but when a spark occurs at the machine between its electrodes, the distribution of electricity is disturbed, and a second spark may occur between the sparking rods. If, now, these sparking rods should be joined by a stout copper wire of very low resistance, it would at first sight appear that no spark at all could be obtained, however near the knobs were placed. But, to the surprise of everybody who saw the experiment, the length of spark was scarcely diminished by joining to the knobs the ends of a No. 1 B.W.G. copper wire running round the room. We have then this extraordinary phenomenon, that although the two rods are in perfect metallic connection, the discharge prefers to take the short path through the air, which must have an enormous resistance, rather than the long path through the copper wire, which has practically no resistance. The explanation, as given by Professor Lodge, is that the self induction of the copper wire is so great as to almost entirely prevent the passage of a current within the very short time the spark lasts. A thin iron wire of equal length was then substituted for the copper wire, and although this had a considerably higher resistance, the sparking distance was not materially altered; it was, in fact, slightly less with the iron wire than with the copper wire. Now, according to preconceived notions, the copper wire should have offered a much easier path for the passage of the current than the iron wire. In fact, when Professor Hughes showed some years ago his classic experiment on the self induction of straight wires, the conclusion was generally drawn from that experiment that lightning conductors should not be made of iron, but always of copper, because a wire of the latter metal has very much less self induction. It is well known that an iron wire when traversed by a current becomes circularly magnetised, and thus its co-efficient of self induction is increased as compared with copper, which, being a non-magnetic metal, cannot become so magnetised. But these experiments were made with currents of a period which must be regarded as slow in comparison with the rapidity of a lightning discharge; hence the iron had time to become magnetised, and develop a counter electromotive force. In Professor Lodge's experiments it appears that the time of the discharge is too short to allow the iron wire to become magnetised, and its greater resistance would seem to constitute even an advantage in slightly diminishing the length and violence of the spark. To further elucidate this point the lecturer inserted a capillary tube of very high resistance (some 100,000 ohms) as a shunt between the sparking knobs, and it was found that the energy of the spark had much diminished. The influence of self induction was also shown by a subsequent experiment in which a shunt between the sparking knobs was formed by a strip of tinfoil folded zig-zag, with insulation between adjacent layers. Such a conductor has very little self induction, and accordingly the sparking distance was much smaller than with the straight copper wire. A tinfoil of equal length, but wound spirally upon a glass tube, was then inserted, and the sparking distance was found to be considerably greater; this was evidently due to the greater self induction. Now, upon inserting an iron core into the glass tube, it would be expected that the length of the spark would sensibly increase, because the tinfoil and iron core would act as a very powerful induction coil when traversed by alternating currents of moderate period. Upon trying the experiment, it was, however, found that no increase of sparking distance resulted from the insertion of the iron core, and it was thus made evident that iron at these rapid alternations completely loses its magnetic properties. The great obstruction which even a stout copper wire offers to the passage of a very rapid current was further shown by the experiment of connecting one end of the wire to one terminal of the machine only, and bringing the other end near it within sparking distance. When a discharge occurs at the machine, a spark is also formed between the ends of this wire loop, showing that the current prefers to flow from the nearer portions of the loop, and leap across the air space rather than flow round the wire. All these experiments illustrate the well known occurrence of side strokes. If a flash of lightning strikes a lightning rod it will sometimes run along the conductor for a certain distance, and then, without apparent rhyme or reason, leap across into the building and do considerable damage. The resistance of the conductor may be exceedingly low, and the earth may be very good; yet the discharge, after leaping through a few hundred yards of air into the conductor, does not take the path of least resistance along it to earth, but strikes off. The explanation, according to Professor Lodge, is that the self induction of the conductor, quite irrespective of its electrical resistance, is sufficiently great to prevent the passage of the current during the very short time of a flash, and thus forces the discharge laterally outwards. He illustrates this by hydraulic analogy. Suppose we have a tube bent into a U shape and filled with water. If on the surface of the water in one limb is laid a piston, and a gradual pressure is applied, the water will be forced out of the other limb without causing any sensible strain on the tube; but if the piston on the surface of the water be struck a violent blow with a hammer there is no time for the water to escape, although the tube may be very wide, and in that case the tube is liable to burst. The side flash from a lightning stroke corresponds to the bursting of the tube, and the evident remedy in the case of the tube is to make it of an elastic material; and in the case of the conductor, to give the system some elasticity of another kind, viz., more electrostatic capacity. This might, for instance, be done by connecting the conductor with one of the coatings of a Leyden jar; and on Saturday last Professor Lodge showed that by this means the sparking distance between the knobs could indeed be slightly diminished. The capacity of jar required for an actual lightning conductor would, however, be far too great to admit of such an arrangement in actual practice, and as a substitute the lecturer suggested that metal roofs and large conducting surfaces about the building should be connected with the conductor, so as to act as condensers. He also recommended to form the conducting system of a large number of thin wires in preference to the employment of a single thick wire.

The lecturer imitated the action of lightning by employing two metal plates fixed horizontally one above the other, but insulated from each other. The lower plate represents the earth, and the upper plate a cloud charged with atmospheric electricity. Into the intervening space are placed conductors terminating in metal knobs or points, and their upper ends can be set at various distances from the upper plate. Upon charging the upper plate from the machine a lightning stroke can be produced which will strike either one or the other of the objects placed between the plates, and by this means can be determined the liability which different objects have of being struck. When the charge slowly accumulates on the upper plate a point is struck sooner than a sphere, even if the point is further from the plate than the sphere; and between two spheres of unequal diameter a smaller sphere is more liable to be struck, although lower than the larger sphere. On the other hand, if the charge, instead of slowly accumulating, is suddenly transferred from another body to the upper plate, all objects are equally liable to be struck. Such a sudden transfer of the charge takes place when lightning strikes from an upper to a lower cloud, and in this case Professor Lodge's experiments make it evident that the lightning rod has no protective zone, and that the body of a house may be struck although its lightning rod and conductor may be in an excellent condition. From Professor Lodge's experiments it would appear that absolute immunity from the danger of lightning is not attainable, but that we may minimise the danger not by the employment of high lightning rods and a few stout conductors, but by fitting the eaves and roofs of buildings with barbed wire, and connecting the wire in a great number of places with the earth by iron wires of comparatively small section. Professor Lodge recommends ordinary galvanised telegraph wire as preferable to copper wire, partly for electrical reasons and partly because it is not liable to be stolen. We would recommend the two lectures, of which the above is only a short outline, to the careful attention of architects.

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THE HYDRAULIC POWER AND ELECTRIC LIGHT INSTALLATIONS AT HAMBURG.



THE HYDRAULIC POWER AND ELECTRIC LIGHT INSTALLATIONS AT HAMBURG.

In May, 1881, the German Government came to an understanding with the State of Hamburg, according to which the latter agreed to join the German Customs' Union on or shortly after the 1st October, 1888. From this contract was excepted a small portion of the harbour within which the trade was to remain free, and it has been resolved to erect bonded warehouses on the quays of the free port, so as to give every possible facility to import and export operations. The whole undertaking, which is now on the eve of completion, was one of considerable magnitude, necessitating important changes in those portions of the town which lay near the new Customs boundary. About 440 sites had to be acquired either by private contract or under compulsory powers, and this expropriated not less than 16,000 inhabitants. The houses were pulled down to make room for roads and quays and for the bonded warehouses. The total cost up to the present amounts to about £5,500,000. The bonded warehouses, as all buildings in the neighbourhood of the river, are erected on pile foundations. The warehouses contain, in addition to cellar and ground floor accommodation, four upper floors and a floor below the roof. All the floors, with the exception of the two highest, have been constructed for a load of 3cwt. to the square foot. The total area which will eventually be covered by warehouses is 430,000 sq. ft. All the warehouses and the adjacent quays are supplied with hydraulic cranes, lifts, and winches; and the district is lighted throughout by arc lamps, whilst the interior of the warehouses is lighted by glow lamps. We publish on this page a sketch plan showing the position of the free port and bonded warehouses, those of the warehouses which are already completed being shown by hatched lines. The position of the arc lights is shown by dots, and the arc light circuits by broken lines. The figures in the space occupied by each building denote the number of glow lamps installed, and the black squares represent junction or distributing boxes for the glow light circuits. The plan on the next page shows the boiler, pump, and dynamo houses to a larger scale. The boiler house is a separate building, large enough to accommodate ten boilers, each of 1500 sq. ft. heating surface. Of these, five boilers made by the Hohenzollern works are now installed. The steam pressure is 100lb. per square inch. The coal is stored in a cellar under the street, and is hoisted by the lifts shown in the plan. At one end of the boiler house is a repairing shop, and at the other are two hydraulic accumulators for the pumps. In the engine house room is provided for eight pairs of direct acting steam pumps working at 50 atmospheres pressure. The pumps are automatically stopped and started by the accumulator striking tappets at the end of the stroke. The general arrangement of this hydraulic power plant is very similar to that of the London Hydraulic Power Company, which was taken as a pattern for the Hamburg installation. The total power of the hydraulic plant is sufficient to actuate 260 hoists, 50 lifts, and 36 cranes distributed along the quay walls. There is also some surplus power for working domestic hydraulic motors, if applications for this purpose should be received. At present there are erected only four pumps—of which one is spare—and two accumulators as already mentioned. Later on, when all the warehouses are erected and more power is required, the remaining pumps and a corresponding number of additional accumulators will be installed. The engines are horizontal compound, 18in. and 27½in. diameter of cylinder, by 27½in. stroke, working at sixty revolutions per minute. They are provided with surface condensers, the cooling water being taken from the river and circulated by a centrifugal pump. The piston rods are prolonged through the back cover of the cylinders and coupled direct to the pump plungers, which are differential, 4·85in. and 3·45in. diam. respectively. Above the engine room are placed two reservoirs containing together about 42,000 gallons, from whence the water is taken by the pumps. After passing through the mains to the various motors, the water is brought back to these reservoirs by a separate service of return mains. The accumulators have fixed cylinders and plungers of 24in. diam. The lift is 23ft., and the contents of each is about 450 gallons. The mains are throughout of cast iron, and the flanges are joined by india-rubber rings. There are at various places suitable branches and valves, so as to isolate any portion of the mains for repairs without interrupting the service over remaining parts. To avoid the bursting of mains from shocks there are fixed at several points short cylinders with plunger pistons held down by strong springs, and to detect leakage iron rods are fixed to the mains in various places, which come straight up to the street surface, so that the noise occasioned by the escape of water may be detected. The mains are laid sufficiently low to be out of the region of frost, and are embedded in sand and carried on brick work. The hoists in the warehouses are all adapted for a load of 12cwt. and a winding speed of 5ft. per second; whilst the lifts are arranged for a load

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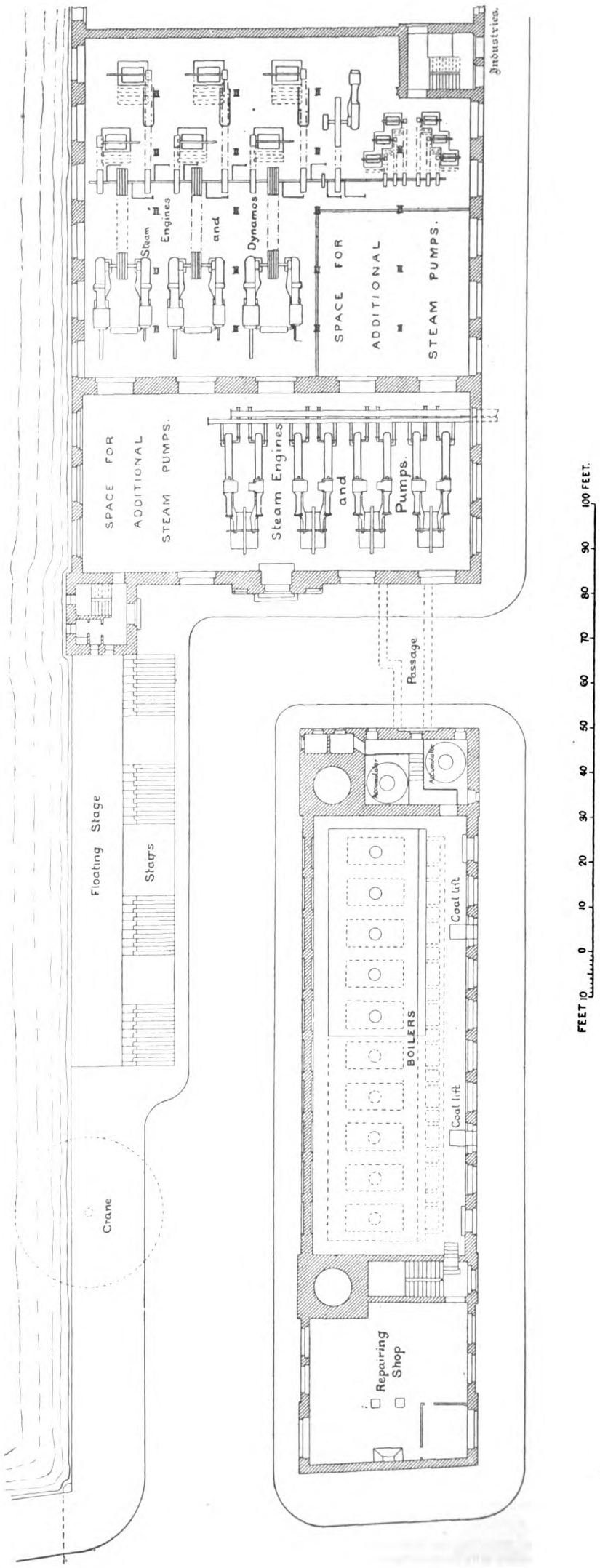
of 24cwt. and a winding speed of 3ft. 4in. per second. Most of the cranes along the quays are for 30cwt., but some for 5 tons are projected.

The electric light installation, when completed, will consist of fifty 10 ampère arc lamps, and about four thousand 16 c.p. glow lamps. The arc lamps are grouped in series of ten, each circuit being supplied by a separate arc light dynamo. The glow lamps are placed in parallel, and sub-divided into various groups, all fed from a main distributing switch board in the dynamo room. Power for the glow lamp installation is supplied by three pairs of compound engines of 220 i.h.p. each. Two of these engines are fixed. The high pressure cylinder is 15¾in. diam. by 31½in. stroke, whilst the low pressure cylinder is 23⅝in. diam. by the same stroke, the speed being one hundred revolutions per minute. These engines are provided with automatic expansion and surface condensers. The six arc light dynamos (five in use and one to spare) will be driven by a single cylinder non-condensing engine with 14¼in. cylinder by 28½in. stroke, running at ninety revolutions a minute. The cables are carried underground in rectangular iron troughs. The engines and dynamos are on the ground floor, and the dynamos are driven by belting from a main counter shaft fixed in the cellar, the latter receiving motion from the engines by rope gear. The pulley of each dynamo is provided on the counter shaft with a friction clutch, so that it may be stopped or started without interfering with the working of the other dynamos. For the glow lamp service there will eventually be provided six dynamos, but only four are now installed. These are eight-pole Schückert disc machines running at 350 revolutions, and designed to give a maximum current of 400 ampères at 120 volts pressure. The machines are all coupled in parallel by means of two main bars on the distributing switch board. There is an ammeter in the circuit of every dynamo, and an ammeter in every external circuit, of which eight are now fixed. The pressure is controlled by an automatic regulator, which we shall presently describe, and pilot lamps attached to small return wires inserted into each main cable are also provided as a guide for the attendant. The mains have been designed for a loss of pressure equal to 14 volts. In coupling the machines the exciting current of each is first regulated by a rheostat worked by hand, so as to obtain the same terminal pressure on all the machines. The rheostats are then coupled together, so that any further adjustment of the terminal pressure may be made simultaneously for all the machines. The pressure is, at the lamps, regulated by inserting more or less resistance into each outgoing main. This is done automatically by a relay electromagnet and rheostat to each main. The rheostat switch is an insulated barrel with circular metal contact fins of unequal length, which, when the barrel is slowly revolved, come automatically into action, inserting a greater or lesser number of German silver resistance coils into the main circuit. Each rheostat consists of fifteen German silver resistance coils. The switch barrel is revolved either in one or the other direction by means of ratchet wheels and pawls, the latter being continuously kept oscillating by a shaft which receives motion from the main shaft in the cellar. Each relay magnet is coupled to the return wires already mentioned, so that the attraction on its core is an exact measure of the pressure existing at the points of consumption. The core is suspended from an adjustable spring, and provided at its lower end with a metal stud playing between two contacts, so that a current may be sent through either one or other of two magnets controlling the two pawls. If the pressure is too high, the core rises and a current passes through the magnet which actuates that pawl by means of which the switch barrel is revolved in such a direction as to reduce the number of resistance coils in the circuit. If the pressure is too low, the core of the relay magnet drops and sends a current through the other magnet actuating the second pawl, which causes the switch barrel to revolve in the opposite direction and couple a greater number of resistance coils in parallel. In addition to the ammeters, there is provided a corresponding number of voltmeters, and the total quantity of electricity is measured by Aron's coulomb meters, one being provided for each dynamo and each circuit.

MINING IN ITALY.

The Italian Government intend disposing of the mine of Valle Imperina, near Agordo, which is owned by them, and which produces zinc, iron, copper, sulphur, and arsenic; and the Italian Consul-General informs the Board of Trade that his Government is prepared to give every inducement to the mine becoming a private undertaking. A report on the mine states that its importance is likely to be greatly increased by the extension of the railway from Treviso to Belluno, and by improvements in the processes used for extracting the minerals from the ore. It is also suggested that material at present wasted might be used for the manufacture of sulphuric acid.

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THE PHYSICAL SOCIETY.

At the meeting of this Society on the 10th. inst., Mr. G. L. Addenbrooke read a paper describing a new portable reflecting galvanometer and a lamp of more convenient construction than those hitherto used for these instruments. The galvanometer had been designed to meet the requirements of electric light and telephone engineers. It is mounted on an ordinary ebonite stand with levelling screws, and the coils are removable, so that coils of different resistances can be used. The suspending fibre is wound upon a spindle, which can be removed from the instrument when it has to be carried, and a damper is attached to the mirror. The instrument exhibited was a single needle one; but astatic galvanometers can be made on the same principle. The adjusting magnet slides without turning on an upright rod attached to the cover of the case; and when it has to be turned, this is done by turning the upper part of the case, which is graduated, so that it can always be replaced at once in the position required. The lamp is smaller than those generally used, and is contained within a brass cylinder. It can be raised or lowered to the extent of about 6in. The lens is movable about a centre coinciding with the centre of the wick for adjusting the beam of light, and the wick is kept in the right position by passing the brass spindle, by which it is raised or lowered, through a slot in the case. The lamp is filled by a funnel without removing it from the case. Mr. E. C. Rimington then read a paper on

The Measurement of the Power supplied to the Primary Coil of a Transformer.

The subject was suggested by some observations made by Professor Ayrton in the discussion on the paper recently read by Mr. Kapp at the Society of Telegraph Engineers, in which Professor Ayrton described his method of measuring the power by means of an electrometer. The author had devised a method which he regarded as an improvement upon Professor Ayrton's, as the latter requires two observations, while his only requires one. As in Professor Ayrton's method, he places a non-inductive resistance R in series with the primary coil; but instead of using an electrometer, he uses a high resistance Siemens dynamometer, the coils of which are respectively connected with the primary of the transformer and the non-inductive resistance. If $\frac{K}{R}$ is the constant by which the dynamometer reading must be multiplied to give the power when continuous currents are employed, the power with the alternating current is

$$P=\frac{K}{R}\left(1+\tan^2\psi\right).\delta$$

The angle of lag ψ is a quantity which must be determined from the periodic time and other known conditions of the apparatus.

Professor Ayrton pointed out that the method was identical in principle with the one described by him, and open to the same objection of requiring the introduction of resistance into the primary circuit; but was distinctly inferior to it, as it requires the period of alternation to be known. He considered that a method was greatly wanted of measuring the power supplied to a transformer without introducing a resistance, and not involving a knowledge of the period of alternation.—Mr. T. H. Blakesley stated that he had devised such a method, requiring only readings on two low resistance dynamometers, and that by the use of a third dynamometer the loss of power due to hysteresis could be determined. His method of reasoning was geometrical. In answer to a question by Professor Ayrton, he stated that he proceeds on the assumption of magnetic lag, but does not assume the existence of a constant co-efficient of self induction.

Professor Perry then read an abstract of a paper by Professor Ayrton and himself

On the Magnetic Circuit in Dynamo Machines.

The authors have worked out a number of formulæ for dynamo machines, involving not the actual numbers of coils on the armature, but the thickness t of the winding and α the highest permanent current in ampères per square centimetre of cross section in that winding. One of these formulæ is

$$W=\frac{2\,v\,N\,t\,\alpha}{10^9}$$

where W = Highest permanent power or output developed in watts;

v = Circumferential velocity in centimetres per second;

N = Total highest permanent magnetic induction through armature in C.G.S. measure.

Then, as the armature winding is thin $t\alpha^2=q^2$ a constant. In some armatures which are always very cool, q is 150, but it is usually 288 in the best modern machines, being much over 300 in some machines. q is less for finer wires. The output can now be expressed in various useful ways, one being

$$W=\frac{2q}{10^9}v\,N\sqrt{t}, \text{ whilst}$$

$$N=\frac{\frac{4\pi}{10}s^1A^1}{\frac{2(d+t)}{a_2}+\Sigma\frac{l\nu}{a\mu}}$$

s^1A^1 being ampère turns on one magnetic field magnet circuit;

d the clearance between armature winding and pole piece;

a_2 area of pole piece exposed to the armature [increased by a fringe all round of breadth $0{\cdot}8\,(d+t)$];

a the cross section of any part of the magnetic circuit of length l, through which there is an induction νN, the magnetic permeability being μ.

From this it follows that W, the permanent output, is a maximum when

$$\frac{2t}{a_2}=\frac{2d}{a_2}+\Sigma\frac{l\nu}{a\mu} \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

That is, when the magnetic resistance of the space occupied by winding on the armature is equal to all the other magnetic resistance of the circuit.

The value of this rule is very great. Thus, for example, we have

$$W^1=\frac{2\pi q}{10^9}\frac{v a_2}{\sqrt{t}}s^1A^1$$

The authors, after giving the history of the Fröhlich and other formulæ for the law connecting N and s^1A^1, that is, "the characteristic of the dynamo," said that they had wasted much time in trying to get a simple formula whose constants could be calculated from the sizes of parts of a machine. They pointed out, while giving credit to the Drs. Hopkinson for their valuable study of the dynamo, that even they were not able to calculate the characteristic for an existing dynamo with what can be called accuracy, and that for all practical purposes the following rule, which is based on (1), is accurate enough:—

1st. For values of N equal to about half the maximum value, it is only necessary to study the air resistance, and

$$N=\frac{4\pi}{10}s^1A^1\div\frac{2(d+t)}{a_2}$$

Let the straight line indicated by this be drawn upon squared paper.

2nd. For the maximum permanent value of N ($=a_1\beta_1$, where a_1 is the diametral section of iron in the armature, and β_1 is from 17,000 to 18,000 in good machines) find the value of s^1A^1 from the formula

$$N=\frac{4\pi}{10}s^1A^1\div\frac{4t}{a_2}$$

and plot these values of N and s^1A^1 as the co-ordinates of a point on the squared paper. Any person who has drawn characteristics of dynamo machines will be able to draw a curve through this point, touching the straight line, which will not differ materially from the characteristic of the constructed machine. In testing this rule on the "Manchester" dynamo, the authors were afraid to trust to their judgment, as the real characteristic was already known. They therefore assumed that a curve

$$N=p\tan^{-1}(k\cdot s^1A^1)$$

was tangential to the straight line, and passed through the point, and the result was shown, with the curves calculated by Dr. Hopkinson and the observations on the same sheet of paper. They stated that in the best modern machines for incandescent lighting the only place in which "throttling" of the induction was allowable was the armature; but the usual rule now was to have β constant everywhere—that is, no throttling anywhere.

THE MANUFACTURE OF SORGHUM SUGAR.

A recent report on the manufacture of sugar from sorghum in the State of Kansas, presented by the English Consul at Chicago to the Foreign Office last month, draws attention to the success which has attended the experiments of last year, and which seem to indicate that sorghum sugar making will become one of the most profitable industries of the country. The earlier attempts in America to introduce the sorgho or sugar grass did not show that the cultivation was sufficiently remunerative to enable the sugar obtained to compete with cane or beet sugar. The sorgho plant was introduced into the United States from China in 1855, and the African variety, or "imphy," was also tried about the same time; but the first crops were unsuccessful. In 1875, the cultivation had extended to several of the central States, and the quantity obtained in that year reached the total of 640,000lb., as compared with 20,000,000lb. of beet sugar, and 63,000,000lb. of cane sugar. From these first experiments, it was seen that the sorgho plant thrives best in localities which were too cold for the sugar cane and too warm for the sugar beet, and that the maximum yield of sugar was obtained if the plants were cut as soon as the colour began to change, immediately before the seeds ripened. It was also found that another essential element of success consisted in the immediate crushing of the cut stalks, as on standing the cane sugar present in the juice reverts to glucose. The defecation can be effected by heating the juice to a temperature of 70° to 80°, then adding lime, and finally evaporating the clear liquid. From 100lb. of stalk about 63lb. of sap can be pressed, which contains about 12½ per cent. of crystallisable sugar and 3·7 per cent. of molasses. The raw sugar from different localities has been subjected to analysis, and was found to contain some 92 per cent. of cane sugar and 2½ per cent. of glucose. The first sorghum factory was erected in Illinois in 1881, and in Kansas during the following year three more factories were opened. The yield of juice by the processes used in these factories was not more than 40 per cent. of the total juice present in the stalk, and those interested in the success of the new industry, by the aid of an appropriation vote from Congress, next tried the process of diffusion in the place of the heavy crushing which had proved so inefficient. Results obtained by the Franklin Sugar Company in Kansas showed that this method extracted all the sugar from the stalk; but, although assisted by the State, the company was unable to make the process a commercial success. On the advice of Dr. Wiley, the Chemist to the State Agricultural Department, Congress voted, in 1885, a fresh grant to the Parkinson Sugar Company at Fort Scott, in Kansas, and the experiments for the year showed that the success of the method would only be a matter of time. In 1886 the experiments were continued by the Agricultural Department, under the direction of Professor Swenson, and the suggestions made by him enabled the Parkinson Factory last year to attain a very favourable result on their year's work. The State Legislature has also recently passed an Act to encourage the industry, by allowing a bounty of 2 cents per pound for five years on all sugar manufactured in Kansas. The value of the sorghum sugar manufactured in Kansas last year amounted to upwards of 34,000 dollars, and the working expenses to 21,000 dollars, showing a considerable profit on the year's work, even when the bounty is not included in the figures. The factory at Fort Scott has plant capable of dealing with 170 tons of stalk per day, which is delivered at the factory by the farmers who grow it. The topped stalk is cut into small pieces by a feed or ensilage cutter, which removes the leaves and sheaths. The material is then carried to the upper part of the building by an elevator. The leaves and sheaths are blown away from the cut stalk by a series of fans, and the cleaned stalk is then cut into chips before being placed in the diffusion battery. Each tank of the battery is capable of holding one ton of chips, from which the sugar is diffused out by soaking in hot water. The water, which is heated by steam pipes, circulates through the series of tanks, and gradually becomes charged with the sugar, and the juice obtained in this manner is then drawn off to the defecating pans. Carbonate of lime is added to each tank to neutralise any acids which may be present, thus preventing inversion from taking place. Lime water is also added to the juice in the defecating pans, in order to insure neutrality before evaporation. After being heated and skimmed the juice is boiled to a syrup in vacuum pans, and is then removed to the "strike pan," a large air tight iron vessel in which the boiling is continued until sufficient water has been evaporated to insure the sugar crystallising out from the molasses in the centrifugal machines. The yield obtained at Fort Scott from one ton of sorghum last year was about 100lb. of sugar and 12 gallons of molasses. At present, no satisfactory process has been devised for obtaining the glucose in a marketable form, although this exists in the plant in considerable quantity, and is formed by inversion in the processes of manufacture unless great care be taken in the different processes. Dr. Wiley hopes to be able to preserve the stalk in silos after cutting without loss of sugar, which will allow of the factory working for a longer period, and enable the farmers to store their stalk until the winter season, and deliver to the factory at their leisure. In the report to which we have alluded it is calculated that the farmer should make £4 per acre for his crop, or about twice the yield of a crop of wheat, and the seed is of equal value to corn for feeding purposes. In France, where the sorghum plant is also now largely cultivated, especially in the districts of Vancluse and Le Gard, the grain, which contains about 40 per cent. of starch, is fermented, and by using diastase instead of acids, the residue is made available as a food for cattle. By the use of Champonnois' apparatus, good brandy can be prepared from the alcoholic liquid obtained by the fermentation of the grain. In France the cultivation has been found less costly than that of the sugar beet, and the yield of molasses is considerably less. In Hungary, within the last

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few years, satisfactory crops of sorghum have also been raised, and the seeds have been used as a substitute for barley. In Pomerania, crops have been grown and used as green fodder for cattle. A recent report on "the sugar outlook," states that the production of sugar in the United States is less than the demand. Considerable quantities are imported to the Western States from the Hawaiian Islands, so that there seems to be a good opening for the new industry in the United States. In California, the manufacture of sugar from beet root is making rapid strides, and large factories are now in process of erection in the neighbourhood of San Francisco to deal with the crops which are there being raised. Sorghum can be grown in the zone north of the sugar cane producing States, and south of those where the beet root is found to thrive; and now that the experimental stage has been passed, the central States will have a sugar industry of their own, which bids fair to become a formidable rival to that of the other States.

Notes.

THE TRADE OF TRIPOLI.

A VERY unfavourable account is given by Consul-General Drummond-Hay of the state of trade in Tripoli, it being stated that there is no capital in the country, as owing to the depressed state of the ostrich feather market traders will not purchase feathers in the interior. British cotton goods are no longer sent in the same quantities as before to Bourun and Waday. A large decrease has consequently taken place in the imports of cotton goods, the value of British cloth manufactures imported in 1887 being £37,500, as against £53,000 in the previous year.

THE INDUSTRIES OF BALTIMORE.

LOCAL industry, says the British Consul at Baltimore, in a report to the Foreign Office, shows remarkable progress. The Pennsylvania steel works have purchased a thousand acres of land, with water frontage, near the city, and have commenced work with a plant which it is intended to extend until eight furnaces, with a daily output of 2000 tons of pig iron, and a steel rail mill to turn out 1000 tons of rails per day, besides other branches, are in operation. It is also proposed to establish a steel shipbuilding yard. Among other important industries carried on in Baltimore are railway carriage and tram car works, and food tinning factories. As regards the imports, it is mentioned that the receipts of chemicals, which come almost exclusively from England, show a slight increase.

BRAZILIAN IMPORTS.

THE increase of imports into Rio de Janeiro for the last official year amounts to about 2½ per cent., the advance being most noticeable in machinery, cottons, woollens, and silk. In cottons, the finer qualities show the most improvement, grey and white half bleached stuffs having declined. Hessians and Osnaburghs have fallen off. Coal, iron, and steel also show a decrease. There has been an augmentation in the value of the imports from England, France, Germany, Belgium, the United States, and Portugal; but German trade has advanced in a greater ratio than that of any other country, a fact which we would recommend to the notice of Mr. R. Giffen, who seems to be under the impression that we are holding our own against Germany.

ROUMANIAN IMPORTS.

THE negotiations between Roumania and Austria-Hungary for the conclusion of a commercial convention, to take the place of that which expired on the 1st June, 1886, have made but little progress hitherto, so that the general tariff continues to be applied to the greater part of the goods imported. On the other hand, an additional treaty of commerce has been concluded with Germany, which provides for several reductions in the tariff, by which, according to the British Consul at Galatz, British trade should profit. He also states that, so far as any judgment can be formed from the published statistics, which at present only give the gross returns of foreign trade up to the end of 1886, the commercial differences between Roumania and Austria-Hungary have benefited German imports more than those of any other country. The values given are: For Austria-Hungary imports in 1885, £4,827,000; in 1886, £3,740,000; Great Britain in 1885, £2,073,000; in 1886, £2,856,000; Germany in 1885, £1,660,000; in 1886, £2,933,000. German imports now rank as second in importance, the principal articles being woollen and cotton hosiery, haberdashery and knitted goods, woollen yarns, iron and steel rails, and metal goods. In metals, the proportion of German imports is very large, and this is no doubt due in some measure to reduced railway rates for through traffic between the two countries.

AGRICULTURAL MACHINERY IN RUSSIA.

IN an abstract of the report of the Russian Department of Agriculture, which has been sent to the Foreign Office, reference is made to the falling off in the imports of agricultural machinery. This is ascribed partly to the impoverishment of the landed proprietors and partly to bad harvests in those districts where expensive machinery, such as thrashing machines and reapers, is used. The trade is now limited to the purchase of cheap ploughs, harrows, and winnowing machines, and a few seed drills. The most popular with the peasantry is the one horse "Eagle" plough, and Swedish iron ploughs also meet with favour. Double and triple ploughs are being more extensively used, and those made by Messrs. Ransome, Sims, and Jefferies are highly spoken of. The imports of agricultural implements are likely to decrease further, as the duty was raised last November; the increased tariff does not, however, apply to machinery worked by a separate steam engine.

GAS BY INSTALMENTS.

WE have before alluded to the competition which gas companies suffer from petroleum oil. The preference of the poor for oil appears to be largely due to the fact that it can be purchased in small quantities—whereas the use of gas results in formidable quarterly bills. Several attempts have been made to meet small consumers in this matter; and the Corporation of Birmingham is now about to institute an entirely new departure in the sale of gas by the use of "pay-before-delivery" meters. A number of prepayment meters, constructed after the principle of the common automatic supply machines, have been offered by inventors; and a trial of one devised by Mr. Brownhills is to be made in a court of small houses. One or more pennies are dropped into an opening, and the regulating apparatus of the meter liberates a quantity of gas of corresponding value—after which it stops, awaiting the advent of fresh pence. The coins accumulate in a locked receptacle, and are removed by the collector at intervals. The mechanical arrangements of the meter will, it is believed, render fraud difficult; and they can be manufactured for about 20s. each.

GUN MAKING IN THE UNITED STATES.

THE *Scientific American* draws attention to the 6in. gun of cast steel now being manufactured at Pittsburg, by the Bessemer process, for the United States Government, and seems to take a very *couleur de rose* idea of this form of manufacture, stating that, as compared with the methods employed in Europe, casting will be more expeditious and cheaper; and if the gun be a success, a great advance will be made in the construction of ordnance. The gun has yet to be tested; but safety apart, it is, we believe, an undoubted fact that the cost of the gun when completed will not differ materially from that of the same calibre of forged steel lately constructed in the Navy Yard at Washington. Moreover, if one 6in. gun of cast steel be successful, it does not follow that those of larger calibre will be equally so. The difficulties in castings increase enormously with their weight; and in the case of the larger calibres, these weights will be excessive. The same journal also states that it is the opinion of American ordnance officers that the gun of the future will be of aluminium bronze, and that it will be lighter, stronger, and cheaper than the steel gun. The merits of this metal are that it is light—as light almost as glass—that it does not rust, is stronger than steel, and with suitable alloys, can be made to replace any other metal.

METALLIC MONEY.

IN the course of a paper read by Mr. J. B. Martin, at a recent meeting of the Institute of Bankers, on some recorded movements of coin and its equivalents during recent years, he stated that taking gold first, our knowledge as to the amount existing in this country, or in the world at large, is extremely vague. Examining the inquiry made by Professor Jevons in 1868, and comparing it with an inquiry conducted by himself in 1882, it appeared that Professor Jevons made what was probably a fair estimate at the time, but this method would not be equally applicable at present. The evidence points to the conclusion that in proportion as the gold coinage suffers from wear and tear, the best of the coins tend to disappear, and the worst to remain in circulation. The Bank of England returns from 1882 to the present time appear to show that about £1,315,000 have been added to the home circulation, while the returns of the registered imports and exports of gold show a balance in favour of this country of £3,420,000; but from a comparison of international statistics and other considerations, official statistics appear to be of very little value. As regards silver, there appears to have been in the years 1871 to 1886 an increase of more than £4,000,000, while there has also been an addition to the bronze coinage more than proportionate to the growth of population. The bank note circulation is steadily declining in every division of the country.

ELECTRIC LIGHTING IN THE UNITED STATES.

WE have already referred more than once to the enormous progress which is being made in the United States with electric lighting, as compared to what is being done in this country. The latest estimate on the subject of the American electric lighting industry is that given by Mr. J. F. Morrison, president of the National Electric Light Association, at their recent meeting in Pittsburg. He puts the present figures of electric lighting in the United States at 3000 incandescent and arc isolated plants, and 1000 central stations in which are installed or contracted for 175,000 arc lights and 1,750,000 incandescents. Mr. Morrison also drew attention to the difference in the growth at home and abroad, and said the whole explanation was to be found in vicious legislation.

DETECTION OF COLOURING MATTERS.

THE detection of colouring matters used in the adulteration of beer, wine, and other articles of food is rendered difficult by the presence of the natural colouring material of the substance, and chemists have hitherto been unable in many cases to certify to the presence of any particular colour adulterant for this reason. F. Goppelsroder has recently drawn attention to the researches of Schönbein on the separation of substances by capillary analysis, and has shown that by this method we have a very ready and simple means for separating and recognising individual colouring matters in their mixtures. If a strip of white unglazed paper be placed in a solution of several substances, the solvent rises more rapidly than the dissolved substances, and these have each their own rate of travelling. If colouring matters are present, zones of different colour are produced, and after some time the piece or pieces of paper can be removed and the substances on them extracted. The extract can then be treated in the same manner a second time, thus making the separation of the various colouring materials present still more complete. The separate zones will vary in their intensity and breadth with the amount of the several substances present, and the ordinary reactions can be applied to the materials on the paper when they have been thus separated. Mr. Goppelsroder has found this method to give very good results in examining food and various other articles to which colouring matters have been added. He has succeeded in detecting picric acid in beer, and fuchsine in wine, by its use.

STEAM VULCANISED FABRICS.

MESSRS. CHARLES MACINTOSH & Co., of Manchester, a short time ago patented an invention, for which it is claimed that it marks a new epoch in the history of the india-rubber manufacture. Notwithstanding the great advances which have been made in the other branches of this industry, very few important improvements have been effected in the manufacture of waterproof clothing. The trade, it is true, has been developed considerably by the employment of a greater variety of fabrics, and wool, silk, and cotton, alone and in combination, now form part of the stock of every dealer in waterproofs. The only obstacle to complete success has been that, hitherto, no manufacturer has been able to thoroughly "vulcanise" the rubber which is inserted between or spread upon the woven wool or silk. These fabrics being non-conductors of heat are not adapted to the ordinary process of steam vulcanising. Some waterproofers, however, have supplied so-called "steam vulcanised" goods; but with the appliances usually employed in this process, the cloth is necessarily dealt with in large rolls, and the heat which is required to thoroughly vulcanise the interior, would burn the outside folds almost to destruction, so that equal vulcanisation has not been accomplished. In consequence of this difficulty most firms have adopted what is known as the "cold cure" process, in which a mixture of bisulphide of carbon and chloride of sulphur is applied to the surface of the rubber. The effect of this is to harden or "cure" the outside surface of the rubber without penetrating far into the interior. The body of the rubber is thus left uncured, and is, in consequence, very liable to early decay. There is generally a most unpleasant smell attending the use of this liquor, and this fact alone is sufficient to condemn its use except on the ground that no practical substitute has been available. In the new process, the fabric is passed through a vulcanising chamber which is heated with air, and fitted in its interior with a system of rollers so arranged that the cloth, in its passage round them, shall occupy the necessary time to effect a complete vulcanisation. As the cloth is being continually wound off the feeding roller and on to another roller when vulcanised, no portion of it can receive more heat than another. The goods produced by this method will, it is said, remain soft and pliable when exposed to intense cold, and, what is of even more importance, they will not decay by being kept in stock in a hot climate.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

9th March, 1888.

15878B. Popp, V. ..... Fluid meters. (This application having been originally included in No. 15878, dated 18th November, 1887, takes, under Patents Rule 23, that date.)
3621. Middleton, J. ..... Breech loading small arms.
3622-3. Rosson, C..... Ejector mechanism of breech loading small arms.
3630. Lockhart, J..... Axle guard for railway rolling stock.
3635. Wilmot, S. M. ..... Galvanised sheet iron roofing.
3638. Higham, J..... Knitting machines.
3640. Fielding, W..... Uncoupling railway trucks.
3649. Dickinson, W., & others Manufacture of paper.
3650. Haworth, J..... Self acting mules.
3651. Evans, P. ..... Governing steam engines.
3652. Stitt, J. C..... Steam engines.
3654. Jagger, E..... Placing cop tubes upon spindles.
3655. Ainsworth, W..... Paper bag making machines.
3656. Lund, E..... Pulsometers.
3659. Boult, A. J. ..... Sheet metal cylinders (*Wonson*).
3664. Bacon, D. H..... Wood turning machinery.
3665. Eades, W. S..... Machines for making "button pieces" for boots.
3667. Walker, H. A..... Wire twisting machine.
3681. Pugh, D..... Tube stoppers for boilers.

10th March, 1888.

3694. Holdsworth, C. ..... Winding yarn on to paper tubes.
3699. Dobson, B. A. ..... Bearings for carding engines.
3701. Fisher, J. A..... Gas engines.
3704. White, C. ..... Winding off yarn from bobbins.
3706. Stead, T. W..... Washing woven fabrics.
3711. Richardson, R..... Steam steering gear.
3712. Marks, G. C..... Machines for lifting heavy bodies.
3713. Norton, R..... Vertical steam boilers.
3715. Jefferies, J. R..... Vertical steam boilers.
3722. Muirhead, W..... Furnaces for the production of steel.
3723. Sutherland, M. ..... Indicating the water level in steam boilers.
3724. Norton & Wood ..... Looms for pile fabrics.
3730. Barthel, A. E..... Production of iron.
3745. McQuat, A. M..... Bottle washing machines.
3749. Willans, P. W..... Driving gear for screw propellers.
3751. Imray, O. ..... Fish plates for rails (*Lee*).
3752. Imray, O. ..... Construction of roadways (*Lee*).
3753. Harmel, A., & others ... Dyeing wool.
3756. Crossley, F. W. ..... Gas engines.
3762. Mosher, S. H., & others Feed water purifier.
3763. Brougher & Funk ..... Skinning knife attachment.
3765. Kingdon, G., & others.. Automatic direct action brake.

12th March, 1888.

3767. Whitworth, C. F..... Railway signals.
3770. Murray, R. ..... Copper castings.
3773. Wallace & Smillie..... Preventing corrosion of screw propellers.
3776. Arnell, J. C. ..... Extracting ferrules from the tubes of boilers.
3785. Winterflood, J..... Water heating apparatus.
3786. Worrall, T. D. ..... Type writing machines.
3789. Baker, G. W..... Leather staking machine.
3790. Herbert & Hubbard... Aiming of machine guns.
3799. Edmeston & Edmeston. Pistons.
3800. McNaught & McNaught..... Air pumps of steam engines.
3801. Selwig, J..... Rotary engine.
3804. Hainsworth, F..... Manufacturing wire fabric.
3806. Leslie, A. ..... Furnaces for smelting iron (*Massey*).
3807. Greenwood, H..... Manufacture of metallic cartridge cases.
3811. Effenberger, J..... Stretching apparatus for wool spinning.
3813. Sudheim, S..... Side couplings for railway rolling stock.
3817. Silverman, L. ..... Magazine fire arms.
3819. Thompson, W. P..... Spark arresters (*Jessl*).
3827. Longton, F. J..... Flour mills.
3829. Barclay, A. ..... Motor for direct acting pumps.

13th March, 1888.

3831. Bradley, E. ..... Wood slicing machine.
3837. Sleeper, F. H..... Lifting jacks.
3839. Jacobs, J. ..... Railway ties.
3840. Warner, H. G..... Prevention of priming in steam boilers.
3843. Wright & Ferdinand.. Cutting pile fabrics.
3847. Guthrie, H..... Gas engines.
3848. Jardine, J..... Machines for lace making.
3854. Ward, J. F..... Vessels' rams.
3857. Halfpenny & Halfpenny..... Annealing furnaces.
3858. Smith, H..... Metal fencing.
3859. Hall, J. W..... Machinery for cutting metal.
3863. Hannay & Doxford..... Burning liquid fuel in steam boiler furnaces.
3873. Crossland, J. E. ..... Keys in railway chairs.
3876. Henderson & Broadbent ..... Rotary engines.
3877. Willford, G. W..... Railway chairs.
3878. Whitehead, J..... Self acting mules.
3885. Cordingley, I..... Pulleys.
3886. Cooper, J..... Jacquards.
3887. Thompson, W. P..... Boats for saving life at sea (*Ducker*).
3892. Mewburn, J. C. ..... Metallic fencing (*Bère*).
3895. Brown, E. V..... Machinery for working leather.
3900. Jordan, T. R. ..... Apparatus for pulverising ores.
3901. Lake, H. H. ..... Vent plugs for steam radiators (*Waggoner*).
3906. Roberts, S. ..... Injector.
3907. Segschneider, G..... Looms for making cut pile fabrics.
3908. Essers, E..... Double pile fabrics.
3909. Wardle, W. W. ..... Rotary engine.
3910. Hoopes, C. R. ..... Liquid fuel in steam boiler furnaces.
3911. Kinnell & Rothnie..... Automatically regulating the supply of liquid fuel.
3913. Farmer, J..... Rolling round metal bars and tubes.
3914. Edwards, E..... Locomotives for ordinary roads (*Oury*).
3915. Appleby, C. ..... Heating feed water.
3918. Hamilton, H. ..... Apparatus for composing type (*Thorne Machine Co.*).

14th March, 1888.

3922. Tucker & Hatton ..... Manufacture of iron and steel.
3923. McMillan, T..... Ploughs.
3924. Jones, J. E. ..... Portable buildings.
3932. Paterson, D..... Ploughs.
3935. Farrar, J..... Twisting yarns.
3937. Heap, E..... Shaping metals to a cylindrical form.
3939. Matthews & Yates ..... Steam traps.
3946. Sharpe, A. H. B. ..... Tea rolling machines.
3953. Hitchon, A. ..... Mechanism for measuring woven fabrics.
3957. Gilmour, J. ..... Steam boilers.
3959. Owens & Butler..... Transmitting power to a distance.
3961. Mapplebeck, E. ..... Manufacture of twisted metallic tubes.
3963. Holland, W..... Tempering metallic wire.
3964. Gazé, E. H. ..... Gas engines.
3966. Hind, A..... Cut pile fabrics.
3972. Bellotti, S. ..... Grinding and polishing machines.
3973. Lewis, A. D. ..... Life saving boats.
3974. Oxley, T. ..... Flyers and spindles.
3977. Dunbar, A..... Manufacture of barrels.
3984. Gosling, R..... Consuming smoke.

15th March, 1888.

3993. Barry, J. H..... Revolving furnaces.
3997. Lovett, S..... Rotary traverse warp.
3999. Smith, D. ..... Punching & shearing machinery
4005. Ford & Clifford ..... Breech loading fire arms.
4009. Farrar, J..... Twisting yarns.
4011. Fletcher & Cawley ... Fire and burglar proof safes.
4014. Sharman, C..... Armour plates.
4015. Baker, J. M. B..... Removal of sand in rivers.
4018. Rothwell, J. W..... Grid for vertical cotton openers.
4021. Crompton & Cochran... Steam boilers.
4023. Eves, J. V..... Footsteps of spindles.
4027. Urry & Tasker ..... Hauling gear.
4035. Spear, M. H..... Printing machines.
4038. Alexander, A. E. ..... Polished sheet iron (*Craig*).
4042. Beaurain-Vautherin, C. Crucibles.

ELECTRICITY.

9th March, 1888.

15878. Popp, V. ..... Measuring the time during which a current of electricity is flowing. (This application having been originally included in No. 15878, dated 18th November, 1887, takes, under Patents Rule 23, that date.)
3670. Siemens, A. ..... Volt indicator.
3678. Olpherts, W. G..... Electrical signalling on railways.
3685. Sharp, S., & others ..... Electrical switches.

10th March, 1888.

3690. Dunn, E. ..... Railway electrical signalling apparatus.
3710. Tweeddale, J..... Electromagnetic motors.
3714. Cockburn & Day..... Electric fittings.
3740. Bernstein, A. ..... Cut-out and switch.
3766. Baldwin, G. J..... Collectors for dynamo-electric machines.

12th March, 1888.

3812. Berry & Franke..... Electrical glow lamps.

13th March, 1888.

3835. Copeland, H. P. ..... Telegraphic apparatus.
3841. Laurie, T..... Telephonic apparatus.
3883. Boult, A. J. ..... Electrical devices for type writers (*McLaughlin*).

14th March, 1888.

3921. Parker, T., & others ... Indicating, measuring, and controlling electrical currents.
3929. Parker, T., & others ... Dynamo-electric machines.
3968. King, J. W. ..... Regulation of arc lamps.
3981. Hopkinson, E. ..... Electrically propelled vehicles.
3986. Drake & Gorham ..... Secondary batteries.

15th March, 1888.

3995. Lake, H. H. ..... Galvanic batteries (*Walter*).
3998. Horsfield & Porter ... Electrical indicator for the locking apparatus connected with railway points
4008. Ullathorne & Gauzentes..... Electric batteries.
4017. Dorman, G. E. ..... Electric arc lamps

CHEMISTRY.

9th March, 1888.

3660. Howarth & Graham ... Calcination of cupreous ores.
3661. Browne, A. ..... Separating the tin from scrap.
3668. Clark, A. M. ..... Manufacturing soda and hydrochloric acid (*Daguin*).
3669. Clark, A. M. ..... Manufacture of sulphuric acid and hydrochloric acid (*Daguin*).

10th March, 1888.

3741. Appleby, C. ..... Ore concentrating machinery (*Rankin, Brayton, & Co.*)

12th March, 1888.

3793. Johnson, J. Y..... Metallic alloys (*Société Anonyme Le Ferro-Nickel*).
3802. Tack & Girard ..... Manufacture of coke.
3823. Butterfield, J. C..... Extraction of metals from ores.

13th March, 1888.

3880. Ellice-Clark & Chapman ..... Obtaining oxygen and nitrogen from air.

14th March, 1888.

3920. Thornton, J. ..... Coating iron with tin.
3926. Wolf, G. de..... Extracting gold from ores.
3949. Justice, P. M. ..... Hydrochlorate of quinine (*Weld*).
3965. Jordan, T. R. ..... Extraction of metals from ores.
3967. Brin, A. ..... Extraction of oxygen and nitrogen from the air.

15th March, 1888.

4034. Taylor & Struvé ..... Coating with tin, lead, or other metals.

MISCELLANEOUS.

9th March, 1888.

3624. Thompson, W. J..... Inside tappet for loom.
3632. Smith & Thomas..... Bobbin frame.
3636. Allen, A. H. ..... Filters.
3639. Rutherford & Fort... Washing barrels.
3662. Didier, J. L..... Cartridges.
3671. Halstead, C. ..... Coverings for rollers.
3673. Rowatt, J. M. ..... Lamp burners.
3674. Lighbody, W. ..... Lamp burners.
3675. Walker, J. ..... Piston and gland packing.
3676. Walker, J. ..... Lubricators.
3680. Pugh, D. ..... Sanitary traps.
3682. Scott, R. ..... Manufacture of corks.
3683. Oriolle, P..... Fire extinguisher.

10th March, 1888.

3702. Anderson, H. ..... Gas regulators.
3716. Ibbotson, E. C..... Lock nuts.
3718. Klauke, C..... Barbed wire for fencing purposes.
3719. Schaefer & Stolberg Horseshoes.
3720. Bunting, S..... Apparatus for filling bottles.
3725. Blakey, J. W. ..... Paring the edges of soles & heels.
3733. Taylor, E. K. ..... Tricycles.
3736. Mills, B. J. B..... Oil lamps (*Weisensee*).
3738. Dean & Groves ..... Padlocks.
3743. Garrard, G. M. ..... Roofing tiles.
3750. Bouverie & Balch ..... Firing signals.
3754. Valentin, B. W. ..... Brewing.
3759. Kubin & Siersch..... Explosives for use in mines.

12th March, 1888.

3768. Gould, H. I..... Lamp burners.
3772. Barclay, J..... Drain pipes.
3774. Wade, J. L. ..... Solidified oil for lubrication.
3777. Wisken, H. ..... Horseshoes.
3778. Rose, G..... Lamps.
3781. Stead, T. W..... Clip employed in machines for stretching woven fabrics.
3783. Williams, S. R..... Oil lamps.
3784. Gibbons, F. J. J..... Locks and latches.
3787. Pearce & Beardsley... Manufacture of paper.
3795. Coninck, F. de..... Incombustible paint.
3797. Shone & Ault..... System of sewerage.
3803. Haddan, H. J. ..... Sliding cocks (*Emery*).
3816. Hainsworth, F. ..... Wire fabric for mattresses.
3822. Moss, J..... Miners' lamps.
3828. Davey, J. ..... Syphons.

13th March, 1888.

3830. Pitt & Van Vleck ..... Distilling petroleum.
3832. Schnell, J. F. ..... Lamp.
3836. Godwin & Hamilton... Protecting wooden picking sticks by a metallic shield.
3838. Brown, A. O..... Regenerative gas lamps.
3844. Bullus, G..... Wheel for iron or rubber tyres.
3865. Varley, F. H., & others. Lamps.
3868. Stevens, B. F. ..... Hose nozzle (*Brentano*).
3870. Wing, J..... Ships' fittings.
3872. Russell, R. J. ..... Bicycles.
3888. Boult, A. J. ..... Door hinges (*Timmel*).
3893. Thomas, G. ..... Hasp locks.
3902. Rogers, G. F. ..... Testing explosives (*Von Ruckteschell*).
3917. Auton, R. ..... Briquettes of compressed fuel.
3919. Neate, P. J. ..... Rotary sieves.

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14th March, 1888.

3936. Noar, F. C. ..... Cinder sifter.
3942-3. Cherrill & Schlichter..... Incandescent gas lamps.
3950. Anton, R. ..... Briquettes of compressed fuel.
3956. Dean, J..... Lubricators.
3976. Leigh, H. H. ..... Heating liquids to be treated in centrifugal separators (*Bernström*).
3980. Kreiss, E..... Dust collectors.
3989. Dresser, C. L..... Explosive projectiles.
3990. Everitt, R. ..... Drying sugar (*Taylor & Lawson*).

15th March, 1888.

4010. Farrar, J. W., & others Automatic fog signal.
4026. Venimore, T. A. ..... Taps.
4033. Dimmack, A. ..... Slip bolts.
4040. Brewster, P. C. ..... Lamps (*Ehlis*).
4041. Allen, F. J. B..... Extinguishing devices for lamps.
4045. Vogt, A..... Washers and nuts.
4046. Vogt, A..... Locking nuts.
4053. Macer, R..... Setting screws.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

17th March, 1888.

3656. Sage, F..... Frame work fences.
3660. Redfern, G. F..... Fluid pressure motor (*Fouquemberg*).
3662. Baxter, W. ..... Finishing textile fabrics.
3689. Beck, W. H. ..... Surfacing cylindrical glasses (*Benoist et Berthiot*).
3744. Richardson & Rowland Valve gear.
3769. Smith, T. ..... Preventing over-winding of engines.
4131. Ross & Bilbie ..... Boot and shoe machinery.
4156. Schofield, I. C. ..... Winding the yarn on to the spindles of mules.
4659. Maynes & Watchurst Steam engines.
5013. Teideman, G. ..... Liquid meters.
5271. Dallas, J. D..... Apparatus for setting up type.
5389. Lake, H. H. ..... Knitting machines (*Boessneck*).
5710. Armstrong, J..... Manufacture of rolled glass.
6136. Smith, E. ..... Automatic motion for stopping the loom when the warp thread breaks.
6240. Cranston, W. M..... Mowing machines (*The Walter A. Wood Mowing and Reaping Machine Co.*).
6586. Ashworth & Ashworth Carding engine.
6773. Buchanan, J. ..... Indicators for steam engines.
6854. Johnson, J. Y..... Disappearing gun mountings (*La Société Schneider et Cie*).
6857. Caillé, J. C..... Permanent way of railways.
6865. Hipkins, T. ..... Steam boilers.
6889. White & Carson..... Boiler furnaces.
6901. Ashworth & Ashworth Apparatus for forming laps of cotton.
6922. Nordenfelt, T. ..... Gun mountings.
6932. Fielding, J..... Mounting and working turret guns.
6934. Longridge, J. A..... Utilising the recoil of guns.
6945. Bird, G..... Paper making machines.
6999. Sykes, G. D..... Looms.
7003. Booth, J. ..... Machinery for "raising" cloths.
7050. Johnston, W. S. ..... Scutching fibrous plants.
7071. Birchall, J..... Steam generator heated by gas.
7081. Garvie, J..... Excavators.
7195. Nordenfelt, T. ..... Breech mechanism for ordnance.
7604. Lawson & Dear ..... Spinning machinery.
7845. McLaine, L..... Flax spinning machinery.
7941. Ash, E. T..... Punching holes in metal.
8502. Hen, L. ..... Manufacturing barbed wire.
11578. Shepheard & Holman.. Adjusting guns to the proper angle of elevation.
15326. Bordone, J. P..... Steam boilers.
16735. Bosley & Dickson ..... Pulley.
17182. Lancaster, C. W..... Doubling and twisting yarn.
793. Webster, G. T. ..... Mitre planing machine.
801. Smith & Smith..... Twist lace fabrics.
1061. Thompson, W. P..... Valves (*Barnett Brass Co.*).
1467. Marshall, C. A. ..... Seamless tubes.
1501. Morrin, T. F. ..... Steam generators.
2074. Hollingworth, E. ..... Jacquard mechanism of looms (*Hutchins*).
2123. Dietz, H. ..... Pneumatic separator for granulated materials.
2143. Hollingworth, E. ..... Jacquard mechanism in looms.
2175. Justice, P. M. ..... Spinning machines (*Metcalf*).
2216. Moyer & Youlls..... Car axle boxes.
2249. Tuck, N. L..... Block printing machines.
2300. Marchetti & Mellor... Manufacture of a new kind of pile fabric.

ELECTRICITY.

17th March, 1888.

16273. Desroziers, E..... Dynamo-electric machinery.
4545. Abel, C. D..... Electrical measuring apparatus (*Siemens & Halske*).
4714. Amoric, F. A. ..... Electrical signal bell apparatus.
5186. Trotter & Goolden ... Dynamo-electric machines.
6409. Crompton & Kyle ..... Dynamo-electric machines and motors.
6681. Crompton, R. E. B..... Secondary batteries.
7317. Kynoch & Habgood ... Secondary batteries.
8262. Mordey, W. M. ..... Electric generators.

CHEMISTRY.

17th March, 1888.

3669. Schultze, C. B. ..... Recovery of tin from tinned iron plate.
5953. Kern, A. ..... Methylic ether of gallic acid.
6718. Grimshaw & Kenyon... Zinc sulphide.
7047. Vivian, A. P. ..... Metallic alloys.
7139. Edwards, D., & others.. Coating metal plates with tin.
2019. Perino, J..... Disintegrating copper pyrites.
2071. Lake, H. H. ..... Separation of metals (*Hayden*).

MISCELLANEOUS.

17th March, 1888.

3707. Postlethwaite, C. E.... Petroleum lamps.
5264. Smith & Hicking. ..... Velocipedes.
5513. Arper, G. W..... Syphons.
6255. Harrison, F. A. ..... Bolts and nuts.
6368. Reaney, A. ..... Projectiles.
6568. Mewburn, J. C. ..... Lamps (*Cambéssèdes*).
6704. Zohrab, E. ..... Treatment of peat.
6727. Beldam, A. ..... Valves.
6916. Baker & Barton..... Miners' safety lamps.
8301. Braithwaite & Braithwaite..... Gas burners.
15387. Flint, J. G. ..... Stop cocks.
15446. Hattersley, T. K. ..... Adjustable bearings for spindles.
17797. Roberts, L., & others... Spiral springs.
883. Adams, S. H..... Ventilating sewers.
935. Turner, S. ..... Roof tile.
1138. Rankin, A. N. ..... Cold packed pipe joints.
1274. Settle, T..... Relieving gas retorts from pressure.
1402. Paterson, J..... Testing the fairness of steam engine crank shafts.
1428. Allison, H. J. ..... Nuts (*Stout & Underwood*).
2050. Lawrence, J. P. ..... Refrigerating apparatus (*Biddle*)
2113. Lane, J..... Heating fluids.
2117. Carson, J..... Seeding machine.
2164. Wimpey, G. ..... Joint for water pipes.
2221. Megill, E. L..... Gauge pin for printing presses.
2373. Stern, W..... Gas lamps.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(*To the 10th December, 1887, inclusive*).

Year 1883.

5624-5. Divine, S. R..... Explosive compounds.
5626. Roos, S..... An electro-telegraphic system.
5628. Johnson, J. H..... Salicylic acid (*Leupold*).
5629. Tolson, G., & another... Opening rags, &c.
5636. Wilcox, S..... Hot air engines.
5637. Clark, A. M..... A woven fabric (*Urbahn & ano*).
5641. Martin, J. H. C. ..... Decorticating grain, &c.
5642. Lake, W. R. ..... Mining coal (*Asper*).
5645. Kilbourn, J. K., & ano. Steering apparatus.
5647. Leeming, H..... Sewing machines.
5648. White, J., & another ... Velocipedes.
5650. Hall, R., & another..... Wood paving.
5652. Thompson, W. P..... Roller mills (*Dowling*).
5658. Thompson, W. P..... Protecting foundations below water level, &c. (*Paponot*).
5667. Hosmer, H. G..... Motive power engines.
5668. Nawrocki, G. W. von... Electric apparatus for fog signals (*Dreyse & another*).
5670. Lake, W. R. ..... Dyeing vegetable and animal substances (*Crébassa & another*).
5684. Telschow, A. J. F. G.... Rope.
5688. Haddan, H. J. ..... A pump (*Reis*).
5689. Daltry, T. L. ..... Looms for weaving.
5690. Lake, H. H. ..... Toggle presses (*Meatyard*).
5692. Lake, H. H. ..... Type writing machines (*Young*).
5693. Lake, H. H. ..... Steam hammers (*Meatyard*).

Year 1882.

5840. Denne, T. J..... Sewing machines.
5846. Morris, C. W. ..... Rowlocks.
5880. Paterson, H. C. ..... Consuming smoke, &c.
5885. Schonheyder, W. A. G. Controlling discharge of water, &c.

Year 1881.

5309. Fleming, J. A..... Electric insulation.
5371. Bissett, J..... Furnaces.

Year 1880.

5093. Cooke, W., & another... Screw propellers.
5094. Justice, P. M. ..... Preparation of vegetable fibres (*Stephens*).
5097. Wright, D. P. ..... Hydrocarbon lamps.
5133. Lake, W. R. ..... Hoisting apparatus (*Johnson*).
5134. Wilkins, F. ..... Producing light and heat.
5142. Dixon, W., & another... Bobbins.
5152. Pitt, S. ..... Electric drills (*Ball*).
5156. Chamberlain, A. P..... Gas.
5168. Ellinor, G. ..... Refining of iron and steel.
5171. Lake, W. R. ..... Railway vehicles (*Chisholm*).
5173. Bolton, F. J., & another Artificial manures.

Year 1879.

5040. Hardy, T., & another... Binding grain, &c.

Year 1877.

4674. Oram, W., & another ... Hydraulic presses, &c.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Rotary Engine.—*J. M. Ross & J. McDowall, Glasgow.*—In the accompanying diagrams Fig. 1 represents a longitudinal vertical section, and Fig. 2 an end section of the improved form of rotary engine. The hollow shaft B is supported on bearings X, and passes through the cylindrical casing A. The ports for admission and exhaust of steam are shown at H H¹. The cylindrical boss C is mounted eccentrically upon the shaft B, and is provided with inlet and exhaust ports. A cylindrical ring D is fixed to the main casing A, concentrically with the boss C, and between the boss and the ring is a series of segmental pistons E, filling up the steam space within D, and fixed to the casing A by means of bolts F. As the distance of the pistons from the axis of A varies according to their position around the eccentric boss C, their distance apart also varies, those pistons bearing on the

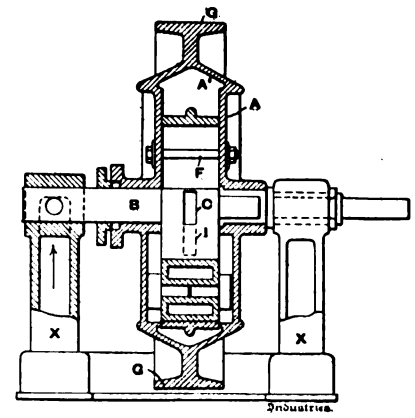


Fig. 1.

portion of the boss with least eccentricity being close together, and those on the opposite side of the boss being furthest apart. When the pistons travel round the eccentric boss, their velocity is therefore greatest at the point of greatest eccentricity; the two ports are formed to admit the steam between each pair of pistons as they pass the point of least eccentricity, and to exhaust when they pass the line of greatest eccentricity. The steam may, however, be cut off at any desired point, and allowed to expand, while the piston in front of it is impelled forward at a greater relative velocity than that following it. Each succeeding piston is acted on in like manner, and a continuous motion of rotation is thus imparted to the outer casing A. The inner casing D is free to rotate with it, and slides to accommodate itself to the radial sliding movement of the pistons relatively with the axis of the casing. The central shaft B is held

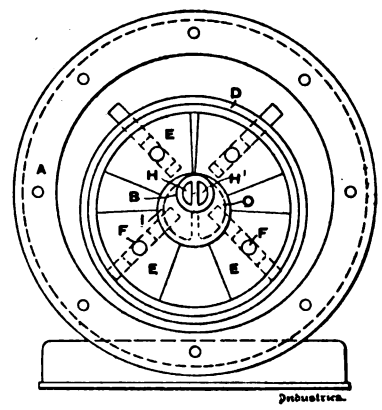


Fig. 2.

stationary, whilst the case A is formed with a driving wheel round its circumference. The speed and power depend on the degree of eccentricity of the boss, as well as on the area presented to the steam. By fitting the parts so that the eccentricity may be varied, the speed and power may be regulated at will. This adjustment is effected by the end of the hollow shaft B forming a valve in the bracket, with suitable ports, so that steam is cut off or admitted in accordance with the motion of the shaft. The engine is reversed by turning the shaft B, so that the inlet becomes the exhaust port. There are two modifications in the construction of the engine described in the specification. Three claims are made.—No. 4403. March 24th, 1887. 8*d.*

Steam Engines.—*P. Haddan, London.* (*Dake Engine Manufacturing Company, Grand Haven, Michigan, U.S.A.*)—This engine has two rectangular pistons which act as their own valves. An outer rectangular shell encloses a cubical piston, inside which the second piston slides in a direction at right angles to the first one. The inner piston has two separate internal steam chambers. There are no valves worked by special gear, but a series of ports are so arranged in the two pistons that they act as their own admission and exhaust valves. The inventor makes four claims for this construction, and for the arrangements of the ports and passages.—No. 6679. May 6th, 1887. 8*d.*

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VALVE GEAR.—*H. H. Lake, London.* (*K. Knott & F. Knott, Chicago, U.S.A.*)—A movable plate, with two sets of ports in it, acts in combination with two sets of ports in the cylinder, and with two slide valves attached to a common rod and operated by a single eccentric. In the accompanying drawings Fig. 1 is a longitudinal central section of an engine cylinder and steam chest, showing the movable or "dead" plate at one end of its movement. Fig. 2 is a similar view, showing the dead plate at the other end of its stroke. The exhaust port L communicates with the end I of the cylinder A through the passage N, and the steam port C also communicates with the same end. The ports D O communicate with the end J of the cylinder, and the exhaust ports E Q are connected with the exhaust pipe by means of the passage R. The dead plate F lies between the cylinder and the slide valve, and is provided with two sets of ports 1 2 3 and 4 5 6 corresponding to the cylinder ports C E D and L Q O respectively. The two slide valves G T are united and are operated by the stem V. The ports in the plate F are not placed at the same distance apart as the cylinder ports are, and therefore the communication between the steam chest and the cylinder will only be established through one set of ports at a time. In Fig. 1 the ports C E D are shown covered by the dead plate, while the ports L Q O are open. In this case the steam is distributed by the slide valve T through the passages 4 5 6. By shifting the dead plate F by means of the rod S communication may be established between the steam chest and the cylinder

FIG. 1.

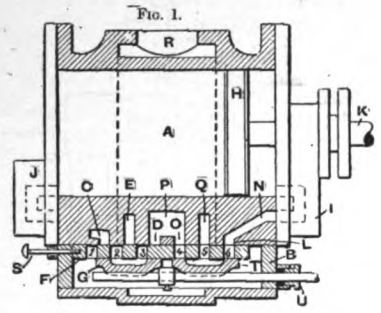
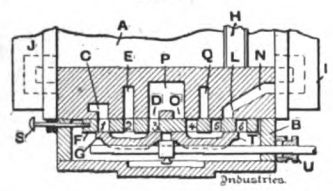


FIG. 2.



through the set of ports C D E, while L Q O are covered by F. The slide valve is so arranged relatively to the ports which they cover, that when the course pursued by the steam is altered from one set of ports to the other, the engine shall be reversed in direction. Several modifications are described for carrying out this invention and in applying it to different types of engines. In order to give the valve the required amount of lead in the two directions of revolution, the eccentric is mounted loosely upon the crank shaft, and upon one side of it a small auxiliary eccentric is arranged. A driving block, having an opening adapted to receive the small eccentric, is keyed to the driving shaft at right angles to the crank. The throw of the small eccentric corresponds to the required lead, so that its rotation in either direction will shift the valve eccentric relatively to the driving block. To give an automatic action to the small eccentric a lever is attached to it, which impinges upon a stud on one of the straps of the valve eccentric. When the reversal takes place the lever will strike the abutment and cause it to turn through 180°, thereby causing the required movement of the valve eccentric. The inventors make nine claims for slide valve and dead plate arrangement, and for the eccentric gear.—No. 988. January 21st, 1887. 11*d*.

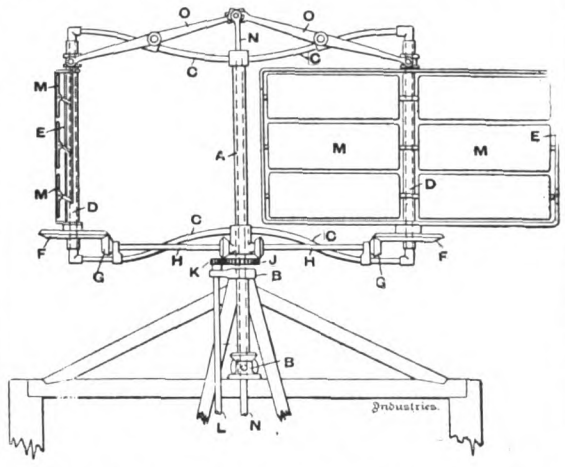
HYDRAULIC LIFTS.—*W. R. Green, London.*—The means of communicating the motion of the lifting ram to the lifting chains in a suspended hydraulic lift is improved and re-arranged by the present inventor. The sheaves forming the multiplying power have hitherto been carried by a cross head fixed to the ram. According to the present arrangement the cylinder is inverted, so that the ram works downwards. Two or more vertical rods are attached to the end of the ram, and pass upwards through guides attached to the cylinder. These rods are continued upwards, and are fastened to a cross head carrying the pulley sheaves. The usual heavy cast iron cross head can thus be dispensed with, and the pulleys may be made of an increased size in consequence. The extra foundations for the guides are not necessary, as these are carried entirely by the cylinder. The inventor claims the employment of two or more side rods to convey the motion of the ram to the pulley sheaves, passing through guides attached to the cylinder.—No. 5520. April 15th, 1887. 8*d*.

RETIRING BEARINGS FOR TRAVELLING CRANES, &C.—*W. Craven, Manchester.*—At the point in the length of the side shaft of the crane where the retiring bearing is required a bracket is fixed in position to any stationary part of the machine. The retiring bearing is supported in a vertical groove in this bracket. A crank pin fixed to a crank and short shaft slides in a horizontal slot in the retiring bearing, and controls the motion of the bearing in the vertical groove. A series of teeth are fixed to the circumference of a wheel attached to the short shaft before mentioned, and are intended to gear with a toothed rack on the carrier. The bearing is lowered from its normal position for the passage of the carrier by the teeth of the rack causing the crank pin to be depressed, and a second rack on the carrier effects the raising of the bearings after its passage in a similar way. The inventor makes two claims.—No. 18. January 2nd, 1888. 6*d*.

WATER MOTORS.—*S. S. Allin, London.*—By this invention certain improvements are introduced into the construction of the motor described in Patent No. 11994 of 1885, granted to the same inventor. The object is to cause the floats to feather mechanically and without any motion relative to the links to which they are connected. The pins passing through the eyes of the links are made to project inwards through those links for a sufficient distance to support brackets opposite each other. These brackets are provided with holes for the entrance of the link pins, so that when they are in place they are supported in positions parallel to the links. The lower extremity of each bracket terminates in a foot at the forward end of its link, and braces of channel iron extend from the bracket on one chain to that on the other, and are secured firmly to both. The pair of brackets and the braces form a rigid cradle which carries the float. In small motors the cradles may consist of a pair of links of the chains, and braces extending from one to the other may be secured to projections on the links. The inventor makes three claims.—No. 5145. April 6th, 1887. 8*d*.

ROLLING MILLS.—*W. F. Cochrane, Cambridge, Indiana, U.S.A.*—The improvements embodied in this invention relate to a new construction of the frame of the machine, and to a new method of communicating motion to the driving shafts. The sectional frame consists of two duplicate side pieces, and of tubular cross bars and through rods which connect the side pieces. The side bars are slotted for the reception of the adjustable bearings of the rolls, and are provided with a recess at the end to receive the disc of the relief mechanism. The detachable pulley frame is composed of end plates and upper and lower divided side bars bolted together. Hangers are held adjustably between the sections of the upper side bars, and links pivoted to the lower side bars carry the frame for a tightener pulley. Parallel driving shafts each pass longitudinally through one series of adjustable rolls, and pulleys are mounted upon these shafts; the tightener pulley is placed between the shafts, and the driving belt passes beneath the tightener pulley, over the front and beneath the rear driving pulleys. Fifteen claims are made.—No. 15239. November 8th, 1887. 8*d*.

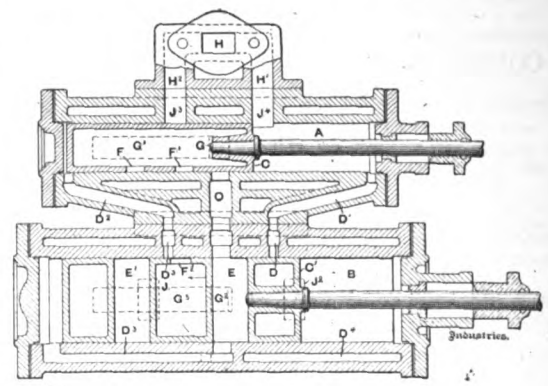
WIND MILLS.—*C. Hawkins, London.*—The object of this invention is to make the sails of a wind mill adjust themselves continuously to receive the force of the wind. Rectangular sails are employed which present their surface in the most favourable way as they revolve round a vertical or horizontal axis. When the sail is moving directly towards the wind the edge is presented to it, and when moving with the wind the surface is at right angles with its direction. In the accompanying illustration one method of carrying out this idea is represented. The hollow vertical axle A is supported in bearings B; the arms C are attached to it in pairs. Across the ends of each pair of arms is fixed the rod D, which ties the arms firmly together, and upon each of these rods is pivoted a rectangular sail E. A toothed bevel wheel F is attached to each sail, and gears with a pinion G on the horizontal shaft H. Another pinion I on the shaft H gears into a wheel J concentric with but loose upon the axle A. This wheel J is the adjusting



wheel, and according to the position in which it is set so will the sails adjust themselves relatively to the wind. On the lower part of J the spur teeth are cast, which gear with a pinion K on the shaft L. The relative sizes of the wheels are arranged so that the sails shall revolve on the rods D through half a revolution and in a contrary direction to the main axle, while the latter turns through a complete revolution. The wheel F is double the diameter of J. Each sail carries hinged louvre boards M, which are opened and closed by the levers O and N in order to regulate the power supplied to the machine. The inventor makes three claims for the apparatus which effects the continuous adjustment of the sails.—No. 2953. February 25th, 1887. 8*d*.

VALVE GEAR.—*R. W. Mewes, Blackhill, Durham.*—The usual reversing lever is entirely dispensed with, and the valve gear is worked from the regulator handle instead. When this invention is applied to a locomotive, a slot link is provided for working the slide valve, and adjusting screws vary its travel, so as to cut off at any part of the stroke. The regulator handle being at the centre may be moved to the right or left, giving forward or backward motion by means of a slide, which admits the steam to one end or the other of the reversing cylinder. This cylinder moves the slot link one way or the other as desired. There is also a crank on the spindle of the operating handle for actuating the valve for the admission of steam to the main cylinders, so that the first motion of the handle, one way or the other, moves the valve in a direction so as to reverse the engine. Afterwards, on the continuation of the motion of the handle, the throttle valve is opened to an extent depending on the amount of travel of the handle. The reversing cylinder and the main cylinders are supplied with steam through separate pipes. Four claims are made.—No. 5598. April 18th, 1887. 8*d*.

STEAM ENGINES.—*C. D. Abel, London.* (*J. C. Grabner, Kupferhammer, and C. Ruperti, Brackwede, Germany.*—According to this invention, the steam is admitted to both sides of the piston by means of specially constructed passages and ports in the cylinder and piston, and the slide valve arrangement is entirely dispensed with. The application of this method to a compound engine is seen in section in the accompanying drawing. A is the high pressure cylinder, and B the low pressure one. The pistons C C¹ are made hollow; C¹ is provided with a longitudinal slot G¹ and ports F F¹, while C is formed with a slot G³, port F², and cross passages E E¹. The pistons act as each other's slide valves. In the position of the pistons shown in the drawing, the piston C¹ has still part of its stroke to travel through, while C is at the commencement of its forward stroke. The steam enters the cylinder B through the port G², and passes through G³ to the interior of the piston C¹. Thence it escapes through F², along the passage D², to the back of the piston C. The exhaust of the steam at the front of the piston C takes place through the passage J⁴, whence it goes along the tube H and enters the piston C through the port G and slot G¹. When the port F¹ comes opposite O, the steam escapes, and



travels across the piston C¹, through the passage E¹, along the pipe D³, to the back of the piston C¹. After performing its work there, it escapes to the atmosphere through the ports J¹. When the piston C is at its dead centre position at the right end, the piston C¹ has still a part of its stroke to travel. The steam passes through F² D D¹, and drives C to the left. The same series of operations takes place with respect to the exhaust steam from the back end of the cylinder A as with the steam at the back of the piston, but it comes through J³ H F O¹ E¹ D⁴ J². There are also single cylindered engines described in this specification, whose pistons act as their own slide valves. The steam enters through a port in the cylinder, and passes through a slot into the interior of the piston. There are ports at each end of the piston, and the ends of the cylindrical part of the cylinders are broadened, so as to allow the steam to escape through the ports to the back of the piston. The exhaust also takes place through a port in the side of the cylinder. Six claims are made.—No. 6238. April 28th, 1887. 11*d*.

SUGAR CANE MILLS.—*J. Thomson, Edinburgh, and J. Black, Kirkaldy.*—By this invention certain improvements are introduced into the construction of the apparatus described in the specification of Patent No. 2586 of 1882. In the apparatus there referred to the same inventors made use of two rollers for the purpose of subjecting the cane to a preparatory splitting and crushing action, with a view of bringing it into a condition to be more completely acted on by the three ordinary rolls. The object of this present invention is to improve the action of these two additional rolls, by constructing them in such a manner that they shall not only split the canes, but shall also break them transversely. With this object the two rollers are made with rounded flutes, and are geared together so that the raised parts of one roll may enter the depressed parts of the other. Angular grooves are also made in the rolls for effecting the splitting operation, and run at right angles to the flutes, or are inclined to them. These rolls may be either combined in one framing with the three others, or they may be mounted in a separate frame; in the latter case they may be easily added to existing three-roll mills. The inventors make one claim for the combined flutings with the transverse grooves.—No. 5660. April 19th, 1887. 8*d*.

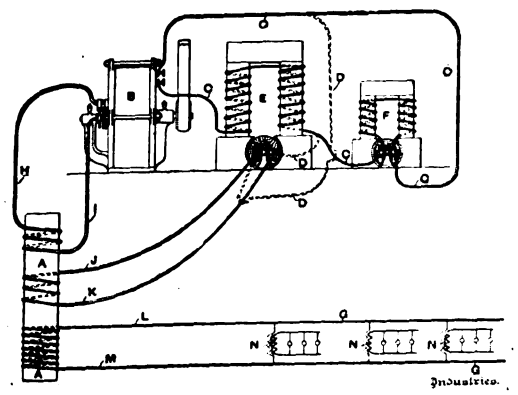
KNITTING MACHINERY.—*H. J. M. Mellor, Nottingham.*—This invention relates to certain improvements in the machinery employed in knitting jerseys. A cylindrical needle head carries latch needles all round it, which can be moved up and down by cams carried by a ring surrounding the exterior of the cylinder. The ring also carries a third ring, upon which the thread guides are mounted; and there are as many sets of cams for raising and lowering the needles as there are yarn guides. The cam ring oscillates round the cylinder, and the ring with the yarn guides is carried round by friction with the cam ring; but it is arrested by stops when the requisite travel has been made. This travel is slightly greater than the distance between the yarn guides, and a slightly greater travel is given to the cam ring, in order to allow a lead for the yarn. Mechanism is provided for lifting the needles out of work, in order to prevent the loops of old work being knocked off when no new thread has been laid on them. Vertical stripes may be produced in this way, and where the stripes meet the work is formed on each needle. One needle at the meeting of the stripes has work formed on it alternately, first with thread from the thread layer used for forming one stripe, and then at the next course with thread from the thread layer used for forming the adjoining stripe. The stripes of work overlap one another on one or more needles where the stripes meet. There may be as many stripes formed in the work as there are thread layers. All the cams carried by the oscillating ring are made to act upon two opposite arms of levers which are coupled to the needle stems at one end. Three claims are made.—No. 3734. March 11th, 1887. 11*d*.

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ELECTRICITY.

PREVENTION OF INCRUSTATION IN BOILERS.—*A. J. Marquand, Cardiff.*—The inventor makes use of electricity in order to prevent the incrustation and corrosion of steam boilers, and for removing it when already formed. The terminal of an electric generator, corresponding with the zinc plate of the battery, is electrically connected with the shell of the boiler, while the other terminal is connected to the conductor, which passes through the shell into the water space. The current used is a continuous one, and its direction is the opposite to that of all similar apparatus previously designed. The inventor makes three claims for the method and for the apparatus employed.—No. 8396. June 10th, 1887. 8*d.*

ELECTRICAL TRANSFORMER.—*R. Dick & R. Kennedy, Glasgow.*—The reversal of magnetism in the cores of transformers consumes the energy by converting it into heat. To obviate this loss the present inventors construct the machine so that no reversals of magnetism are necessary. The transformers are wound with primary and secondary circuits for the alternating currents in the usual manner, and a third circuit for the circulation of an independent continuous current is employed for initially magnetising the core of the transformer. This third circuit may be wound side by side, either over, under, or between the two other circuits. The continuous current may be supplied by a continuous current dynamo, or by a shunt from the generator



which excites the field magnets. The accompanying diagram represents a general view of the application of this invention to a practical system of electrical distribution. B is the alternating dynamo, E the continuous current dynamo, and F a small separate continuous current dynamo, which excites the field magnets of both B and E, through the wire C. Round the main transformer A is coiled the primary wire circuit H I, from the commutator brushes of the alternating dynamo B. The secondary wire L M supplies alternating currents, induced by the wire H I, to the secondary generators and glow lamps N arranged in parallel arc at G. The third circuit is shown at J K, and is wound round the main transformer A; a continuous current passes through it from the commutator brushes of the dynamo E. The dotted lines D indicate how the field magnets of B can be excited by a current from the continuous dynamo E, and the third circuit supplied with a continuous current as a shunt from the commutator brushes of E. The dynamo F is not required under the latter arrangement. The inventors make three claims for the combination of a transformer with primary and secondary conductors of alternating currents, with a third conductor of continuous currents as described, for the purpose of obviating the reversal of magnetism in the core of the transformer.—No. 3658. March 10th, 1887. 8*d.*

DYNAMOS.—*G. Kapp, London.*—This invention consists of improvements in continuous current dynamos, and is applicable to those which have drum or disc armatures. In machines of the latter type the core of the armature is preferably constructed partly of soft iron wire and partly of soft iron tape. The tape is comparatively narrow; two tapes are coiled to form the end faces of the core, and the iron wire is coiled into the annular trough thus formed. The object of employing narrow tapes and iron wire is to facilitate the penetration of the core without undue heating by magnetic lines of force in other directions than those which are parallel to the axis of rotation. The magnetic field may be either bipolar or multipolar; but in all cases the magnetic system is split up into two portions, one of which is excited by coils in series and traversed by the armature current. This portion of the system may be called the "normal field," and the second portion may be called the "auxiliary field." The pole pieces of the auxiliary field are arranged a certain distance in advance of the pole pieces of the normal field, so that each individual wire on the armature, after passing the neutral zone, comes under the influence of the normal pole piece before it is influenced by the auxiliary pole piece of the same polarity. The reversal of the current in the wires passing under the brushes takes place when the normal field only is active, and thus any variations in the strength of the auxiliary field do not materially affect the best positions of the brushes for the sparkless collection of the current. Two armatures may be employed instead of one, and may be mounted on the same spindle; one armature will revolve in the normal field, and the other in the auxiliary field. For purposes of regulation the inventor varies the exciting current in the auxiliary field. This may be done by hand, or by the following arrangement in cases where the resistance and speed are variable. The armature, normal field, auxiliary field, and external circuit are all coupled in series. If the auxiliary field is of the single horseshoe type, a shunt rheostat is placed across the terminals of the exciting circuit. If the field is of the double horseshoe type, the rheostat may be arranged as a shunt in the exciting circuit of one horseshoe only. The contact pieces are grouped round an insulating cylinder in a similar manner to the sections of the commutator of a continuous current dynamo. A brush capable of rotation round this commutator serves as the movable contact, and according to its position, which is controlled by a solenoid, the amount of current passing through the rheostat and the exciting circuit of the auxiliary field may be varied. The solenoid is in circuit with the main current, and is counterbalanced by an adjustable weight. Nine claims are made for the construction of the dynamo and for the governor.—No. 5096. April 5th, 1887. 8*d.*

DYNAMOS.—*W. Main, Brooklyn, New York.*—The invention here described is one of several modifications explained in the specification. Fig. 1 represents a vertical section of the machine in the plane of its rotation, and Fig. 2 gives a front view partly in section. The field magnet F consists of a core B, surrounded by the exciting coil E. The tube B is confined between the polar discs L^1, which are formed with eight radiating pole pieces L. The field magnet and its coil are

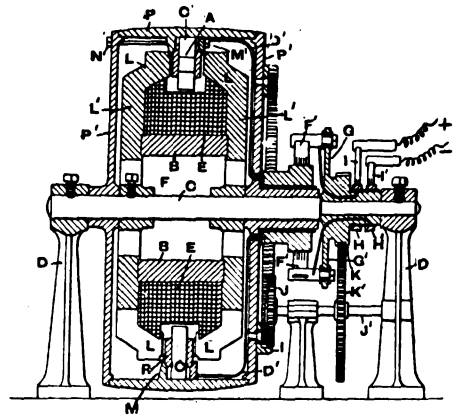


FIG. 1.

held stationary, and are fastened to the shaft C. The armature A revolves, and is mounted on the shell P, which serves also as a pulley for carrying the driving belt. The fixed flange M and the ring M^1 hold the armature between them. The armature has sixteen coils, while the field magnet has nine pole pieces. If the armature were stationary, and the pole pieces revolved, the neutral line in the armature would revolve forward with nine times the rapidity of the poles. But as in this machine the armature revolves forward while the field magnet is stationary, the neutral line revolves backwards with eight times the velocity of the armature. This may be accomplished by means of stationary commutator brushes and a commutator of nine successive series of sixteen segments in each. In the machine shown in the drawings the same effect is obtained by rotating the commutator brushes backward at a speed of eight revolutions while the armature and commutator segments are revolving forward through one revolution. The commutator segments E^1 are carried on the hub of one of the discs P^1, attached to which is an internal gear I. A pinion J on a shaft J^1 transmits the motion through K^1 to K, which turns freely in the stationary shaft C. The proportions of the various parts of this gear are such that the rotation of I in one direction causes a rotation of K at eight times the velocity in the contrary direction. Attached

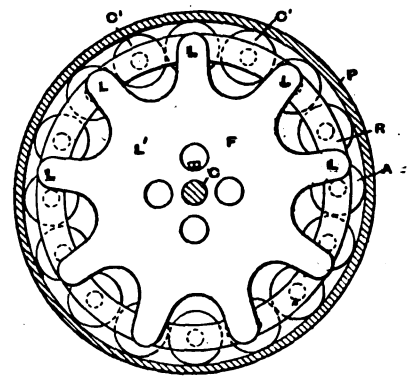


FIG. 2.

to the pinion J are the brush arms G G^1 carrying the brushes F F^1. These are connected respectively with two insulated rings H H^1, which are swept by two take-off brushes I^1. The iron armature rings R are chiefly desirable when the machine is used as an electromotor. The armature cores may be omitted, in which case the coils C^1 should be made flat and thin, in order to bring the opposite poles L as near together as possible. It is characteristic of all the modifications described in this specification that the ring armature is wound so as to develop alternate north and south poles presented to the poles of the field magnet as the armature is traversed circumferentially, and that there may be any suitable number of magnetic poles on the armature. Fifteen claims are made.—No. 15858. November 18th, 1887. 1*s.* 1*d.*

VARIABLE ELECTRIC CURRENTS.—*J. C. Mewburn, London.* (*La Société Anonyme pour la Transmission de la Force par l'Electricité, Paris.*)—This invention consists of apparatus whereby a part of the main electric current may be shunted to a derived circuit, without expending the remainder in useless work. A counter electromotive device is introduced into the main circuit, and into the derived circuit thus obtained another counter electromotive device is introduced. These devices may be two induced rings or armatures of dynamos. The two rings are mechanically connected by being keyed to the same shaft. If the inductors for the main circuit are alone excited this device will produce a counter electromotive force equal to the difference of potential engendered by the main current between the connecting points; this force will therefore be taken up by the derived circuit with its whole intensity. If, on the other hand, the inductors in the derived circuit are alone excited, this device will take up all the power and prevent any current passing into the derived circuit, with the same result as if this circuit did not exist. If the inductors of both devices are excited together, they will each receive a counter electromotive force in proportion to the magnetic field given to it; the current will be divided between the main circuit and the derived circuit in the inverse ratio of these forces. The proportion of the intensity of the current which is derived to that of the remaining current may thus be regulated at will. When the counter electromotive devices employed are armatures or rings, the inductors may be supplied from the main current, either by a simple winding or by a double winding. By dividing the circuits wound on the inductors into sections leading to a commutator, the current can be sent into any desired number of the sections. By moving the commutator the sections traversed by the exciting current may be only those of the inductors connected with the device in the main circuit, or only those of the inductors in the derived circuit, or partly one and partly the other. The counter electromotive forces can thus be modified at will. Two claims are made.—No. 6972. May 12th, 1887. 8*d.*

CHEMISTRY.

ALUMINIUM.—*E. de Pass, London.* (*M. Bernard & E. Bernard, Paris.*)—The inventors here modify the process of extracting aluminium by electrolysis from the chlorides and fluorides of aluminium and sodium. A bath is formed in which the aluminium fluoride or double fluoride of aluminium and sodium is employed as the principal electrolyte. The greatest yield of aluminium is found to be when its fluoride is in a melted state without being mixed with any other salt. Very good results are obtained by using forty parts of aluminium fluoride with sixty of common salt. If pure aluminium is required the two electrodes are of carbon; and for obtaining aluminium bronze the electrodes are carbon and copper. The crucible may be of refractory earth or of metal. Five claims are made.—No. 10057. July 18th, 1887. 8*d.*

MANUFACTURE OF DEXTRINE.—*A. Schuhmann, Strassburg, Germany.*—This invention is designed with the object of producing a commercial dextrine, which is free from any disagreeable odour. Starch flour is mixed with fresh water until it arrives at the consistency of a thick milk, and one per cent. of a fixed acid is then added. The mass is well stirred and left for twenty-four hours, after which interval the acid water is decanted, and the precipitated starch is washed. This pure starch is then mixed with fresh water, so as to form a milk of 15°Bé, and to this mixture is added one-half per cent. of sulphurous acid. The mass is then boiled in a digester at a pressure of three atmospheres. As soon as any glucose makes its appearance, the treatment is stopped, and the material is filtered through charcoal, from which it issues as a clear liquid without taste or smell. This process is also said to be less expensive than the ordinary one, as large quantities can be prepared at one time. Three claims are made for this process.—No. 5460. April 14th, 1887. 6*d.*

COATING METALLIC ARTICLES WITH TIN.—*A. E. Barthel, New York, and J. C. J. Möller, Hamburg.*—In preparing the metallic objects before exposing them to the molten tin, the inventors make use of an electrolytic bath, in order to impart to the object a surface of chemically pure iron. The bath is composed of 600grm. of sulphate of iron dissolved in 5 litres of water, together with a solution of 2400grm. of carbonate of soda in 5 litres of water. The resulting precipitate of carbonate of iron is dissolved in as much concentrated sulphuric acid as will cause the fluid to assume a green colour. The bath is then rendered aqueous by adding 20 litres of water. The objects to be provided with a coating of chemically pure iron are placed in the bath in a position opposite to the anode of cast iron, and both parts are connected to the corresponding poles of a dynamo or electric battery. After this process is completed the objects are immersed in a solution of ammonia in chloride of zinc, and immediately afterwards plunged into the molten tin. It is found that the resulting coat of tin adheres with great tenacity to the chemically pure iron surface. Two claims are made.—No. 17356. December 17th, 1887. 4*d.*

MISCELLANEOUS.

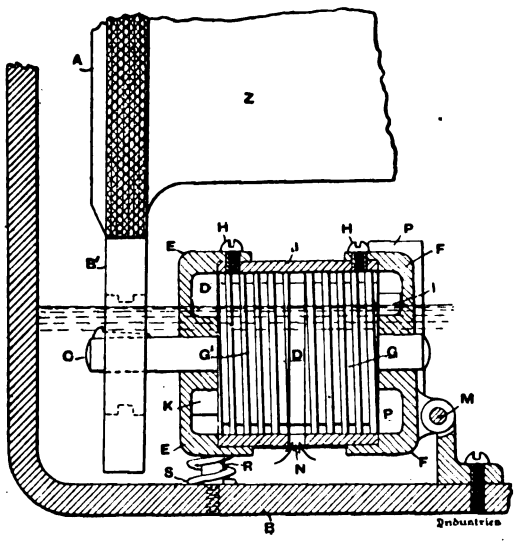
DYEING FABRICS—*W. J. S. Gravitz, St. Maur-les-Fossés, France.* In dyeing vegetable and animal textile materials before spinning, the inventor employs a hollow cylinder of wire work. The material, in the form of lap from the scutcher or sliver from carding engine, is wound upon the hollow cylinder, and is retained in its position by a second open work cylinder, concentric with the first. A very large bobbin is thus formed, which is afterwards keyed upon a horizontal shaft over a dye vat. The bobbin is partly immersed in the liquor, and the usual operations of boiling, mordanting, and dyeing are proceeded with. Rotary motion is imparted to the bobbin, and thus the material is not disarranged in the slightest, and can afterwards be submitted at once to the ordinary process of spinning. The inventor makes one claim for the method of dyeing the materials before spinning, by placing them between the two concentric open work cylinders.—No. 13445. March 4th, 1887. 6*d.*

SWING BUCKET.—*A. Thomas, Cardiff.*—The improved bucket is intended for use in loading and unloading ships and waggons, and is provided at one side with a pair of spring bolts which are carried in hinged sockets. When the bucket is attached to the chain, in order to be filled, the handle lies at one side between the tongues of the spring bolts, and the bucket is not free to revolve within the handle; but when the loaded bucket is set upon its bottom, and the tension in the chain relaxed, the handle drops, and a notch on it is brought in contact with the tongues of the spring bolts, which are thus forced back into their sockets. To enable the handle to drop in this way it is slotted, and the neck of the trunnion rests in the slot. If the chain is now drawn up, the bucket turns over and discharges its contents. After discharge the bucket swings back again into its former position, and the handle becomes locked again between the spring bolts. The trunnions are placed sufficiently

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low on the sides of the bucket to ensure its swinging freely when the handle is released and the bucket raised. When it is required to prevent the bucket from tipping automatically, a pawl, hinged to the handle, is made to bear upon the neck of the trunnion, and the descent of the handle is thereby obstructed. Three claims are made for the construction of this automatically tipping bucket.—No. 436. January 11th, 1888. 6*d*.

LUBRICATORS FOR AXLE NECKS.—*J. Loesewitz, Witten, Prussia, and G. Moass, Duisberg, Prussia.*—This invention relates to an apparatus for lubricating the axle necks of railway cars in such a manner that no oil can escape and no dust enter. With the movement of the neck the oil is continually conducted over the axle. The method will be understood by reference to the accompanying diagram, which represents a longitudinal section



through part of the bearing box. The axle neck Z is provided with fine corrugations on its head A, which is in gear with the rubber disc B¹. The screw piston D rests in the cylindrical covers E and F, which are fixed on the cylinder J by means of the screws H. The paddles I and K rotate in the grooves at the ends of the case E F. At both sides of the covers E F are the two pins R, over which are placed the spiral springs S, supporting the shoulders of E F. The whole apparatus is connected to the bottom of the bearing box B by means of a pivot M. As it is supported only by this pivot and the springs S, the transference of the vibration of the axle neck is avoided, and the rubber disc B¹ is always kept in contact with the head A¹. The cylinder J has an opening N in it for the introduction of the oil; the case F is provided with a vertical channel P, and the case E with a similar one for conveying the oil above the axle neck Z. A leathering is arranged in a groove in the bearing box, and a spring ring presses the leathering against the walls. The apparatus E F is surrounded with oil, and on the rotation of the screw piston the oil is conducted through the opening N. The paddles I then force it up through the channel P, and a tube carries it above the leathering on the axle neck. The oil flows down again into the reservoir, and is made use of an indefinite number of times. The apparatus being entirely closed, the air and dust cannot enter, and the oil cannot escape. There are five claims for this lubricating apparatus.—No. 17783. December 27th, 1887. 8*d*.

BOOT AND SHOE MACHINES.—*A. V. Newton, London.* (*J. Keats and H. C. Keats, Frankfurt-am-Main.*)—The object of this invention is to construct the rotary compound cutters of boot and shoe sole paring machines in such a manner as to obtain a uniform depth of cut from the profile cutters, notwithstanding

FIG. 1.

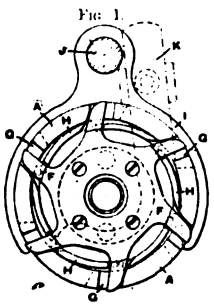
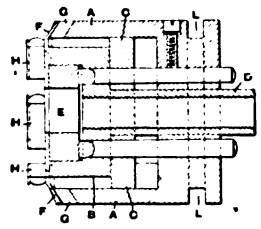


FIG. 2.

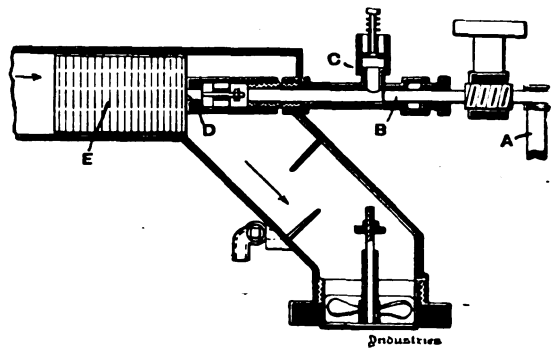


the wearing away of their cutting edges, and also to provide for the adjustment of the chamfering or face cutter relatively to the profile cutters, in order to suit the work in hand. In the accompanying diagrams, Fig. 1 gives a front view and Fig. 2 a longitudinal section of the cutter. The essential parts are the sleeve A, the profile cutter holder B, and the chamfering cutter holder E. The profile cutters H are segment-shaped from their front edge to their heel, and are fitted in rebates cut in the periphery of the block B, so as to give them an eccentric set. The disc C is screwed to the back of B, and receives the sliding sleeve A. The hollow centre piece D is cast in one block with B, and is internally threaded to fit on the spindle of the machine. Holes are drilled through B and C, in order to form guides for two parallel rods projecting rearward from the cutter holder E. These rods pass through the rear end of the sleeve A, and the holder E is made fast to the sleeve A by means of a binding screw bearing against one of the rods. The chamfering cutter F is secured to the front of E by means of screws, and recesses G receive the blades of the cutter. The cutters H have a raised part at their outer side for the removal of the burr from the inner angle of the sole. The inventor makes three claims: (1) For attaching the holder of the chamfering cutter adjustably to a sleeve which is capable of sliding over the profile cutter holder; (2) for the construction of the holder and cutters B and H to receive the holder and cutter E and F, and to permit the adjustment of the chamfering cutter to its work; and (3) for the general construction and mounting of the cutters.—No. 2968. February 25th, 1887. 8*d*.

DYEING TEXTILE MATERIALS.—*H. H. Lake, London.* (*U. Weldon, Cohoes, New York.*)—This apparatus consists essentially of a dipping wheel, which rotates in a vat containing the dyestuff. To the axle of the dipping wheel is fixed a series of radial vanes, the outer ends of which are in the form of perforated semi-cylindrical pockets. The cross-section of the wheel thus presents an appearance similar to a series of sickles with their handles fixed to the hub. The fabric is carried up in these pockets, and after arriving at the highest point of the wheel, it drops out again into the liquid. It remains in the dye after half a revolution, and afterwards it is again taken up by the same pocket. The sides of the pocket are made of a series of round rods. These arrangements of the wheel are for the object of insuring a more uniform treatment of the material than has been obtained by machines hitherto in use. Three claims are made.—No. 402. January 10th, 1888. 8*d*.

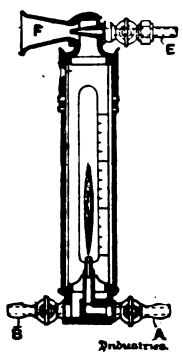
GERMAN PATENT ABSTRACTS.

PETROLEUM ENGINES.—*Boris Lutzky, Munich.*—This apparatus is intended for generating gas for petroleum engines. The piston B¹ receives a reciprocating as well as a rotating motion from the



lever A, thereby sucking oil through the valve C, and forcing it through the valve D against the brush E. In this brush it comes in contact with hot air circulating in the direction indicated by the arrows, and is evaporated.—No. 42290. July 21st, 1887.

FURNACES.—*Schäffer & Budenberg, Magdeburg.*—This invention relates to an apparatus for ascertaining the nature of the gaseous products of combustion leaving furnaces. By means of a sucking arrangement E F a mixture of gases from the furnace



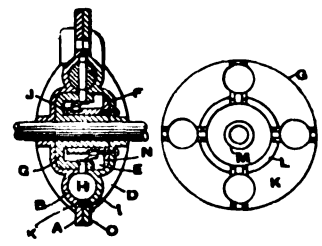
and air is introduced into the apparatus through the tube B. A gas flame is burning inside, which is fed by the tube A. A scale is provided by which the length of the flame may be measured, and from the measured length of that flame a conclusion may be arrived at as to the nature of the furnace gases.—No. 42393. June 10th, 1887.

UNITED STATES PATENT ABSTRACTS.

NUT LOCK.—*H. O. Whyman, Norfolk, Nebraska.*—This nut lock consists of a spiral spring of metal, one end of which tapers to a point. The outer turn of the spiral groove of the nut is cut deeper than the other turns, so as to admit the tapered end of the spring. When the nut has been screwed up into its position on the bolt, the metal spiral is inserted in the deep groove, and effectually prevents any slipping of the nut. Two claims are made.—No. 378563, dated 28th February, 1888.

LOOM.—*H. Eastwood, Paterson, New Jersey.*—According to this invention the depending lay is provided with two or more reeds, and the ordinary shuttle boxes are placed at the ends of the lay and between the reeds. Picker sticks hang from a beam on the lay swords—one from each box—and are connected near their lower ends by straps. They are fastened to the ends of oppositely placed levers, which are pivoted to the beam, and operated alternately from tappets on the cam shaft by means of a system of connecting rods and tappet levers. The sticks are thus thrown first to one side and then to the other, and they drive the shuttles through the several sheds. Springs are employed to bring back the outside sticks, and guides limit and direct the movement of the picker sticks. One claim is made for this improvement.—No. 377425, dated 7th February, 1888.

ROTARY ENGINE.—*D. Williamson, New York.*—This engine consists of only three main pieces, a shaft, a casing, and a revolving disc and vanes. The left hand figure in the accompanying illustration represents a longitudinal section in the plane of the shaft, and the other figure shows a front view of the revolving disc. The case A C is strengthened by the ribs D, and each of the two separate pieces A and C is provided with an annular groove. These grooves form an annular fluid channel H when the cases are riveted together. Inlet and exit ports in the casing allow the fluid to enter and leave the channel H; they are located side by side, and communicate with H on either side of a division wall. This abutment or division wall is in two parts, and fills the annular channel in each of the parts of the casing faces up flush with its edges. A space is thus left between the faces of the abutment. The central chamber E contains part of the disc G and the cam F. The cam consist



of a sleeve having a peripheral cam groove J, and a flange at right angles to the shaft. The disc G consists of a flange, centre box, and sleeve, all cast in one piece. The sleeve M surrounds the shaft and is tightly secured to it, and the flange portion K of the disc is perforated to receive the vanes. A circular shape is given to the vanes, and their thickness is equal to that of the flange K. Each vane is provided with a spindle which runs in one of the bearings of the flange, and which extends through the wall into E. A crank which carries an anti-friction roller is fitted to the end of the spindle, and the roller runs in the cam groove J. The vanes are given a quarter turn while passing through the first quarter of the channel H. They remain in that position until they reach the beginning of the last quarter, when they commence to fold, in order to pass between the faces of the abutment. The number of vanes is preferably four. The space between the faces of the abutment is kept constantly closed by the flange of the disc G, and consequently the entering and exhausting fluids cannot interfere. The entering fluid presses against and rotates the vanes; when the vanes arrive opposite the exhaust they are moved flush with the disc G by means of the rollers, so that they can pass through the abutment. Three claims are made.—No. 375788, dated 3rd January, 1888.

ELECTRIC CONDUCTOR.—*W. A. Barnes, Bridgeport, Connecticut.*—This method of forming the conductors applies to the construction of the circuits of electrical fire alarms. The wire is made of sections of fusible metal united together by short pieces of a metallic compound which is more easily melted than the longer parts. This slight irregularity in the fusibility of the circuit obviates any delay in the desired operation. The inventor makes two claims for this conductor.—No. 378078, dated 21st February, 1888.

ELECTROLYSING COPPER.—*E. S. Hayden, Waterbury, Connecticut.*—In order to purify copper, and free it from foreign and debasing matter, the inventor makes use of an electrolytic bath. The usual anode and cathode are placed at some distance apart, and the copper plates are rolled up and suspended in the solution. They are not connected with either electrode, but are only in contact with the solution. The liquid is kept circulated in order to accelerate the action of the current. Three claims are made.—No. 377487, dated 7th February, 1888.

CLEANING TOOTHED FEED ROLLS.—*H. Tindell, Harrison, New Jersey.*—Each end of the main cylinder is formed with a cam groove which has several undulations, and a stud playing in the groove is fixed on a forked plate which embraces the shaft of the cylinder. The outer ends of the forked plates are pivoted to links which in their turn are pivoted to the shaft of the feed roller. These links carry a cleaning plate, which is vibrated by the cams and pins, in order to clean the teeth of the feed roller. The inventor claims the combination of the links and cams which give the cleaning plate its motion for the purpose described.—No. 378739, dated 28th February, 1888.

ALUMINIUM.—*J. S. Howard, Springfield, Massachusetts, and F. M. Hill, Brooklyn.*—The aluminium ores are first boiled in muriatic acid. The resulting product is charged into a lime lined crucible together with a certain amount of Spanish white. When the temperature has been raised considerably, the mixture is covered with chloride of tin or chloride of sodium, and the whole subjected to a smelting temperature of 1000°F. The resulting alloy is afterwards melted in lead or bismuth; the aluminium then comes off free, and is subsequently purified by exposure to heat upon a bed of porous material. Three claims are made.—No. 378136, dated 21st February, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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INSTITUTION OF NAVAL ARCHITECTS.

The annual spring meeting of the Institution of Naval Architects was held in the hall of the Society of Arts on Wednesday, the 21st inst., and the two following days, the proceedings opening with the annual report of the Council, in which it was stated that the summer meetings held in Liverpool, Newcastle-on-Tyne, and Sunderland had proved very successful, and an invitation has been accepted from the President of the Institution of Engineers and Shipbuilders in Scotland, and from the Directors of the Clyde Steamship Owners' Association, and of the Sailing Ship Association, to visit Glasgow this summer. The last visit to the Clyde took place in the year 1877, and the prosperity of the Institution is said to date from that meeting. The Council having been informed that an attempt was being made to induce the Science and Art Department to remove and partly break up the Museum of Naval and Marine Engineering models at South Kensington, made representations in favour of allowing the collection to remain undisturbed. An official assurance was received that the Department did not desire to interfere with the existing arrangement, and that its hands would be strengthened by the action taken by the Institution. The number of members of the Institution shows a considerable increase, and the finances are in a satisfactory condition.

In moving the adoption of the report, Lord Ravensworth congratulated the Institution on its favourable nature. He regarded the approaching visit to Glasgow as especially appropriate, this year being the centenary of steam navigation. Referring to the general question of trade, Lord Ravensworth said that symptoms of improvement are noticeable, especially in our shipbuilding yards, but that it is vain to hope for a permanent improvement till peace is assured. During the year he had been impressed with the overwhelming importance of the question of the national defences, which had received a great impulse by the speeches of the Commander-in-Chief at the Newcastle meeting of the Institution. The question was still further brought into prominence by Lord Armstrong's speech on the Address, and by the report of the Committee of Inquiry into plans for the defence of our naval and mercantile ports. The Committee consisted of nine members, of which only two belonged to the services—an admiral and a general—and the charge could not be made that the seven civilians were prejudiced in favour of the expenditure of funds whether necessary or not. The gist of the report is that, upon the weakness of our present position, the witnesses were unanimous, and that the necessary works should be carried out without delay. The vote for this purpose of £3,000,000 during the next three years was regarded as inadequate. The importance of this question to the members of the Institution was insisted upon, as their property and works are situated in inadequately defended ports, and their ships are imperilled by the weakness of the coaling stations. The question involves four distinct issues, viz., the additional strength of the ports at home, of our coaling stations, of our colonial ports, and the necessity of keeping open the ocean routes upon which our food supply is dependent; but his Lordship regarded the first as of paramount importance. He next dealt with the question of the maintenance of our maritime supremacy, and declared that the only true policy is that now adopted—viz., to go ahead and keep there, be the cost what it may. Though the naval estimates for the present year are moderate, they provide for four new types of vessels. First are two armed cruisers, the "Blake" and "Blenheim," one being built at Chatham, and the other, fortunately, by contract. They are to have a speed of 22 knots at sea, and a displacement of 9000 tons. Their coal supply would enable them to run 15,000 knots at 10 knots an hour, and 3000 knots at 20 knots an hour. The second class is an entirely new one, and is represented by the "Vulcan," a torpedo depôt ship, which is to have a speed of 18 knots, and the duty of which will be to protect the small craft. The third class is that of unprotected sharp shooters, or torpedo gunboats, as they are termed, which are to have a speed of 21 knots. The last type consists of powerful sloops like the "Buzzard," and represented by the "Beagle" and the "Basilisk." They have a displacement of 1150 tons, 14½ knots speed, and twin screws, and their function is to act as police in distant seas. Turning from the navy to the merchant service, Lord Ravensworth said that in matters of construction the latter has shown even greater advance, as instanced by the "Oceana," the sister ship of the "Arcadia." Fortunately, these have satisfied the Admiralty requirements, and have been placed on the list of the naval reserve. The recently launched vessels, the "City of New York" (see *Industries*, Vol. IV., page 270) and "City of Paris," built for the re-constituted Inman and International Line, are also worthy of note. Their great peculiarity is in the minute sub-division of the hull, and there are no doors to the bulkheads, so that such an accident as that which occurred to the "Oregon" is prevented. Their displacement is 10,500 tons, and their speed at sea 20 knots an hour. During the past year there has appeared the report of the Committee of Inquiry into loss of life at sea. All the experts examined were unanimous about the marked improvement in all classes of ships. Mr. Dale, the chairman of the Liverpool Underwriters' Association—a body which controls annually £200,000,000 of insurance—said in his evidence that premiums are steadily becoming lower, and that they are now less than at any previous time. Mr. Glover put in a table to show that the reduction is general in all classes of ships, and Mr. Martell, of Lloyd's Register, has shown that the number of ships of the higher class is constantly rising in proportion to that of the lower. Mr. William Denny has testified to the improvement in cargo ships, and Lord Ravensworth's own observations fully confirm his evidence. Mr. Martell has given the following statistics on the subject:—

	Average in 1883.	Average in 1888.
Size	1500 to 2000 tons	3000 to 3500
Nominal h.p.	140	200
Speed	9 knots	10 knots

In discussing the causes of the progress, credit was given to the energy of the owners, the vigilance of Lloyd's, and a large share to the Institution of Naval Architects and kindred societies, as owing to the discussions of technical questions at their meetings improvements are well advertised and remedies constantly suggested for defects. Probably still more important is the influence of merchant ships being admitted as naval auxiliaries, which stimulates both the navy and the merchant service. Now that the Admiralty watches the building of all ships intended to be added to the reserve list, this factor has become especially important.

Our space only allows of our giving abstracts of the papers and of the discussion on them. As the first three papers on the programme dealt with allied matters they were read in succession, and the discussion on all three was taken together.

The first paper was by Mr. W. John, on

American Warship Design.

Though the United States Government has not gone to any great length in building up an ironclad fleet, yet during the past few years efforts in this direction have been made. In August, 1886, the Secretary of the United States Navy, Mr. W. C. Whitney, advertised for designs for a steel armoured battle ship and armoured cruiser. Mr. John, who was at that time general manager of the Barrow Shipbuilding Company, entered the competition and gained the 15,000 dollar prize for the battle ship. As he has been repeatedly asked for further details, he thought the following particulars would be of interest. The dimensions of the vessel are as follow: Length, between perpendiculars, 290ft.; breadth, 64ft. 1in.; depth, 39ft. 8in.; mean draught of water, 22ft. 6in.; displacement at 22ft. 6in. draught when fully equipped and with 500 tons of coal, 6300 tons.

The cruiser proposed was of a totally different type. The author much preferred a water line belt to internal protection, as the latter would give a background for bursting shell against, and thus yards of the thin side in the region of the water line might be ripped off, and both speed and stability be seriously affected. The belt in this ship is of 12in. steel faced armour, and is 2ft. above water amidships, and 4ft. 6in. below at the constructor's load water line. With an additional 450 tons of coal in the bunkers between decks the draught would be 14in. more. The main battery is of two 12-inch breechloaders placed in turrets in echelon, and six 6-inch breechloaders; the secondary armament consists of four 6-pounder Hotchkiss rapid-fire guns, six 3-pounder and two 1-pounder, eight Hotchkiss revolving cannon, four of 47mm. and four of 37mm., and four Gatling guns. Six torpedo tubes were stipulated, one in the bow, one in the stern, and two on each side. Four electric search lights were provided. The ship is built on the cellular double bottom principle, the double bottom extending under the engines and magazines for 158ft. There is a protective deck 3in. thick extending over the top of the armour belt and sloping down forward and aft at the forward end to the point of the ram, 10ft. below water. The bulkheads are of 6in. steel faced armour. The armour belt is backed up with 6in. of teak, two thicknesses of 25lb. plating, rigid framing and girders. The communications from the conning tower for navigating the vessel are protected by an armoured tube 3in. thick, and the hoists from the magazines by 6in. armour. In regard to the range of fire, the 12-inch guns are so placed that both command a fore and aft fire, a complete broadside range on one side, and a range of 40° for the forward gun and 70° for the after one on the other side. Of the 6-inch guns, two are arranged as bow and stern chasers, and four on sponsons on the main deck. The smaller guns are placed on the main deck, and some in the tops. Two second class torpedo boats are provided for, and sufficient boats to carry the crew, including a steam pinnace and a steam cutter, each mounting a 3-pounder Hotchkiss rapid-firing gun. In conclusion, the fighting qualities of the ship were summed up as follow: She has a speed of 17 knots in fighting trim. If she engages an enemy, her full battery of heavy guns, as well as three out of her six 6-inch guns and most of her secondary armament, will be available either when bow on, when chasing, or when running away; but if the enemy is one of the internally protected cruisers she will be liable to be raked fore and aft by shot, and especially by shell If the ships engage in an artillery duel, avoiding both ram and torpedo, this battle ship would have full play on her broadside for both her 12-inch guns, four out of her 6-inch guns, and most of her secondary battery. Hence the author maintained that for single action fighting, there is a great advantage in having the main guns echeloned and placed so high that their fire fore and aft cannot be interfered with by forecastles or poops, especially if the heavy broadside concentration can be maintained at the same time.

The next paper read was by Captain C. C. P. Fitzgerald, R.N., on

Unarmoured Water Lines in Warships.

The author commenced by explaining that the object of his paper was to call attention to the greater probability of one of our modern battle ships being sunk by many small wounds below the water line, rather than by a torpedo, the ram, or by what Sir E. J. Reed has called one of "the earthquake projectiles of modern warfare." Our experience of the sinking of ironclads is very meagre, including only the loss of the "Re d'Italia" by ramming, and of one or two small ironclads in the American Civil War. Nevertheless, the opinion is gaining ground that in the future more ships will be sunk in naval engagements than in the past. Sir N. Barnaby has told us that one of his main principles in design was so to construct vessels that they could not be disabled or destroyed by one blow; but even if this end has been attained, it will be but small consolation to a crew to know that having avoided the one heavy blow, they are slowly sinking, or are preparing to "turn turtle," from a cause against which they are quite powerless. The one blow theory catches the imagination more than the series of smaller wounds; yet it is the latter which will probably be more effective in the long run. Captain Fitzgerald ridiculed the "end on" theory of attack represented by such ships as the "Nelson" and "Northampton," as the system could not be applied in practice unless the enemy were so accommodating as always to run away. Besides this extreme case of the danger due to the designing of ships with one marked and distinctive feature, there is the more serious one, that in order to secure speed, coal endurance, and immunity from destruction on the "one blow" theory, many ships have been left with large areas of their water lines unprotected by armour, and the danger, moreover, has been greatly accentuated of late by the development of quick-firing guns. To avoid this, the French are adopting a preparation of cocoa nut fibre, called cellulose, as a lining to the unarmoured parts of their warships. The intention is to exclude water if pierced, and their new cruiser the "Dupuy de Lome" is expected to be practically unsinkable, owing to this lining. The author had experimented in this connection with india-rubber, and found that a 2·2in. projectile could be fired through an 1½in. plate without leaving any hole through which water could pass. At his suggestion, the Admiralty had caused other experiments to be made, and had declared the system to be a failure; but the author objected that it had not had a fair trial, and regretted that he had not been informed either as to the time or nature of the tests till after they had been made. A company has recently been floated to manufacture a patent composition known as "woodite," which is said to serve the same purpose. Without expressing any definite opinion as to the relative merits of these water excluding materials, the author insisted upon the necessity for experiment, as our already overloaded citadel ships cannot sustain any additional armour, and, therefore, the destructive effects of quick-firing guns on their exposed ends may lead to serious national disaster.

The third paper read was by Captain Hubert Grenfell, R.N., on

The Development of Modern Weapons, considered in relation to the Designs of Warships.

The author introduced his paper by insisting upon the necessity of unity of design in warships, to secure unity of action, a factor of great importance to success in battle. Early in the century the ultimate object in naval tactics was to get broadside to broadside, and trust to superiority of metal and endurance; but the introduction of steam, armour, heavy guns, torpedoes, &c., has entirely destroyed any such dominant idea, except with those who believe that the naval tactics of the future will be based on the exclusive use of one weapon, such as the torpedo or the ram. A definite pronouncement on the part of naval officers as to the mode in which naval actions should be fought is obviously necessary, to enable the naval architect to design ships so as to answer all requirements.

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The author's paper was an effort to do this, by discussing the relative value of the various factors that influence ship designs. Mr. White was quoted, to show the almost absolute agreement amongst naval authorities on the importance of high speed in all classes of vessels. Hence it may be inferred that a similar agreement on other points is not unattainable. In regard to the construction of the largest class of ships, which it was understood the Admiralty had determined to discontinue, Captain Grenfell pointed out that this was only because we had sufficient for our needs, and as Italy still prefers them, and France is about to complete the once abandoned "Brennus" and "Charles Martel," the heavy ironclad seems to be still regarded as the most efficient implement in naval warfare. Guns capable of piercing 3ft. of iron plate were declared to be far superior, in proportion to the armour opposed to them, than those of any previous period had been. Moreover, a marked increase in gun power has been gained by greater frequency of hitting; thus from the Elswick quick-fire gun—a weapon of good weight and penetrating power—three shots have been kept in the air at the same time. In regard to torpedoes, the case of the Harvey and spar torpedoes was quoted, as illustrating the possibility of arriving by proper analysis at the capabilities of a weapon without any practical experience. They were both discarded after adoption in the navy as too limited in range, and with too many chances of failure, though these objections were known at the time of their adoption. The ram, as Mr. White has pointed out, exercises very little influence on ship designs, while its use has fallen into the background since Admiral Colomb showed what a hair's breadth separates the case of ramming an adversary from being yourself rammed. Turning to the ships themselves, though the gun is accepted as the most influential factor, we have oscillated from the principle of distributing the main armament to that of concentrating it—as in the case of the "Victoria," with her two 110-ton guns in the centre of the vessel, to that of more numerous and smaller weapons distributed, as in the "Admiral" class. The author considers high speed a disadvantage to the efficient use of artillery, and, therefore, not rightly a tactical factor in artillery duels. It was also remarked that, in the "Admiral" class, the effort to cover the whole horizon with her guns much diminishes the amount of fire that can be concentrated upon one spot. Another question upon which a definite understanding is required, is whether mere weight of metal is to be preferred to frequency of fire in cruisers. Whether, in fact, a more numerous armament of quick-firing 30-pounders would not be more advantageous in such vessels than a few heavy 10-in. breech loading guns. In discussing the subject of torpedo cruisers, the author lamented the fact that, though the preponderating influence of the gun is fully accepted for large vessels, yet for small ones the torpedo is regarded as the "dominant idea." In accuracy of aim, instantaneousness of discharge, rapidity of flight, and number of rounds that can be carried, the flying "air torpedo" is far superior to its submarine brother, while, on the most favourable assumption, the effect of a fair torpedo hit can only be rated as equal to that of the gun projectile. This change of principle is especially to be regretted in "torpedo catchers," a class of vessels built to chase torpedo flotillas in rough weather, in which the speed of the latter would be reduced, while that of their pursuer would be comparatively uninfluenced. In such work a number of small calibre quick-firing guns would be much more efficient than the cumbrous set of torpedo tubes with which they are provided. In conclusion, it was contended that, in frequency of discharge, accuracy of aim, simplicity of construction, economy in working, greater range, and less liability to derangement, the gun is far and away superior to the torpedo; and, therefore, the tendency to supplant the more powerful weapon by the less powerful is to be deplored, and is a change that will not stand the test of experience.

The discussion on the preceding three papers was commenced by Sir Spencer Robinson, and several of the naval officers present also took part in it. Those of our readers who have on previous occasions attended meetings of the Naval Architects when similar papers were read, will not be surprised to learn that the discussion was remarkable chiefly for its discursiveness, and the wide difference of opinion expressed by the various speakers on such questions as the relative value of side armour, internal protection, the ram, guns, torpedoes, and other points upon which very little actual experience has as yet been obtained. We heard again the same arguments and statements of opinion which were put forward last year in discussing Mr. Biles' paper on "Internal Protection *versus* Armour Belts," and as this was reported at some length in our issue of 15th April, 1887, a very condensed account of the present discussion will be sufficient.

Admiral Sir Spencer Robinson, who congratulated Mr. John upon his success in the competition, drew attention to the fact that the designer was handicapped by the United States Government in being compelled to adopt dimensions which almost preclude the possibility of a good design. The thickness of armour for a vessel of such small displacement necessitated its concentration upon a limited area, leaving the remainder much exposed, so that if this ship heels over only a few degrees the top of the belt will be below the water line. He deplored the absence of any definite system in deciding on what lines our ships should be designed, and thought Capt. Grenfell's paper a step towards such a system.

Admiral Colomb was in absolute accord with Captain Grenfell, except when he said that a successful torpedo hit would not do more damage than a successful gun projectile. He did not rate the torpedo quite so low, though at the same time he did not consider that a single torpedo would be fatal. Some of our most experienced torpedo officers had assured him that they would not regard a ship disabled with less than three good torpedo hits. In regard to Mr. John's paper, he was interested to note that we are returning to the old theory of short ships with narrow belts. The battle ship under discussion is weak on the port bow and starboard quarter, and it is doubtful whether it is quite adapted to either of the two main modern formations, viz., echelon and broadside fighting stem to stern. He had no doubt that quick-firing guns were more to be feared than the huge projectiles; no part of the water line should therefore be without armour.

Mr. Biles regretted that Mr. John had gone over to the enemy in the matter of vertical armour belt, and inquired in what way this ship would have an advantage in a running fight over one internally protected. It mattered little whether a hole were blown in the side of the ship at the water line or 2ft. above it. The main question was, what was sacrificed for the armour belt, and he maintained that two 45-ton guns and 3 knots of speed had here been lost. The speaker next pointed out that till further experiments have been made on woodite, cellulose, &c., the proper remedy against quick-firing guns is greater sub-division of the hull.

Sir Nathaniel Barnaby defended the design of the "Nelson" and "Northampton." The "Ajax" and "Agamemnon," designed in 1876, are 8500-ton ships, with armour rising many feet above the water line; but now we have vessels 500 tons larger, or even as much as 13,250 tons in one case, without armour on the sides. The "Blake" and the "Blenheim" show that we must have large ships. He agreed with Captain Grenfell that quick-firing guns were necessary for torpedo catchers, and he had designed a series without torpedoes and with only such guns for service in the Baltic during the crisis with Russia.

Admiral Scott considered that single action fighting will be more important than column fighting; hence vessels should be made strong all round, and weak parts should not be left to be protected by consorts. He regarded Mr. John's ship more as an armoured cruiser than a battle ship, and thought that armoured cruisers were rendered still more necessary since the development of quick-firing guns.

Mr. White called attention to the fact that narrow belts had been adopted by common consent. The French adopted it, and placed their guns high above water, thus producing a type that would have been unquestionably fatal to our ships with their low guns. It must be remembered that we build our ships to fight, not our own, but those of foreigners, and hence our designs must have reference to the action of other countries. It was pointed out that when the "Admiral" class were designed, beginning with the "Collingwood" in 1880, quick-firing guns were already in use, and since then they have been steadily gaining power. He had seen 36-pounders that could be fired fourteen times a minute. A 100-pounder quick-firing gun has now been made, and the limit has not yet been reached.

Mr. Benjamin thought the great defect in Mr. John's ship was the mass of armour about the turrets, which would weigh at least 300 tons. It might have the supports shot away, and thus the stability of the whole ship would be ruined.

Mr. John, in reply, said he would have been glad to have carried the belt right round the ship, but could not do so, as he was bound by certain definite conditions. In reply to Sir N. Barnaby's remarks on the "Nelson" and "Northampton," he declared he would not have those ships as a gift, as, if fought at an oblique angle, a shot might carry away all the side guns and then enter into the end turret, which would form a recess where a shell could explode with a maximum of injury.

(To be continued.)

Dutch Industrial Statistics.—These statistics will henceforth be published by the Government, who have appointed two travelling inspectors, with the object of collecting and arranging them. They will go about from place to place, visiting all factories and workshops. The municipal and other local authorities have been instructed to give these inspectors all facilities and information.

ERECTION OF THE SUPERSTRUCTURE OF THE FORTH BRIDGE.*

Three years ago, in a paper dealing with the construction of the steel tubes, I stated that to the end of those tubes as they lay in the yard the skewbacks were being connected. Since that time the whole of the twelve skewbacks have been placed in position on their respective piers, and are now riveted up and completed.

The Steel Piers.—These piers form three groups, and the skewbacks in each are so placed, in relation to one another, as to represent a rectangle. In each of these groups there are four skewbacks. They carry the entire steel superstructure, consisting of the steel pier overhead and the cantilevers on each side of the pier. The skewbacks in each set are connected to one another by tubes and heavy lattice girders. The tubes run parallel to the centre line of the bridge, the lattice girders at right angles and diagonally to the same centre. The vertical columns (improperly so called) are 12ft. in diameter, and spring from the skewbacks. Each pair of these columns batters towards the centre of the bridge as they rise, being 120ft. apart at their base and 33ft. at the top. The box girders on the top of each set of columns form a rectangle, two sides of which form the top tension members, while the other two act as braced struts. In the sloping plane of the columns diagonal tubes 8ft. diam. are placed, which run from one side of the skewbacks to the top of the opposite vertical column. In the other, or vertical plane, the wind bracing and the supports for carrying the internal viaduct are placed. The viaduct extends, unsupported, from the one vertical plane to the other. Additional diagonal and longitudinal bracing girders, fixed in a horizontal plane at the crossings of the diagonal tubes, take up the various stresses at these points. These members may be said to complete a steel pier.

The Cantilevers.—Each of the cantilevers may be said to consist of two braced brackets, securely connected along their lower part by diagonal bracing, and fixed at various points. They approach each other as they recede from the pier, and batter towards one another as they approach the top. All members of each bracket lie in the same plane. The bottom or compression member of these brackets is built up of six straight bays, joined at an angle. As the bays near the point of the bracket they approach a horizontal position, till the last bay

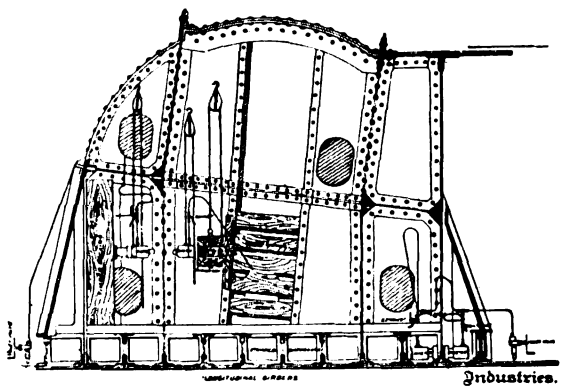


Fig. 1.

is actually horizontal. In section the first four bays are circular in form, in the fifth the shape gradually changes to the rectangular, and continues thus to the end of the sixth. The top or tension member is straight throughout, and, like the bottom member, divided into six bays, which are rectangular in form. The bracing in the brackets is of the double triangular type. The struts extend from the back of each bay in the bottom member to the front of the corresponding bay in the top member. The ties are the converse of this, the struts and ties therefore crossing each other. At the point of crossing a tie is fixed, which, extending to the bottom member, diminishes some stresses in that member due to dead weight. Between the struts box girder bracing is placed. Similar bracing is also fixed between the bottom members. Through these bracings the wind stresses of the cantilevers are transferred to the piers, and as this bracing, in conjunction with that between the struts, is utilised to transfer the wind stresses of the top member to the pier, no wind bracing between the top members is needed. The internal viaduct, insignificant in itself as compared with the cantilevers required for the carrying of it and its load, is supported by girders at the centre and ends of all the bays. After the cantilevers have been built, two gaps, of 350ft. each, will still remain. These will be closed up by a double parallel girder road. The girders will rest on the ends of the brackets, and lie towards one another with a batter similar to that in the piers. The skewbacks (Fig. 1) are the most complicated parts of the entire structure, the difficulties at this point arising out of the various angles at which the different parts lie in relation to one another and to the skewback. Each skewback may be looked upon as being either the starting point or the termination of five separate tubes and five distinct box girders. All these members are connected in such a manner to it as to transfer into or through the various parts of the skewback the stresses of each member. The skewbacks also act as the upper or sliding bed plates, on which some of the movements of the piers and cantilevers, due to expansion and contraction, take place. The sliding surface is the lowest course of several layers of steel plates, which form the base of the skewback. To the top of these plates a series of longitudinal girders are riveted, which are crossed at short intervals by one central and two smaller side diaphragms. Small stamped diaphragms are also placed between the longitudinal girders, immediately under the main ones. Between the centre and side diaphragms, and beyond the latter, are

* Paper recently read before the Institution of Engineers and Shipbuilders in Scotland by Mr. Andrew S. Biggart, C.E.

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riveted four longitudinal lines of plates, and also a top plate, all of which merge into the horizontal and cantilever tubes at the opposite ends of the skewback. To the inner lines of the plates the sides of the two diagonal tubes are riveted. These also serve as part of the connection to the vertical column. Gusset plates and angles are principally used in effecting the connections of the girders to the skewbacks. The construction of the parts of the structure subjected to compression is very different from that of the parts subjected to tension, hence the dissimilarity between the bottom and top members. The cross section of the larger tubes consist of ten plates and ten H beams, running longitudinally, and as the plates overlap one another in this direction, they form five outer and five inner courses. Butting each other on end, they are there connected by double covers. The H beams are placed immediately over the laps of the plates, and are secured by the rivets passing through the longitudinal seams. At intervals of 8ft., stiffening circular diaphragms are introduced. In the smaller tubes, comprising the diagonal columns and struts of the cantilevers, the form is somewhat different, two flat sides being introduced to simplify the connections and crossings. These tubes consist of longitudinal plates and ties, varying in number with the size of the columns. The diameter of the largest tube adopted is 12ft., while the thickness of the plates employed is in some cases as much as 1¼in. In the cross section of the top members there are four booms, each consisting of ordinary flange and web plates, and in addition an extra horizontal web, for connecting the wind bracing. This, coupled with the vertical bracing, binds the whole into a stiff box form. The ties are similar to the top member in section, with the exception that there are no horizontal webs. In this case the horizontal wind bracing is secured to the flanges. The greater part of the wind bracing between the columns is of the same form as the ties, though in some cases it only consists of one angle iron at each corner of the box. The internal viaduct consists of two main girders, with the necessary cross girders, bracings, and roadway. The top booms of the main girders serve as troughs for two of the rails. The other rails are laid in troughs resting on the cross girders.

Erection of Steel Piers and Cantilevers.—The order in which the first portions of the steel superstructure should be erected was easily determined, but as the work proceeded many slight departures from the original plans were made. Some of these were caused by the exigencies which arose as the work proceeded, while others were dictated by experience. The first part of the work—immediately over the piers—was to place the lower bed plates in position. Following these came the skewbacks, which on being lowered were joined to the horizontal tubes and bracing girders. The latter were resting in position on trestles, having been built while the bed plates and skewbacks were being constructed. As soon as the skewbacks were ready to receive them, the vertical columns and diagonal tubes were, by means of cranes, built up to a height of about 50ft. Beyond that height rectangular platforms were built around the pier. The platform, weighing about 500 tons, was carried by the four vertical columns, and raised in stages of 16ft. at a time, by means of hydraulic rams placed within them. After each lift the four vertical columns, the four diagonal tubes, and as much of the wind bracing as convenient or necessary, were constructed. The work proceeded thus until the full height was reached. The top of the vertical columns, and the top members between the columns, were then erected. After that the erection of the top members and the first ties of the cantilevers was commenced. While the top members of the pier were being built, the internal viaduct over the pier, and in the first section of the cantilevers, was raised in small portions into position. After the bottom members were carried out a distance of about 150ft., and secured by temporary ties, platforms were built along their upper surface, and were afterwards used for the erection of the ties at the centre of bay one, strut one. These platforms were raised until they almost reached the crossing of the first ties and struts. Meanwhile, the first ties were carried from the top, down to, and across the struts. After they were secured a new base was formed for continuing the internal viaduct, the bottom and the top members, and the struts and ties, with the necessary bracing.

Platforms and Lifting Plant.—In structures like the Forth Bridge, where work requires to be executed at great heights, various kinds of staging, or false works, become a necessity. The first portions of the bridge were erected by ordinary

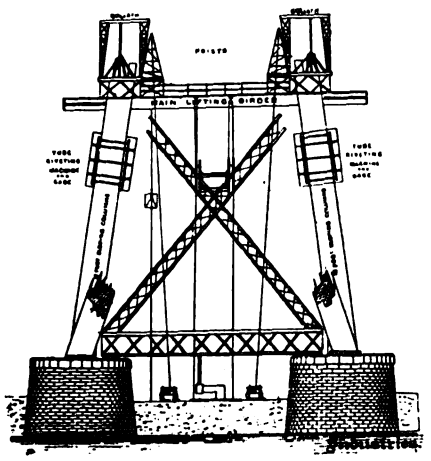


FIG. 2.

derrick cranes. Soon, however, the increasing height necessitated the use of platforms, on which cranes were placed. The platforms employed are of different kinds, and vary greatly in size. The largest is that presently in use on the top of the Inchgarvie main pier, its dimensions being 350ft. by 56ft. In striking contrast to this is the smallest, popularly

THE FORTH BRIDGE.

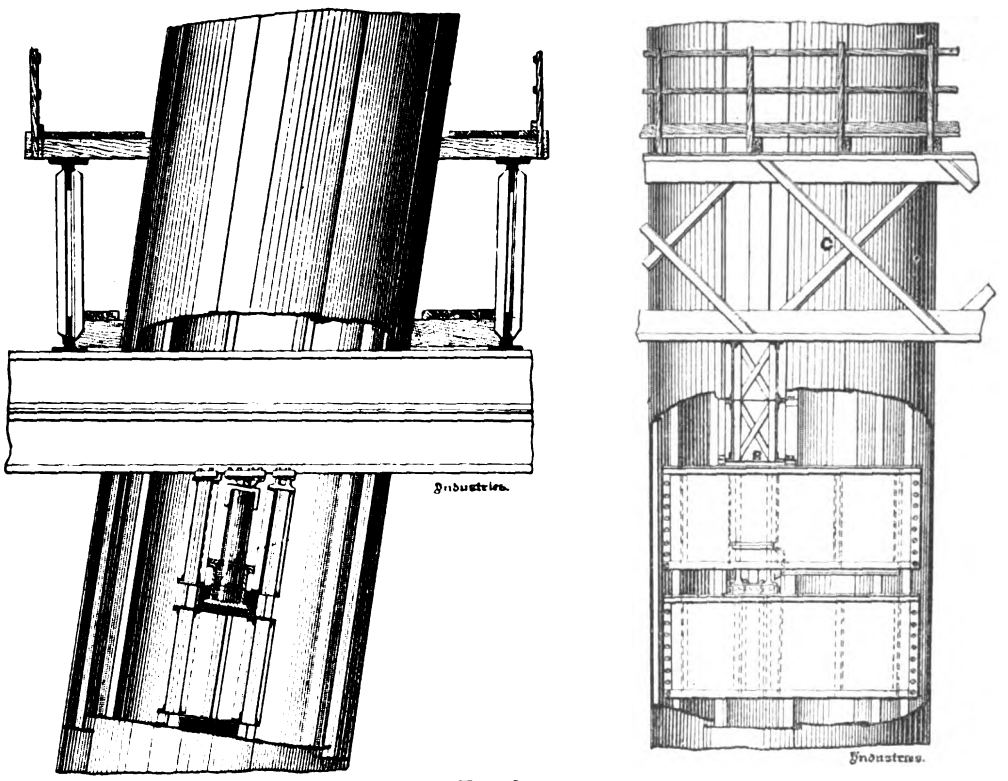


FIG. 3.

known as the "boatswain's chair." Between these two extremes the number and variety are almost innumerable. The platform with which the main piers were built surrounded in each case the entire pier. Those for the Fife and Queensferry sides of the river were similar in form and size, while that on Inchgarvie is larger, and has extra bearing and lifting columns placed in its centre. The Fife and Queensferry platforms (Figs. 2 and 4) consisted of two semi-independent platforms running parallel with the bridge, each surrounding the two vertical columns and

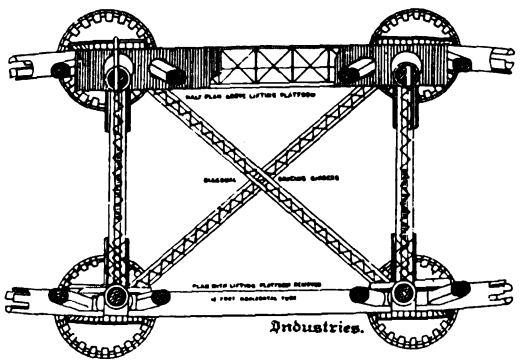


FIG. 4.

the two diagonal tubes on their respective sides. Each platform consisted of two parallel lattice girders, placed 18½ft. apart, with the necessary bracing, and were covered with planking, well holes being left to allow the columns to pass through. These half platforms rested on sliding blocks, placed on two strong box-shaped main lifting girders, which lay across the bridge and passed through the vertical columns. On the top of these box girders gangways were laid. These main lifting girders were in turn carried by short cross girders (see Fig. 3) within the vertical columns, pins passing through the girders and the permanent longitudinal H beams of the columns, to take up the weight. Similar cross girders were in like manner secured underneath these, and carried the hydraulic rams used for lifting the platform. The plant used in connection with these platforms was of a varied description, and comprised hoists for raising the material, cranes for building the columns, rivet heating furnaces, the large machines for riveting the vertical columns, and numerous other articles. So soon as a length of 16ft. had been added to the top of the columns above the platform, and one riveted underneath, the whole platform was raised another 16ft. This was effected by means of the hydraulic rams already referred to. On water being admitted to the rams, the weight of the main lifting girder was taken off the top cross girder, which allowed the pins to be withdrawn. This done, the main lifting girder and the cross girders were then raised 12in., and the pins re-inserted. One end of the platform now rested 1ft. higher than before. The action of the rams was reversed, and the lower cross girders were then raised the same height as the upper. The other end of the platform was similarly raised, and this alternate action was so continued till the full 16ft. lift was accomplished. During the operation of lifting, the two semi-platforms were moved towards each other to prevent them coming in contact with the battering columns as they rose. Before the pier reached its full height the bottom members of the cantilevers were commenced. As in previous instances, the first lengths were built by ordinary steam cranes. Soon, however, other means had to be adopted for carrying out the work. A cage (see Fig. 5) carried by the tube was secured round each of the members. It projected beyond the outermost point of the tube, and served as a platform whereon the men worked. A hydraulic crane was employed to put the material in position. It travelled along the whole length of the top of the cage, and could be turned completely round by means of hydraulic gear, in addition to raising and lowering the load. The cage is rectangular in shape, and consists of duplicate sections in 8ft. lengths, all of which are interchangeable. The cage is held in position by struts and ties, which extend from its corners to rings encircling the tube. As the work advances the sections are transferred from the back to the front of the cage. The hydraulic crane (see Fig. 5) used is of a peculiar design. It consists of two side travelling carriages, connected together by cross girders, on the latter of which are secured the connections necessary for carrying the jib and working the crane. The movements of the crane along the

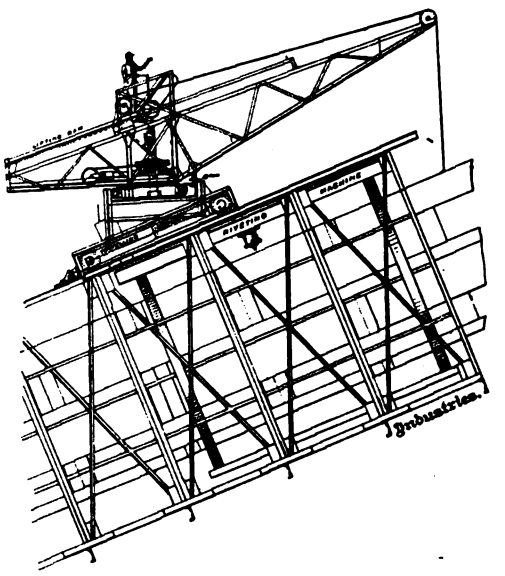


FIG. 5.

top of the cage are controlled by a ram on each of the side carriages. The raising of the load is effected by a single ram lying along the top of the jib. To the plunger of the ram a pulley is attached, and round it and the pulley on the jib point a rope is made to pass. This arrangement enables the load to be lifted a distance equal to twice the stroke of the ram. All the rams are made of wrought iron tubing, and castings are connected to the ends of the tubes for the fixtures and stuffing boxes. Steel wire ropes are employed to lift the load and slew the crane. For the building of the first section of the cantilevers, platforms (see Fig. 6) similar, though smaller, to those used in the case of the piers, were employed. They were built immediately over the bottom members, raised to a level position, and then lifted in stages till they reached a height about

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THE FORTH BRIDGE.

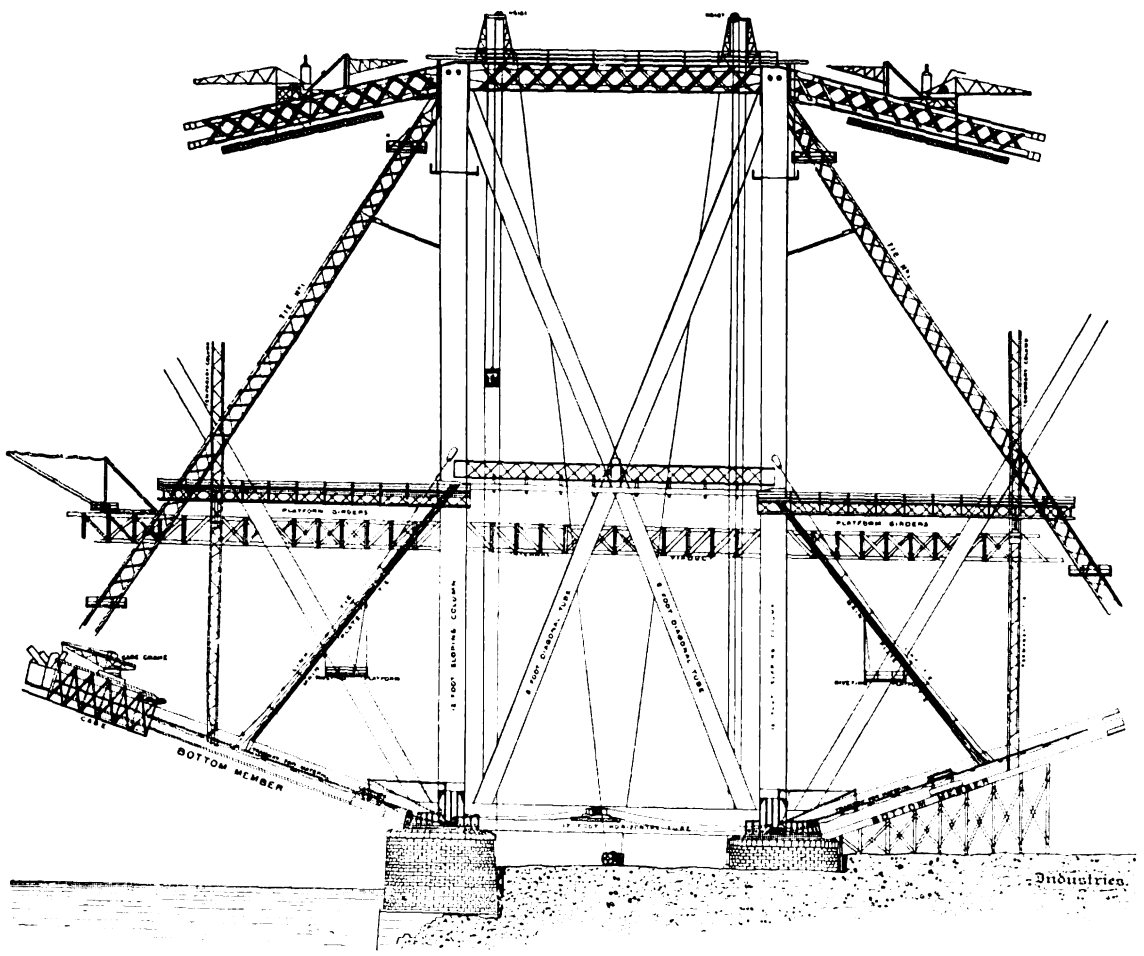


FIG. 6.

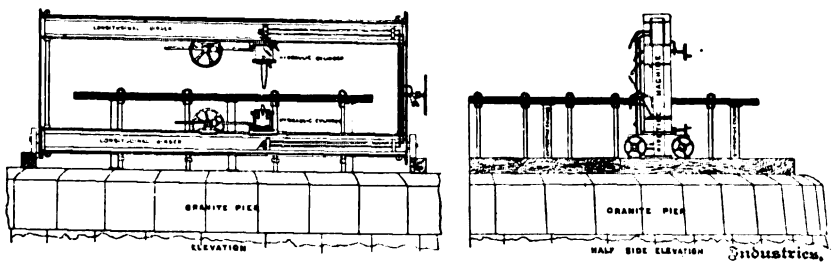


FIG. 7.

200ft. above high water. The raising was effected by means of hydraulic rams placed at each end of the platform. Those at the pier end were fixed to a projecting girder, secured to the vertical columns. Ties, or hangers, extended down to the platforms from these rams. Provision was made for the removal of the ties as the platforms were raised. The outer ends of the platforms were raised by rams, within the ties, which extended from the crossing of tie one and strut one to the bottom members in the middle of the bay. To the main lifting girders, extending across the bridge and carrying the platforms, these rams were fixed. Underneath the rams, and also on the opposite side of the ties, cross girders were secured by steel pins. In the erection of the top members and the upper parts of the cantilevers plant of peculiar construction has been adopted (Figs. 9 and 10). The plant rests on the upper surface of the top members, and consists of a sliding frame work of steel, from which a large platform is suspended. On the top of this frame work there are two cranes, one of which is actuated by steam and the other by hydraulic power. The former projects over the frame work towards the point of the cantilever, while the latter points in an opposite direction. The principal part of the work is done by the steam crane, as it is employed to build the webs of the top members, and also the upper half of the ties and struts. The hydraulic crane, on the other hand, is employed in placing the flanges of the top member in position, and afterwards in the riveting of the same. The steel frame work is composed of two main girders, lying across the two top members, and several cross girders. It is level on the top, and varies in depth and shape, so as to have a direct bearing on the respective sliding blocks fixed to the members. The steam crane is placed immediately over the top of the main girders, and has a jib 35ft. long, capable of being slewed 115 degrees on each side of the centre line of the bridge. The hydraulic crane rests on a platform projecting from the main framing. This platform is 76ft. long and 45ft. wide, and is secured to the frame work by braced angles. Its length is such that it almost extends as far as the points of the steam and hydraulic cranes, and in width is a little greater than the top members. It is made up of four longitudinal girders covered with timber, a hole in the front end being left for the material to pass through. When a length has been finished in front of the crane, the whole arrangement is moved forward to a position suitable for proceeding with the next length. The steam crane just referred to also places in position part of the material of the first ties and struts, and small stages are employed for work on these members. That for tie one (Fig. 6) consists of a timber scaffold, suspended by wire ropes from a beam lying across the upper booms of the tie. As the tie is gradually built downwards the scaffold is lowered by tackle. The stage for strut one is a steel cage surrounding the tube, and having two timber platforms, which are placed at different heights. It is secured to the tube by brackets, fixed at intervals, and is lifted by the steam crane on the top members. This cage is required only for the top half of strut one, as the lower part has been already built from the platforms used in the erection of the first section of bay one. Flexible steel wire ropes have been used in the lifting plant with good results. Accidents which occurred when chains and Manilla ropes were employed, have now entirely disappeared. During the erection, a large number of temporary ties and struts were employed for the purpose of keeping some of the members in position while unconnected, or enabling them to carry more temporary material. In the piers, both the vertical columns and diagonal tubes had, at several points, to be kept apart by struts, while the diagonal tubes had also to be tied to each other before they reached the top. The bottom members are now supported by temporary ties, which extend to the vertical columns. In these diagonal ties, the stress produced, for each bottom member, is about 500 tons. Although large platforms had been adopted in the beginning, smaller ones now take their place, as they are more easily managed. The reasons for employing these large platforms to build the piers, were principally a regard to the safety and convenience of the men at work. They enabled them to handle a large quantity of material, not only with speed, but attended by little danger to themselves. Large platforms are now not of the same value in the carrying out of the work, because cranes are already placed on the top of the bridge, which, without difficulty, can place material in position at a point 300ft. below themselves. By the introduction of light scaffoldings, only a few temporary ties are required to carry the permanent members.

Riveting Plant.—The hydraulic plant provided for closing as many as possible of the rivets in the bridge is, according to the work to be done, of a varied description. It may be divided into the following three types: 1st, the ordinary Arrol patent grab machine; 2nd, direct acting riveters, using pressures up to 3 tons per square inch; 3rd, special girder machines, for such work as the tubes and large flat surfaces. The first type mentioned does not call for special comment. The second type, or the direct acting riveters, using such a high pressure, is, however, we believe, novel. The riveter consists of a steel cylinder about 7in. long, provided with a solid piston having a cup leather at the back end. Two cylinders are used together, one acting as the holder-on, while the other is employed to close the rivets. Into each cylinder a pipe is screwed, which provides for the ingress and egress of the water, and at this point also the exhaust is regulated. The high pressure water is controlled by a valve on the pressure pipe at a point further back, and from where a convenient connection can be led to both cylinders. These riveters were originally designed and employed for riveting up the longitudinal girders and diaphragms in the skewbacks. Some of the spaces in which they had to work were only 2ft. 6in. long by 15in. high by 15in. broad, and access to this small space was still further reduced at the top by a 4in. angle all round. The method of application was to place one riveter on each side of the work. To each of these the water was led by a copper pipe from the regulating valve. A spring check valve was introduced into the pipe leading to the closing riveter, for the purpose of keeping back the water until the holding-on riveter had pushed the rivet home. When inserting a hot rivet, the holding-on riveter was moved out of position. After being replaced the water was turned on, when the riveter immediately pushed the rivet home, and held it firmly there. The other now came into play and formed the rivet head. A point requiring careful attention was the timber backing, on which the riveters had to take up their thrust. This was equally essential for both the speed and the quality of the work. Within the skewbacks it was no uncommon thing for a squad to close one hundred rivets per day, shifting during that time all the copper pipes and connections from cell to cell as they moved along. Although designed primarily for the riveting of the skewbacks, the application of these riveters has not been confined solely to them, but they have been usefully employed on other parts of the structure. Thus the heaviest rivets in the top connections of the vertical columns were almost all closed by them. In this case one of these riveters was used within the junction, while without an ordinary ram of about equal power was secured to a slide on a box girder. This girder, moreover, could be moved along the face of two other girders, thus giving the ram complete command over a large surface. The working pressure in this ram was 1000lb. per square inch, and in the small cylinder 3 tons per square inch. With this combined machine 150 rivets, from 8in. to 9in. long, could be closed per day. Before leaving the subject of high pressure riveters it may be interesting to consider the means adopted for raising the pressure of the water to almost 7000lb. per square inch. The most efficient means to gain this end is a pressure multiplier. This machine (Fig. 8) was constructed almost entirely out of ordinary plant. The principle was to employ a large ram, with a small pressure, for exerting an increased pressure by an attached small ram, the increase being proportional to the difference of the areas. This was effected by securing an 11in. ram to the one end of a frame, while at the other end of the same frame a 4¼in. cylinder was fixed. On the first ram a cylinder was placed, and attached to it was a small ram which acted as a plunger to the small cylinder. Water at a pressure of 1000lb. per square inch was led into the cylinder on the large ram, and as this power was transmitted to the small ram it gave a correspondingly greater pressure on the small cylinder. As the large cylinder moved backward and forward, it reversed

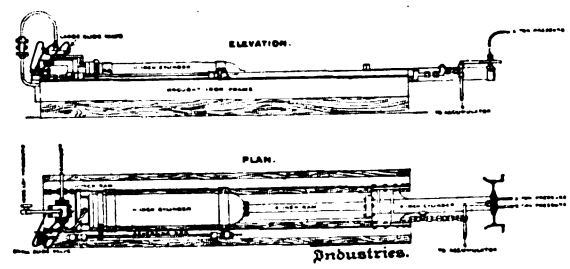


FIG. 8.

a small hydraulic slide valve which served to actuate the larger valve that regulated the water entering or leaving the low pressure ram. Besides this form of multiplier there are also portable ones. They are on the same principle as the large ones; but instead of being automatic in their action, they are worked by hand. The high pressure water pipes are made of wrought iron, and have flanges of the same material screwed and riveted on to their ends. The third type of riveting machines employed is of an entirely new pattern. Here also two rams are used. If required for such work as riveting the circular tubes, one of the rams is supported on a longitudinal girder outside of the tubes, while the other is held by a girder inside. These rams move on slides, and are capable of being raised or lowered by a small hydraulic jack. On the outside girder a compound slide is arranged to facilitate the adjustment of the die; but on the inside girder other means serve the same end. The outer longitudinal girder is, by slides at the top and bottom, secured to ring girders encircling the tube, and is traversed round the former by hydraulic jacks. Within the tube, and opposite these ring girders, are two diaphragms carried on brackets fixed to the longitudinal H beams of the tube. Each diaphragm has a centre socket or step, within which the points of the inside longitudinal girder are free to revolve. By gearing commanded from the platform on which the men are at work, this revolving motion is imparted to the girder, and through it to the ram. Working platforms are secured to both the outside and inside rams, and are raised or lowered along with them. The inside ram, being in most cases far removed from the rivet head, a special die has to be used. The machines when used for riveting the columns of the main pier were suspended

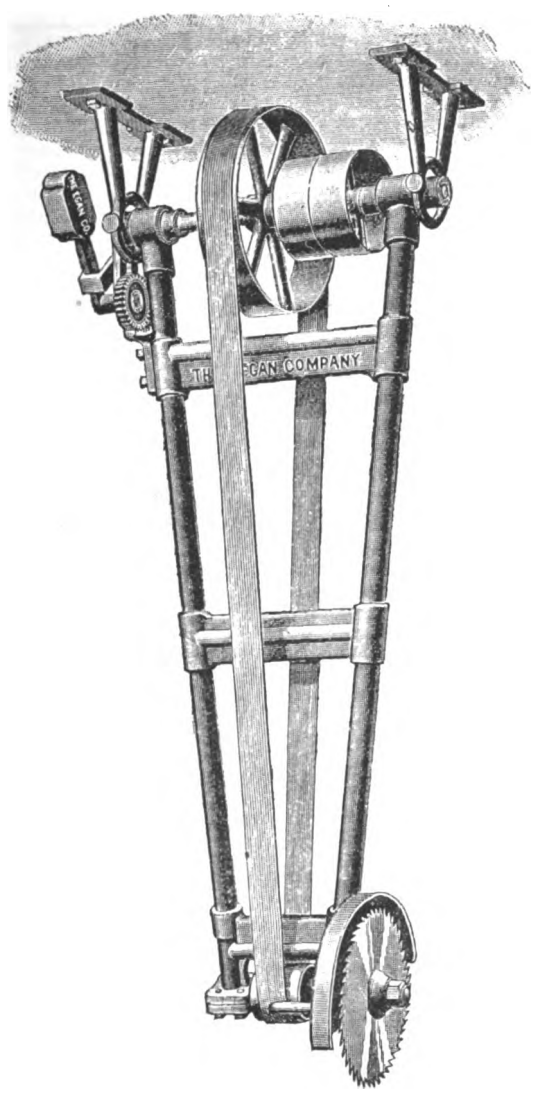
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from the platform and raised along with it. On the main pier six hundred to eight hundred rivets were closed in a day with the machine just described. The machines used for the diagonal tubes were the same in principle as the above. The outside girders and inside diaphragms were, however, different. These had a double D form, being thus similar to the tube. This was to permit of their traversing the longitudinal girders at a distance parallel from the tube, and with the rams always pointing in the right direction. In the case of the outer girder this was effected in a manner similar to that adopted in the large machines, while the inner girder followed a race on the diaphragm. These various movements were obtained by small hydraulic rams. The machines were raised and lowered by tackle secured to the tubes, and were quite independent of the movements of the platform. For the riveting of large surfaces of flat plates, such as the bed plates (see Fig. 7) under the main pier, the principle adopted was the same as that for the large tubes—viz., two longitudinal girders, one on each side of the work, both provided with a ram for closing the rivets. The girders were secured at the ends by the plates. These also served as part of the carriage on which the machine was moved along as the work advanced.

Oil Heated Rivet Furnaces—As a full illustrated description of the oil furnaces used at the Forth Bridge for heating rivets was given by us a short time ago (see *Industries*, Vol. III., page 618), we need only refer our readers to this description.

SWING CUTTING OFF SAW.

A NEW swing cutting off saw is being made by the Egan Company, of Cincinnati, Ohio, of which we give an illustration herewith, reproduced from the *Railroad Gazette* of New York. The frame consists of wrought iron pipes with cast iron braces, and is suspended in



turned sleeve boxes, which are fixed in the brackets by which the whole machine is bolted to the ceiling. For clearness of illustration these sleeve boxes are omitted in our engraving. The counter shaft, with fast and loose pulley and driving pulley for the saw, is supported in the head of the frame and in line with the sleeve boxes, so that the frame may swing freely without affecting the driving belt. On one side of the frame is fixed a segmental rack, gearing into a pinion which raises a balance weight when the frame is brought up to the cut, and automatically swings the frame back when the cut is finished. The makers claim that by this method of balancing the frame, the speed of work is increased; whilst through the suspension in special sleeve boxes the shaft is protected from bending strains.

THE FORTH BRIDGE.

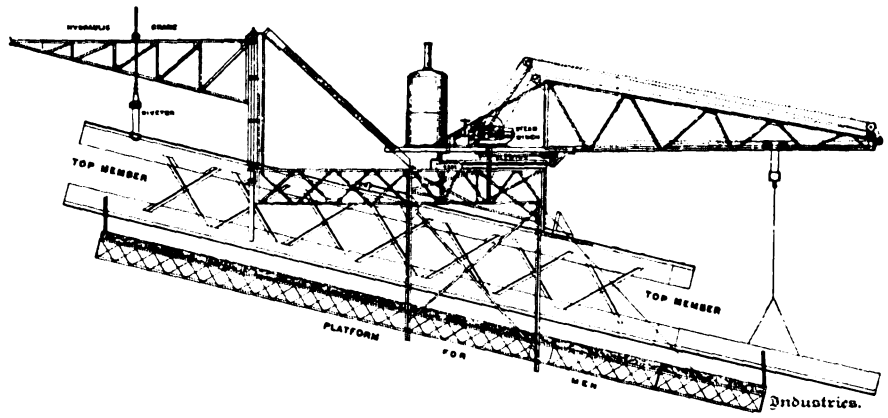


FIG. 9.

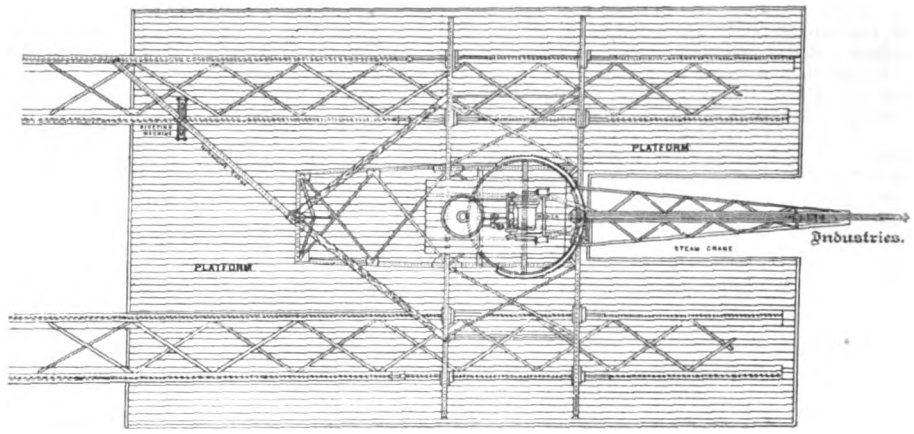


FIG. 10.

BRICKS AND BRICK MAKING.

AN interesting paper was recently read by Mr. William Johnson, of Leeds, before the Inventors' Institute, on the above subject. The principal improvements described by the author were as follow: (1) Process for manufacture of bricks from weak clays which are largely impregnated with lime; (2) the manufacture of fire bricks by machinery; (3) a new process for making a strong engineering and highly finished facing brick; (4) a process for the manufacture of sand faced bricks; (5) the utilisation of slate waste in the manufacture of bricks and other goods; (6) a substitute for the existing arrangement of brick making plants in Staffordshire.

Many clays which are used in the manufacture of ordinary bricks contain so much lime that the results obtained are far from satisfactory. The attention of the author was first drawn to improvements in the production of bricks from this weak clay by an engineer in Dublin. In several parts of Ireland the superficial clay contains from 20 to 30 per cent. of lime. On crushing this material, mixing it with water, tempering it, and subjecting it to heat, it was found by this engineer that the lime became silicated, and formed a flux which caused the whole to become one hard and strong conglomerate body, capable of withstanding a great strain. After several experiments, which were performed by the author with a view of producing this article in an economical manner, a machine was perfected which will turn out sound, strong bricks from the weak clay at a cost of 5s. per 1000. This character of clay is invariably of a soft and plastic nature, and must be first dried before it can be reduced to powder. For this purpose the author adopted a revolving cylinder 27ft. long by 5ft. in diameter. This is subjected to a temperature of from 700° to 1000°, which is produced by gas. The clay is brought up from the clay hole in the ordinary way by hoisting, tipped into a hopper, in which rotates a winged valve, forming a series of pockets which, as they come into position, are filled with clay, and each in turn discharges its load into the revolving cylinder, and the clay thus begins its traverse through the whole length of the cylinder, taking about thirty minutes to accomplish the journey. During all this time it is being subjected to the heat of the cylinder, the moisture thus being completely expelled. The thoroughly dry clay is then delivered at the lower end of the cylinder by a shoot into a perforated edge runner grinding mill, whence it is elevated into a revolving sieve. The fine powder drops through the sieve into a hopper, and the coarse is returned again to the grinding mill to be re-crushed. The powdered clay then runs in a constant stream into a double shafted and differential mixer, where the necessary water is added; then into the brick making machine and steam lever press, and the bricks, as they are discharged, are placed upon a bogie and taken direct to the kiln.

Another new departure in which the author has achieved success, is in the manufacture of fire bricks by machinery. There has always been strong prejudice against machine made bricks intended for refractory purposes. This has arisen from repeated failures, the bricks made having been either too loosely bound together or too densely formed. If the former, they were too friable and porous; if the latter, the contraction in cooling caused them to crack and break to pieces. The author stated that it was possible to produce by machinery a brick superior for resisting heat to the hand made brick. The necessary plant is simple and requires little power. It consists of an ordinary edge runner grinding mill, in which the clay is crushed; thence it is elevated into a differential double shafted mixer, where the water required is added; thence it drops into a hopper of the brick making and pressing machine, containing double moulds, making two bricks at once, which machine is both self feeding and delivering. The clay is fed into the hopper of the machine in a damp and granulated state. At the bottom of the hopper is a bottomless box, which is filled with clay, and travels over the two moulds, which are sunk below the surface of the table. The charger passes over them, empties its load of clay, and remains over them while a heavy pressing head drops with its own weight upon the body of clay in the charger, and insures the moulds being properly filled. This head is then withdrawn, and allows the charger to return again under the hopper for a fresh load of clay, during which time the pressing head drops a second time with its own weight upon the already charged moulds, and rests there to allow two further powerful pressings to be given to the bricks in the moulds. The head is then raised, and the bricks being automatically lifted out of the moulds level with the table are pushed away by the returning charger, to be placed by the attendant boy on to a bogie, and taken direct to the kiln without any shedding or drying. Examining the bricks thus made when burnt, it is difficult to distinguish them from the best hand made fire bricks.

The production of bricks from the waste of slate quarries has hitherto proved a failure; several modifications of the plant employed have been suggested by the author, with the effect of considerably improving the manufacture of bricks from this material. The fine even surface and the firm character of these bricks, and the perfect form in which they can be moulded, are such that they would no doubt largely, if not altogether supersede what are called rubber bricks, which, when ready for use, are worth probably not less than £10 per thousand, whereas these could be placed in the market at £5, and which price would insure a most handsome profit to the makers. They would also be preferred where resistance to great weight was required, and for hydraulic work, on account of their density and their non-absorbent character. They would also be suitable as adamantine paviours, invert blocks for main sewers, and for many other purposes. One great advantage in this material is that it is waste, and is already got to hand, and therefore to owners of quarries all royalty and cost of getting are saved.

The writer of the paper also described some useful improvements in the manufacture of facing bricks and sand faced bricks.

INTERNATIONAL TARIFF CONFERENCE.—An international conference, consisting of seventy-two members, is being held in Vienna, under the presidency of M. Lambermont, on the subject of Custom House tariffs, the object being to translate the tariffs into French, English, German, and Spanish.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 27TH MARCH, 1888.

THE IRON MARKET.—The situation appears to be growing desperate for the Paris merchants, who cannot agree among themselves. The Syndical Chamber, which was designed as a bond of union between them, is in a fair way of becoming disorganised. The consequences are a drop of 4s. a ton in bars and joists, and the prospect of unstable markets for some time to come. This question of the merchants apart, all circumstances at present are favourable to the revival of trade. We are entering upon the season of spring, the building of the Exhibition structures is in full swing, the building trade is unusually active, and large orders from the Panama Canal Company are on hand for execution. The demand for old rails steadily increases, the price being very firm at £3. 4s. The latest reports from the chief centre of industry are encouraging. The revival makes steady progress, particularly in cast iron goods, the prices of which are constantly rising. It is rumoured that the Société des Hauts-Fourneaux, of Pont-à-Mousson, have obtained through the Comptoir d'Escompte an order for about 550 miles of 8in. pipes for the conveyance of petroleum from the wells of Baku to the Black Sea. If this rumour, which seems to be well founded, prove true, we may expect a considerable advance in prices in the course of the current week. Business in finished iron and steel continues on the whole fairly animated, and prices are everywhere firmly maintained. The foreign trade shows a tendency to expand in finished iron goods. The exports in the first two months of the year amounted to 5506 tons of pig iron, against 6290 tons in the corresponding period of last year; to 5663 tons of finished iron and wire, against 3503 tons; and to 2750 tons of steel goods, against 9353 tons. The falling off is in steel rails. The imports in the same time were 20,360 tons of pig iron, against 19,454 tons; 4208 tons of finished iron and wire, against 5508 tons; and 1483 tons of steel goods, against 2041 tons last year.

THE METAL MARKET.—The metal market exhibits symptoms of weakness. Copper has receded £2 a ton, and there are abundant indications of a continued relapse. The "ring" of speculators who have taken this metal under their control, will no doubt keep the market in a state of constant fluctuation; but they cannot prevent the decline of prices on the whole. Tin is weak, particularly English tin. Holland has ceased to buy on the Paris market. Stocks here are sufficiently abundant to enable consumers to press for concessions in prices. Excepting Straits, all kinds have lost this week £2 a ton. Lead shows symptoms of weakness. Spelter maintains its price, but the demand is by no means strong.

THE FOREIGN WORKMEN QUESTION.—This question continues to disturb the industrial world. The agitation is chiefly among the working classes, who seem resolved to take vigorous action in the matter. A few weeks ago a deputation from the working men of Paris waited upon the Deputies of the Seine, to urge upon them the necessity of excluding foreigners from all Government contracts. Last week an important meeting of workmen was held at Marseilles, at which the following resolutions were unanimously passed: (1) That foreign workmen should be excluded from all national and commercial workshops. (2) That they should be excluded also from the workshops of all companies and firms who execute State orders. (3) That all private persons or public companies who employ foreigners in their service should be taxed. (4) That the proportion of foreigners should never be greater than one-tenth of the total number of hands employed. (5) That a heavy fine should be inflicted upon all who infringe these rules. It was further resolved to call the attention of the Government to the "disastrous situation to which the German competition has brought our commerce."

BERLIN, 26TH MARCH, 1888.

THE IRON MARKET.—Close upon the action of the rolled iron syndicate, which, as reported in my last letter, has raised the base price 2s. 6d., follows a similar step taken by the makers of profile iron, who, at a meeting in Frankfort-on-the-Main, have decided to raise prices 2s. a ton. In Upper Silesia the condition of the market is not only firm, but may be characterised as rising, especially as regards crude iron. This is partly due to the heavy orders for forward delivery, and partly because the discrepancy between the prices of crude and finished iron becomes more and more noticeable. It seems highly probable that good foundry pig will in the coming week not be obtainable under 57s. or 58s. per ton, whilst for inferior brands 56s. will have to be paid. Forge pig is also tending upwards, the probable limit within the next few weeks being from 50s. to 54s., according to quality. Plate makers are well employed, showing that considerable activity exists in boiler shops and engineering works generally. In the syndicated districts bar iron sells at 140s., profile iron at 155s., and boiler plates from 160s. to 165s. The building trade promises to become very active this year, and considerable quantities of building iron will be required. For this class of rolled iron the quotations vary from 111s. to 123s. according to the district, and the increase of 2s. 6d. per ton will be partly shared by dealers in the shape of a better discount. Steel wire for export is quoted at 103s. to 105s., and for the home market at 118s. The export trade is languishing.

MACHINE EMBROIDERY.—In Saxony the long winter has somewhat delayed the placing of orders for the summer requirements of embroidered goods; but, nevertheless, this branch of business is at present in a more satisfactory position than at the same period last year. Common embroideries and embroidered flounces are not much asked for since the fashion has changed, and the fine cambric Nansoe and silk embroidery have taken their place. Cotton weavers are well employed with gauze linings, Marly, &c., whilst English curtains are in fair request; bleachers and finishers are, consequently, also well employed.

JUTE.—At a recent meeting of the Society of German jute manufacturers, it was decided to prolong the union scale of prices till the 1st of July next, provided that the members of the Society agree to abstain from any extension of their business. One large works would, however, only agree to this on the understanding that the weekly working time of both spinners and weavers should be limited to sixty hours. The discussion of this proposal was adjourned till the next meeting of the Society.

TRADE WITH ITALY.—The new treaty of commerce with Italy affords advantages which must tend to promote the trade in cotton and woollen manufactured goods with that country. Already there are signs of the new life infused into the textile industries by the prospect here opened up. Manufacturers are preparing to meet a heavy demand which, it is confidently expected, will result from the establishing of favourable commercial relations in these branches of trade between Italy and Germany. There is good ground in the past for this expectation. Since the opening of the St. Gothard Railway, German intercourse with Italy has rapidly grown, and the advance is nowhere more strikingly seen than in the exports of cotton and woollen piece goods, in which we come into competition with English manufacturers. Last year the exports amounted to 23,434cwt., against 17,594cwt. in 1886 for cotton piece goods, and to 10,366cwt., against 7529cwt. for cotton yarns. The increase in woollen goods for the same period was from 20,434cwt. to 24,220cwt. for woollen fabrics, while yarns declined from 2202cwt. to 1308cwt.

HOPS.—During the past week about 700 bales of hops have been sold, but at rather low prices. Merchants are glad to dispose of their stocks, and are quite open to make concessions. The buyers are partly commission agents and partly exporters. The stocks of hops of good qualities are not very considerable, but large quantities of inferior qualities are in hand at Nürnberg, which is the principal market.

VIENNA, 26TH MARCH, 1888.

THE IRON MARKET.—No change of any importance has as yet taken place in the iron market; but the situation in some branches has been still further depressed by the heavy floods in Hungary. Crude iron remains dull; but some improvement is noticeable in rolled iron, especially for building purposes. In those districts which have not been affected by floods building operations are now being actively pushed forward. There are many public and private buildings in Hungary now in course of construction, and a brisk demand for rolled iron is setting in. There is also a good demand for plates and tinned sheets, but hardware is dull. Engineering works are fairly well employed. Negotiations have for some time been in progress with a view to forming a syndicate of wire nail makers. Some forty representatives of the trade met on the 14th and 16th instant, and agreed on the more important clauses. At these meetings the difference of opinion was so slight that there seems little doubt but that the syndicate will shortly be established. The necessity for a syndicate lies mainly in the low prices and heavy discounts which are usual in the nail trade. Some fairly good orders have been booked for rails, sleepers, and axles.

TEXTILES.—Large transactions in cotton yarns are taking place, both buyers and sellers being eager to do business; but the prices for wool have a downward tendency. The commencement of the season in the Buda-Pesth market has not brought about any alteration in the situation. Business in silk is by no means active, and the war of tariffs between France and Italy has had no favourable influence on our trade. Linen goods remain in good request.

THE SUGAR TRADE.—The success of the syndicating of other trades has led to a sugar ring being formed here, which proposes to raise the price of sugar by 20 florins per ton. The total annual consumption in this country is about 250,000 tons, so that if the present movement proves successful, sugar manufacturers here will benefit to the extent of 5,000,000 florins per year, a sum equivalent to the export bounties received by them.

ELECTRIC TRAMWAY.—Some time ago I reported the inauguration of a short experimental electric tramway line from the Central Station along the Königsgasse and part of the Ringstrasse, the total length being 1·1 kilometres. The service on this line has now for some months been perfect. The generating dynamo is established in a shed near the railway station, and the current is supplied by means of a central channel and a pair of conductors, against which slide two contact shuttles. There are at present only two cars in use. These are of the same type as those on the Lichterfelder tramway near Berlin. The transmission of power from the motor spindle to the car axle is by steel wire spiral cords. The central channel is of masonry throughout, with cast iron chairs for the support of the conductors, and has two steel rails on the top, leaving a slot 1¼in. wide. Manholes are provided in several places to give access to the channel, and efficient provision is made for draining it. Messrs. Siemens and Halske, who have built this line, are now experimenting with various forms of contact shuttle. They have asked for a concession to extend the line the whole length of the Grosse Ringstrasse, now building, and they also made an offer to the town authorities to build, and equip with electric apparatus, several tramway lines which were originally projected for steam traction. In all cases they ask that the usual concession of forty years should be prolonged to fifty years, the extension of time being justified by the heavy initial outlay for the permanent way.

CARBONS FOR ARC LAMPS.—The manufacture of arc light carbons forms an industry of considerable magnitude, and the works of Herr Hardtmuth, in Döbling, are now turning out about 3500 metres of carbons daily. Some improvements have recently been made in the process of manufacture, under which the homogeneity and density of the carbons are increased. These refer more especially to cored carbons. As usual, the rod of plastic material issues from the press in the form of a tube, and after drying and baking, the carbons are steeped in a heavy hydrocarbon, by which the pores left after the first baking are filled. The carbons are again baked, and the core is then inserted under a pressure not much greater than that of the weight of the plastic mass forming the core. In connection with this factory is a well equipped electrical laboratory for the testing of arc lamps. There are dynamo machines by various makers, viz., Pöge, of Chemnitz; Kremenezky, Mayer, & Co., of Vienna; Krizik, of Prague; and Siemens and Halske (alternator). The reason for installing various dynamos is to be able to test any lamp which may be sent to the laboratory. There is also a spectroscope for determining the elements contained in the carbon from the spectrum of the arc, and the laboratory is equipped with the usual electrical measuring instruments and photometers. The work at this laboratory is done on a thoroughly scientific basis, and both lamps and carbons are tested so as to determine the best quality of carbon to be used for each type of lamp. At the forthcoming Jubilee Exhibition Hardtmuth carbons will be largely used for the arc lamps.

BRUSSELS, 27TH MARCH, 1888.

THE COAL MARKET.—Although the influence of the winter season on the coal market is near its end, all kinds of coal maintain their position, and an advance has taken place in small coal. The future prosperity of our coal industry is a question of cheap transport. This subject has been discussed at a meeting of the Union Syndicate of Brussels, at which Messrs. Sabatier and De Vergnies advocated the total suppression of all tolls, and expressed the opinion that a reduction of the rates of freight was necessary to enable our coal to meet the competition to which it is subject. A reduction of the North-Eastern rates to Longwy and Nancy has caused a considerable increase in the railway traffic, and further steps of a similar nature are required to facilitate the export trade. Forward sales of coke have been made for the last quarter of the year at 12s. per ton. It is, however, doubtful whether the iron market will admit of such high rates being paid, as the exports of rolled iron this year will probably be less than in 1887, and the manufacturers of finished iron are unable to pay the high price asked for pig if they do not obtain more for their goods. In the Mons district the market is very good. Household coal finds a ready sale, and there is a strong demand for industrial coal. The situation at Liège is also favourable.

THE METAL MARKET.—As far as prices and orders are concerned, the market is satisfactory; but the scarcity of raw material causes some uneasiness among manufacturers. The sales of old railway material which took place last week show a decided difference in the prices compared with the last. The following contracts have been obtained for rolling stock for the State railways: Lots, each of 50 10-ton trucks—Société Internationale, £4,370; Société Haine St. Pierre, £4,376; Baume & Marpent, £4,384; Société Franco-Belge, £4,390; and Chandronneries de Houdeng, £4,390. Lots, each of 50 10-ton coal trucks—Morlauwelz, £5,080; and Dyle & Bacalan, £5,120. Lots, each of 50 coke waggons—La Metallurgique, £6,480; and Malines, £6,520. Lot, of 35 coke waggons—Nicaise & Deleave, £4,550. Lot, of 35 large covered waggons—Société Franco-Belge, £4,676. Lot, of 30 covered waggons—M. Verhaegen, £4,032. The plate syndicate has officially adopted 120s. as the base price for No. 2 plates, and the rates are now as follow, delivered in Belgium and on the Terneuzen canal: No. 2 plates, 120s.; No. 3, 137s.; No. 4, 192s.; No. 5, 240s. Large plates: No. 2, 112s.; No. 3, 120s.; No. 4, 145s.; steel sheets, 140s. Owing to stocks being low, pig iron continues very firm, and the high rates are maintained. M. Cambier will put a second furnace into blast next month at La Louviere, and this will have some effect on the situation. The production of rolled iron during the present season will amount to about 500,000 tons. Calculating that on the total consumption there is about 10 per cent. of loss—580,000 tons of iron were required for last year's production of 532,108 tons of rolled iron. The imports of foreign forge pig amount to 40,000 tons per year. This leaves about 540,000 tons to be produced in Belgium. There are at present in blast twenty-two furnaces, turning out daily 1845 tons of forged pig. Deducting 10 per cent. loss, this makes a total production of about 600,000 tons. It is therefore expected that the re-lighting of another furnace will produce a

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better balance between producers and consumers.—In the Charleroi district the works of Dyle-Bacalan and La Metallurgique are busy with rolling stock for the State railways and some narrow gauge lines, and with material for the Braine-le-Compte and Malines railway stations. There is a strong demand at Liège for pig, and prices are maintained, the Athus works quoting 38s. 5d., and Halanzy 40s. for No. 3.

Glass Works.—The foreign trade in glass during January, 1888 and 1887, was as follows, the figures for the latter year being given within brackets:—Imports: Window glass, £191 (£38); plate glass, £22 (£25); common glass ware, 222 tons (163 tons); ordinary glass ware, £2,500 (£2,328); fine glass ware, £46 (£37). Exports: Window glass, 5923 tons (5896 tons); plate glass, £19,942 (£10,283); common glass ware, 417 tons (93 tons); ordinary glass ware, 663 tons (835 tons); fine glass ware, 95 tons (40 tons). There are plenty of orders from the United States, but otherwise export trade is slack. Unfortunately, owing to the uniform prices established by the syndicate, most of the American orders have fallen into the hands of two or three of the large works, and smaller firms in consequence do not derive any benefit from the improved rates.

DÜSSELDORF, 26th March, 1888.

The Iron Market.—The iron market has changed but little in the past week. The greater part of the country is under snow, a circumstance unfavourable to the development of the spring trade. External influences have neutralised one another. Thus we have increased strength in England and weakness in Scotland. A languid market for finished iron and steel in Belgium, and renewed vigour in France. At the last meeting on the Siegen Iron Exchange business was active and prices were buoyant, sellers having apparently full confidence in the future. Spiegel pig for home consumption is in strong demand, but on foreign account few dealings take place. Contracts have been entered into sufficient to cover the next three or four months. The 10 to 12 per cent. manganese quality is still quoted at 59s. Forge pig is less inquired after. A few transactions for delivery in July and August have been recorded at 52s. Bessemer pig is in brisk demand at 54s. to 54s. 6d. Thomas pig remains unaltered at 45s. 6d. to 46s. Foundry pig is still much sought after. Business in finished iron and steel is on the whole fairly animated, but manufacturers complain of the high cost of the crude material. In present circumstances a further rise in finished iron seems impracticable. A journal has given the relative prices of German bars to Scotch pig iron warrants for each year since 1872. In the ten years ending with 1882 the ratio of bars to pig warrants was, on an average, 2·4. In the next five years, ending with 1887, the average was 2·5. The highest in the fifteen years period was 2·9, the lowest 1·6. At the present time the ratio is 3·3. This is a sufficient answer to those who maintain the opinion that prices are not abnormally high. There is more inquiry for bars; but joists are in feeble demand, the weather being unfavourable to building operations. For plates and hoops the market is active. Sheets are not much sought after, nor is there much life in the wire trade.

The German Export Trade.—At a meeting of the Union for the Protection of Industry in Rhineland and Westphalia, recently held here, the vitality of the export trade was made the subject of discussion. Figures were quoted to show that while the exports from England in 1887 compared favourably with those of the preceding year, the increase in the foreign trade of Germany was much greater. Thus, for cotton goods, the increase from England was 2 per cent., from Germany 25 per cent. Woollen goods increased 2 per cent. from England and 7 per cent. from Germany, and machines showed an increase of 10 per cent. from England and 80 per cent. from Germany.

LILLE, 27th March, 1888.

Textile Manufactures.—The wintry weather of the last week has had a retarding effect upon the course of trade in textile goods. Under ordinary conditions the spring trade begins to grow brisk in the fortnight immediately preceding Easter; but this year, with the greater part of the country under snow, the retail houses refrain from purchasing. The turnover in the linen goods trade has increased since last week, but it is considerably below that of the corresponding week of 1887. With the return of fair weather we may expect a rapid revival of business. In the Roubaix district the tone of affairs has improved, though the markets for woollen goods show no greater activity. It is, however, felt that we are on the eve of a revival. The present week, being that immediately preceding Easter, is likely to bring a great increase of business. Yarns are in slightly better demand, and spinners hope to obtain shortly more remunerative prices. South American wool has advanced fifteen centimes per kilo. Woollen cloth for men's wear is better situated than most other classes of goods, and weavers who make this a specialty have plenty of orders on hand. Hosiery, too, a branch of the woollen industry, which is rapidly growing in importance in the Tourcoing district, exhibits a fair amount of life. A report from Lyons describes the market as fairly active for silk goods. Many English buyers are on the spot, and these, as well as the agents of Paris houses, are purchasing freely. The goods most dealt in are Glacé, Moiré, and Pékin. The death of the Emperor of Germany occasioned a very heavy demand for crape.

Flax and Yarn Markets.—Home grown flax is still in good demand, and prices remain firm. There has been less buying in Russian, but prices have not given way. The situation is unaltered for yarns. The finer numbers are much sought after, at prices that tend upwards, while the middle numbers are comparatively neglected. Foreign and home orders are, however, sufficient to absorb the production, so that spinners are able to resist the efforts of buyers to obtain easier terms. Tow yarns are slightly weaker in price. A satisfactory amount of business has been done in jute yarns. Prices are very firm.

The Iron Market.—The market for iron has been less animated this week; but, as manufacturers have plenty of work in hand, these fluctuations attract but little notice. Doubtless the calm is in part due to the inclement weather. The strikes, which for some weeks past have disturbed the course of trade, have now come to an end. Prices are as follow: Merchant bars, £5. 4s.; joists, £4. 16s.; angles, £5. 12s.; common plates, £6. 8s.; boiler plates, £7. 6s.

The Sugar Trade.—The campaign of 1887-88 is now at an end, and the exact figures of the quantity of sugar produced are now known. The quantity of roots operated upon was 3,614,632 tons, against 4,873,755 last year, a diminution of 1,250,123 tons. The crude sugar produced amounted to 380,000 tons, against 472,000 tons last year, a decrease of 92,000 tons.

MADRID, 26th March, 1888.

Pig Iron.—The Viscaya Blast Furnace Company, of Bilbao, have now published their prices, which are about 12 per cent. under those obtained by the syndicate during the last twelve months. These rates are so low that some works will be unable to compete, and if the syndicate be not re-established, with prices on a more remunerative basis, it is difficult to see how these works can continue to produce.

Railways.—The shares of the railway between Bilbao and Durango are quoted at a premium of 100 per cent., which is in marked contrast with many of the other railways in this country, the shares of which stand at about half their original value. The difference is due to the way in which the schemes have been financed, and capital can be judiciously invested in Spanish railways if they be promoted in a proper manner. In the case of a concession for a line from Oviedo to Infiesto the whole of the necessary capital was immediately subscribed, as the business was in the hands of men whose names were a sufficient guarantee that the line would be constructed at a reasonable cost. It is probable that this line will be extended at a future period so as to pass from Oviedo to Bilbao through Llanes and Santander. Our railway lines have been much damaged by recent snowstorms, and in many cases they have been completely blocked. A bridge, near the coal basin of Mieres, was carried away a month ago, causing a total cessation of coal traffic; but communication was re-established last week.

NEW YORK, 17th March, 1888.

The Coal Market.—The anthracite coal trade remains dull, the supply exceeding the demand. Nearly all the miners have returned to work, and it looks as though the market would be greatly overstocked in a short time. At the conference to determine prices for the coming season, the following were adopted for anthracite: $3·75 per ton for fire burning broken, $4 for egg, and $4·25 for stove and chestnut, all f.o.b. The bituminous market is quiet, with but little inquiry. Prices, as fixed by the Seaboard Association, are $3·25 f.o.b. at South Amboy (New York), and $2·60 at Philadelphia and Baltimore. A number of European steamers are taking large cargoes of coal outward on account of scarcity of freight.

The Iron and Steel Markets.—The iron trade has again been dull this week. The pig market is practically unchanged. Makers of standard brands, whose stocks are low, fail to see either dulness or weakness; but those who have accumulated a lot of inferior brands or have new brands for sale, find the market very weak. There are moderate sales at old prices, and although some manufacturers are looking for a heavier demand, there seems to be little prospect of a decided change. As regards bar iron there has been a fair amount of business in specialties; but the general market is very dull. Some of the makers are willing to undersell the market; but as the price of bars is now nearly the lowest ever recorded, and considering the cost of the raw materials is the lowest ever known, a fall can hardly take place. Small lots command about 1·9 to 1·95 cents per lb. for best refined bars, and 2·1 to 2·2 for plates; but considerably better returns are given for anything like fair sized orders. The steel rail market is quiet, and prices are being maintained. Business will not be likely to improve as long as the tariff agitation continues. A reduction of $5 per ton duty would admit rails to the southern ports, such as Galveston, New Orleans, and Mobile, and would put the Pacific trade entirely in the hands of foreigners. The owners of the twelve steel rail mills in the United States have held a meeting to decide how the output for the coming year should be distributed. It is estimated that the demand will be but little over half what it was in 1887, and that prices will be lower. A leading coke operator states that inquiries for coke indicate that the steel rail mills will resume operations in a few weeks.

Electricity.—The current number of the *Electrical Review* of this city commences the thirteenth volume, and a new departure has been made by the addition of a coloured cover, the front page of which bears a bold design, which is free from all advertisements. The issue contains a number of interesting articles, is well illustrated and printed, and several improvements have been made in the arrangement of the letterpress.

The Metal Markets.—The copper market has been dull, but slightly higher. The total sales have amounted to 3,500,000lb., the greater part being for future delivery, at prices as high as 16·50 cents per lb. No more smoke is issuing from the Calumet and Hecla Mines, and the temperature is falling. The tin market has been quiet, about 160 tons having changed hands, the market closing at 35·80 cents to 35·95 cents per lb. The greater part of the dealings in lead during the last week have been speculative. Light sales for distant future delivery were made, evidently with the intention of impressing consumers with the idea that now is the time to buy. Spot sales were made at from 5·17½ cents to 5·20 cents, futures running as high as 5·35 cents per lb. for September.

Railroad Building.—The future of the iron trade is largely a matter of opinion, differences being due to guesses as to what railroad builders may do. Purchases of rails and material to date have been mainly for repairing or replacing equipment. The projected mileage for the next two years covers about 20,000 miles, that is, the mileage that is seriously intended to be built. Two years ago estimates were for 37,000 to 40,000 miles, of which 23,000 miles were actually built. The railroads will mainly be built to make land, mineral, and timber investments productive in the next five years, instead of for the traffic they may haul in the time. Short lines generally of from fifty to one hundred miles in length will be wanted, and most railway building will be of this character. The last report of the Railroad Commissioners of New York State gives some interesting data respecting accidents on New York railroads during 1886 and 1887. During 1886 there were 513 persons killed and 1138 injured, while in the last year the number had increased to 532 killed and 1260 injured. Attempts in every case were made to determine if possible where the blame for accidents should be laid, and an analysis of the tables in the report shows that the increase was not due to defective construction, rules, or discipline, but partly to unpreventable causes, and the greater part to the carelessness or misconduct of the parties injured. Although great improvements have been made in the last five years in the adoption of uniform signals and rules, and in the improvement of the construction of bridges, much remains to be done to make life safer.

PHILADELPHIA, 17th March, 1888.

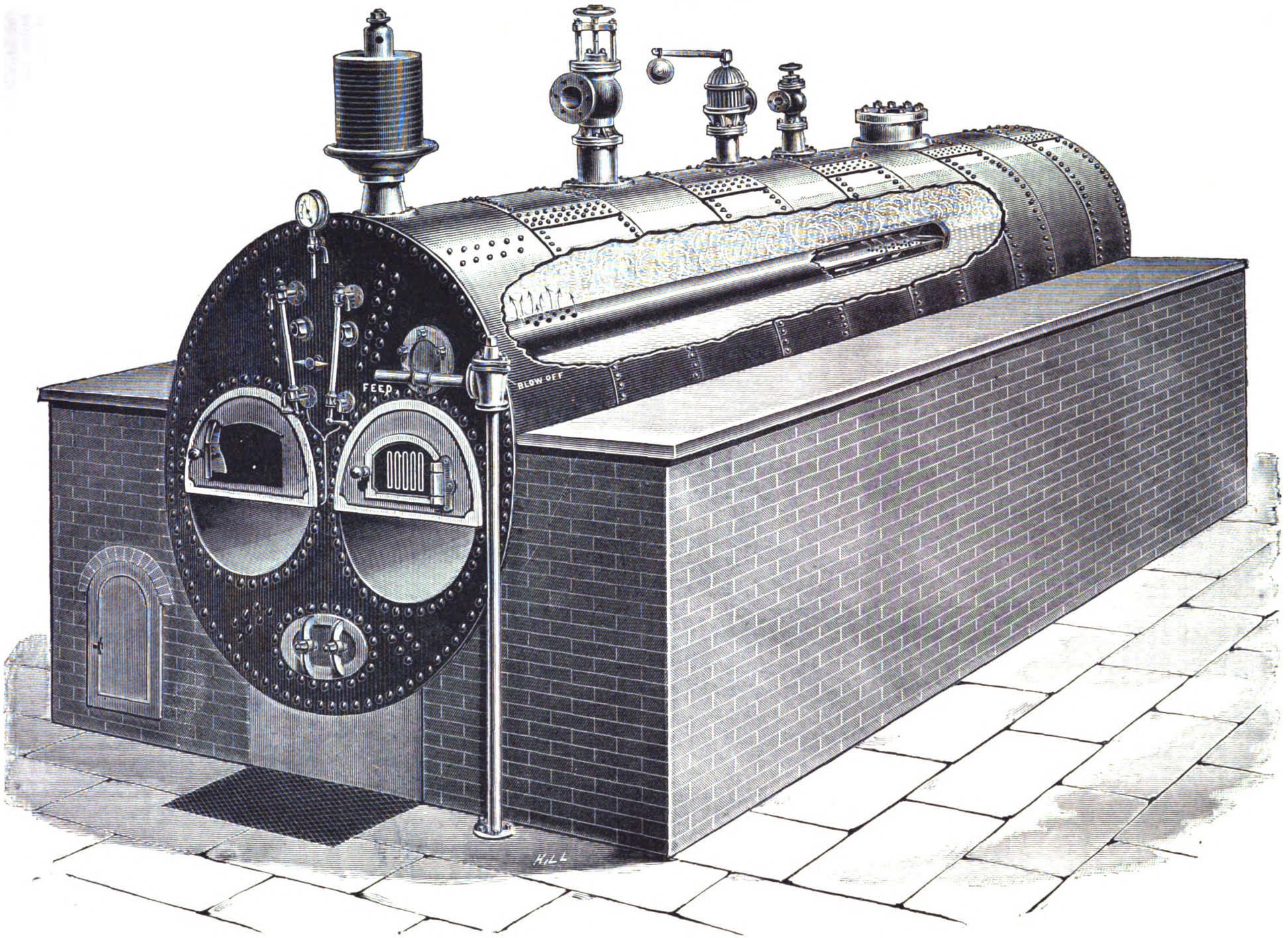
Central Electric Light Station.—The Edison Electric Light Company of this city are erecting the largest station for lighting in this country. As this station is to supply the central portion of the city, the land on which it is built is very valuable; it was therefore necessary to limit the area to 70ft. by 100ft. In order to get the required space, the building is carried up 114ft. above the pavement, and is divided into six storeys. On the ground floor will be located twenty engines of 250 i.h.p. each. They are of the Armington-Sims type, running at 200 revolutions per minute. The foundation for the engines will be practically solid with the concrete foundation of the building. On the second floor will be forty dynamos of 1500 lights each, making the total capacity of the station 60,000 16-c.p. lamps. The dynamos will weigh about 7 tons each, and will run at a speed of 650 revolutions per minute. On the third floor will be the workshops, where wires and conduits are prepared for laying in the streets and making connections with houses. On this floor will also be located the two blast fans, driving 50,000 cub. ft. of air per minute into the furnaces. The products of combustion will be discharged by means of two shafts, 9ft. in diameter, and so built on either side of the house as to resemble huge bow windows starting from the third floor. On the fourth floor will be placed the boilers. Their rated capacity is 5000 h.p., and they are to be of the Abendroth & Root tubular pattern. The smoke will be discharged downwards into the flues on the third floor, and the ashes, which will fall into pyramidal ash pans, will be discharged into cans on the same floor. On the fifth floor there is storage capacity for 1000 tons of coal. The arrangements are such that on the first floor the coal waggons are driven on to scales. After being weighed the coal is discharged into shoots, delivering directly into elevators, which carry it to the fifth floor, where it is shot into the bins. Arrangements are made for delivering the coal directly in front of each boiler. On the sixth or top floor will be the general offices of the company. The distribution is to be on the three-wire system, and there are thirty-five mains leading out of this station. The company has already expended £40,000 for copper conductors, and eleven miles of street mains have been laid, leaving about twenty miles more to cover the district. This quantity will be laid during the coming summer. The station when finished will cost £200,000. Arrangements have already been entered into to furnish upwards of 10,000 lamps, and as the company intends furnishing power in any quantity that may be desired up to 100 h.p., there is no doubt but that the venture will be a financial success.

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FEED WATER HEATER AND PURIFIER.

CONSTRUCTED BY MESSRS. CHARLES APPLEBY & Co., ENGINEERS, LONDON.

(For description see opposite page.)



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FEED WATER HEATER AND PURIFIER.

In the annexed illustration of a Lancashire boiler, a part of the shell is removed to show the arrangement of an improved feed water heater and purifier which is being introduced by Messrs. Charles Appleby & Co., of 89, Cannon-street, E.C. The apparatus is singularly simple in construction, consisting of a horizontal wrought iron pipe which extends into the boiler at or near the water level. The ends of the pipe are closed by cast iron plugs, that at the front acting also as a flange for fixing to the front plate of the boiler. In the centre of the pipe runs a horizontal wrought iron diaphragm, held at the two ends in a slot in each casting, and being tightly fitted into the pipe throughout its length at the mid section, it cannot sag. In the far end of the diaphragm a series of holes are drilled, and at the top of the front part of the tube there is a second set of holes. The feed water is introduced by a T pipe into the lower half of the tube, and travels its full length, passing upwards through the holes in the end of the diaphragm and returning through the upper half, when it finally passes into the boiler through the holes in the top of the tube. By thus forcing the feed water to traverse twice the length of the tube, it is heated to a high temperature, and at the same time the heat causes the water to deposit its impurities before it reaches the boiler. The deposition is facilitated by the comparatively low velocity of flow through the tube. The impurities are thus retained in the tube, and can be blown out from time to time. The pipe delivering into the lower half of the purifier is in connection on one side with the main feed, and on the other side with the blow-off pipe, each branch being fitted with a valve. The valve for the feed is shown on the right in the engraving, the connection with the blow-off pipe being shown broken off. When it is desired to clean out the purifier, the feed valve is closed, and communication opened with the blow-off pipe. The flow is now reversed, steam and water rushing in at the holes in the top of the purifier, flowing along the part above the diaphragm to the extreme end, then through the holes in the diaphragm and back along the under side of the diaphragm to the front of the boiler, and thence to the blow-off pipe. Under this action, all sediment deposited on the diaphragm and the lower part of the purifier is scoured out.

On a recent visit to Messrs. Appleby & Co.'s works we saw two Lancashire boilers, one of which was fed with Thames water in the ordinary manner, whilst the other had been fitted with one of these purifiers a fortnight previously. The difference of the colour of the water in the two gauge glasses was most striking. In the boiler which was fed in the ordinary manner the water was thick and muddy, and the cocks in a dirty condition. In the other the water showed perfectly clear, and the cocks were all clean. This boiler, we were informed, had not been cleaned out for a fortnight before the fixing of the purifier, so that the latter had not only cleared the entering water of deposit, but had partially purified the water already in the boiler. The purifier tube in the boiler we inspected is 18ft. long, 6in. diam., and $\frac{3}{16}$in. thick, the wrought iron diaphragm being of the same thickness. The holes in the diaphragm and pipe were ten in number, and 1in. diam. From testimonials shown to us from America, where the apparatus has been fully tried, both in stationary and locomotive boilers, we learn that the apparatus causes considerable saving in fuel, and an almost absolute freedom from scale in the boilers to which it is affixed.

Notices of Meetings.

NEXT WEEK.

Royal Institution of Great Britain.—Monday, 2nd April, 5 p.m. General monthly meeting.

Architectural Association.—Friday, 6th April, 8 p.m. Members' soirée. Fifth sessional visit.

Geologists' Association.—Friday, 6th April, 8 p.m. Ordinary meeting.

Junior Engineering Society.—Friday, 6th April, 7-45 p.m. Paper to be read on "Steel Manufacture," by Mr. H. Smethurst.

Institution of Civil Engineers.—Friday, 6th April, 7-30 p.m. Students' meeting. Paper to be read on "Coke Making," by Mr. G. E. J. McMurtrie, Stud.Inst.C.E.

New Process for Casting Copper.—Stern Brothers, of Essen, have obtained a patent for a new process of casting copper, whereby any shape and dimensions may be produced free from defects. The process, which has been found to give perfectly satisfactory results, offers great advantages, inasmuch as castings may be used in the place of drawn and rolled pieces. As these castings may be obtained in any degree of hardness, the process is likely to be largely used in the manufacture of electrical apparatus.

CLYDE SHIPBUILDING FOR FEBRUARY, 1888.

The tonnage launched in February was exceptionally small, the vessels for which contracts were booked in the autumn being still on the stocks. New contracts booked during February have not been of any considerable importance. Messrs. John Reid & Co., Port Glasgow, have a contract for a vessel of 1000 tons. Wm. Simons & Co. are constructing a dredger for the Manchester Ship Canal Company. Messrs. Fleming & Ferguson have on the stocks a small steam yacht of 40 tons for Mr. Sholto Douglas. Besides these a number of yachts are being built by various firms. Among these is a vessel somewhat similar to the "Thistle," but composite instead of steel. This yacht will be built by Messrs. D. & W. Henderson & Co., who were also the builders of the "Thistle."

The following vessels were launched during the month: "Chasely," steel screw steamer, 450 tons gross measurement, built by Messrs. Murdoch & Murray, Port Glasgow; "Nil," twin screw hopper barge, 400 tons, engines 300 i.h.p., built by Messrs. Lobnitz & Co., Renfrew, for the Suez Canal Company; "Strathearn," steel screw steamer, 2814 tons, engines 250 h.p., built for Messrs. Burrell & Son by Messrs. Alex. Stephen & Sons; small wooden tug, 10 tons, screw, for towing purposes on the Ganges, built by Mr. Rodger, Port Glasgow.

	Steamers. No.	Tonnage.
United Kingdom	2	3264
Egypt	1	400
India	1	10
	4	3674

	Tons.
Aggregate, February, 1887	7,399
" " 1886	11,360

PRICES CURRENT, 28th March.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/7½	Cash
Scotch Warrants, m/n		38/10	"
Hematite Warrants, m/n		41/11	"
Stocks in Stores. Scotch	963,461—Inc. for week,	2943	Tons
Middlesbro'	322,326—Dec. "	4432	"
Hematite	211,358—No change.		

Exclusive of stocks in makers' yards.
Market has a fairly steady tone.
Scotch shipments 6001 tons, against 7271 tons for same week last year.

	No. 1.	No. 3.	
Coltness	47/9	42/–	f.o.b. Glasgow.
Gartsherrie	44/9	41/3	" "
Dalmellington	39/9	38/3	" Ardrossan
Eglinton	39/–	37/–	" "
Glengarnock	43/9	39/9	" "
*Derbyshire	—	35/6	f.o.t. Works.
*Lincolnshire	—	32/6	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 17 6	.....	5 7 6	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 2 6	.....	5 12 6	Manch'r.
" Angles	5 12 6	.....	6 2 6	"
Crown Sheets	6 5 0	.....	6 10 0	"
" Hoops	5 5 0	.....	6 5 0	"
"Siemens-Martin" Steel Boiler Plates			7 17 6	"
" Ship and Girder			7 12 6	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/–
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/–
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/–

METALS.

Spelter: Ordinary	£19	5	0	to	£19	10	0
Copper: British Cakes and Ingots	79	0	0	"	80	0	0
" Chili Bars	80	0	0	"	80	5	0
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	0	0	"	15	2	6
" English Sheet	16	0	0	"	16	2	6
Tin: Straits	166	0	0	"	166	5	0
" Australian	167	0	0	"	167	5	0
" English Ingots	157	0	0	"	159	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Quotations for Chili very steady, but only a limited business has been done in ingots during the past week. Manufactured quiet, and quotations without change.

Tin.—Although quotations for Straits spot parcels keep firm at about £166 per ton, forward deliveries are obtainable upon a lower basis—say for May £135, and for June down to £125 per ton.

Lead.—We have no change to report.

Spelter is a little easier.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	27	10	0
" Ceylon	"	24	10	0
Cottonseed	"	20	15	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	18	10	0
Palm, Lagos	"	21	10	0
Rapeseed: English	"	23	10	0
Seal: Pale	"	23	10	0
" Brown	"	17	0	0
Sperm	"	41	10	0
Whale	"	14	0	0
Turpentine	per cwt.	1	8	3
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6½
" Spirit	"	0	0	7¾

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2¾	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	7	—	0	1	8
" Oxalic	"	0	0	3½	—	0	0	4
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6¼	—	0	1	6½
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3¼	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	17	6	—	12	0	0
" Liquor	lb.	0	0	3¼	—	.....		
Bleaching Powder	ton	7	7	6	—	7	10	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	30	0	0	—	31	0	0
Benzole (90%)	gal.	0	3	6	—	0	3	8
" (50/90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	0	0	5¾
" Prussiate (Yellow)	"	0	0	7	—	0	0	7¼
" Sulphate (Basis 90%)	ton	8	15	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—	.....		
" " (" 60%)	"	5	15	0	—	.....		
" " (Cream, 60%)	"	5	13	9	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	7	6	—	6	10	0
Zinc Sulphate	ton	7	0	0	—	8	0	0

We understand that Messrs. Holden & Brooke, Limited, St. Simon's Works, Salford, Manchester, have secured the principal employés formerly engaged by Messrs. Sharp, Stewart, and Co. in their injector business. The latter firm on removing to Glasgow have, we understand, arranged to discontinue the manufacture of injectors, and Messrs. Holden & Brooke are now supplying duplicates of the Giffard, Atlas, Friedmann, and other patterns recently made by Messrs. Sharp, Stewart, & Co.

On Tuesday, the 27th inst., Her Majesty's ship "Nile" was successfully launched at Pembroke dockyard. The "Nile" is a sister ship to the "Trafalgar," and she measures 345ft. in length between perpendiculars, and 73ft. beam. Her load draught will be 27ft. forward and 28ft. aft, and her displacement 12,000 tons. The hull is built entirely of steel, and her total weight amounts to 4230 tons, exclusive of glacis plates and protective decks. Two sets of triple expansion engines indicating 12,000 h.p. will propel her at a rate of 16½ knots.

On Thursday, the 22nd inst., Mr. Henry Robertson, M.P., died at his residence, Pale Hall, Corwen, North Wales. Mr. Robertson was well known as a railway engineer and director of several railways, besides being the owner of extensive coal and iron works. He was the engineer of the Chester and Shrewsbury Railway, and constructed the viaduct of nineteen arches across the Dee. He was also one of the principal promoters of the railway now in progress from Birkenhead across the estuary of the Dee.

On Saturday, the 24th inst., Mr. Benjamin Piercy, M.Inst.C.E., died in his 62nd year. Mr. Piercy was well known as the pioneer of railways in North Wales, and as the engineer of the lines which now form the Cambrian system, and also of several railways in Wales and Shropshire. He also constructed the lines of the Royal Sardinian Railway Company, and was engineer-in-chief of the Vendee Railway in France, and of the railways and collieries of the Assam Railways and Trading Company in India. He was largely interested, with the late Mr. Henry Robertson, M.P., in the coal and steel industries of North Wales.

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HOME INDUSTRIES.

MANCHESTER, 29TH MARCH, 1888.

THE COTTON TRADE.—During the past fortnight the fall in price of American cotton has become more marked; Middling Orleans now stands at 5⅜d per lb., which is a reduction of 1/16d. on the week. There can be no doubt that even the "bulls" are at last reluctantly compelled to admit that the size of the crop is larger than was estimated in November last. The trade helped to advance the price by free purchase early in the season, apparently because of an implicit belief in the *bonâ fides* of the American reports. It is perhaps a little premature, but it is quite safe, to predict that the autumn will again see a repetition of the same tactics, and in all probability with the same success. It is again proved that cautious buying is the best policy during the period when the first part of the crop is coming to hand, and it is hoped that spinners will take this view in the future. A similar fall has occurred in all ordinary spinnings, and the result is that spinners are little better off than they were. No sales of great magnitude have taken place, and there is a little anxiety among some spinners who are completing present contracts. At the same time there is evidence of business in the market if it can be transacted at the prices offered; but as sellers are still able, in most cases, to hold out against a reduction, sales are not effected. It appears likely that buyers will have to advance rather than that sellers will come to them. Silver is at present very weak, and the offers from the Eastern markets are made at lower rates in consequence. Cloth is weaker, and there is here an undoubted tendency to obtain orders even at reduced rates. For the moment the supply has overtaken the demand, and when the new manufacturing concerns which are in process of erection begin to work the pressure will be increased. There is some talk of a movement in North and North-East Lancashire for a reduction of wages, but at present no decided action has been taken. It is, however, certain that the margin which is now obtainable is very much narrowed, and the dividends of manufacturing establishments are likely to show a considerable decrease in the immediate future. On the whole, makers are still under contract, but in many cases these contracts are beginning to run out, and an era of lower prices seems inevitable.

RAILWAY ENTERPRISES.—The new line between Wigan and St. Helens was formally commenced last week, the contractors being Messrs. Pilling & Son, of Manchester. The line opens up several coal fields, and puts them in communication with the works of St. Helens and Liverpool. A direct line is projected between Burnley and Clitheroe. The line is only four miles long, and will thus save 10½ miles in distance. The company which has the matter in hand has a very strong directorate; the capital of the line is £168,000, and the engineers are Sir Douglas Fox, C.E., and Mr. G. H. Leane. The existing line of the Preston and Wyre Railway between Preston and Fleetwood is to be doubled. The contractor for this work is Mr. T. Riley, of Fleetwood. A much talked of line between Preston and Blackpool, running along the coast, is being begun, and will form a direct communication between Blackpool and the midland counties. The line is in connection with the West Lancashire Railway, and will be worked by the Cheshire Lines Committee.

THE SILK TRADE.—A meeting of the committee of the newly formed Silk Association, which was originated at the Manchester Exhibition, was held in Manchester a few days since. A code of rules was adopted, and the officers and committee appointed. It was determined to call a meeting of dyers and finishers, to consider what steps could be taken to improve this branch of the trade. A general meeting of the Association is to be called during the silk sales in London in July, and altogether the Association appears likely to be of great service in resuscitating the silk trade in the United Kingdom.

LONDON, 29TH MARCH, 1888.

THE MONEY MARKET.—The demand for money was considerable at the beginning of this week for the purposes of the Stock Exchange settlement, and the rates for loans hardened as compared with last week. Though there has been a fall in the Bank rate of a half per cent. since last settlement, the rates ruling this week were only about a quarter less than those charged a fortnight ago. Withdrawals of gold from the Bank, and the expectation that still more will follow if the course of exchange maintains its present tendency, have helped to give the harder tone to the market. The approach of the Easter holidays begins to tell upon the stock markets, for the Stock Exchange is always on the look out for an excuse, be it good or bad, for doing little business; but with the opening of the new account a better feeling is exhibited in nearly all departments. Investment business continues to run in an easy but steady current, and British Government securities remain strong. The foreign market is fairly good, though very susceptible to Continental rumours. Home railways have an upward tendency. There is also an appearance of the beginning of the long looked for improvement in American stocks, but this market is still most uncertain. The Budget this year is of special interest to the Stock Exchange, because a number of the new taxes affect it. The increase of the duty on contract notes puts a heavy tax upon every transaction. The taxation of the capital of new limited liability companies is a judicious step; and if the stamp duty on foreign securities can be thoroughly put into operation, it will be one of the most satisfactory and just features of any recent Budget.

COMPANIES.—The following new companies have been registered since our last report: Rockwell Silver Mines, Limited (New South Wales), with a capital of £175,000; Elandsfontein Gold Mining Company, Limited, with a capital of £150,000; Threlfall's Brewery Company, Limited, with a capital of £600,000; Tarapaca Water Works Company, Limited, with a capital of £40,000, to supply water to Iquique, Chili; the Gordon Diamond Company, Limited (South Africa), with a capital of £200,000; the Delta Metal Company, Limited, with a capital of £150,000; Hewitt Brothers, Limited, with a capital of £200,000, to carry on the business of brewers, at the Tower Brewery, Great Grimsby; the Patent Enamel Company, Limited, with a capital of £150,000; the Exeter Electric Light Company, Limited, with a capital of £20,000; the Callington United Mines, Limited, with a capital of £100,000; the Aboukir Company, Limited, with a capital of £300,000, to take over a concession granted by the Egyptian Government to reclaim Lake Aboukir; W. & R. Richards, Limited (brewers), with a capital of £11,000; the Moruya Gold and Silver Mining Company, Limited (New South Wales), with a capital of £85,000; the Springwell Brewery Company, Limited, with a capital of £150,000, to acquire the business carried on by Whitworth Brothers, Heckmondwike; Elk Mountain Gold and Silver Mining Company, Limited (Colorado), with a capital of £400,000; Waterloo Brewery Company, Limited, with a capital of £10,000, to carry on business at Oldham; the Fire Brigade Equipment, Limited, with a capital of £75,000, to acquire patents for fire escapes, and to manufacture such apparatus; G. P. Lee, Limited, with a capital of £25,000, to carry on a cabinet making business; the Hispania Tin Mining Company, Limited, with a capital of £175,000; the Guarino Hydraulic Gold Mines, Limited (Republic of Colombia), with a capital of £50,000; Dale Mills Company, Limited, with a capital of £12,000, to carry on the business of spinning, weaving, &c.; the Continental Pneumatic Tool Company, Limited, with a capital of £60,000, to acquire the Continental patents for the pneumatic tool described in *Industries*, Vol. IV., page 157; the Schanschieff Electric Light and Power Company, Limited, with a capital of £200,000; and the Julien Electric Company, Limited, with a capital of £100,000.

HEMP.—For spot sales of Russian hemp full prices are obtained, stocks being small, and moderate business has been done in futures at advanced rates. Italian hemp is unchanged. There is little doing in Manilla hemp for immediate delivery.

SUGAR.—Sales by refiners have increased, the stocks in the hands of dealers being low, but the market continues quiet.

SHIPPING.—A deputation from the Chamber of Shipping has had an interview with the President of the Board of Trade with reference to the necessity, in the interests of British shipping, of applying certain rules to foreign vessels trading with this country. The speakers suggested that the load line should be applied to foreign ships, and discussed several other points. Attention was also drawn to the importance of improving the means of access for large steamers to the Thames. The London and St. Katherine Docks Company announce that a new direct route will be opened on Saturday between Hamburg and St. Katherine Docks, by a service of steamers three times a week. On the motion of the Earl of Onslow, the Merchant Shipping (Life Saving Appliances) Bill has been read a second time in the House of Lords. Messrs. H. E. Moss & Co. in their circular state that in spite of what has been lately said about the large amount of tonnage under construction, there is not much fear of the freight markets being swamped. As it is, the building yards could accommodate twice the number of ships at present in hand. The firms now contracting for vessels are of a better class than those who went into shipping ventures between 1882 and 1884, and have practical knowledge of steamship management. Messrs. Moss state that the rumour of an intention by Lloyd's Committee to increase the scantling of steel built vessels has caused some owners to make inquiries about vessels of iron, and there is a probability of a slight reaction in favour of building with the latter material. Another thing that is having much weight is the difficulty in getting quick delivery of steel plates, the demand being so great and the manufacture so limited, while the production of ship plates of iron is practically unlimited. In connection with this subject, it is mentioned that heavy contracts for steel plates and angles have been placed in Belgium by some shipbuilders. Almost every contract placed during the last six months is for steel hulls and triple expansion engines.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 18th March, amounted to £1,103,074 on 15,850¼ miles, as compared with £1,089,675 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 141½ miles or 0·8 per cent., and in the receipts of 1·2 per cent.—A Select Committee of the House of Commons has passed a Bill authorising the construction of the proposed Metropolitan Outer Circle Railway, which will pass through Ealing, Sudbury, Kinsbury, Hendon, Finchley, Southgate, and Tottenham.

FOREIGN EXHIBITIONS.—At the first meeting of the Executive Council of the British Section of the Paris Exhibition the financial aspect of the matter has been discussed, and it has been decided to make a charge of 5s. per square foot to cover the various expenses which will be incurred in fitting up the courts, &c. Should any surplus be left, the exhibitors and guarantors will decide what shall be done with it. The guarantee fund already exceeds £12,000, which it is anticipated will be largely increased. The Council will be glad to hear from firms of high standing who intend to exhibit, and information may be obtained at the offices of the British Section, 2, Walbrook, E.C.—The Secretary of State has communicated to the Society of Arts a dispatch from the British Ambassador at Madrid, stating that the first batch of goods for the Barcelona Exhibition has arrived from Germany and Austria, and that great efforts are being made to insure the success of the French portion of the Exhibtion. It is stated that there will be over 30,000 exhibitors, of whom only eighty are English.

THE NAVY.—Owing to the falling off of the amount of boiler work at Sheerness Dockyard, about forty-five men will have to be discharged.—A successful trial was made on the Thames on Monday of a new torpedo boat, built by Messrs. Yarrow & Co., of Poplar, for the Government. She is 56ft. long by 8ft. 3in. beam, and has a displacement of 10 tons light and 14 tons loaded. Her speed is 16 knots per hour. —The new armour plated barbette ship "Rodney" has completed the trials of her four 69-ton breech loading guns at Sheerness, and is ordered to be ready for sea by Saturday, 31st March.—The Admiralty has decided that in future midshipmen in the navy will have to acquire a knowledge of steam and marine engineering, and instruction will be given to them during the last two years of their term of service in these branches.

GLASGOW, 29TH MARCH, 1888.

THE GLASGOW CENTRAL RAILWAY BILL.—This Bill, promoted by the Caledonian Railway Company, came before the Lords' Committee on Opposed Bills last week. Although the standing orders were held not to have been complied with so far as regards the promotion of the Bill by the Caledonian Railway Company instead of the original promoters, this will not interfere with the progress of the Bill, but it will now be pushed forward by the original promoters. It is, of course, open to the Caledonian Railway Company to purchase the undertaking immediately after it receives the royal assent, should it reach this stage.

SHIPBUILDING.—Messrs. Macmillan & Son, Dumbarton, have contracted with foreign owners for the construction of a steamer of 1200 tons. The Ailsa Shipbuilding Company, Troon, have entered into a contract with Captain Weatherill, of Dublin, for the construction of a steel screw steamer of 500 tons, with triple expansion engines of 500 i.h.p.

ENGINEERING.—Messrs. Brownlie & Murray, Possil Park, have just contracted for the erection of a sugar factory for a foreign firm. The building is to be 400ft. by 85ft.

PATENT CASE.—An important patent case, in which a Glasgow firm was involved, has just been made the subject of a judgment of the House of Lords. The United Horseshoe and Nail Company, Limited, London, sued Messrs. John Stewart and Co., iron and steel merchants, Oswald-street, Glasgow, for alleged infringement of two patents for machinery for the manufacture of horseshoe nails, claiming damages to the amount of £10,000. The London company had been selling through their agents in Scotland (Messrs. John Donald & Son, Glasgow) horseshoe nails manufactured by their patent machinery, and allege that Messrs. Stewart purchased from a Swedish firm quantities of nails produced by machinery which violated the patent rights in question. An interdict against the sale by Messrs. Stewart of these nails was sought for and obtained; but there remained the question of damages. When the case came up before the Court of Session in Edinburgh, Lord Kinnear awarded £530 to the London company; but on appeal to the First Division of the Court of Session, the damages were reduced to £50. Against this judgment an appeal was taken to the House of Lords, and here the judgment of the First Division of the Court of Session has been reversed, and the decision of Lord Kinnear affirmed. The damages payable by the Glasgow firm are thus fixed at £530.

INTERNATIONAL EXHIBITION.—The fairy fountain is now approaching completion, and Messrs. Doulton's fountain is also making good progress. The barricade which will shut off for the purposes of the Exhibition a large portion of the West End Park, is being erected. The bishop's palace, the refreshment rooms, and the switchback railway are practically finished. The second bridge over the Kelvin, for the service of the Exhibition, has been built. Exhibits are now beginning to be put in their places, and altogether the arrangements are well forward.

(From our own Correspondents.)

LIVERPOOL, 28TH MARCH, 1888.

NEW WHOLESALE FISH MARKET.—On account of the great increase of the fish trade of the port, which last year amounted to about 25,000 tons, the existing premises were found to be totally inadequate for the requirements of the trade. Fresh plans have been drawn out by the city surveyor for new premises to be erected on the site of Lucas' repository. In the presence of the City Council, and others interested in the movement, the foundation stone was laid by the Mayor on Monday last.

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THE PIPE TUNNEL UNDER THE MERSEY FOR THE VYRNWY WATER SUPPLY.—At the meeting of the Water Committee held on Monday last, the tender of Messrs. Monk & Newall for constructing the tunnel to convey the double line of pipes under the Mersey at Fiddler's Ferry, from the Vyrnwy Valley to the Prescot reservoir, was accepted; the amount of the tender being about £20,000.

THE CUNARD STEAMSHIP COMPANY.—The annual report of this company states that the profits of the working or revenue account is £263,983. 17s. 6d.; the amount at the credit of the profit and loss account, after payment of debenture interest, is £254,482. Of this sum £135,500 has been transferred to the depreciation fund, and £77,839 to the insurance fund; £40,000 of the remainder is recommended for payment of dividend, at the rate of 2½ per cent. per annum. The rates of freight had been very low, but there had been a considerable increase in emigration. A larger number of cabin passengers had been carried than in the year before. The "Umbria," "Etruria," and "Aurania" have been fitted with gun platforms, to enable them to act as armed cruisers, in accordance with the agreement of the company with the Admiralty.

SHEFFIELD, 28TH MARCH, 1888.

THE STATE OF TRADE.—There is a good demand for manufactured iron. Bars are selling at £5. 5s. per ton, with an upward tendency. The returns made to the Board of Conciliation as to the decreased output of manufactured iron for January and February this year, compared with that in the two closing months of last year, has not caused any surprise, for makers had large stocks, and these in some cases have not been worked off to any extent. The next two months should show a decided improvement, for both iron and steel are in extensive demand. Plates for shipbuilding, propellers, heavy machinery, and boilers are yielding plenty of employment, and there is, in fact, in most of the heavy departments a steadily developing trade. There is much industrial enterprise in the town. Firms are putting down improved plant and machinery, and in not a few cases extending their works. The new forge at Grimesthorpe, put up by Messrs. Cammell & Co., for the production of great ingots, will soon be completed, and the Cyclops, as well as several other large Sheffield concerns will perhaps be busy before the year is out on material for coast defence, or more aggressive warlike purposes. The outlay in plant and machinery at the ordnance works recently erected in the local industrial quarter of Brightside is very great. At the foundries work is tolerably brisk, and the rolling mills are going almost constantly. One or two good orders have recently been received for heavy plant for use abroad; and the Japanese, who are making wonderful progress in industrial skill, are taking engineering work from Sheffield. Now that there is some prospect of the departure of winter, a brisker trade is being done in garden tools.

NORTH STAFFORDSHIRE, 28TH MARCH, 1888.

BANKRUPTCIES.—The public examination of Mr. Edward Williamson, late coal and iron master, trading as Kinnersly and Co., Clough Hall Iron Works, Kidsgrove, was continued yesterday, and eventually adjourned to allow of certain parties being examined in Chambers.—An application was recently made at Hanley to the County Court Judge, on behalf of Mr. T. W. Handley, of Manchester, trustee in the bankruptcy of John Nash Peake, colliery proprietor at Knutton and elsewhere, for leave to disclaim a lease of some mining property at Knutton, granted by the governors of the endowed schools at Newcastle-under-Lyme to the late Mr. Thomas Peake, and assigned by him to the bankrupt, from whom he obtained an indemnity against liability under the lease. The latter had spent in sinking pit shafts and putting up plant nearly £20,000, the greater portion of which, counsel stated, had been found by his creditors. The judge ordered that the trustee should have power to disclaim, but he gave the lessors six weeks in which they might buy the fixtures. If the interest in the fixtures was not purchased by the lessors, the trustee should have six weeks further, in which he should have a right to sell and remove such interest as he had in the fixtures of the bankrupt estate affected by the lease, and after that he is to be at liberty to disclaim.

NORTH STAFFORDSHIRE WATER BILL.—The North Staffordshire Water Works Company have failed in their effort to obtain special powers to bring a sufficient quantity of water by a process of gravitation from Moddershall Oaks to the town of Stone, the Committee of the House of Lords having decided that the preamble of their Bill had not been proved.

BIRMINGHAM, 28TH MARCH, 1888.

THE METAL TRADES.—In the metal trades of this district it is very common to hear the opinion expressed that the revival in trade, talked about so much recently, has quite disappeared. In the copper and brass industries, the high prices engendered by speculation are causing slackness. It is feared that the reaction which must come will not altogether suffice to bring about a return to the *status quo ante*. The inflation of prices is causing railway and other companies to substitute soft steel for copper in fire boxes, and brass in boiler and condenser tubes; and when once the cheaper metal has been proved to be practicable, the copper goods will not easily regain their former position. The world may, in the end, be the gainer; but a considerable amount of inconvenience and loss must for a time result. The constriction in the use of copper is leading to accumulation of stocks in the hands of the syndicate, and to sales at reduced rates by outsiders; hence it is thought that the stability of the copper combination is becoming less assured, and the near future may have some surprises in store for the brass trades. In the iron trade a tendency to quietness prevails, but restriction in the output of pigs is preventing any fall in prices. Wrought iron is chiefly in demand for sheets and for galvanising purposes, and prices are lower than at the beginning of the year, the fall in double sheets being about 12s. 6d. Galvanisers are busy on certain classes of goods, such as wire netting, which always go off well at this season; but in the larger branches, for example corrugated sheets, there is in some cases absolute slackness. Steel is in good demand.

LEICESTER, 28TH MARCH, 1888.

WOOL, SPINNING, AND YARN TRADES.—There is a slight change in the direction of better business. Prices are at present at such a low level that some buyers are of opinion that they cannot go any lower; some transactions have, therefore, been concluded at late rates. But this feeling is not general, and many consumers of the raw material are deferring their larger operations, and are content to buy only for their immediate wants. Country dealers and growers are not disposed to yield a fraction on late rates, and as staplers are not pressed, there is but little being bought. The demand for yarns is not very brisk, and spinners find some difficulty in keeping their machinery employed, and stocks, moreover, are as a rule fairly heavy. Cashmeres and fine yarns are mostly in demand; the bulk of the business done is at very narrow profits, and competition is remarkably keen all round. Yarn merchants are not doing a very good trade.

BARROW-IN-FURNESS, 28TH MARCH, 1888.

SHIPBUILDING.—The first official visit of the directors of the Naval Construction and Armaments Company, Limited, was paid to the works at Barrow this week. All the directors were present, including the Marquis of Hartington, Lord Brassey, and Mr. Nordenfelt. From the date of the formation of the company up to the present time attention has been chiefly directed to the preparation of the works for what is expected to be a very large trade, and the visit of the directors to Barrow is associated not only with the inspection of the new property acquired, but with large schemes for the construction of steamships of great size and power for mercantile and other purposes. In the course of a short time it is expected that the yard will be very busily employed; in the meantime the new company have booked their second order for a new steamer of the "Como" type. The "Como" was built by the Barrow Shipbuilding Company, and now the new company have secured the order for two duplicates of her. Of course the commencement of active operations at the yard of the new company will lead also to a brisker trade at the Barrow Steel Works in the production of steel shipbuilding material, so that Barrow will secure two advantages from this new enterprise. Shipbuilding at Whitehaven is in a better condition, three sailing ships being now on the stocks. Messrs. Westray & Copeland, at Barrow, have cut the Manx steamer, "King Orry," in two, and are putting an additional 30ft. in her midships, preparatory to fitting the new engines and boilers, which are in course of construction. By means of forced draught and other alterations, the Barrow Shipbuilding Company, through the Naval Construction and Armaments Company, Limited, are making progress with the Manx steamer "Mona's Queen," which will be on her station in the early part of the season, with accelerated speed.

IRON AND STEEL.—The depression in the iron and steel trades, reported last week, has not been maintained. A better demand has sprung up for hematite, and prices have moved upwards in sympathy, being quoted to-day at 43s. 3d., against 42s. 6d. last week. Makers, however, are not pressing sales, as they are busy, and expect better prices. In the steel trade there is a very firm tone, and in all departments the demand has strengthened. Heavy rails are quoted at £4 per ton, against £3. 18s. 6d. last week. Plates and angles, which are in better request, are quoted at £7 and £6. 10s. respectively; and billets, which are firm, at £3. 18s. 6d. Iron ore is quiet in tone, but firmer in price, 9s. to 11s. per ton net at mines for ordinary qualities.

MIDDLESBROUGH, 28TH MARCH, 1888.

FINISHED IRON AND STEEL.—Manufactured iron is unchanged. The works are going steadily, as there are plenty of orders. Most manufacturers have orders which will keep them going for some time, and these maintain the prices that they have been obtaining. In steel there is hardly the same activity as formerly, except in ship plates, which cannot be delivered as rapidly as wanted. The stormy weather, however, being unfavourable for shipbuilding, will so far enable the plate makers to keep pace with the work.

PIG IRON.—The attendance at the market on 'Change to-day was good, and the tone was steady and firm. As the month is drawing to a close there was little or no disposition to do business, except in small parcels urgently wanted. The unfavourable weather interfering with shipments has somewhat marred the expectations of holders of iron that prices would advance; buyers are content to wait to see what the returns will show. In the meantime the nominal price of No. 3 G.M.B. is still 31s. 6d. per ton. Forge continues to be much in demand, on account of the improvement in the wrought iron trade, so that even as high as 32s. has been given for approved brands From 30s. 9d. to 31s. is the usual price.

SHIPMENTS OF PIG IRON.—The weather having become more favourable the shipments have again maintained an increase over those of last year during similar periods. The weather is still far from settled, and has told upon the home consumption as well as on foreign exports.

NEWCASTLE, 28TH MARCH, 1888.

STEEL.—In the early part of the month Messrs. Hawks, Crawshay, & Sons made a successful commencement with the manufacture of steel by the Siemens-Martin process, and the effect of this new venture is already beneficially felt in the local shipbuilding yards, where the difficulty of obtaining necessary supplies of material has for some time past been a serious hindrance to operations. Only one furnace, capable of turning out about 200 tons of steel weekly, has as yet been put in operation, but the erection of a second furnace is now nearly completed, and it will be ready for work by the middle of April. Steel plates for shipbuilding are being produced in considerable quantities, and the firm have secured several forward contracts for material of this description. Among others may be mentioned one entered into with Messrs. J. L. Thompson, of Sunderland, for plates, &c., to be used in the construction of some of the large vessels now on the stocks at the North Sands yard. Messrs. Hawks, Crawshay, & Sons have also re-commenced the manufacture of iron ship and boiler plates, which they discontinued some years ago, and in this department of their business they are likely to be very actively engaged during the whole of this year. One of the two new Siemens-Martin furnaces recently erected in connection with Messrs. Palmer's steel works, Jarrow, has also been put in operation, and the other will be started by the end of the present week or the beginning of next. Messrs. Palmer are themselves large consumers of the steel plates, &c., manufactured in their works; but in addition to supplying their own wants, they have hitherto taken an important part in meeting the requirements of other shipbuilding firms on the North-East Coast. With the increased resources now at their command they will, of course, be able to do this more effectually, and will no doubt prevent a good many orders for shipbuilding material from going out of the district. Messrs. Spencer & Sons, of the Newbury Steel Works, are well supplied with orders for their various specialties, such as patent anchors, patent cranks, shafts, ships' stern frames, &c.

IRON.—A satisfactory tone is still manifested in the finished iron trade, and the substantial advance which was obtained some weeks ago in the price of plates and sheets is fully maintained. The rolling mills at Gateshead are working almost without intermission, a condition of things which offers an agreeable contrast to the state of matters a year ago, when they lay idle for at least two weeks out of four.

CHAIN AND ANCHOR WORKS.—The makers of small chains, at Messrs. Abbot's factory, Gateshead, are kept tolerably busy, but in the cable chain department there has been nothing done for the past three weeks, owing, it is understood, to some difference between the employers and the operatives, respecting the price to be paid for the work. In the anchor shops there is considerable briskness, the firm having a good many orders for Tysack's patent anchors to execute.

RIVET WORKS.—The rivet works at Yeams and Gateshead are extremely busy with orders, which are chiefly local.

DUNDEE, 28TH MARCH, 1888.

FLAX AND JUTE TRADES.—Little change can be reported in the staple industries of the town and district during the last fortnight. There is no disposition to do forward business with the United States until something definite is known about the proposed alteration in the tariff. In flax there is less doing, if anything. Spinners seem to have satisfied their wants for the present. Russian reports are somewhat firmer, and their exchange has risen slightly. Flax and tow yarns are difficult to move, but stocks are understood to be small, and with a little more activity prices will probably advance. The demand for linen goods is still quiet. Manufacturers are fairly well employed, and as quotations are lower, it is anticipated that orders will now come in more freely both from home and abroad. Sailcloth is in good demand at late prices. There have been large arrivals of jute, and some parcels have been sold from the ship's side at 2s. 6d. to 5s. below recent rates. There is not much buying for shipment, as the Calcutta market remains firm. The demand for jute yarns is scarcely so active, but spinners are all well foresold, and are very firm in their quotations for quick delivery. In jute, good Hessians barely maintained late values. The demand is not equal to the production, and for some widths buyers have the advantage. Sacking and bagging move off freely at firm prices. There is also a steady inquiry for the narrower widths of tarpaulin.

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THE ISLE OF MAN STEAMER "QUEEN VICTORIA."

The celebrated steamers which were last season placed on the Isle of Man and Liverpool route, by the Isle of Man, Liverpool, and Manchester Steamship Company, Limited, as the pioneers of the new Manx Line, excited a great amount of public interest, on account of the exceptionally fast passages which they made during the season. We recently, in a two-page supplement (see *Industries* of 29th January last), gave a general view of the engines of the "Queen Victoria," and in our two-page supplement this week we illustrate the hull of the vessel. The model is particularly handsome, being designed for high speed. The spacious deck accommodation affords a splendid promenade, the vessel being intended for day service only. The dimensions which apply to the "Queen Victoria," as well as to her sister vessel, the "Prince of Wales," are as follow: Length, 340ft.; breadth, 39ft.; depth moulded, 24ft.; gross tonnage, about 1500 tons. There are eight water tight bulkheads, seven of which are carried up to the main deck. Communication between the compartments is controlled by self closing doors (Shepherd's patent, see *Industries*, Vol. III., page 81). The sides of the vessel are plated up to the upper deck forward of the paddle boxes. The shelter thus formed is lighted by unusually long side lights. Abaft the paddle boxes, the sides are open above the line of the main deck bulwarks, for the purpose of light and ventilation. A spacious smoking room and large refreshment bars are special features of these vessels. In a large deck house there is a series of reserve state rooms, fitted in a luxurious manner. The whole of the after part of the vessel is fitted up for first class saloon passengers, second class passengers being accommodated forward. The dining saloons are arranged apart altogether from the general sitting saloons, and there are, moreover, private rooms for select dining parties. The working appliances of the vessel are of the most recent type, comprising steam capstan windlass forward and steam capstan aft, and steam and double screw hand steering gears. One of the special features of the vessels is the completeness of the outfit of life saving apparatus. Four large lifeboats (two of which are always hung outboard on the davits with patent detachable hooks), several patent reversible seat lifeboats, and collapsible boats afford very ample accommodation for the whole of the passengers in the event of a catastrophe. We intend to give the details of the engines of these fine vessels in an early issue.

A NEW METHOD OF ROLLING TUBES.

By our Düsseldorf Correspondent.

For some time past German rolling mill engineers have been discussing the probability of success of the new method of rolling tubes, which has been invented by Herr Reinhard Mannesmann, of Remscheid; but as the inventor has as yet not suffered the details of his process to become publicly known, no very definite opinion could be formed in technical circles. Some engineers here expect the new process to completely revolutionise the rolling of tubes and articles of this kind, whilst others will only allow the invention a very limited sphere of application, and Herr Martin Balcke, in a paper recently read before the Society of German Engineers, even goes so far as to condemn the new system altogether. This criticism is based on the supposition that the tubes produced by the new process are weaker than welded tubes, and that an excessively large amount of power is required to drive the new rolling mill. It need hardly be said that both objections are purely conjectural. Where opinions are thus divided, some definite information on the subject will probably be of interest to the readers of *Industries*, and with a view to lay the facts before them, I recently paid a visit to the works of the inventor, and inspected the new rolling mill and some tubes made by it. The invention is protected in Germany by Patent No. 34617, but the specification is so vague that no definite idea as to the details of the invention can be formed from a perusal of its contents. In the German patent the inventor claims to be able to roll in a single pass all kinds of sections, including tubes with ribs and other projections; but, as a matter of fact, he has up to the present confined himself to the rolling of straight tubes only. The American patents are more definite, and the sketches which accompany this description are reproduced partly from the American patent specification. The numbers of the American patents are from 361954 to 361963.

The only rolling mill on the new plan which has yet been built and practically worked, is a small one at the works of the inventor in Remscheid. I have seen tubes of various diameters, and up to 10ft. in length, rolled by this mill without a mandrel out of solid blocks of Bessemer steel, Thomas steel, and Delta metal. All the samples were perfect in appearance, and to judge from the manner in which they can be bent and the edges flanged over, the strength of the tubes is certainly greater than that of ordinary welded tubes of the same dimensions and materials. The success achieved with this experimental mill has induced one of the largest German tube works (Pönsgen, of Düsseldorf) to adopt the process, and to set apart a portion of their works for the rolling of tubes on this system. A large rolling mill on Mannesmann's principle has been there erected, and will be driven by a large engine of 800 h.p., running at 150 revolutions per minute. A second installation on the same system is in course of erection at a tube works in Saarbrück, and a third in Komotau (Bohemia). These facts will show that the new process is of practical importance, notwithstanding the adverse criticism of some German engineers.

The principle on which the action of the new tube rolling mill is based will be understood from Fig. 1, where A and B are two conical rolls, the axes of which are situated in two parallel vertical planes; but each axis is inclined to the horizontal, so that the smaller end of roller A and the larger end of roller B are uppermost. The rolls are preferably provided with spiral corrugations, although this is not absolutely necessary. In the illustration these corrugations are only shown for the roll A, but it must be understood that all the other rollers shown in the figures may be similarly corrugated. The object of the corrugations is to provide a firmer grip on the block which is being worked. If the rolls revolve in the direction shown by the arrows, and a metal block C be inserted between their smaller ends, it will be gripped by the rolls and revolved, whilst at the same time, owing to the horizontal component of the rotary motion, the front end of the block will be drawn to the right. It is, of course, necessary to guide the block, so

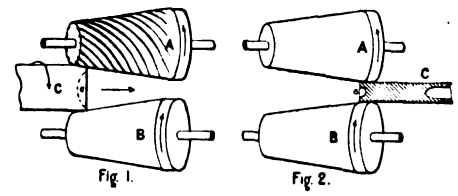


Fig. 1.

Fig. 2.

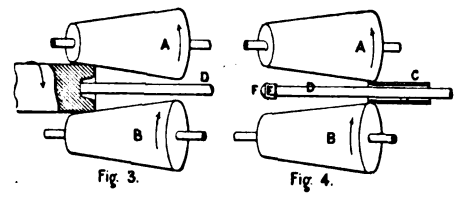


Fig. 3.

Fig. 4.

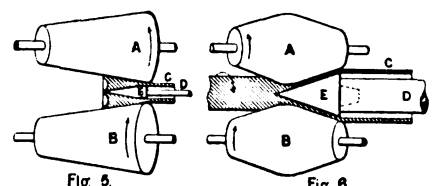


Fig. 5.

Fig. 6.

/Industries.

as to prevent its jumping out from the rollers. This can be done either by separate guide rolls or by placing a similar pair of inclined working rolls above and below the block. For simplicity of illustration the guiding arrangements are omitted. The effect of the rotary and forward motion imparted to the fibres of the material is to draw them out spirally, whereby the metal is taken from the interior of the block and transferred to the surface. The drawing out action on the surface of the block is greatest at the front end, where, owing to the larger diameter of the rolls, the speed is greatest, whilst at the same time the rear end of the block is prevented from following equally fast by the conveying surfaces of the rolls. At the beginning of the process a cavity C is thus formed, and as the block advances the diameter decreases whilst the cavity extends, so that when the whole block has passed through the rolls it presents the appearance of a tube open at the forward end, but closed at the rear end, as shown in Fig. 2. A small cavity *c* is also formed at the place where the tube leaves the rolls. A tube is thus formed out of a solid block in one pass, and the dimensions of the finished tube depend upon the form of the rolls, their distance apart, and the inclinations of their axes. It will be seen that this process of rolling tubes is fundamentally different from the ordinary method. In the latter the rolls revolve in opposite directions, so that their working surfaces where they come in contact with the block have the same direction in space, and the block passes at right angles to the axes of the rolls which are parallel. In this new mill the rolls revolve in the same direction, and their working surfaces, where they are in contact with the block, travel in opposite directions, imparting to the latter a rotary movement, whilst the block advances approximately parallel to their axes. It is also evident that with this system the tubes can only be open at one end, since the tubular formation must cease as soon as the retarding influence of the conveying surfaces of the rollers on the rear end of the bar ceases. If it be desired to obtain tubes open at both ends, it is necessary to employ a mandrel, as shown in Fig. 3. In this case the block must be well heated before being put between the rolls. The mandrel has the effect of keeping back the centre portion of the block, especially towards the end of the pass. The illustration represents the moment when the tubular formation has begun, and the bottom of the cavity has come in contact with the end of the mandrel. The other end of this mandrel is supported in a footstep or thrust bearing, so that it can revolve with the block. In some cases a detachable head E is attached to the mandrel (Fig. 4), and when the pass is finished a small quantity of metal F is generally torn off the rear end of the tube. If the material to be operated upon is very ductile and soft, previous heating is not required, and in that case a mandrel D with a pointed head E (Fig. 5) is used. The rolls A and B then act partly as faced rollers, which push the block C over the end of the mandrel. The same apparatus may also be used to reduce the thickness of tubes previously rolled, as above described. The inner diameter is then determined by the size of the mandrel head, whilst the outer diameter depends upon the distance between the larger ends of the rolls. For certain very soft materials the inventor finds it advantageous to assist the feeding motion of the rolls by providing the mandrel with a screwed head and revolving it by power. In this case the material is fed from the inside as well as from the outside, and the fibres are arranged spirally throughout the length of the tube. In all previous arrangements the size of the finished tube is smaller than that of the original block; but where it is required to produce a tube of larger diameter than the block, Herr Mannesmann adopts rolls of the form shown in Fig. 6. In this case one half of the rolls act as shown in Fig. 1, whilst the other half simply serve to enlarge the tube thus formed. The material is also in this case fed forward by the horizontal component of the surface motion of the rolls, and the tubular formation begins slightly before the middle is reached, where the diameter of the rolls is greatest. From that point the metal is spread out by the insertion of a mandrel with a conical head, and thus a tube of larger diameter than the original block is produced.

THE EFFECT OF SEA WATER ON PORTLAND CEMENT.

At a meeting of the Society of Engineers, held on the 5th inst., a paper was read on the above subject by Henry Faija, M.Inst.C.E.

The paper referred to the failure of certain concrete work at Aberdeen Graving Dock, and the author first alluded to the several published reports ascribing the failure to the chemical action of the sea water on the cement. After pointing out that Portland cement has been used in marine works for forty years, and that until now any failures that may have occurred have never been traced or ascribed to the chemical action of the sea on the cement, the author gave a general description of the work carried out at Aberdeen, embodying extracts from the reports of Mr. Smith, Professor Brazier, and Mr. Messent, descriptive of the manner in which the cement was used, the specification to which it was supplied, and the argument on which their theory is based—which is, briefly, that the magnesia precipitated from the sea water enters into and becomes a compound part of the cement, thus destroying it. The presence of magnesia in cement was then considered, and the reason explained why it is deleterious when in excess; but the magnesia as precipitated from the sea water was shown to be in a very different condition to magnesia when it is incorporated in a cement in the course of manufacture. The result of a large number of experiments, comparing the behaviour of cement when gauged in sea water and when gauged in fresh water, the analyses of the cements before and after gauging, and of the scale on the surface, together with the scum and sediments in the waters in which the cement had been placed, were given. The specification and the analysis of the cement used at Aberdeen were then considered, and it was pointed out that, though such a specification was not antagonistic to the production of a good cement, there was nothing in it which insured a good and sound cement being delivered, and it was suggested that one or other of the methods now known for determining the soundness of a cement should in all cases be used, the author being of opinion that, given that a cement is well ground and is proved sound, it will, in nearly all cases, be strong enough for any purpose for which it is likely to be used. The concrete at Aberdeen was used in what is called a "plastic" form—*i.e.*, it was allowed to partially set, and was then broken up and placed in position. The danger of using cement in this manner was shown, and the results of several experiments given, proving that under certain conditions the cement never re-sets. The conclusions arrived at were that sea water has no deleterious chemical action on a sound and properly used Portland cement, and that the failures at Aberdeen must be attributed to some other cause: either to an inherently bad cement having been used, or to the injudicious use of it in a plastic form.

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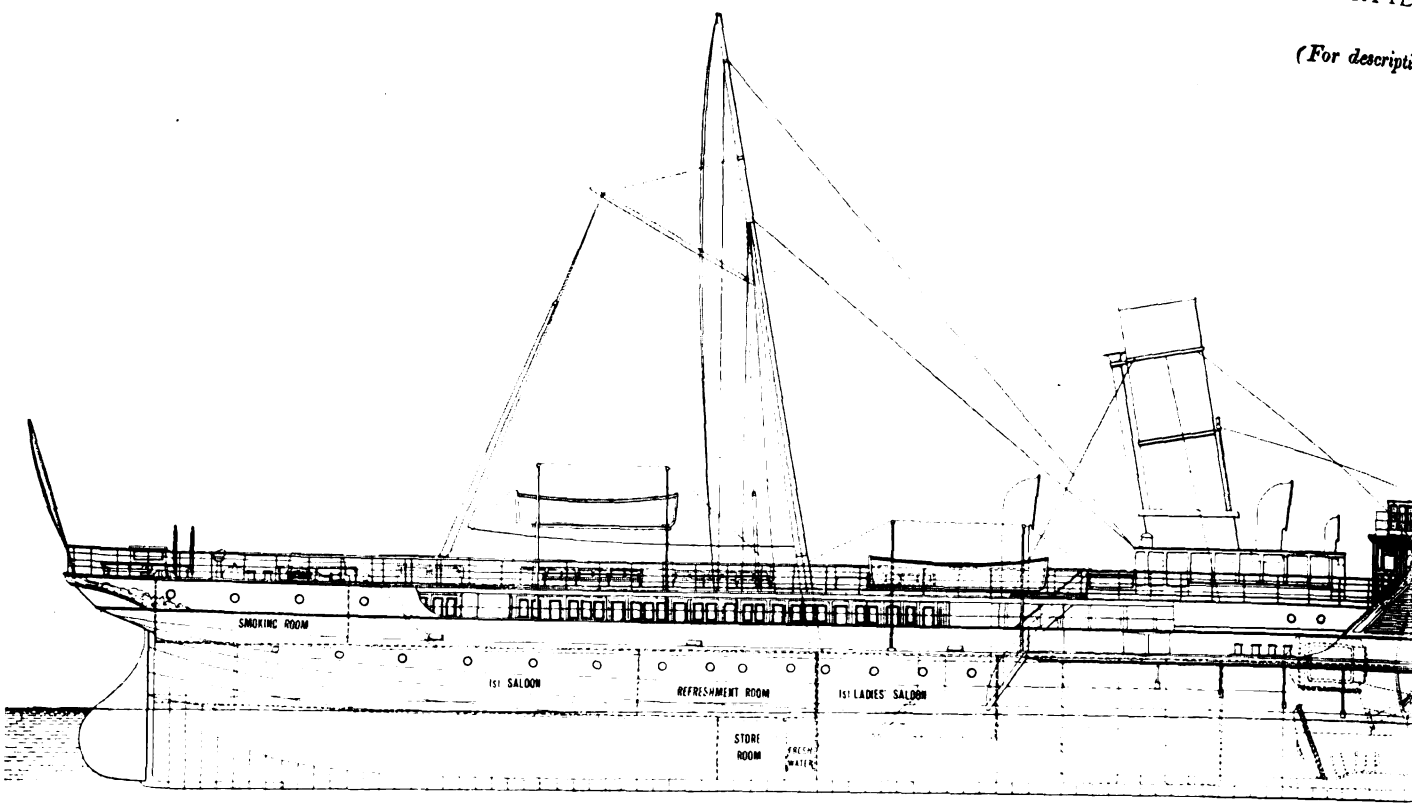
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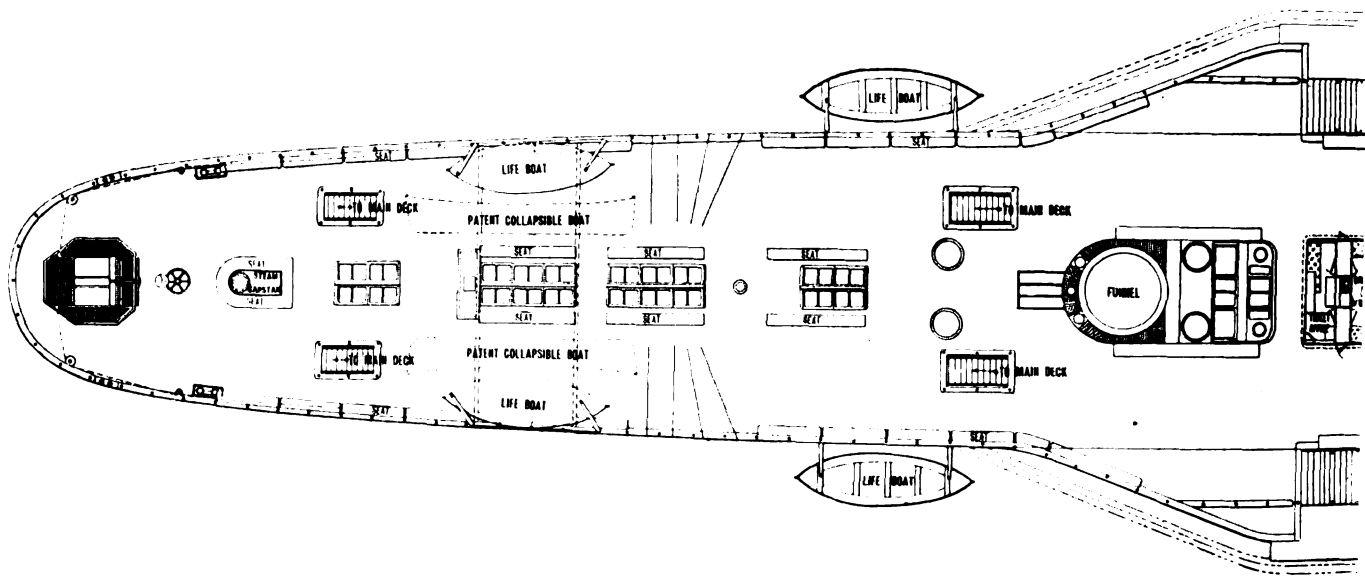
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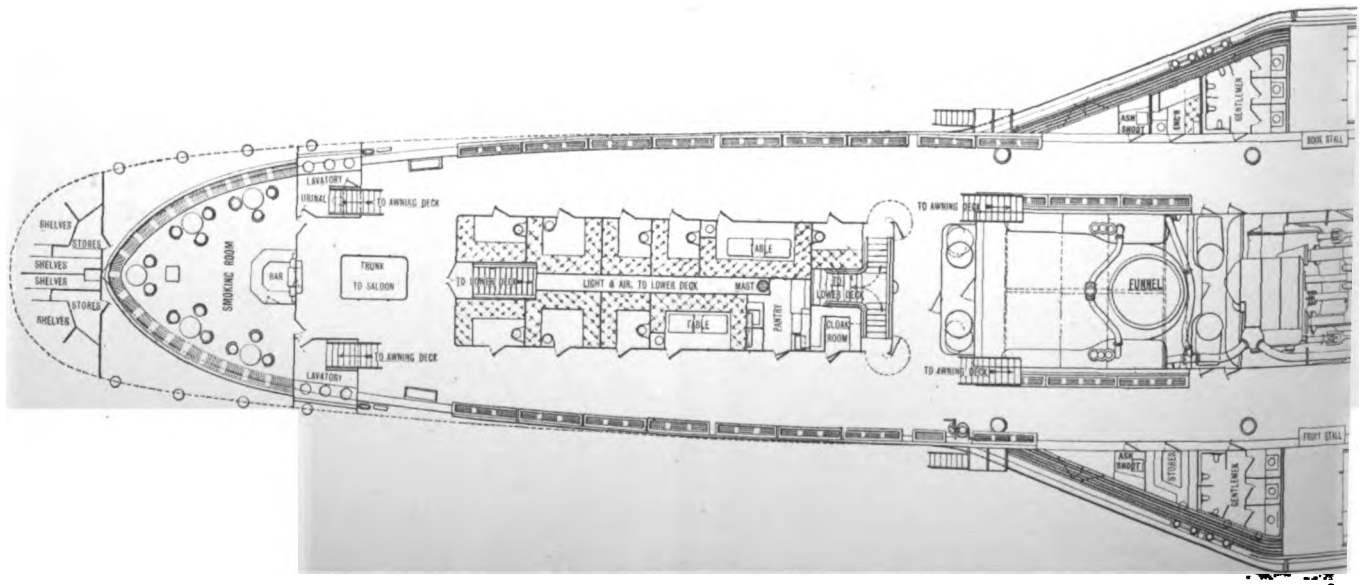
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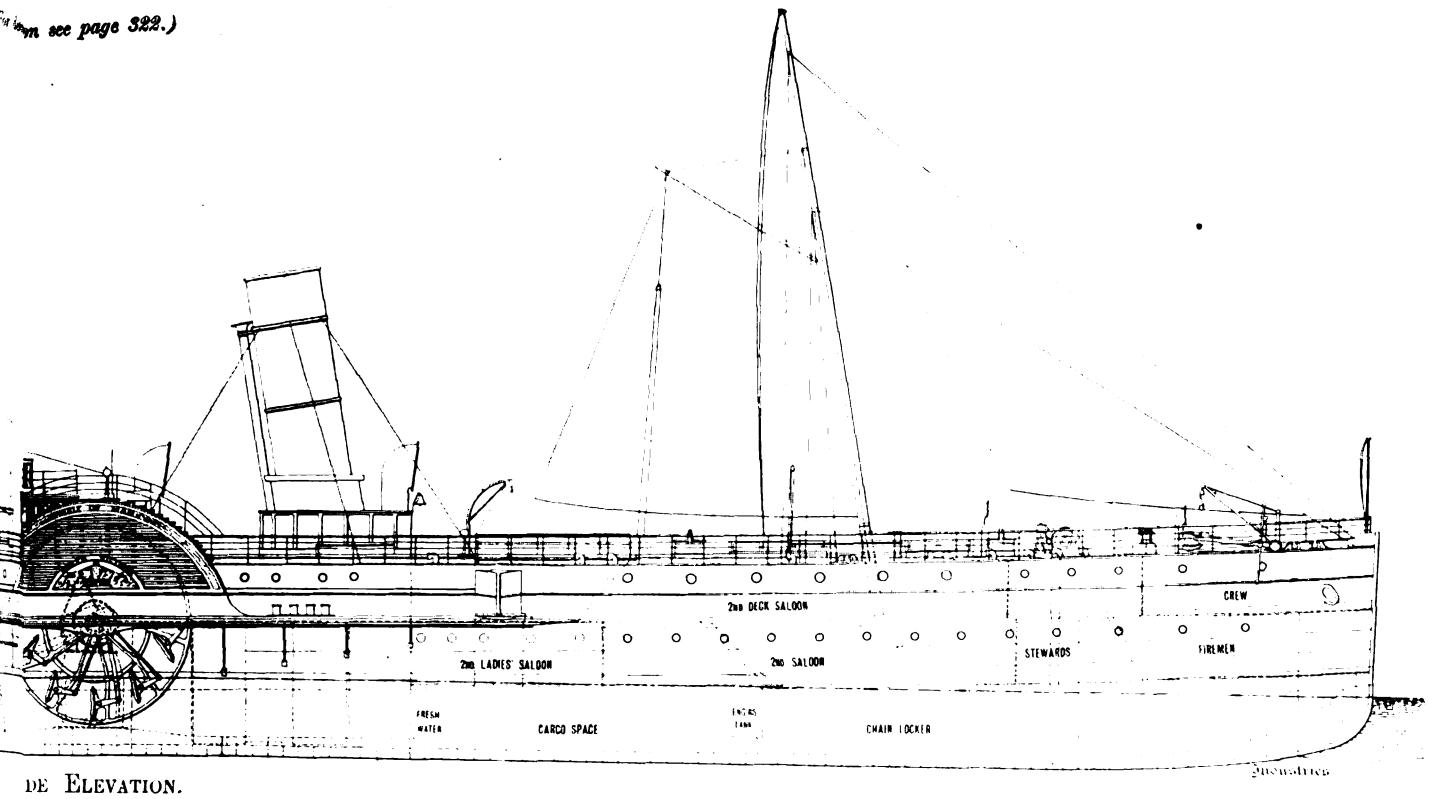
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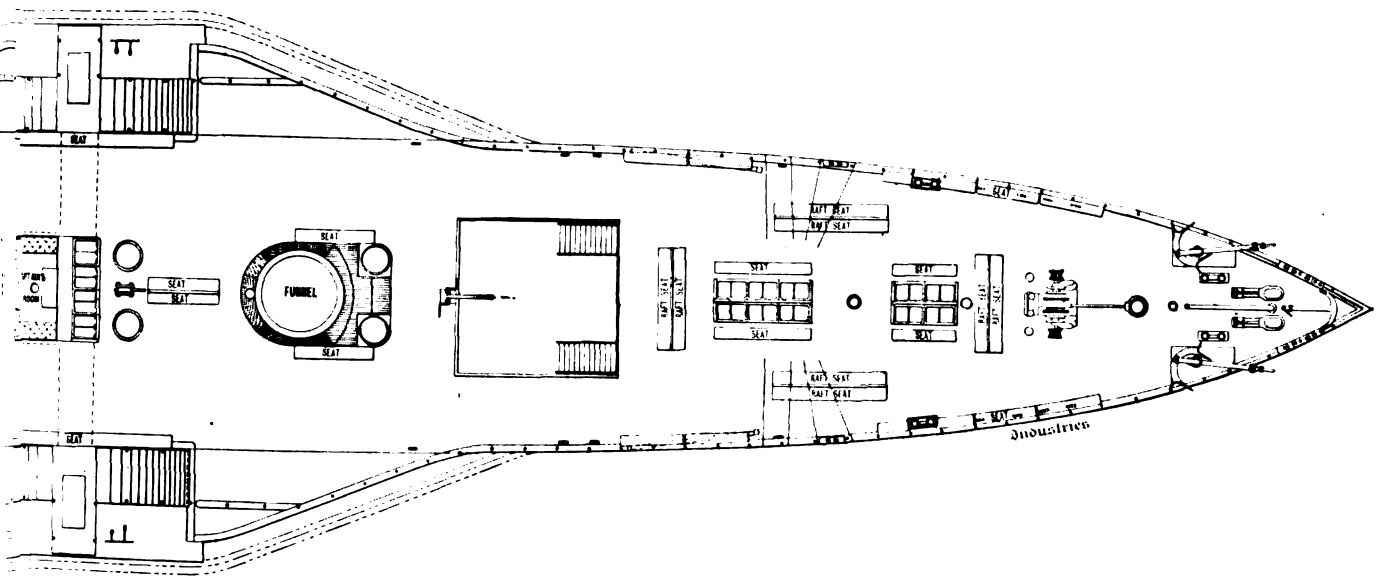
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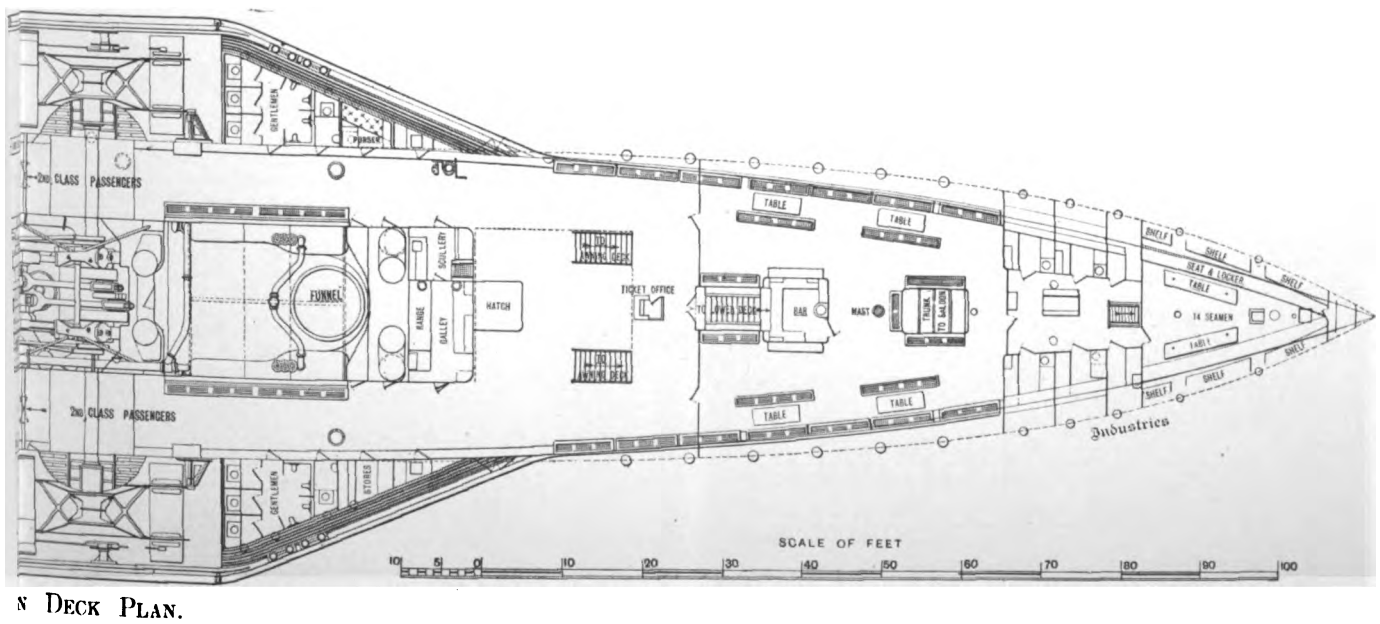
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Offices for Publication:
22, Wellington-street, Strand, London, W.C.
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THE PADDLE STEAMER "QUEEN VICTORIA."

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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FRIDAY, 30TH MARCH, 1888.

DEFENCE OF OUR MERCANTILE PORTS.

LORD RAVENSWORTH did well, as President of the Institute of Naval Architects, to use his opportunity to force home to the representatives of the shipbuilding industry assembled in the hall of the Society of Arts a truth which is giving rise to some alarm throughout the country, viz., that our mercantile ports lie open to an attack from an enemy's cruisers. To the community of shipbuilders and shipowners, to whom the question appeals directly, it is perhaps sufficient to make the danger known to insure a willing co-operation on their part with the Government in the efforts about to be made to avert the evil; but the risks to which our trade and industry are exposed through this source may need to be insisted upon to make their importance felt by all classes of manufacturers. Yet a very little reflection will reveal the true magnitude of the interests at stake. In every sense it is a national question, affecting deeply all our great industries. We cannot contemplate without dismay the consequences of a successful attack upon even one of our principal mercantile ports. In a time of war these would be crowded with shipping, among which a single armoured cruiser, accompanied by torpedo boats, could in a few hours make ruinous havoc. It is, too, in these ports that our great shipbuilding yards are situate, the partial destruction of which would seriously impair our commercial life. Moreover, an occurrence of that nature is to be feared from the disastrous moral effect it would produce. Lord Ravensworth aptly described it as a stab at the heart that would paralyse the vital powers. Our possible enemies must be equally cognisant with ourselves of the character of these places, and we have no ground for assuming that the policy of striking at our most vulnerable part will fail to recommend itself to their judgment. We should make ourselves guilty of suicidal folly by obstinately shutting our eyes to the risks to which we are exposed. Our extensive coast line and numerous ports render it extremely difficult, in these days of steam, armoured ships, and long range guns, for our fleet to guard effectively every pregnable point. A few swift armoured cruisers, resolutely handled and aided by torpedo boats, might do incalculable mischief before a sufficient force could be brought to bear upon them. This is the danger apprehended, and it is solely against such attacks that the Government now seek to make provision. That the danger is real is shown by the unanimous testimony of the witnesses examined by the Committee whose report has just been made public; and that it is imminent the actual state of Europe affords sufficient evidence.

The opinions of the Committee appointed by the Secretary of State for War to consider with him the plans proposed for the fortification and armament of our military and home mercantile ports, will be received by many more readily because the civil element largely predominated in its constitution. The members were: Sir W. H. Houldsworth, M.P., Admiral Sir W. M. Dowell, Lieutenant-General Sir E. B. Hamley, Sir F. Bramwell, J. W. Lowther, M.P., G. L. Ryder, of the Treasury, S. Whitbread, M.P., and E. R. Wodehouse, M.P. This Committee have arrived at the conclusion, from the evidence brought before them, that the kind of attack most to be apprehended is that of armoured cruisers, accompanied by torpedo boats and other small craft, which, say the Committee, can be repelled by submarine mines and torpedo boats. They add: "The special importance of the Tyne, the Clyde, and the Mersey may, however, necessitate the addition of a heavier armament." The Committee is further of opinion that where mercantile ports are situate at some distance up a river, submarine mining defence will in general afford very great protection. But whenever this defence is adopted, it is essential that the mine fields be protected by quick-firing guns. Basing the recommendations upon these conclusions, the Committee advise the immediate construction of works and the provision of armaments, sufficient to meet the case. It is suggested that the mercantile communities interested in these ports should contribute something towards the cost of the additional defences recommended, and definiteness and point are given to the suggestion by an expression of opinion to the effect that the local authorities might be expected to provide the sites for the forts and pay for the civilian labour, in doing which they would only be following well established precedent. The giving of land for forts and barracks dates as far back as 1701, so that to call upon the local authorities to furnish, free of charge, the ground on which works for the protection of their towns are to be built is not a new departure, but, on the contrary, it is a practice that has long prevailed in this country. In places where an active defence is of paramount importance, it is suggested that it may be better to endeavour to induce the locality to undertake the cost of the torpedo boats which it is necessary to provide for the defence of the port. In all cases, say the Committee, the local authorities should be expected to provide the necessary garrison, in the form of volunteer artillery or submarine miners. These are the points on which the commercial community is to be asked to co-operate with the Government, and we make no doubt that the invitation will call forth a ready response. The ports to be defended are: The Mersey, the Clyde, the Bristol Channel, the Humber above Grimsby, the Tyne, Sunderland, Hartlepool and the Tees, the Forth, the Tay, Aberdeen, Falmouth, Dublin, Belfast, and Holyhead. The estimated cost is about two millions sterling.

The measures proposed are doubtless necessary, and being necessary are urgently called for. But the real character of such works must not be lost sight of. They are utterly incapable of maintaining a long defence, and are only fit to delay capture till help arrives from the fleet. This is, no doubt, an important service, sufficient, it may be, to save our shipping and building yards from destruction. But it is to be borne in mind that such service is to be rendered only on condition of there being ships of war in fighting order near at hand. Our safety depends upon the efficiency of our fleet, and upon that alone. If our second line of defence ever be broken through, nothing can save these mercantile ports. Even strongly fortified military places have almost invariably yielded to a vigorous organised attack from a hostile fleet. It is, therefore, of paramount importance to keep the navy in the highest possible state of efficiency. There is some danger that this scheme of defence for our mercantile ports may attract undue attention to itself, to the neglect of the more effective means. The Committee, in their report, have acknowledged

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the vastly superior importance of the active defence. They have, moreover, pointed out a probable method of attack against which land fortifications are of no avail. "According to the balance of evidence of naval experts," they say, "the most probable danger to be apprehended is not a direct attack upon the ports, provided they are placed in a reasonable state of defence, but that armoured cruisers will be sent to watch the lines of our commerce converging upon them, and to intercept and destroy merchant vessels." They say, moreover, that no amount of passive defence can adequately provide against the danger, to towns on the seaboard, of bombardment, owing to the long range of modern guns. Our safety lies in keeping the command of the sea, a truth which our traders and manufacturers will do well to bear constantly in mind. Only through it may we hope to escape the terrible calamity of seeing our shipping captured, our building yards destroyed, our commerce crippled, and our industries ruined.

LORD BRASSEY'S NAVAL ANNUAL.

Lord Brassey has just issued his second Naval Annual. It is in every respect a decided improvement on its predecessor, and may be described as the most remarkable storehouse of information relative to the maritime branch of the public service that has ever been published. In addition to the 784 pages of matter, every line of which is not only important, but also interesting, it contains eight illustrations of the most recent additions to the Navy and the merchant marine, sixteen charts and plans of coaling stations, &c., several hundred diagrams of British and foreign war and merchant vessels, and nearly thirty additional illustrations of armour and ordnance of the newest types. The book is in four sections, the first being the work of Lord Brassey himself, the second that of Mr. F. K. Barnes, the third, on gunnery, that of Captain Orde-Browne, and the fourth, which deals with torpedoes, the production of Lieutenant Sleeman. One of the first things that strikes the reader of the "Naval Annual" is the remarkable diversity and complexity of ships of war. The work contains illustrations and details of vessels in every navy in the world, and scarcely any two of them are alike. This is the feature of the work that is most likely to interest the naval architect, shipbuilder, and engineer. This increased and increasing complexity necessarily involves increased expense in the production of the same nominal tonnage, and we therefore find that the average cost per ton is now-a-days more than double what it was a few years ago, and that the Navy Estimates, in so far as they are affected by new tonnage and repairs, are greatly on the increase. The dockyard expenditure accounts show that for the last financial year dealt with there was expended :—

	Dockyards. £	Private contract. £	Total. £
On armoured ships.....	990,833	877,281	1,878,114
On unarmoured ships...	613,785	1,245,562	1,859,347
Totals.....	1,604,618	2,131,843	3,737,461

The increase of contract work is a feature of the year's work upon which the country and the Admiralty may both be congratulated. The quality of such work may not always be equal to dockyard work, although there is no reason why it should not be, nor may it even be found in all cases equally economical; but the country is likely to be better satisfied when naval constructions are given out to tenders, resulting in a strong competition among a number of high class and responsible firms.

While Lord Brassey never loses an opportunity of insisting upon the great importance to England of maintaining her navy in the highest possible state of efficiency, and lays down a definite programme as to what is still necessary to make it an irresistible fighting machine, his pages bear testimony to the very considerable increase of superiority that has taken place within recent years.

The often debated question of whether France is inferior as a naval power to England, and if so, to what extent, would appear to be completely set at rest by a statement of the number and tonnage of the vessels belonging to each country which Lord Brassey has drawn up, and which shows the following results :—

Vessels.	England. No.	England. Tonnage.	France. No.	France. Tonnage.
Armoured, first class.....	24	234,440	10	105,245
„ second class...	24	143,140	18	126,270
„ third class ...	11	92,110	5	23,508
For coast defence	13	40,390	14	35,293

This table shows that England commands a fleet of seventy-two vessels, of 510,080 tons displacement, as compared with forty-seven vessels, of 290,321 tons displacement, possessed by France. Russia has thirty-seven vessels, of 164,991 tons displacement. England's fleet, therefore, is more than equal to the combined fleets of the two next most important naval powers in Europe; and if we take the relative number and tonnage of first class armour clads into account, the superiority is much greater than it would appear as expressed by tonnage alone. The following statement shows the amounts expended on the chief navies of the world in the latest financial year :—

Country. Year 1886-87.	£
France	9,141,700
Germany	2,280,145
Austria.....	886,365
Italy	3,768,700
United States	3,646,660
United Kingdom	11,866,000

This record shows that the *effective* expenditure on the British Navy (for these figures do not include the non-effective expenditure, amounting to £2,036,000), largely exceeds that of any other country. On the whole, and in spite of much waste and possible maladministration, there is reason to believe that England gets as good a return for her money as any other country. This, however, by the complexity of the accounts, is not made quite so clear as it might be made. It is, for example, impossible to believe that private contract work costs on an average, for unarmoured ships, about £51 per ton more than dockyard work, and yet this is the conclusion to which the Admiralty returns point. This will be clear from the following table, which we abstract from larger tables given by the author :—

Year.	Average cost per ton. Dockyard. £	Contract. £
1879-80	69·80	152·00
1880-81	73·00	124·66
1881-82	73·00	123·26
1882-83	80·00	110·00
1883-84	93·88	131·56
1884-85	78·00	145·58
Averages	77·84	128·80

The solution of this enigma is probably that in the dockyard expenditure there should be items charged that are omitted and debited to some other accounts. But there is nothing to enable us to identify this fact, and as the figures now appear, they do a manifest and serious injustice to private shipbuilders, which the Government of the day should at once be asked to explain, and if possible, redress.

One of the most serious items in the annual naval budget is the cost of the repairs and alterations of armoured ships. It may be, and probably is, necessary that this expenditure should be incurred, in order that ships that are not perfect in their aggressive power should be brought up to the most modern conditions of efficiency. The figures, however, suggest that there has been a great deal too much pure experimentation on the part of Admiralty constructors, and not a little failure. Thus, we find that between 1880 and 1886, £120,873 were expended in repairs and alterations to the "Hotspur;" while there are corresponding items of £131,546 in respect of the "Bellerophon," £111,829 in respect of the "Audacious," £85,723 in respect of the "Iron Duke," and £84,655 in respect of the "Black Prince." Twenty-eight ironclads have involved an expenditure for repairs and alterations of not less than £1,471,709 between 1880 and 1886, being an average of nearly £53,000 per vessel. The total outlay on the repairs and maintenance of the fleet during the last ten years has been about nine millions sterling, or £900,000 per annum. During the same interval the cost of new construction has advanced from less than one and a half million to over three millions a year, the tonnage built by contract and at the dockyards having been since 1880-81 :—

Year.	Dockyard. £	Contract. £	Machinery. £	Total. £
1880-81	891	236	299	1426
1881-82	1150	292	240	1682
1882-82	1174	301	292	1767
1883-84	1187	236	507	1930
1884-85	1333	449	459	2242
1885-86	1153	1550	1003	3737
1886-87	1480	1430	746	3656
1887-88	1473	1017	568	3058

£1 = 1000.

It will be observed that 1885-86 is the only year in which the contract built tonnage exceeded in value that built by the Admiralty at the dockyards. In each year, however, the machinery has been mainly supplied by private firms, so, that when the machinery is added to the hulls, private contractors have had a considerable, if still inadequate, share of the work.

A subject which is of considerable importance at the present time to English shipbuilders, inasmuch as it is likely to lead to their direct profit and advantage, is the re-construction of the Spanish Navy. The "Annual" states that the programme of new ships to be built in respect of the expenditure of £9,000,000 sterling recently resolved upon by the Cortes, includes three cruisers at £280,000 each, eight cruisers at £200,000 each, six torpedo cruisers at £100,000 each, four torpedo cruisers at £80,000 each, ninety-six torpedo boats at £24,000 each, one transport, to be fitted as a floating factory, at £100,000, and a number of minor vessels of different kinds, bringing the total cost of new ships about to be constructed up to £7,596,000, in addition to a sum of £904,000 to be expended on vessels at present under construction. At the present time the Spanish Navy is perhaps the most backward of any in Europe. Of five ironclads, one alone is modern, and it is remarkable that the new programme fails to provide for the remedy of this serious defect. The navy of Spain has three completed first class cruisers of 3000 tons and upwards, and four in course of construction, as well as three modern second class cruisers and a torpedo flotilla of seventeen vessels. It is manifest that much remains to be done in order to bring the Spanish Navy up to a standard of efficiency commensurate with the importance of the country and its extensive seaboard, and in the adjustment of this balance Great Britain is likely to play a prominent and profitable part.

Russia is another country that has hitherto been backward in the extent and quality of its fleet. But the "powers that be" are determined that this reproach and danger shall be wiped out with the least possible delay. A shipbuilding programme has recently been adopted by the Russian Government, which provides for the construction of seventeen first class ironclads for the Baltic and the Black Sea, with a large equipment of gunboats, cruisers, &c., estimated to involve an expenditure of £15,468,000, in addition to £1,904,000 for artillery and £559,000 for torpedoes. This expenditure, judiciously applied, should give Russia the command of a fleet second only to our own. The Minister of Marine calculates the cost of the various vessels required at £503,791 for each first class ironclad, £408,000 for each second class ironclad, £195,916 for each cruiser, £25,000 for each gunboat, and £8,750 for each torpedo boat. These figures, it will be observed, are much under the cost of the same class of vessels in our own country, from which it would be inferred either that naval construction is cheaper in Russia than in England—which is extremely unlikely—or that the Russian ships will be of inferior power.

AMENDMENT OF THE PATENT LAW

It is highly probable that during the present session an attempt will be made to remove some of the more prominent defects of the Patent Law, which has now been in operation for upwards of four years. The Institute of Patent Agents have had the subject under consideration for a long time past, and have, with practical unanimity, formulated a set of proposals which, we believe, will command general approval. It would have been easy to have suggested many other important improvements, but we believe that we are correct in stating that Government support could not be obtained in the present condition of public affairs for any proposals which would be likely to give rise to prolonged discussion. It is difficult to conceive what material opposition can be raised to the proposals made by the Institute, and which are not put forward in the interests of any clique, class, or profession, but are clearly intended for the good of all concerned.

The question of examination is one of the utmost importance, but it is also one that would be likely to give rise to prolonged discussion, and probably defeat the passage of the proposed Bill. Its consideration has consequently been deferred, but some of the consequences of the establishment of an examining staff, and the definition of their duties under the Act, properly form the subject of proposed modifications.

Under the 7th section of the Act, it is provided that, under certain circumstances, the Comptroller may require an application, specification, and drawings to be amended before he proceeds with the application, and no limit of time is given within which the amendment must be effected. It is clear that this affords an opportunity for fraud. An applicant may file an incoherent or vague document professedly relating to an invention. This quasi specification is returned to him for amendment in due course, but there is nothing to prevent his deferring the amendment until the period of provisional protection has nearly expired, at which time he may, if dishonest, include or describe an invention by himself or another of which he had no conception at the date of his application, and thus obtain a priority to which he is by no means entitled. It is desired that the time within which an amendment may be made should be limited, but it would probably be much more fair and more just to permit no amendment whatever, except of an obvious clerical or formal error, before the filing of the complete specification. The sub-sections which set forth that the Comptroller

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shall give notice to applicants whose specifications appear to comprise the same invention, have not worked satisfactorily, nor does there appear to be the least probability that they can by any means be made to do so, and it is, therefore, proposed to strike them out. In section 11, which relates to the opposition to grant of patent, it is suggested that the grounds of opposition should be: (1) That the applicant has obtained the invention from the opponent, or from a person of whom he is the legal representative; (2) that the invention is described in a provisional or complete specification of an application for patent or of a patent of prior date, provided that the said provisional or complete specification was filed before the date of the opposed application, and provided that, when the opposition is based on a provisional specification, followed by a complete specification, the invention is described in the complete specification; (3) that the applicant's complete specification claims an invention other than the invention the nature of which was set forth in his provisional specification, which claim forms the subject of an application made by the opponent in the interval between the lodging of the provisional and complete specifications of the applicant. If these modifications are made, we believe that the number of frivolous or vexatious oppositions will be very few in future. Section 12 of the Act provides for the grant of a patent to the inventor, or to the inventor with other persons or corporations with whom he may be associated. It frequently happens that an inventor sells his rights before the grant of the patent, and it would therefore be a great advantage if, on his request, the patent could be issued to his nominee, precisely as in the United States.

For the first time it is permitted under the Act of 1883 to pay renewal fees after they have become due, but the Act imposed the conditions that a fine should be paid, and that the deferred payment could be accepted only in cases of accident, mistake, or inadvertence. Temporary poverty cannot, therefore, be accepted as a reason, but there is nothing to prevent a false allegation being made to secure the continued validity of the patent. Since a substantial fine is inflicted for the delay, there appears to be no sufficient reason why any further conditions should be imposed, other than the limitation of time, and it is proposed, therefore, to remove them. By sub-section 10 of section 18 it is enacted that no application for leave to amend a specification can be made when and so long as an action for infringement, or other legal proceeding in relation to a patent, is pending. It is proposed to remove this disability, but it is also proposed in the following sections to enact that an amendment made during legal proceedings should not be used or put in evidence for the purposes of the action without the leave of the Court.

In relation to compulsory licenses, which would at present have to be granted by the Board of Trade, which in other matters appears to be guided by the whim of the moment rather than on fixed principles, it is properly proposed that the Comptroller, who is a far more competent authority, should have the decision, with an appeal to the Law Officer. It is also suggested that the Comptroller should decide questions of prolongation, with a similar appeal. This would unquestionably be more satisfactory and logical than the existing system, which compels the movement of the cumbrous machinery of the Privy Council and a prodigious outlay for its lubrication. When a patent is revoked on the ground that the patentee obtained the invention in fraud of the patentee, a new patent may be granted to the original inventor, but this patent must bear the date of revocation. In such a case it is clear that the spirit of the Act will not be complied with, for the public may be restrained from using the invention for a longer period than fourteen years, while on the other hand an intermediate patent or publication might subsequently be held to anticipate and consequently to invalidate the patent so granted. The Institute propose either that the original patent should be re-issued to the true inventor, or that the new patent should bear its date. In section 32, which sets forth the remedy in cases of groundless threats of legal proceedings, it is suggested that legal doubts should be removed by clearly defining that the validity of the patent on which the threats are based should come in question. It is now enacted (section 36) that a patentee may assign his patent for any part of the Kingdom precisely as if the patent were originally granted for that part only. It is easy to reduce this section to an absurdity. Each assignee may amend the specification with the result that several entirely different patents may co-exist for the same invention. This section is impracticable and misleading, and should be repealed. The section permitting exhibition without prejudice of an inventor's rights is still more misleading, and should share the same fate; for it is cheaper to provisionally protect the invention at once, and thus prevent risk of fraud. The Institute desire that a definition of the words "within the realm," which occur in the Statute of Monopolies, should be defined in section 46; but probably the definition given in the schedule to the Act, Form D, is sufficient for the purpose.

At present the Comptroller may exercise his discretion as to the registration of a design, and frequently does so. It is proposed to remove the discretionary power, and consequently clothe the applicant with the risk of an anticipation, which would not be serious. When a design is registered it certainly should be open to inspection within a reasonable period, so that intending applicants could ascertain for themselves what was already actually protected. In such a case a copy of all textile designs should be deposited at the Manchester office. It is also proposed that the discretion of the Comptroller in respect to the registration of trade marks should be terminated, except in the event of a similar mark being already on the register for the same class of goods. The appeal from the decision of the Comptroller refusing to register a trade mark should be removed from the Board of Trade to the Law Officer, and the present cumbrous and expensive treatment of oppositions to registration should be simplified by substituting the Comptroller for "the Court," and by permitting an appeal to the Law Officer. The term "fancy word" in the definition of a trade mark has given rise to a great amount of annoyance and litigation, and might easily be strictly defined in an amending Act. Throughout the Act, in every case in which the Board of Trade is mentioned, it is proposed to substitute the Comptroller, and it will be readily admitted by those who have had experience of the action of the Board of Trade, under the Act of 1883, that such a substitution cannot be disadvantageous.

The ratification of the International Convention since the passage of the Act renders further explanation or additional rules necessary, as the procedure in an application for a patent previously protected elsewhere under the Convention is nowhere set forth, and may be varied without notice or reason.

The suggestions of the Institute conclude with the words: "There should be a register or roll of properly qualified persons to act as patent agents." This may appear, coming from such a source, to be a somewhat selfish recommendation, but there are some grounds of public policy for the enactment of such a regulation, which we have already discussed in these columns. We think that much more might have been said in this respect, but it is probably thought that this may be said with better grace and greater force by those outside the profession.

We have been able to discuss and set forth only very briefly the proposals made by the Institute, in order that our readers may have as long an available period as possible for their consideration before the proposed Bill is submitted to Parliament. The matter is one of great public importance, and one upon which the opinions of those directly interested should be expressed without delay.

Letters to the Editor.

ALTERNATE CURRENT TRANSFORMERS.

To the Editor of "Industries."

Sir,—I notice in your late issues, a series of reports of the discussion on the above subject at the Society of Telegraph Engineers and Electricians, which took place during my absence in America. Both Mr. Gordon and Mr. Crompton seem to be extremely doubtful of the possibilities of an alternating system—assuming certain details of working on which the efficiency of the system must depend to be impracticable. I allude to the coupling up of alternating machines in parallel, and the use of small machines instead of large ones. My company having interests in this system of distribution of electricity, I inspected several stations in the States equipped with complete Westinghouse plants. The practice in all of them was to use small dynamos, each dynamo running off a separate Westinghouse engine, the power being transmitted through a belt. They would have in the day time a sufficient number of machines running to just supply the required current (thus obtaining a maximum efficiency of both engine and dynamo), and as the demand for current increases, more machines are connected in parallel to the working system. The method of connecting in parallel has been brought to a simplicity that leaves nothing to be desired. The already working system and the fresh dynamo that is to be added to it are connected to two circuits on a small piece of apparatus, showing by two lamps the difference of phase of the two currents. Each lamp varies from a maximum brilliancy to "black out," at a comparatively slow rate, and not coincidentally. The "beats," of the lamps alter in respect to each other, until in a few seconds the lamps go out and attain their maximum brilliancy at the same time. When this point is reached the switch is put on and the machines are running in parallel without any disturbance taking place. Looking at the machine that is about to be switched on, the only evident sign at the moment of connection is a tightening of the belt from the load placed on it. One is bound to conclude, therefore, that "the bottom has been knocked out" of many of the arguments used in the course of the discussion above referred to, and that the concensus of opinion in this country in favour of distribution by means of transformers is fully justified and strengthened by what is being achieved daily in America.

Yours, &c.,

London, 21st March, 1888. E. Manville.

FIRE OFFICE RULES.

To the Editor of "Industries."

Sir,—We feel exceedingly alarmed at the prospect that opens out before us now that another set of rules has been published. It would be difficult to arrange at the present stage of the industry any set of rules the following out of which could better guard against dangers arising from electric lighting than those which have been drawn up by Mr. Musgrave Heaphey. The writer has seen a number of installations both on the Continent and in the United States, with the result of feeling assured that work of this kind in England is infinitely superior to that carried out in other countries, and there can be no doubt that our comparative immunity from fire arises from the judicious enforcement of proper fire rules. A number of installations in this kingdom, including one or two of the largest, has been carried out by us, always under the Phœnix Fire Office rules, and in no single instance has an electrical fire occurred. It must certainly be the experience of every contractor that there is no difficulty in obtaining the approbation of fire insurance authorities for installations conscientiously executed. If we are to have several sets of rules it will be impossible to tender for work without a specification, and this means an expensive item added to the price of electrical work for the services of a consulting electrical engineer in each case, whose presence is unnecessary when a duly qualified fire inspector fills the position free of cost to the proposed user of the electric light. We think that this is a matter for the leading contracting firms to interest themselves in, and there can be no doubt as to their opinion on the subject. To frame and impose rules it is necessary to have a status. What is the status of those who are seeking to introduce the new rules, and what authority have they to handle a matter which so seriously affects the trade without first consulting it? The matter is such a serious one that we trust more direct and public impeachment will quickly ensue.

Yours, &c.,

London, 22nd March, 1888. Installers.

[We print our correspondents' letter without being able to indorse it. It is evident that the writers of the letter have a somewhat erroneous idea of the nature of the new rules and of the status of their framers. While fully admitting the good service rendered hitherto by the Phœnix rules, and the fair and conscientious way in which Mr. Musgrave Heaphey carries them into effect, we cannot shut our eyes to the fact that some other insurance companies, for reasons best known to themselves, are averse to the adoption of these rules, and two companies have actually contemplated bringing out rules of their own. It was partly to prevent the multiplication of rules thus threatened that the Council of the Society of Telegraph Engineers and Electricians took the matter in hand by instituting a Fire Rules Committee, with instructions to draw up such general rules as would be acceptable to all the fire offices, without precluding the use of the more detailed Phœnix rules. The Society, whose status and fitness to deal with a matter of this sort can hardly be doubted, have thus adopted the best means in their power to prevent the evil of an indefinite mutiplication of rules, which our correspondents seem so much to dread.—Ed. *Industries*].

THE LOCAL GOVERNMENT BILL.

The singular change which has come over party politics could hardly be more clearly manifested than in the strange irony of fate which has led a Conservative Ministry to introduce by far the most comprehensive scheme of local government which has ever been advanced by responsible statesmen. The idea of decentralising political power, which has long been an element in French political discussions, has almost invariably come from those who profess to represent in a special manner the mass of the people. It is a new, but quite a natural experience, to find the devolution of political power by a central authority proposed by those who may be presumed to represent in a special manner that authority itself. For in England, at any rate, government has become a function of extreme and increasing difficulty. Howsoever ardently some men desire to share in the exercise of that function, the strain involved in its exercise in a nation whose government is so democratic as ours is peculiarly laborious, and the problem of how to procure men sufficiently able and sufficiently popular both as administrators and as debaters is one that must tax the resources of either political party as occasion arises. The vast arrears of Parliamentary business, the slowness with which measures of practical importance are carried through the forms of either House of Parliament, and the obvious absurdity of discussing matters of purely local interest in an assembly of uninterested individuals from other localities, or even to an array of empty benches, have combined to force upon the attention of many Governments the urgent need not to extend the area of Parliamentary business, but to diminish it. Mr. Ritchie's scheme is extremely comprehensive. He proposes practically to hand over to County Councils the administration of local affairs, thus giving into their hands a great number of matters which are at present administered from the offices of the Government Departments in London. The County Councils so established would be representative bodies; the districts over which they possessed administrative powers would be divided into single member constituencies. A very decisive confirmation of the principle of popular election, which for good or evil is a potent factor in English politics, is thus established.

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Three-fourths of the members of the new County Councils will be elected by ballot in the same way as members of Parliament are elected. A probable forestalling of the triennal parliament is proposed, for the Councils are to be elected in the first instance for three years. Thereafter one half of the members will retire every three years. Some such proposal as this has been made for tenure of Parliamentary membership, and this suggests the reflection that these County Councils may not inexpediently be utilised for experimental purposes. Proposed methods may be taken tentatively in one of them, and then if they were found practicable they could be adopted by the others or by Parliament. Such a course might save much waste of time, and save also delayed reforms, through fearful and sometimes groundless anticipations of their supposed impracticability. The extent of area to be comprised in the new counties would of course vary greatly; but the numbers of the population would approximate to equality. The great towns in England would form counties with separate councils. Manchester, Liverpool, Birmingham, Leeds, Sheffield, Bristol, Bradford, Nottingham, Hull, and Newcastle will each be a county possessing its council. A vast number of questions which have frequently been the subject of special attempts at legislation will be in some degree settled by the measure. The partial re-construction of the government of London, for example, will form an integral portion of the scheme. London will no longer be divided among the counties of Middlesex, Kent, and Surrey, but will form a county by itself. The County Council of the new London thus created will absorb the functions of the Metropolitan Board of Works. Although the police government of London will still remain in the hands of the Home Office, this absorption of the Board of Works in the new County Councils is a great step towards the re-casting of metropolitan government. The licensing question is dealt with also by the proposed measure. The granting of licenses will, under it, be part of the business of the County Councils, and will therefore be immediately controlled by popular election. The existing provisions for the granting of licenses are altered under the Bill, mainly in the direction of increasing the power over licenses. The principle of compensation for the refusal of licenses is not only accepted in the Bill, but is regarded by the Government as vital to the existence of the portion of the measure dealing with the licensing question. Compensation involves revenue from some source, and the source from which this is to be drawn is an increase of 20 per cent. in the license duties, payable by spirit dealers. Accompanying this devolution of power to the Councils, the Bill proposes to give them an increased grant from the Exchequer. A sum of £5,600,000 a year will be handed to them by Government, and the existing grants in aid, amounting to £2,600,000, will be discontinued.

The whole scheme is conceived on the most comprehensive lines, though the clear enunciation of the principle of direct popular representation is modified slightly, but not altogether prejudicially, by the provision that three-fourths of the membership of the Councils are to be elected by the general electorate, and one-fourth is to consist of selected members, the selection being made by the Council. It is to be noted that all the provisions of the Bill are in the direction of the decentralisation of administration, rather than the decentralisation of legislation. Yet the establishment of County Councils will undoubtedly either prepare the way for this, or obviate the necessity of its adoption. Legislation affecting local interests will hardly be entered into without consulting these local parliaments, and thus even at once their almost direct influence upon legislation will speedily become apparent. The subject of Local Government is rather too complex to found a party cry upon. The arguments for and against are too numerous for the public to take an excited interest in it; thus there is ample ground for Mr. Ritchie's complaint, that there is no public demand for the measure. Yet there is none the less public necessity, and the Government are unquestionably to be congratulated upon the skill, boldness, and open-mindedness with which they have approached this difficult practical question.

Petroleum.—A gradual but definite change is coming over the petroleum industry in Hungary. The principal features of the situation during the past year have been the increase in traffic with petroleum in tanks both from Trieste and Fiume, the greater production of petroleum in Roumania and Galicia, and the almost complete cessation of the imports of American petroleum. Of refined oil only Caucasian brands are now imported; but the imports of crude oil both from Baku and from Roumania have increased, and more oil is now refined in the country. There have been some experimental bore holes sunk in Marmaros, Murakoz, and Peklenieza; but no definite results have as yet been obtained to show whether Hungary is likely to become an important petroleum country. In Transylvania a new company has been formed under the title of the Transylvanian Petroleum and Refining Company, with head quarters in Kronstadt.

PROPOSED STEAM BOILER LEGISLATION.

In our issue of the 17th February, we drew attention to a Bill that was brought before Parliament last year for dealing with the supervision of engines and boilers, entitled the "Steam Engines and Boilers Bill," backed by Messrs. Burt, Crawford, Abraham, Fenwick, Pickard, and Dyke-Acland; the object being to compel all boiler attendants to pass an examination before, and to receive a certificate from, the Board of Trade. As then pointed out, this Bill was a revival of a similar measure rejected on a second reading some time before, and although we thought there was little probability of its being again brought forward, we find that Mr. Fenwick, Mr. Wm. Crawford, Mr. Burt, Mr. Wm. Abraham (Glamorgan), Mr. Pickard, and Mr. Arthur Acland have again prepared and brought in a Bill entitled "The Engines and Boilers Act, 1888," with a similar purpose, and to extend to the whole of the Kingdom. Nothing appears to have transpired in the meantime, or any additional evidence obtained showing the necessity for such a measure.

The leading provisions of the new Bill are: (1) Every engine or boiler in the United Kingdom must be placed and kept under the supervision of an attendant holding a certificate of qualification under the Act; the number of engines or boilers under one attendant to be prescribed. (2) Every user shall keep a register containing particulars of every engine or boiler owned, name of attendant, and other information, to be produced for the inspection of any examiner under the Act, factory inspector, Court, or person nominated by the Board of Trade. The penalty for default of any part of provisions I. and II. is not to exceed £50. (3) Certificates of qualification *(a)* will be granted to persons passing examinations provided by this Act, and *(b)* to persons who have had charge of an engine or boiler two years previous to the 1st inst. A certificate obtained from the Board of Trade under the Merchant Shipping Acts will be recognised as satisfactory. (4) The Board of Trade will have power to appoint and remove examiners, fix districts, determine regulations as to examinations, qualifications, necessary fees, &c. (5) Also power to suspend, cancel, or re-issue certificates. (6) Penalty of £100 on examiner receiving fees from applicants. Any person forging a certificate, or altering or procuring the same, is liable to imprisonment with or without hard labour, for a period not exceeding twelve months. For fraudulently using a certificate, a penalty is imposed from £10 to £100.

THE LATE MR. T. E. HARRISON.

By the death of Mr. Thomas Elliot Harrison, which took place suddenly on the 20th instant at Whitburn, near Sunderland, the engineering world has lost one of the most respected and prominent pioneers in railway work. He was nearly eighty years of age, having been born on the 4th of April, 1808, and the day before his death was occupied with traffic arrangements on the North-Eastern Railway, of which he was engineer-in-chief. His apprenticeship was passed with Messrs. W. and E. Chapman, civil engineers, of Newcastle-on-Tyne, and when about twenty years of age he came on the expiration of his time to try to make his way in London. He had a letter of introduction to Telford, who told him he had made a mistake in selecting the profession of a civil engineer, as there were very few who rose to eminence, and the others had little or nothing to do. For a time Mr. Harrison was disposed to think Telford was right, but his subsequent career proved the contrary. In 1830 Robert Stephenson engaged him to take the levels between Wolverhampton and Rugby for the London and Birmingham Railway. He was next engaged on the Stanhope and Tyne Railway, afterwards included in the North-Eastern Railway, and in connection with this he designed the Victoria Bridge, which is 157ft. high. Mr. Harrison had a share in the construction of various other lines in the North of England, and ultimately became the successor of Robert Stephenson as engineer-in-chief of the York, Newcastle, and Berwick Railway. Together with Robert Stephenson he had designed the high level bridge at Newcastle. After various difficulties, the competing lines in the North were amalgamated in 1854 under the title of the North-Eastern Railway Company, with 720 miles of line and £23,000,000 capital, which has now increased to 1500 miles of line and £62,000,000 capital, Mr. Harrison taking a very prominent part in connection with this great system. As engineer-in-chief of the new concern he had control both of the permanent way and of the locomotive department, and among the works carried out by him were the Jarrow Docks, which were opened in 1858, and the Hartlepool Docks. He also designed the railway bridge which has recently been built across the Wear at Sunderland. In addition to his more immediate duties, he acted as consulting engineer to the London and South-Western Railway and other lines. He was elected a member of the Institution of Civil Engineers in 1834, and before this Institution he read several papers. He was elected President of the Institution for the session of 1873-74, and in his presidential address dealt with railway management. Mr. Harrison was a member of the Royal Commission on Railway Accidents appointed in 1874, and he was well known by parliamentary committees dealing with railway subjects. By his death one of the most typical figures of the sturdy North has vanished from the railway world, and his sound advice in engineering affairs will be much missed by those who were accustomed to consult him in matters of difficulty.

PUMPING IN MINES BY ELECTRICITY.

In our issue of the 9th December last we published a paper, read by Mr. Frank Brain, before the South Wales Institute of Engineers, in which he described a pumping plant erected at the Trafalgar Colliery. The capacity of this plant in water lifted exceeds 10 h.p., and at that time this was probably the largest underground electric pumping plant at work in England. Since then, however, further progress has been made in the application of electricity to deep mine pumping, and a plant laid down by Messrs. Immisch & Co., at St. John's Colliery, belonging to Messrs. Lock & Co., is designed to cope with a salt water feed of 5100 gallons per hour, at a vertical depth of nearly 900ft. below the surface. It was decided to raise the water at one lift, and at the rate of 7200 gallons per hour, so that the pumps need only work eighteen hours out of the twenty-four in order to cope with the full quantity of water. The plant consists of a 30 n.h.p. compound semi-fixed engine, by Messrs. Robey and Co., driving an Immisch dynamo of 53 h.p. The armature of this machine is 16in. diam. by 24in. long, and the average current is 66 ampères at 600 volts pressure; but owing to the variation of load in the high pressure pumps, the current varies about 10 ampères up and down from the average. The weight of the dynamo is about 4 tons. The motor, which weighs 3½ tons, is also of the Immisch type, and of 575 volts. The speed of both dynamo and motor is 450 revolutions per minute. The actual horse power in water lifted at 120 gallons per minute is 33 h.p. Thus, the efficiency from the electrical energy supplied by the dynamo to the water actually lifted is 62 per cent., which includes the loss of energy in the circuit, motor, gearing, pumps, and that caused by friction in the rising main. Assuming the commercial efficiency of the dynamo to be 85 per cent., the total commercial efficiency of the plant is nearly 53 per cent. The loss in the cables is 2·5 h.p., whilst 13 h.p. is absorbed by the gearing and pumps, and by friction of water in the pipes. We need hardly say that, with a transmission plant of compressed air, the same efficiency could not be obtained, whilst the erection of high pressure air pipes, or even of the smaller pipes required in a hydraulic transmission plant, must be very much more costly, and involve more labour than the running of cables. To show the speed and facility with which such cables can be laid, Messrs. Immisch inform us that the circuits for this plant were laid in seven hours.

Reviews.

A Text Book of the Principles and Practice of Book Keeping. By Professor A. W. Thomson, B.Sc., Royal Agricultural College, Cirencester. London: George Bell & Sons. 1886.

In these days of depression in agriculture, a correct system of book keeping is almost of as much importance to the farmer as improved methods of cultivation, so that he may have a good idea of the nature of the return made by the different kinds of crops. This is especially true when we find there is a growing tendency to "payment in kind." At one time this system of payment was pretty common in various parts of the United Kingdom, and it certainly seems the fairest to all concerned, as by the system of fixed rents no man can tell what may happen to defeat his calculations. The market values of produce may rise or fall, the price of labour may increase or be reduced, whilst the weather is an important factor in all agricultural proceedings; and it is unfair that all the risks of these should be thrown on the farmer over a long period of years. Mr. Thomson's book was specially designed to meet the wants of his students in the Agricultural College at Cirencester, where it was adopted with marked success; but, as the principal of that college remarks in the preface, the clear elucidation of principles contained in it will probably commend it to a much wider circle of teachers and students, especially those who are preparing for any public examinations or public offices, as one of the most useful manuals of the science and art of book keeping which have yet issued from the press.

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Minutes of Proceedings of the Institution of Civil Engineers. Vol. XCI. 1888.

This, the first volume of "Minutes" for the current year, contains like its predecessors a vast amount of valuable and interesting matter. It commences, of course, with the President's address, a masterly review of the present state of engineering science as compared with that of fifty years ago. There can be no question as to the scientific progress of engineering during the last half century, and as a body engineers have every reason to be proud of their profession. It may, however, be safely asserted that among the hundreds who listened to Mr. G. B. Bruce's address, there were many who looked back with regret to the early and—for the individual—palmy days of engineering, when chipping and filing had not yet become obsolete, when contractors did not act as civil engineers, and when competition had not yet reduced prices almost to the vanishing point. The first paper in the volume before us, is the second part of that by Sir Frederick Abel on "Accidents in Mines." With respect to the connection between atmospheric pressure and explosions in mines, the author considers that gas escapes from goaves or old workings, which are liable to accompany a sudden fall of barometer, constitute an important source of danger in coal mines. These goaves, which are formed by filling up old workings with the rubbish produced in getting the coal, are not always compact, as the *débris* available is insufficient to completely fill all the cavities, and, consequently, there is often plenty of space for gas to accumulate in the interstices in a position where it is inaccessible to ventilation and inspection. This fact was well established by the evidence of many experts before the Royal Commission on Accidents in Mines. The author discusses the question as to the part played by coal dust in causing or promoting explosions in mines. He points out that no less than eighty years ago Mr. J. Buddle, who was at the head of the Newcastle coal miners at that time and for many years subsequently, drew attention, in a published account of an explosion at the Wallsend Colliery, to the disastrous results caused at a distance from the point of first explosion by the combustion of coal dust; and the possibility of accumulated coal dust being ignited by the flame from an explosion of fire damp, was referred to in 1828 by Mr. Robert Bald in the *Edinburgh New Philosophical Journal*. Experiments made at various times and places, more especially those of the Prussian Fire Damp Commission and those carried out by the author at Chatham, seem to prove conclusively that coal dust alone, if sufficiently dry and fine, may produce an explosion when ignited by the firing of a charge. There is no doubt whatever that it is a source of great danger when present with fire damp.

Of all the matters dealt with in his paper by Sir Frederick Abel, perhaps none is of greater interest than the construction of safety lamps, and it seems probable that at no very distant period portable electric lamps will have superseded those now usually employed in mines. The most promising of these hitherto brought before the public appear to be that by Mr. Scharschieff, in which a small primary sulphate of mercury battery is used, and that by Mr. Blumberg, which weighs only 4½lb. and furnishes a light at starting equal to 1 c.p., the luminosity of which diminishes only very gradually, and after eight hours is yet a little superior to that of a Davy lamp. An interesting discussion and correspondence followed the author's paper.

The succeeding paper is that by Dr. Edward Hopkinson on electric tramways, an abstract of which has previously appeared in our columns. The Bessbrook and Newry tramway appears to be the most important work of this kind in England, having a daily traffic of 100 tons of minerals and goods each way in addition to the passenger traffic. It was specified that the electric locomotive should be capable of hauling a gross load of 18 tons, in addition to the weight of the car itself and its full complement of passengers, at an average speed of six miles an hour on the up journey, and a load of 12 tons at an average speed of nine miles an hour. That these conditions were satisfactorily complied with proves that electric locomotion has now advanced beyond the experimental stage, and it is satisfactory to learn that the cost of working does not exceed that of steam traction on a similar line. The discussion turned chiefly upon the relative cost of electric and other modes of propulsion for tramways, and the limits of length and electromotive force up to which it was desirable to employ conductors, and at which it became more economical to use storage batteries.

Among the selected papers is one by Mr. B. H. Brough, instructor in mine surveying at the Royal School of Mines, on "Tacheometry, or Rapid Surveying." The method of surveying designated tacheometry appears to be little used in this country, but is familiar to engineers on the Continent and in America. According to Mr. Brough it was first adopted in Italy as long ago as 1823. It consists in obtaining by a single observation the elements determining the position of every point visible and accessible from a fixed station point. Surveys by this method can be made in one-third to one-fifth of the time required for the older methods, and it is particularly useful in a mountainous country. As regards accuracy, the author states that Signor Porro, a Piedmontese officer, who made many improvements in tacheometry, attained such accuracy in the measurement of distances that his errors never exceeded $\frac{1}{2000}$. The St. Gothard and Simplon lines, and all the railways constructed in Switzerland during the last fifteen years, have been made from plans prepared by means of the topographical stadia, which differs from the tacheometer only in the fact that the micrometer is applied to the alidade of a plane table instead of the telescope of a theodolite. Mr. Brough gives examples of the cost of surveys made by the tacheometer, and a model of the field book employed in this kind of survey. It seems rather strange that "although the best tacheometers are manufactured in London and largely exported," no details should be available of any application of the method in this country. It would be admirably suited for use in the Colonies and India, and generally for preliminary surveys and pioneer work. If our surveyors and engineers are as ignorant of the advantages of this system of survey as the author would lead us to believe, we would recommend them to study his paper carefully.

An interesting account of the equipment and methods pursued in the engineering laboratories of the Massachusetts Institute of Technology, by Professor Gaetano Lauza, will be found in the same volume. Deserving of special mention is the fact that the Fairbanks testing machine of 50,000lb. capacity can be arranged in such a way as to enable full sized beams of timber to be tested for their transverse strength and deflection up to spans of 25ft. It has been found that the actual strength of such beams is only one-third to one-half of that given by calculations based on the constants given by Rankine, Laslett, Trautwine, Rodman, and Hatfield. This the author ascribes to the circumstance that these investigators made their experiments on small pieces, and that the results obtained are not applicable to the sizes occurring in actual practice.

There are in this volume of "Minutes" two papers by students of the Institution, one on "Propelling Machinery of Modern Warships," by Mr. S. H. Wells, Wh.Sc., and the other on "Hydraulic Appliances at the Forth Bridge," by Mr. E. W. Moir. The foreign "Abstracts" with which the volume concludes, contain as usual much valuable material; their chief use is, of course, to direct the attention of those interested to the original source of information, while at the same time giving briefly some idea of the contents.

Patent Cases Decided by the Comptroller-General and Law Officers of the Crown in 1887, together with Some Unreported Cases in the Courts of Law. Edited by Ralph Griffin, Barrister-at-Law. London: Waterlow & Sons, Limited.

We have been favoured with an advance copy of this valuable supplement to the "Reports of Patent Cases" issued by the Patent Office. Mr. Griffin has taken the greatest possible pains to secure accuracy, and has had the advantage of the assistance and collaboration of the best authorities in carrying out his work, which will be of great assistance to inventors and patent practitioners generally. The cases are arranged in their natural order, so that all those which relate to a particular stage are found together, and reference is facilitated. The first case relates to an application for patent in which the title included the words "and analogous vessels." The Comptroller declined to accept the title including these words; but on appeal the Attorney-General decided that in this particular case the words objected to were limited in the specification and claims, and might be allowed. There are ten cases of opposition to amendments of specifications reported. We may quote from the judgment of one of these cases a passage which should be taken to heart by patentees: "I do not intend to give any costs of this appeal; although I have decided in the patentee's favour, I must say that people who come forward with specifications so loosely framed as this one seems to me to be—I express no concluded opinion upon it—must not be surprised if their rival traders are disposed to oppose their getting the amendment which they may be entitled to." Fourteen cases of opposition to grants of patents are reported, from one of which we may quote from the decision of the law officer with respect to a frequently discussed point: "I am of opinion that if a workman is employed by an inventor to make a model for the purpose of carrying out his invention, and the workman suggests improvements in detail of the machine which are adopted in the machine or model as completed, these suggestions are the property of his employer, and the workman cannot afterwards take out a patent for them." The remaining portion of the work is taken up by cases which have not been previously reported relating to actions for infringement.

COMMERCIAL EDUCATION IN JAPAN.

The efforts which have been made for some years by the Japanese Government, with the view of furthering both scientific and general education in Japan, are now widely known. Colleges and schools have been established and are well maintained in nearly all the leading industrial districts of the empire, and an activity shown which might well be imitated in many industrial centres in this country. So rapid has been the march of events in Japan, that the whole social fabric has been changed; and classes of men now taking a leading part in the industrial development of the country were, under the former system of government, deprived of the social importance which they now possess. The merchant class is a good example of this change, for after suffering centuries of governmental indifference, this class is now receiving assistance from the Government on every hand. One feature of this assistance is shown in the formation of a large commercial educational establishment in the capital, known as the Tokio Commercial College. Attached to this College is a Commercial Museum, which at present, however, only contains exhibits of native productions. The director of the College, Mr. G. Yano, in a recent pamphlet, states that "The Japanese Government being fully aware of the importance of such an institution to Japan, have founded a Commercial Museum in Tokio, and have decided to devote to its success special care and attention." He also remarks that "Mr. Takashi Masuda, of the mercantile firm of Mitsui & Co., and an influential member of the committee of the Tokio Commercial College, has been requested by the Minister of the Educational Department to collect specimens of merchandise from foreign manufacturers." In order to give effect to the request of the Japanese Minister of Education, Mr. Masuda has forwarded a circular letter to the leading English manufacturers and merchants, a copy of which we publish below. We have also been asked to assist Mr. Masuda in his praiseworthy attempt to extend the range of exhibits and usefulness of the chief Commercial Museum of Japan, because of some knowledge we possess of the technical requirements of the country. We have already taken some private action in the matter; and if we can give any of our readers any information not contained in the following letter, we shall have great pleasure in supplying it:—

(Copy of Mr. Masuda's Letter.)

To English Manufacturers and Merchants.

Gentlemen,—I have the pleasure to state for the information of English firms now doing, or desirous to do, trade with Japan, that there has been established in Tokio, the capital of Japan, a Commercial College and Commercial Museum. The Museum is connected with the College, and both are under the direct supervision of the Government Educational Department. Up to the present, however, this Museum only contains exhibits relating to the productions of Japan, and consequently there is, especially amongst the Japanese commercial community, an earnest desire to greatly widen the scope of the Museum, so that it may contain not only native exhibits, but also exhibits from all the industrial centres of the world.

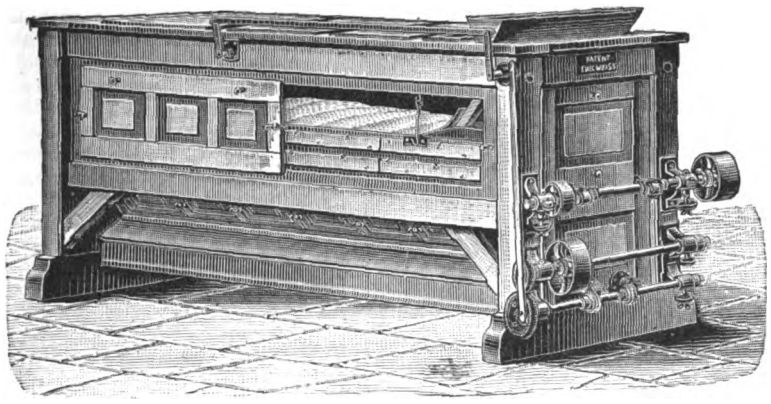
In order to carry out the object in view, it has been recently proposed to sufficiently extend the present Museum buildings to enable them to contain any samples of foreign productions which may be obtained from manufacturers or merchants desirous of permanently exhibiting their goods or machinery in Japan. The extension of the Museum buildings having been practically decided upon, I am deputed—as vouched for by the Consul's certificate at the foot of this letter—by the members of my Committee to solicit from English manufacturers and merchants contributions for our Commercial Museum. These contributions may take the shape of samples of raw or finished materials, small machines, models, tools, general appliances, photographs, drawings, maps, plans, sketches, catalogues, price lists, or circulars, all of which will be permanently housed, classified, and exhibited in the Museum. In the case of merchantable articles, the current prices should be affixed to the samples.

As regards the exhibits of manufactured goods, it would be of great interest and value if the exhibits were grouped and arranged to show the different stages in the progress of manufacture—that is, from the raw material to the finished product. In order to prevent a repetition of exhibits, intending exhibitors are requested to communicate with the London branch of my firm (Messrs. Mitsui & Co., 1, Crosby Square, London, E.C.), stating the exhibits which they propose to send out, so that they may be informed whether similar exhibits have been already promised.

With the view of making the exhibits commercially valuable to all concerned, it is hoped that exhibitors will forward periodically the revised prices of their goods, and also send early particulars of any invention or improvement in a process relating to the goods or machinery exhibited. Such revised prices or particulars may be sent out direct, addressed to "The Commercial Museum, Tokio, Japan," and will be at once affixed to the exhibits to which they relate. Any exhibits sent will be gratefully acknowledged by the Museum authorities, as they feel that each exhibit will help to make our people better acquainted with the comforts, luxuries, and general material advantages enjoyed by western nations. This increased knowledge of the productions of other nations will lead to an extension of our requirements, and in that way probably enlarge or originate a market for any articles which may be kindly sent for exhibition in our Museum.

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THE WEISS PURIFIER.



All packages containing exhibits or catalogues should be sent to our packers, Messrs. Perrott & Perrott, Tenter-street, London, E.C., and be marked **C M**—within a diamond. Any further information will be gladly supplied by the London office of my firm, and in conclusion I confidently hope that this application will meet with a liberal response, and that any exhibits sent may be at once mutually advantageous to our people and to the firms supplying them.

I am, Gentlemen,
Yours faithfully,
T. Masuda,
(Managing Director of Mitsui & Co., Japan),
For the Tokio Commercial College Committee,
Tokio, 15th January, 1888.

Consul's Certificate.

I hereby certify that Mr. Takashi Masuda is one of the Committee of the Tokio Commercial College, and I hope that his application for exhibits on behalf of the College will be entirely successful. I also certify that the Editor of *Industries* is authorised to solicit exhibits on Mr. Masuda's behalf.

M. Arakawa,
Acting Consul for Japan.

London, 5th March, 1888.

THE RECENT STORM IN AMERICA.

(From a New York Contributor.)

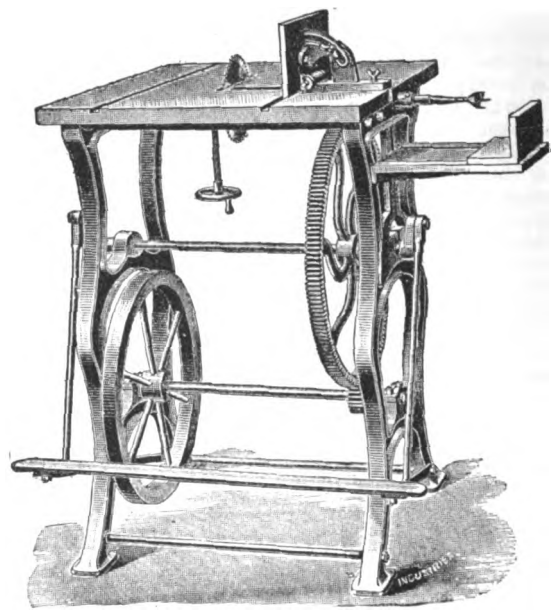
For the first time since steam and telegraphic communication has been established, New York city, the entire country for a distance of about five hundred miles in every direction from the Metropolis, has been practically deprived of all modern means of intercourse for a period of from two to six days. On Sunday, March 11th, at 3 p.m., rain began to fall, which at midnight turned to snow, accompanied by a high wind reaching a velocity at times of eighty miles per hour. This combined storm of snow and wind continued with increasing severity until Tuesday morning, the temperature falling meanwhile from 22° to zero F., with all the characteristics of a western "blizzard." Business was practically suspended on Monday and Tuesday. Steam and horse railways and ordinary vehicles found it impossible to cope with the immense volume of driven snow, which was probably from 18in. to 24in. deep on a level; but in numerous localities lay in drifts of from 4ft. to 15ft. in depth and hundreds of feet in length in city streets and railway cuttings. Telegraph and telephone wires were torn down in many cities and towns by the high wind, and at the time of writing (the 16th inst.), telegrams are arriving in this city by special messengers on the Sound steamboats from various points along the shore of the State of Connecticut, which are as yet isolated from this city by the non-resumption of railway and telegraphic communication. Three thousand telephone circuits are yet incomplete in this city, although every possible effort is being made to restore them. Telegraphic communication has been maintained to a very limited extent with various points by most circuitous routes. For three days press dispatches between New York and Boston have been exchanged *vid* Europe. This has been feasible owing to the fact that the Commercial Company's cable lands at Coney Island, about ten miles from this city, from which point an underground line is laid to the office at No. 1, Broad-street—excepting, of course, the East river crossing. The lines of the long distance telephone company being new and substantially built, have also been utilised for communication with Philadelphia and Boston. Bridgeport, Connecticut, fifty miles away, has been reached by telegraph *vid* Albany and Pittsfield, and the Housatonic Valley, through a region usually more subject to interruptions of this kind than the immediate suburbs of New York. The reliability of all classes of subterranean systems has fairly established itself. Water, gas, pneumatic tubes, and such electric wires as have already been placed under ground, have, of course, been unharmed. The arc lighting wires, while enduring the storm very satisfactorily, have added an element of danger to the general wreckage, and as a precautionary measure the dynamos were not started until the lines had been inspected, as the possibility of fire arising from any cause while the streets and hydrants were buried in snow made the situation extremely critical. The fact that several disastrous conflagrations had occurred within a month pointed to the necessity of exercising every precaution, the fire alarm telegraph system itself being seriously crippled. The loss of life accompanying this storm cannot be ascertained for many days. The whereabouts of missing people cannot be established until all means of communication have assumed their normal condition. Many perished from exposure on Monday in their attempts to reach their families on foot, in order to relieve anxiety as to their welfare. Many railway employés lost their lives through abortive attempts to drive locomotives through the drifts; milk vendors, and others whose duties compelled them to start out at an early hour on Monday before travel was seriously impeded, were in many cases compelled to succumb to the fury of the storm. Amidst all the suffering and annoyance, a determination to patiently endure the hardships of the situation was apparent when it became generally known that business was practically suspended in every direction, and that the situation was simply a holiday cessation of ordinary duties, to be resumed whenever the abnormal condition of affairs could be supplanted by the more ordinary but less sensational methods of civilisation.

THE WEISS PURIFIER.

A machine is now being introduced into this country for the purification of wheat middlings without the use of fan or stive room. The principal advantage in doing away with the latter appliances is a reduction in the risk of fire and explosions, and a consequent saving in the premium to be paid for fire insurance. The machine we are about to describe is the invention of Mr. Emil Weiss, and is illustrated in the accompanying engraving, which shows a perspective view with a portion of the panelling removed. In this machine a somewhat novel principle has been adopted for agitating the material to be treated by air, without, however, using an actual current of air. The middlings are introduced through the hopper seen at the front end of the machine, and fall upon the upper one of two silk sieves, fixed parallel to each other, and with a slight inclination towards the other end in an oscillating frame. According to the results desired, the mesh of the sieves may be varied. The sieve frame receives reciprocating motion from two small eccentrics fixed to the upper horizontal shaft, shown in the engraving. This shaft runs at about three hundred revolutions per minute. The top of the sieve frame is covered in by a cloth, which fits tightly round the edges and round the spout of the hopper: but there is sufficient material in the cover to allow of the oscillation of the frame, and in this way the folds of the cloth participate more or less in the oscillating movement, at the same time agitating the air between the cover and the first sieve. To increase this agitation certain portions of the cover receive a slow up and down movement from wooden rods fixed to a transverse rocking shaft below the cover. This shaft is set in motion by means of the cranks and connecting rods shown in the front of our illustration, power being supplied through an intermediate shaft and a pair of spur wheels. On the shaft to which the larger of the two spur wheels is secured are also fixed two bevel pinions driving archimedean screws, by which the material, after passing the sieves, is propelled to the end of the machine, where it is delivered into sacks. The effect of the two motions imparted to the cloth is to cause an alternate decrease and increase in the air pressure over different portions of the upper sieve, and by this means the branny particles and fluff are kept in motion and gradually lfted along the upper sieve towards the tail end of the machine, where they are delivered by a spout into the bran sack. These light particles are thus kept in motion over the surface of the sieve, whilst the heavier granular meal is allowed to pass through the meshes. The shutters which give access to the interior of the machine are provided with felt joints, and the hopper inlet is fitted with a clapper door and spring to prevent currents of air passing over the sieve when the machine is at work. The purified product, after passing through both sieves, falls into a hopper extending the full length of the machine, but having about its middle a vertical partition by which means the product is divided into two grades. The inventor claims that by this machine bran is completely separated, and to judge from the samples submitted to us, the meal is of a very satisfactory character. One of these machines is now working at the mills of Messrs. Thomas Sugden & Sons, of Brighouse, Yorkshire, and is giving satisfaction. A second machine is being fixed at the mills of Messrs. Sutcliffe & Son, of Bacup. We are informed by the agents of the inventor, Messrs. Whitmore & Binyon, of 28, Mark Lane, E.C., that this type of machine is also finding favour among Continental millers.

IMPROVED TREADLE SAW.

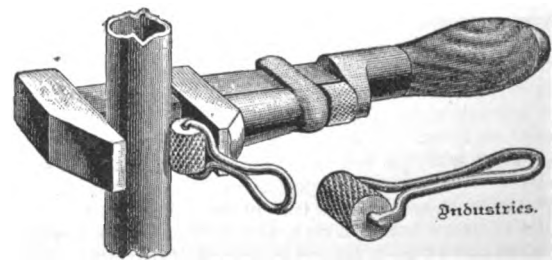
A new circular saw has been brought out by the Britannia Company, Colchester, which is likely to prove a very handy tool for all wood workers who do not possess steam power, as the makers claim for their design a



great ease of working as compared with older patterns. Grooving, dowelling, mitre cutting, and, by means of a separate appliance, scroll cutting may be quickly and neatly done. There is also a boring apparatus provided, which will bore holes up to 2in. with great rapidity.

AMBLER'S ATTACHMENT FOR MONKEY WRENCHES.

We are indebted to our contemporary, the *American Machinist*, for the accompanying illustrations, showing a novel attachment, by which a monkey wrench may be



used for gripping round objects, such as pipes, stud bolts, &c. This apparatus is made by Mr. A. A. Ambler, Springfield, Ohio, and consists chiefly of a small steel roller, which is milled and tempered, and has a wire handle attached to it for convenience of application. There are three points of contact, and the object gripped is not unnecessarily injured. The attachment is so simple that breakage is very improbable, and, not being fastened to the wrench in any way, a slight backward turn disengages it, leaving the wrench available for ordinary purposes. With these advantages, this should prove a useful tool, especially for jobbing work.

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AGRICULTURAL AND DAIRY SCHOOLS.

We have on several occasions expressed the opinion that in the cry for improved technical education, the interests of the oldest industry of all, that is agriculture, were not sufficiently attended to. In August of last year, however, the Lord President of the Council appointed a Departmental Commission for the purpose of inquiring into and reporting upon agricultural and dairy schools in Great Britain, which may properly receive Government grants, and to advise as to the department which should be charged with the administration of such grants. That Commission has now issued its report, which will be read with interest by all concerned with agriculture, and of which the following short account will be useful to our readers.

The evidence on which the report of the Commissioners is based is not given; but they state that they have considered the subject under the various heads of (1) the teaching of the principles of agriculture as aided by the Science and Art Department; (2) the practice of dairy farming, including butter and cheese making, breeding, rearing, and feeding of dairy stock; (3) the instruction now available for agricultural labourers, and yeomen and tenant farmers, and for the training of teachers, whether for employment as practical or as theoretical instructors; (4) the agricultural instruction now afforded by universities, colleges, and schools, whether by means of existing endowments, Government grants, or private adventure. The consideration of the evidence has shown the Commissioners that there is a great loss to the country through a want of a wide spread knowledge of the most effective modes of dairy practice, and of certain other agricultural operations, and they are of opinion that an efficient system for supplying this want, and for assisting our farmers to compete with foreign producers, who have the advantage of recently perfected systems of State aided technical instruction, cannot be set on foot without the stimulus of similar State aid in this country. They are, however, averse to launching suddenly into an extensive scheme, but rather suggest that an endeavour be made to carry out cautiously the process of construction; to begin by meeting the most pressing wants, and by engrafting practical agricultural teaching on a limited number of existing schools, to avoid unnecessary building, and to proceed on a well matured system capable of future growth and expansion. Such a system should take into account the interests of all classes directly connected with agriculture, and special provision should be made for labourers, in addition to what is made for tenant farmers and others requiring higher agricultural education.

The Commissioners propose that, in order to prevent schools springing up at random, and unduly multiplying in any locality, and to insure the selection of proper centres, advantage should be taken of the five "produce districts" into which England has for some years been divided by the Agricultural Department for the purpose of estimating the average annual yield. These, with two such districts in Scotland, they propose should form a base for operations, the details of which would be superintended by the local authorities; and they are of opinion that with the exception of a Central Normal School of Agriculture (which they suggest should be provided and maintained by the State), the other agricultural schools now required should owe their origin to local effort, but should be stimulated and assisted by Government.

The Commissioners are strongly of opinion that increased facilities should be given for the study of the principles of agriculture in rural elementary schools, and that gardens, allotments, and farms in connection with them should be encouraged; and they suggest arrangements for bursaries for the scholars, and facilities for the teachers studying practical agriculture. They state, moreover, that the bulk of the evidence taken has demonstrated the fact that district dairy schools are an urgent and pressing need, and can be readily supplied, and they therefore recommend the immediate establishment of seven district dairy schools—one in each of the five "agricultural produce districts" of England and Wales, and two in Scotland, and that an endowment of say £500 a year should be given to each school. The most important recommendation, however, is the establishment of a Central Normal School of Agriculture for Great Britain, to be used chiefly as a training college for teachers of dairy work, at fees of from £40 to £50 a year, to include board, but to which other pupils not intending to be teachers might also be admitted, and that the college should be fully equipped with land, buildings, and staff at the expense of the State. They suggest that it should be established at some central place easily accessible by rail, and that the neighbourhood of Rugby would probably be convenient. They moreover express the wish that the central college should not enter into competition with the already established colleges at Cirencester, Downton, &c.; and they say that if sufficient local effort were forthcoming, a general school of agriculture should be engrafted on to each one of the seven district schools, which would then become active centres of instruction and information in all branches of agriculture in their respective districts. Various other recommendations are made, the most important of which is that the State should make an annual grant of £3,000 to the Agricultural Department, to be expended in such manner as might be thought best, whether in investigation as to diseases of animals or plants, or in prosecuting discoveries in other branches of agriculture. Mr. Mark J. Stewart has issued a memorandum along with the report, founded on the evidence of the Highland and Agricultural Society of Scotland, in which he suggests arrangements suitable for Scotland; but these, and a criticism of the recommendations of the Commissioners, we will reserve for some other occasion.

THE THERMO-DYNAMIC ANALYSIS OF THE GAS ENGINE.*

After remarking that the term "caloric engine" had become narrowed in its application, the author stated that gas engines might be divided into two distinct classes, viz., those engines using water as against those using no water at all. These might be sub-divided into internal and external combustion engines, and again into regenerative and non-regenerative, and into the three following types referred to by Mr. Clerk, and illustrated by small diagrammatic curves of expansion, shown by the author. (1) "An engine drawing into its cylinder gas and air at atmospheric pressure for a portion of its stroke, cutting off communication with the outer atmosphere, and immediately igniting the mixture, the piston being pushed forward by the pressure of the ignited gases during the remainder of its stroke. The instroke then discharges the products of combustion." (2) "An engine in which a mixture of gas and air is drawn into a pump, and is discharged by the return stroke into a reservoir in a state of compression. From the reservoir the mixture enters into a cylinder, being ignited as it enters, without rise in pressure, but simply increased in volume and following the piston as it moves forward, the return stroke discharges the products of combustion." (3) "An engine in which a mixtute of gas and air is compressed, or introduced under compression, into a cylinder, and then ignited while the volume remains constant and the pressure rises. Under this pressure the piston moves forward, and the return stroke discharges the exhaust." Clerk puts the relative dynamic values of these three types as 21, 36, and 45 respectively; but the relative values of the three different types are not properly represented by these figures. The author then dealt with the peculiarities of each class, showing that No. 3 had a higher pressure at times than the others, and had therefore to be more strongly proportioned. So far as steadiness is concerned, No. 2 would be the best, the third type being the most unsteady of the three, the only regulation being obtained by letting the engine make a few strokes empty. Again, Nos. 1 and 3 cannot start without the aid of auxiliary appliances, whereas No. 2, being constructed with a reservoir, was better in that respect, and is the best fitted to take the place of the steam engine. The author then dealt with the question of the injection of steam along with the charge, and said that whenever water is mixed with the charge of air and other dry gases, the combination resulting must be smaller in direct proportion to the quantity used. Thus if we use a charge of dry gas only we get a dynamic value of 2,920,784ft.-lbs. per pound of fuel, while if we use a charge of half dry gas and half steam we get only 1,713,584·5ft.-lbs. per pound of fuel, or lose by the use of steam 1,207,199·5ft.-lbs.—about 40 per cent. Dealing with the water jacket, the loss by incomplete combustion was referred to, and the difficulty of getting accurate figures. With reference to dissociation, Mr. Guthrie was of opinion that the point of dissociation could not be arrived at by experimenting in closed vessels, for the simple reason that it is entirely regulated by pressure, and on a diagram would form a curve somewhat similar to the adiabatic, but reaching far above it. This point was illustrated by a reference to the boiling point of water, which increases with the pressure, and it was urged that if pressure regulates the temperature of dissociation of water, as water, and at certain pressures and temperatures prevents the molecules from flying off from one another, have we not every reason for supposing that a similar condition of things obtains at the higher temperatures, regulating the temperature at which the molecules themselves split up into their elementary atoms? If this be so, he said, then experiments in closed vessels are useless, for the pressure produced by ignition entirely counteracts the dissociation tendency. The opinion of Captain A. Noble was quoted in support of this contention, and it was pointed out that in steel melting furnaces, with the high temperature used, no approach to dissociation was found. It was therefore hardly likely that dissociation would occur in a gas engine at the temperatures obtained; and it was urged that some other explanation of the slow combustion was necessary, a diagram shown by the author being used to illustrate this point, small light letters representing the air both in quantity and dispersion of the atoms, and larger and thicker letters the gas in combination with the oxygen of the air. Supposing the hydrogen, which has a very great affinity for oxygen, to completely combine in a very short space of time—a couple of atoms of the hydrogen only requiring one atom of oxygen. This would not be so with the carbon, which is four times as greedy of oxygen as hydrogen, and may be involved in a double operation. First, that of taking up one atom of oxygen to form carbonic oxide, having done which, it has to seek about, as it were, to find a second atom to form carbonic acid and complete combustion. Now this seeking about must take time, and that time must vary with the amount of commotion going on at the moment. The greater the commotion the more rapid the combustion. In the gas engine of the day the commotion is comparatively small. The charge is first enclosed within the cylinder, commotion comparatively ceasing. Then, by the firing, it is violently but only momentarily agitated, and expansion begins; but expansion is not commotion. It is only a widening apart of the atoms or molecules, their relative positions not necessarily changing. There would be a slight commotion certainly, this slight commotion slowly causing the propagation of inflammation. Agitation after ignition was, in the author's opinion, a very important element in the future gas engine. Summing up, four chief features were stated: (1) Compression, for by it we get greater power in less space, consequently less loss by radiation and conduction, less wear and tear, less cost of production, and should there be anything in the dissociation theory, compression is the antidote; (2) sustained pressure, as in a steam engine, is a feature absolutely essential for many purposes, and is not got in the gas engine of the day; (3) commotion is another very important feature, and this again is not found, at any rate not in that degree necessary for rapid combustion; (4) a hot cylinder and no water jacket is the greatest necessity of all, and seems to be the chief plan for materially augmenting the efficiency of the present engine; for by cold cylinders, it is generally admitted that possibly 50 per cent. of the thermal energy is now lost. In dealing with these propositions Mr. Guthrie described a patented arrangement, the chief feature of which was that of bringing in cool air from the opposite end of the cylinder to that which, so far, has been universally the practice; the cold air port being placed as near the packing rings of the piston as it is possible to arrange. At this point a stream of comparatively cool air is admitted by means of an annular cavity and narrow annular portway, so that the whole of the circumferential surface of the plunger and cylinder is covered with cool air. As the piston moves out, leaving a narrow annular cavity between the plunger and the working surface of the cylinder, the whole of that narrow annular space is filled with this cool air, effectually excluding dust as well as heat, so that the working surface of the cylinder will be as clean and cool as any steam engine. If the cylinder is prevented from getting hot, it is not necessary to apply the cold water method to prevent too high a temperature. Commotion is only to be obtained by adopting the principle of sustained pressure. Mr. Guthrie said that in his proposed engine he intended to have a separate pump which would compress the air up to the working pressure of the engine, so that there may always be a pressure in the valve chest slightly superior to that of the cylinder, just as in an ordinary steam engine; with this pressure behind the valve the cool annular injection before referred to can be secured, and the water jacket abolished, in addition to which a steady inflow of gas and air during combustion can be obtained. Only in this way can a hot cylinder be used. The admission of gas and air was described, the valve near the piston proper being the air valve, which supplies the cooling injection before described. The air just after passing through this valve is divided into two streams, part is for the purpose just mentioned, and part is taken along a small passage or portway to the hot end of the cylinder to mix with the gas and promote combustion. The valve near the hot end of the cylinder is the gas valve, the portway leading direct to the cylinder in such a way as to cause the jet of compressed gas to impinge upon the jet of cool air last mentioned. The process of one revolution would be this: The piston being at the end, and with no more clearance than that of an ordinary steam engine, both valves would open, perhaps just a slight lead being given to the air valve, so as to fill the cylinder clearance with initial pressure before actual combustion commences. Then the instant the piston begins to move, gas and air will enter together and burn as they enter without explosion. The combustion thus carried on will nearly expand the air and gas without any increase of pressure, for the instant that expansion takes place, the inflow of fresh gas and air is checked, and only as the pressure tends to lower will fresh supplies flow in, burn, and keep up the pressure, so that the action is automatic. The ignition, of course, is spontaneous. The lining of the cylinder being hot, no igniting slide is necessary. Some igniting apparatus will be required for starting purposes until the cylinder becomes hot enough from working; but it is only necessary to form two very small bore holes leading into the ignition portway, the one to be supplied with gas and the other with air, under pressure, direct from the valve chest. Another small opening near these must also be provided, through which the gas and air may be lighted, and once lit up will remain alight until turned off. One small double-way cock, or two small single-way cocks, then, is all the lighting apparatus required, and the same apparatus would be used for warming the cylinder before starting if required. This steady burning and expansion under uniform pressure would go on until the valves shut off the supply, after which expansion under reducing pressure would continue to the end of the stroke, as in the steam engine. A pretty brisk commotion or agitation will be maintained, for during the burning under uniform pressure a jet of flame is projected right across the cylinder, creating a constant disturbance; then, again, there is the flow of air from the annular space surrounding the plunger, which, like an Argand burner, streams out in a tubular form, and impinges against the side of the flame, assisting the combustion, not only by the agitation created, but also by the supply of fresh air for combination with any gas which may have escaped from the first flame unconsumed. Such an engine could be worked exactly as a steam engine, with cut-off and reversing gear.

In the discussion which followed, Mr. Dixon pointed out that the range of temperatures in a gas engine was large, and constituted one difficulty. He thought a hot cylinder was the thing to be aimed at, the experience of triple expansion steam engines confirming this. Like the author, he did not think that dissociation was a practical difficulty.

Mr. John Taylor suggested that the solution of the problem might be found in the use of more powerful explosives.

Mr. Lewis was doubtful whether the lubrication of gas engine cylinders with steam was so harmful as Mr. Guthrie thought. Could not some refractory material,

* Abstract of paper read before the Manchester Association of Engineers, March 24th, 1888, by Mr. H. Guthrie.

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like asbestos, tightly compressed, be used for cylinder linings? With reference to incomplete combustion, he referred to Professor Harold Dixon's experiments on the velocity of flame, and thought that the speed of chemical combination would be so great that there would be little of the searching about of the atoms to which Mr. Guthrie referred.

Mr. Dempster asked a question as to the effect of using oxygen instead of air, and Mr. Hartley remarked that hot gases should not be put into cold cylinders. He questioned whether the gas engine could be used effectively as an expansive engine, but considered that it was undoubtedly superior as a heat engine provided the energy produced could be utilised. He thought that the unsteadiness at present existing was a great evil, and that the tests should be made by lifting water, and not by the brake.

Mr. Guthrie, in reply, said that one of the points to be remembered was the antipathy of the atoms of any body for each other, thus inducing them readily to combine with others. Fleeming Jenkin had worked for some time at refractory linings; but, unless these were non-porous, the gases got into the pores and blew the lining to pieces. With reference to the admission of cool air, he contended that it produced a useful effect, and added to the efficiency of the engine. All loss of heat could not be prevented, but the greater proportion could, he thought, be obviated. The practical engine was undoubtedly that in which a steady push would be given to the piston at every stroke and throughout it, and not that in which a violent propulsion was given intermittently. With reference to dissociation, the experiments already made proved that it did not occur at higher temperatures than those common in gas engines.

ELECTRICAL STRESS.

At the meeting of the Society of Telegraph Engineers, held on the 22nd inst., a paper on the above subject was read by Professor A. W. Rücker and Mr. C. V. Boys.

Professor Rücker, in introducing the subject, referred to the researches of Ker, Gordon, Quincke, and Röntgen on the stress in dielectrics placed between conductors at different potentials, and mentioned that Professor S. P. Thompson had exhibited a lecture experiment to his classes, illustrating the stress in bisulphide of carbon. The authors did not profess to give any new results, but in view of the importance of a general recognition of the fact that electrical action takes place in the dielectric separating conductors, and not in the conductors themselves, they had devised some experiments which would exhibit these actions to an audience.

We need hardly say that the experiments were carried out in admirable manner, peculiar to both authors, and we regret that it is impossible to convey by description even an approximate idea of the beauty and elegance of these experiments. We can only give in the following the merest outline, but would advise our readers not to miss the opportunity if the authors should read another paper on the subject.

The first experiment shown was the introduction of a slab of paraffin between the plates of a charged condenser in connection with the two pairs of quadrants of an electrometer, showing the increased induction owing to the specific inductive capacity of paraffin being greater than air. That the effect was not due to a film of moisture on the surface of the paraffin acting as a conductor was shown by touching the paraffin, which did not alter the deflections of the electrometer; but when the paraffin was coated by tin plates, though the same deflection was produced in the first place, the needle flew back when this metallic casing was touched. Maxwell arrived at the conclusion that the stress in the medium was of the nature of a hydrostatic pressure perpendicular to the lines of force, combined with a longitudinal tension along the lines of force. A kind of crystalline structure should therefore be produced in the medium, so that we should expect its action on light to be similar to that of a crystal with its axis parallel to the lines of force. It was shown when plane polarised light passing through a glass plate placed between two Nicol's prisms is extinguished by turning the second Nicol, the light is partially restored when the glass is subjected to stress. Some experiments due to Ker on electrical stress in bisulphide of carbon were then shown, with the modification of using long cylinders as conductors in the place of spheres, in order to increase the thickness of the medium, and magnify the effect sufficiently to render it visible when projected on a screen. A glass and wood cell, cemented with shellac, and containing two parallel cylinders immersed in bisulphide of carbon, was placed between two Nicols and traversed by a beam of light parallel to the axis of the cylinders. It was then shown that after extinction had been produced, the light passing through the annular space between the cylinders again became visible, when they were oppositely charged, by means of a Wimshurst machine, showing that the attraction was accompanied by stress in the intervening medium. Two cylinders, connected together, and placed between a pair of metallic plates, also in connection, were then charged, the pair of plates and the pair of cylinders forming the electrodes, and it was shown, as before, that the repulsion between the similarly charged cylinders was accompanied by a state of stress in the medium between them. The existence of stress was then shown in the case of a Franklin's pane, with bisulphide of carbon as the dielectric instead of glass. In a similar Franklin's pane, but containing windows in its lower half, the restoration of light was greater in the upper half, which would be expected on Maxwell's theory; while, if the effect was due to irregularities of action at the edges, there ought to be a greater restoration of the light passing through the lower half. The phenomenon of Newton's rings was reproduced by means of a pair of plates, one of which was plane, while the opposed face of the other was a portion of a convex cylindrical surface, the colours being due to the varying stress in the bisulphide of carbon separating them, the stress, of course, being greatest where the distance separating the conductors was least. Some beautiful chromatic effects were also shown by means of Franklin's panes, with the aid of quartz and selenite plates.

UNDERGROUND ELECTRIC LIGHT WIRES.

In a short article on this subject, published in our issue of the 16th inst., we drew attention to the many failures of underground cables which, according to the paper brought before the Electric Light Convention at Pittsburgh, by Mr. Leggett, had occurred in America, and we then expressed the opinion that if the work had been done in England the results would not have been the same. As a matter of fact, the few underground high pressure cables which have been laid at Eastbourne and other places in England have as yet given very little trouble, and the natural inference is that with good material and workmanship distribution of high pressure currents by means of underground cables is perfectly feasible. In America, the work done in the factory is admirable; material, workmanship, and finish of electrical apparatus as it leaves the makers' hands is everything that can be desired. But the same cannot be said of the way the apparatus is erected and worked, and herein lies the reason why we hear so much of cables failing. In England, central station lighting is unfortunately so far behind America and the Continent that very few data regarding the behaviour of high pressure underground cables are available, and we have to look abroad for information. We have, therefore, requested one of our Milan correspondents, who is an electrician of high standing, and intimately acquainted with central station work, to supply us with information regarding the underground systems used in that town, and the following is the account received:—

Milan was one of the first cities in Europe in which the distribution on a commercial basis of electric light from a central station was attempted. The Milan station has been in continuous operation for nearly five years, and has steadily increased its capacity year by year, maintaining its claim to be the largest electric light station on the Continent. It has passed through various phases of development, supplying at first only incandescent lamps in multiple arc, and then successively adding arc lamps supplied from the incandescent lamp circuits, an independent arc system, and finally the alternate current system. These systems require different types of conductors, with varying degrees of insulation adapted to the different currents and pressures. At first, while the station supplied only incandescent lamps on the Edison two-wire system, the requirements as regards insulation were moderate; but with the application of new systems, operated with pressures of 1500 to 2000 volts, and both direct and alternate currents, new conditions presented themselves, and more particularly in the circuits that were laid underground.

The Milan installation, as at first projected, supplied only Edison lamps from a general underground network, as usually adopted in Edison stations, and in which a constant pressure is maintained by feeders. Edison tubes were at first exclusively used, but on the introduction of the arc lighting system a new type of conductor had to be adopted. The conductors for the supply of the Edison incandescent lamps are all underground, and comprise at present over 13 kilometres (8·1 miles) of Edison tubes (two-wire system) and 1 kilometre (0·6 miles) of Siemens cable. For the series arc lighting the Thomson-Houston system is used, only part of the circuits being underground. For this purpose single conductor, lead covered and armoured Siemens cables are used, and of this type about 6½ kilometres (4 miles) have been laid. A Siemens double conductor concentric cable, having a length of 1·8 kilometres (1·1 miles), supplies a number of incandescent lamps at some distance from the station, on the Zipernowsky-Deri system. We have thus installed in Milan at present a total length of underground conductors amounting to 22·3 kilometres (14·2 miles). These several lighting systems are representative of the various conditions of supply which a well equipped station is called upon to meet, and a few details of the various conductors used, and their electrical properties, may be of interest.

The construction of the Edison tubes is too well known to merit a detailed description. Suffice it to say, that in Milan the two-wire system tubes are used with the lamps in simple parallel. In the underground conductor network the tubes are of two classes—mains and feeders. The former have a constant sectional area of 92 sq. mm. (0·14 sq. in.), and represent a total length of 8 kilometres (5 miles). The feeders have sectional areas varying from 250 sq. mm. (0·386 sq. in.) to 650 sq. mm. (1·02 sq. in.), and lengths varying from 118m. (387ft.) to 690m. (2260ft.), representing a total length of 5 kilometres (3·1 miles) in tube lengths of 6·2m. (19ft.) each. In the case of feeders, the large number of joints which the use of such short conductor lengths entails is not advantageous and not necessary, as feeders have no derived circuits, and run from the station straight out to the point at which they are attached to the distributing mains. These conductors carry currents as high as 400 and 500 ampères, with a pressure of 110 volts, and require to be fairly well insulated, as a short circuit or heavy earth in conductors of such a large sectional area might compromise the regularity of the station service. The insulation resistance between the copper segments is usually higher than the insulation to earth, which in the different feeders, after having been in use for five years, varies from a minimum of ½ megohm up to 150 megohms. Cables are to be preferred for feeders, as they may be laid without intermediate joints, or with a relatively small number of such joints, rendering it less difficult to obtain and maintain a higher insulation resistance than in the case where tubes are used as feeders. For one of the feeders a Siemens single conductor lead covered and armoured cable is used for each pole of the circuit. The cable has a sectional area of 625 sq. mm. (0·96 sq. in.), formed of thirty-five strands of wire, each wire having a diameter of 4·77mm. (No. 7 B.W.G.). The resistance per kilometre is about 0·0253ohm.

The cable is provided with a testing wire, which permits of the application in the station of a voltmeter showing the pressure at the feeder terminals, where they are attached to the distributing mains. The stranded core has an insulation of specially prepared hemp, over which follows a lead covering, which is in turn served with a layer of tarred hemp, and the armour consists of two spiral iron bands wound in opposite directions, and served on the outside with a layer of tarred hemp. The external diameter of the cable is about 2·2in. The cable has a total length of about 1000m. made up of lengths of 100m. each, joined by heavy copper clamps in suitable junction boxes, which are filled with a special insulating compound. The insulation to earth of each pole of the cable has not varied sensibly since it was first laid down some six months ago. This cable has been daily carrying a current of 350 ampères at 110 volts, and the insulation remained constant at about 750 megohms per kilometre of conductor. The cable was delivered in coils of 100m., which were mounted on a drum supported by an axle spanning the ditch into which the cable was to be laid, high wheels on the sides serving to move along the drum while the cable was being unwound.

The conductors (tubes or cables) are laid in ditches at a depth of 25in. to 30in. below the street level, and the cables are unrolled from the drum right into the ditch. The conductor (tube or cable) having been covered with a layer of earth to 3in. or 4in., a rough charred and tarred plank is laid over them, to give warning to any future diggers of the proximity of the conductors, and the ditch is then filled up and the paving made good. This simple expedient of laying a board over the cables has saved them from many a pick hole. The Edison tubes were given an extra coat of tar paint before laying in the trenches; but in Milan, which is sadly in need of a complete sewage system, the leakage from the roughly constructed sewage conduits has in many places attacked the iron of the tubes. The streets are built up over the *débris* of the habitations of past generations, and the soil in such localities would in time have ruined the tubes. To effectually preserve the 2000 tubes laid in Milan from becoming corroded to an extent that might in course of time endanger their insulation, it was decided to protect them with a layer of asphalt. The tubes as they lay in the ditch were scraped free from the attached earth, and a tarred wooden box slipped around them, leaving a space of 4in. between the tubes and the sides of the box. Into this space was poured an asphalt in a semi-liquid state, and consisting of two parts of fine sand to one part of tar, forming a durable and perfect protection. Some tinned wrought iron gas pipes that were laid in Milan thirty-five years ago, and protected with a layer of similar

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composition, were dug up a short time ago, and the tinned iron surface underneath the asphalt was found as bright as when first laid down.

In planning a distributing system for a central station, it becomes exceedingly difficult to provide beforehand for all consumers that may wish to use the current, and the immediate installation of service branches for them all entails a heavy expense. As the electric light station of to-day is called upon to supply current not only for lighting, but also for operating electric motors and for electrolytic purposes, a continuous service of twenty-four hours per day becomes necessary, and the multiplicity of consumers makes it impossible to cut out even for a short time a section of main for attaching new services. It is therefore necessary to use as distributing mains conductors of such a construction that will allow new branch services to be connected while the current is flowing in the mains. As the coupling joints of the Edison tubes are only 6m. apart, they are always near on the one hand or the other to the new service to be connected, and the branches of a T joint for the service conductor can be connected to the coupling joint without interfering with or interrupting the circuit or its connections.

Turning now to the conductors for the Thomson-Houston arc light system, in which the use of a high pressure requires a more perfect insulation than in the case of the 110 volts circuits, the four dynamos installed in the Milan station have each a capacity of thirty arc lamps connected in series, and generate a normal current of 10 ampères. Each dynamo has an independent circuit, and two of the dynamos have only their outgoing wires underground, the return being through an aërial line, whilst the other two dynamos have both of their circuits underground, and in this case the underground conductors are therefore subjected to the full pressure of the dynamos. The underground conductors are all lead covered and armoured cables, with a single No. 8 B.W.G. wire. Two types of conductors have been used, one in which the armouring consists of spirally wound iron wires, and a later type in which (as in the case of the previously described larger cable) the armouring consists of two spiral iron bands wound in opposite directions, the outside diameter of the cable being about 1in. Although these cables have been in continual use for two years subject to a pressure of 1500 volts, no decrease of their insulation resistance has been observed, and no difficulties of any kind have ever been encountered in their use. They were furnished in lengths of 300m., and had an insulation resistance of about 1200-1500 megohms per kilometre, which, after laying down with joints and connections, became reduced to about 600 megohms per kilometre. At this point it has remained. In especially exposed places the cables are laid into tarred wooden troughs, and the space around the cable filled in with cement.

The introduction of the alternate current transformer system called up new requirements, and to meet them we have the double conductor concentric cable. The Zipernowsky-Deri system is used in Milan for the lighting of two theatres that are too far from the station to be economically reached by the network of the Edison system. These theatres are situated respectively at 1200 and 1800 metres from the central station. The concentric cable conveys the 2000-volt primary current from the station to the theatre, where it is transformed into a 110-volt current supplying Edison incandescent lamps. In general construction and protective armour the concentric cable is similar to those already described, with the exception that it has two conductors placed concentrically. The internal conductor is a single wire of 6mm. (No. 4 B.W.G.) diam., and the outer conductor is composed of forty-four strands of wire of 0·88mm. diam. (No. 20 B.W.G.), with a heavy hemp insulation separating the two circuits. At a point 1000 metres from the station, the cable divides into two branches, one of 200 metres and the other of 600 metres, making a total length of 1800 metres. A part of this cable was laid down in June, 1885, and used during several weeks for the lighting of one of the theatres with a temporary installation at the central station, from which an alternating current of 1200 volts e.m.f. was conveyed to the theatre. The following year the cable was used for several months for running a number of Thomson-Houston lamps in the International Milling Exhibition, held in the vicinity of the theatres. Careful tests made before, during, and after these periods failed to indicate any variation in its insulation resistance. Last December, whilst making some experiments on the coupling in multiple arc of alternate current dynamos, the cable was subjected to abnormal conditions, and the insulation suddenly broke down, establishing a short circuit. The defect was immediately located and repaired, and after that the insulation resistance was found to have suffered only a slight permanent diminution. The regular lighting of the theatres was inaugurated a few days later, and has been in continual operation since then, without the slightest hitch, careful daily tests failing to show any permanent change in the insulation resistance. The cable is now carrying a current of 35 ampères, under pressure of 2000 volts, with eighty-five alternations per second. Although conductors carrying high tension currents have not been in use for a sufficient time to make it safe to assert what effect the continual strains to which they are subject may have upon the maintenance of their insulation, the results thus far obtained do not warrant the pessimist views expressed by some American electricians. The electric light is gradually making its way into favour as a general public illuminant, and its future progress largely depends upon the security and continuity of the service without which the general displacement of other illuminants cannot be undertaken. Occasional breakdowns and extinctions were tolerated whilst the electric light was in its experimental stage; but now that stations are projected for the supply of whole districts, with capacities of 20,000, 30,000, and 50,000 lamps, continuity of the service becomes of paramount importance. How closely allied the question of underground conductors is with the future of electric lighting from central stations needs no demonstration, nor do the local engineers claim that this difficult problem has been completely solved in Milan; but what has been done in that direction, thus far, makes it appear probable that no very serious difficulty will be met with in a general system of distribution of high tension currents by means of underground cables.

Notes.

PUBLIC WORKS AT CHERBOURG.

The British Consul at Cherbourg states that the works for the improvements of the outer port and floating basin at that port have been carried on with energy during the past year. The deepening of the outer port is carried on under two iron coffer dams by about eighty men, mostly Italians, who work in relays day and night. Nothing has been done to advance the deep sea pier, though it was commenced some years ago. The railway from Montebourg to St. Vaast and Barfleur, which was opened in 1886, has now been completed, with a branch to Valognes, and is in working order.

INDIAN RAILWAYS.

Reports of the Public Works Department of the Government of India state that the following sections of line have been opened for traffic recently: The Miraj-Belgaum section of the Southern Mahratta system, 85 miles in length; the Warangel-Dornakal section of the Nizam's Guarantced State Railway, 53½ miles in length, and the mineral branch line of Singareni, 16½ miles in length; the Palghat Town extension of the Madras Railway, a length of 3 miles; the Calicut extension of the same line, a length of 9 miles; and the Channrah-Thansi section of the Indian Midland Railway, a length of 95 miles. Sanction has been given for the construction, at the cost of the Darbars of Gondal and Porbandar, of a metre-gauge railway, 69 miles long, from the Dhoraji station on the Bhaonagar-Gondal Railway to the seaport of Porbandar, *viâ* Superi Upleta, Bhayawadar, Jampur, and Wansjalia, and the work of constructing the line is to commence at once.

HARBOUR WORKS AT LLANELLY.

The operations which have been carried on during the last six years in the Burry Inlet, opposite Llanelly and up to Loughor, for the improvement of the navigation, have been eminently successful, as the depth of water in front of the harbour is now nearly double what it was before the commencement of the new works, and vessels of nearly 1200 tons can now enter the harbour. It is anticipated that there will be shortly as much water at this port as at Swansea. The improvement has been effected by constructing a heavy slag bank about three miles in length in such a manner as to divert the main deep water channel which formerly flowed down the middle of the estuary. A new channel, five miles in length, and about 1000ft. broad, has thus been naturally formed so as to flow past the entrance of the harbour. This channel will not have to be kept open by artificial means. The work has been carried out by Mr. W. R. Kinipple, of 2, Westminster Chambers, S.W., and now that it is nearly completed, the Commissioners have resolved to retain Mr. Kinipple's services at a fixed salary as their consulting engineer.

A NEW FLAMELESS EXPLOSIVE.

A new variety of "securite" has been prepared by Herr Schœneweg, which is said to be flameless when exploded, and will, it is expected, be of especial value as a substitute for ordinary blasting powder and other explosives in fiery coal mines. It consists of nitrated hydrocarbons mixed with an oxidising agent such as chlorate of potash and some organic salt which renders the mixture flameless. The substance is not hygroscopic, and is of a bright yellow colour, and can be kept for any length of time without undergoing any change. It cannot be exploded by a flame nor by a hot substance, but only by a detonating cap. Recent experiments at Hendon have proved that the new explosive fulfils the anticipations of the inventor, and we understand that the Flameless Explosives Company have undertaken to introduce it to the notice of mine owners and others to whom an explosive of this nature should be welcome. Its power is said to be equal to that of No. 1 dynamite, and can be manufactured at a less cost. The organic salt which is added to the "securite" to produce this effect, has also the property of rendering dynamite similarly flameless when mixed with it.

WATER SUPPLY.

A prize of 25,000 francs is offered by the King of the Belgians for the best work on the means of supplying good, cheap, and abundant water for large towns, especially for Brussels and suburbs. The essays may be either in print or manuscript, and may be written in either French, Flemish, English, German, Italian, or Spanish. A new edition of a printed work cannot take part in the competition, unless important additions are made to it within the period of the competition, viz., in one of the years 1889 to 1892 inclusively. The essays are to be sent before the 1st of January, 1893, to the Minister of Agriculture, Industry, and Public Works, Brussels.

QUARRY (FENCING) ACT, 1887.

We call attention to the provisions of this short Act, which was passed in the last session of Parliament, and came into operation on the 1st January of the present year. The Act applies to England and Wales, and the term "quarry" includes every pit or opening made for the purpose of getting stone, slates, lime, chalk, clay, gravel, or sand, but not to any natural opening. It enacts that where any quarry dangerous to the public is in open or uninclosed land, within fifty yards of a highway or place of public resort dedicated to the public, and is not separated therefrom by a secure and sufficient fence, it shall be kept reasonably fenced for the prevention of accidents, and unless so kept shall be deemed to be a nuisance, liable to be dealt with summarily in manner provided by the Public Health Act, 1875.

THE POLARISCOPE AND ITS APPLICATION TO BREWING.

At the meeting of the Society of Chemical Industry, held on Monday, the 19th inst., a paper was read on the above subject by Mr. John Heron, in which he described the various polariscopes used for the purpose, including Laurent's, which is most generally employed. In this instrument monochromatic light is used, such as approximates to the D line of the spectrum, and is produced either by placing a salt of soda in the flame of a Bunsen's burner, or by passing light through a glass cell filled with a solution of bichromate of potash. Between two Iceland spar Nicol's prisms is placed a circular disc of glass, one-half of which is covered by a thin plate of quartz cemented thereto, and the indications are read off on a graduated scale; and a small Galilean telescope, placed in the optical system, brings the indicator into focus. The prisms and indicator are so arranged that a disc of uniform tint is first seen; then, by turning the analysing prism in one direction, one-half the disc becomes light, and the other dark; by turning the prism in the other direction, the light and dark halves of the disc are reversed. The liquid to be tested is placed in the optical system of this instrument, and the extent to which it rotates the transmitted rays is read off upon the scale. With some other instruments white light is used, and the disc consists half of a piece of right handed quartz, and half of a piece of left handed quartz. The zero of the instrument is obtained by so arranging the prisms that the whole disc appears to be of uniform purple colour, called "Alpha J." With the slightest motion of the analysing prism to right or left, the uniformity of "transition tint" is destroyed, and by farther motion the different colours come into play on the two halves of the disc. To make observations by these different instruments comparable with each other, the accompanying table is used:—

	Specific rotatory powers of carbohydrates.		Deflection for 1 grm. per 100c.c. in 200mm. tube.		
	AD	AJ	Laurent. Ray D	Soleil Scheibler. Transition tint.	Soleil Dubosc.
Dextrin	195·0	216·0	3·900	11·25	18·00
Maltese	135·4	150·0	2·708	7·81	12·50
Cane sugar	66·5	73·8	1·330	3·84	6·15
Dextrose	52·88	58·6	1·057	2·96	4·88
Levulose	95·65	105·98	1·913	5·52	8·83
Invert sugar	21·3	23·6	0·426	1·23	1·96

The author went at great length into the minute details of his experiments with the polariscope, which, he argued, when properly used, is a trustworthy instrument for the testing of beer. In the discussion, Mr. B. E. R. Newlands (the chairman) and Mr. Salomons said that chemical testing in relation to brewing operations is at present in an unsatisfactory state, and that the experiments of Mr. Heron will be carefully studied.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

16th March, 1888.

4054. Foster, J. W. ..... Winding yarn from cops.
4057. Turner & Brightmore Application of compressed atmospheric air to motors.
4075. Brogan & Malloch..... Manufacture of figured rolled plate and sheet glass.
4081. White, G. ..... Apparatus for drying cotton.
4083. Neish & Wilson ..... Propulsion of ships.
4085. Wood & Wrightson .... Differential pulley blocks.
4091. Peate, J. ..... Producing a yarn or thread of varying thickness.
4096. Wier, M. A. ..... Type writing apparatus.
4098. Punshon, R. ..... Supporting railway rails.
4102. Johnson, J. Y. ..... Nap raising machines (*Bauche and Bauche*).
4107. Fleischhauer, O..... Weighing machines.
4116. Johnson, J. Y. ..... System of overhead transport (*Torres*).
4117. Hoad, E. A. ..... Apparatus for testing pressure and vacuum gauges.

17th March, 1888.

4121. Proctor, J. ..... Steam boiler furnaces.
4123. Little, A. J. ..... System of drainage.
4152. Gaskell, J. ..... Slide valves.
4156. Hardingham, G. G. M.. Manufacture of twine (*McCormick Harvesting Machine Co.*).
4157. Woolley, G. A. ..... Springs for road vehicles.
4159. Greenway, E. C. ..... Lifeboats.
4160. Bonnefond, N. A. ..... Valve gear.
4166. Redfern, G. F. ..... Closing holes in the hulls of ships caused by collision (*Holmes*).
4168. Lock, C. ..... Couplings for railway vehicles.
4172. Dorman, J. F. W. ..... Printing presses.
4173. Swartzbaugh, J. H., and others. ..... Spark arrester.

19th March, 1888.

18034. Connelly, J. T. ..... Tapping stay bolt holes. (Received 19th March, 1888. Ante-dated 18th August, 1887, under International Convention.)
4176. Kudlicz & Ahlemeyer. Moulding and casting socket and flange pipes.
4179. Garrett, R. ..... Automatic steam cylinder lubricator.
4186. Hargreaves, J. ..... Internal combustion thermo-motors.
4191. Gudland, J. K. ..... Machinery for drilling rock.
4201. Sylbe, P. ..... A combined motor and sectional boiler.
4202. Drummond, G. P. ..... Type writing machines.
4203 Hurst, W. ..... Mules.
4209. Chapman, A. ..... Sugar cane mills.
4216. Abraham, L. ..... Brakes.
4218. Dyson, E. ..... Looms.
4226. Weir, J. ..... Permanent way of railways.
4229. Kempe & Kempe ..... Cutting the surface of textile fabrics.
4231. Taylor, G. ..... Loading and discharging of vessels and waggons.

20th March, 1888.

4239. Hartley, J. W. ..... Potters' wheels.
4246. Aykroyd, E. ..... Smoke consuming furnaces.
4247. Aykroyd, E. ..... Boiler furnaces.
4250. Kirkman, G. ..... An improved traveller employed in ring spinning and twisting of yarn.
4253. Southall, R. H. ..... Machinery for paring the heels of boots.
4254. Gillon, E. W., & others Treating and tempering open hearth or Bessemer steel wire.
4259. Hawley, C. P. ..... Permanent way of railways.
4263. Martin, B. D. ..... The founding of chill rolls.
4266. Gaukroger & Sykes ... Sight feed lubricators.
4268. Fox, C. J. ..... Coffer dams.
4273. Boult, A. J. ..... Increasing the frictional contact between the wheels and rails in railways (*Riels*).
4280. Boult, A. J. ..... Increasing the frictional contact between the wheels and rails in railways (*Ries & Henderson*).
4281. Beasley & Wood..... Lining for furnaces used in the manufacture of iron or steel.
4283. Fletcher & Cawley ... Burglar resisting safes.
4290. Lake, H. H. ..... Pulverising ores (*Wiman*).
4291. Hawley, J. ..... Manufacture of barrels.
4296. Evenstad & Senstad... Machines for making wood wool.
4300. De Coar & Keast..... Railway and tramway brakes.
4304. Cranston, W. McI..... Mowers and hay tedders (*Eddy*).
4306. Haddan, H. J. ..... Magazine fire arms (*Leineweber, Thielepape, & Schrohe*).
4307. Brehmer, H. ..... Machines for cutting pasteboard for the manufacture of boxes.
4308. Krauss & Kumpfmiller Automatic device for letting off waste water from cylinders of steam engines.

21st March, 1888.

4315. Cordes, T. ..... Apparatus for making bullets.
4319. Lumb, J. ..... Speed regulators for steam engines.
4323. Ingham, D. S. ..... Rag grinding machines.
4324. Harrap & Harrap..... Winding, doubling, and twisting yarn.
4326. Shackleton, R. ..... Apparatus for making paper cylinders.
4330. Fuess, P. ..... Dynamometers.
4336. Allmann, J. ..... Fluid meters (*Abegg*).
4337. Isaac, W. ..... "Turn wrest" ploughs.
4339. Carey, A. E. ..... Breakwaters and piers.
4340. Allen, J. J. ..... Feeding sheets of paper to printing machines.
4342. Sanderson, R. W. B. ... Feed water purifier and heater (*O'Brien & Weaver*).
4355. Clark, C. F. ..... Frame pulleys.
4358. Walker, H. C. ..... Hydraulic lifts (*Sélfe*).
4360. Grant, S. A. ..... Ejector mechanism for drop-down guns.
4362. Shilton & May. ..... Bronzing machines.
4363. Thien, K. ..... Preparing moulds for casting pipes.
4364. Haddan, H. J. ..... Safety raft (*Millet*).
4370. Pratt, E. ..... Road or field rollers.

22nd March, 1888.

4378. Leather, J. H. ..... Securing "Garnett wire" to the periphery of cylinders.
4381. Maxwell, J. ..... Railway waggon couplings.
4397. Nicoll, D. ..... Brakes.
4402. Thompson, W. P. ..... Hydrocarbon furnaces (*Porcelain Dental Art Co.*).
4413. Lee & Neale ..... Producing a marbled enamelled surface on cast iron.
4417. Baker, A. ..... Jacks.
4422. Blackstone, E. C. ..... Harvesting machines.
4426. Chatwood, S., & others. Safes, locks, and strong rooms.
4428. Edwards, E. ..... Lubricators (*Elsner-Bourgeois*).
4432. Cito & Funck ..... Lifting jacks.
4433. Low & Smith ..... Apparatus for hardening or tempering projectiles or shells.
4435. Zdziarski, A. ..... Rolling mills.

ELECTRICITY.

17th March, 1888.

4153. King, F. ..... Regulating electric currents.
4171. Freeman, W. S. ..... Electrical governor for motive power engines.

19th March, 1888.

4177. Baines, E. ..... Regulating the tension of telegraph and telephone line wires.
4188. Beaumont, F. J. ..... Arc lamps.
4221. Coad, T. ..... Holders for incandescent lamps.
4222. Holt, H. P. ..... Regulating appliance for dynamo-electric machines.

20th March, 1888.

4240. Yardley, H. B. ..... Burglar alarms.
4270. Fiske, B. A. ..... Regulating electromotors.
4274-5. Thompson, W. P. ..... Storage batteries (*Gibson*).
4277. Boult, A. J. ..... Electro-mechanical movements (*McLaughlin*).
4292. Gilbert, C. E. G. ..... Switch and fuse for electric light.
4294. Myall, A. ..... Commutator for alternating currents (*Judd*).

21st March, 1888.

4317. Mason, J. J. ..... Electric lamps.
4345. Kapp, G. ..... Distributing electrical energy by alternating currents from central stations.

22nd March, 1888.

4393. Freeman, W. S. ..... Control of electric currents.
4425. Charles, P. J., & others Dynamo-electric machines or motors.

CHEMISTRY.

17th March, 1888.

4143. Godefroy, M. L. ..... Treatment of magmas for distillation.
4155. Jones & Jones..... Separating oxides of iron.

19th March, 1888.

4187. Bayley, T. ..... Manufacture of oxide of iron.
4215. Redfern, G. F. ..... Treating decomposed organic substances (*Senorans*).
4217. Thompson, W. P. ..... Colouring substances (*Actiengesellschaft für Chemische Industrie Rheinau*).

20th March, 1888.

4262. Boake, A., & others..... Sodium-meta-sulphite.
4284. Wood, M. R. ..... Mono-carbonate and bi-carbonate of soda.
4286. Croselmire, C. F. ..... Extracting zinc from ores.

21st March, 1888.

4350. Taylor & Struvé ..... Coating with tin and lead.
4353. Buller, E. W. ..... Electric telegraph insulators.

22nd March, 1888.

4418. Abel, C. D. ..... Extraction of gold from ores (*Rotten*).
4430. Atkins, G. J. ..... Treatment of metallic ores.

MISCELLANEOUS.

16th March, 1888.

4055. Smith, A. C. ..... Spring mattresses.
4056. Palmer, J. E. ..... Needle sticking machines.
4060. Doyle, J. E. ..... Bicycles and tricycles.
4061. Howarth, R. ..... Waste preventing stop cocks.
4064. Rylands, D. ..... Stoppering bottles.
4065. Willis & Tuxford..... Locking nuts.
4066. Taylor, J. W. ..... A steam boiler cleanser.
4068. Lancashire, J. ..... Taps and valves.
4072. Müller, J. ..... Miners' safety lamps.
4076. Rawson, T. ..... Bottle stopper.
4077. Hazeland, S. S. ..... Wood workers' edge tools.
4079. Simpson, R. ..... Machine belting.
4080. Samson, A. ..... Set screw.
4086. Bull, J. C. ..... Metallic alloys.
4087. Clifford, W. ..... Safety lamps.
4089. Lansard, J. E. ..... Nut locks.
4092. Weldon, G. ..... Inking rollers in printing machinery.
4099. Newton, J. H. ..... Refrigerating machines.
4101. Wells & Charles ..... Safety lamp.
4103. Street & Ellis ..... Ventilators.
4104. Grant, H. ..... Velocipedes.
4114. Lilley, G. H. ..... Porous blocks for the combustion of liquid hydrocarbons.
4115. Ferranti, S. Z. de ..... Non-return valves or stop cocks.

17th March, 1888.

4122. Gomm, G. R. ..... Reversible copying press.
4126. Zimmer, G. F. ..... Pipes allowing their contents to expand without bursting.
4129. Harrison & Bowing ... Patent fuel.
4133. Bates, H. ..... Internally stoppered bottles.
4134. Pickering, J. T. ..... Automatic fence for lifts.
4135. Rochester, E. ..... Horseshoes.
4136. Pickles & Mitchell ... Preventing the issue of smoke from furnaces.
4137. Tucker, H. C. ..... Velocipede.
4139. Hicks, J. J. ..... Apparatus for ascertaining the specific gravity of liquids.
4144. Harrison, T. ..... Mariners' compasses.
4151. Grant & Francis ..... Tanning leather.
5158. Avery, R. B. ..... Burning gaseous fuel.
4161. McFarlane, G. ..... Spring mattress.
4163. Berger, J. H. ..... Proportional compasses.
4167. Brogden, G. W. H..... Connecting pipes and tubes.

19th March, 1888.

4175. Bunting, S. ..... Manufacture of bottles.
4183. Lloyd, W. ..... Miners' safety lamp.
4195. Justice, P. M. ..... Regenerative gas lamps (*Stein*).
4207. Johnson, S. ..... Portable standard measure and surveying instrument.
4208. Thode, C. W. F. ..... Opening doors by pneumatic or electrical agency.
4211. Rivière, V. ..... Re-tanning hides and leather.
4227. Lake, H. H. ..... Dust collectors (*Smith*).
4234. Wood, A. M. ..... Constructing buoyant cables.

20th March, 1888.

4237. Bell, A. F. ..... Portable tyres for wheels.
4244. Trueman, H. P. ..... Oil lamps.
4245. Moore, D. S. ..... Gas burners.
4249. Smallwood, J. ..... Automatic extinguisher for oil lamps.
4265. Parker, J. ..... Compressing and cooling air.
4267. Rodger, G. ..... Purifying and clarifying water.
4269. Grundig, C. R., & others Dust collector.
4272. Wigzell, E. E. ..... Instruments for taking soundings.
4288. More, J. ..... Aerating liquids.
4289. Dunn, B. S. ..... Gas and air comminglers.
4297. Pistoja, A. G. von B. di Torpedoes.
4303. Cluse & Walters ..... Manufacture of bottles.
4309-10-11. Turpin, E. ..... Explosives.

21st March, 1888.

4314. Garforth & Clayton... Wind bellows.
4321. Robertson, W. ..... Book binders' bordering tools.
4331. Adey, A. W. G. ..... Drying tea.
4334. Cluff, S. J. ..... Improvements in paint and printers' ink.
4344. Postlethwaite, G. R... Hydrocarbon oil burners.
4347. Thompson, H. ..... Rolling tea leaf.
4361. Coltman & Billson..... Manufacture of gloves.
4367. Elphick, O. ..... Water waste preventers.
4369. Booth, W. H., & others. Stoppers for bottles.

22nd March, 1888.

4371. Shelley, W. ..... Water taps.
4372. Foulis & Liversedge... Manufacture of gas.
4383. Dowell, J. S. ..... Buckets.
4384. Swift, H. W. ..... Boiler taps.
4386. Ince, W. ..... Dust collectors.
4388. Rogers & Player ..... Cleaning metal plates.
4398. Pascall, T. G. ..... Evaporating pan.
4401. Higgins, C. M. ..... Forming casts in resinous cements
4405. Higgins, C. M. ..... Bottle stoppers.
4409. Brothers, C. ..... Ventilators.
4411. Williams & Williams. An improved tap.
4412. Ludbrook, S. W. ..... Door for gas retorts.
4419. Boulton, S. B. ..... Preservation of timber.
4423. Malcomson, W. ..... Cooling and desiccating milk.
4424. Parrington, M. B..... Hurdles.
4427. Edwards, E. ..... Miners' safety lamps (*Merlin*).
4431. Henderson, F. J..... Ball valves.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

24th March, 1888.

2380. Fitch, W. B. ..... Manufacture of glass bottles.
2544. Doran, C. G. ..... Train elevator.
2560. Durnford, F. A. ..... Permanent way of railways.

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2587. Boardman & Halstead Hoists.
4047. Elwell, R. J. ..... Lubricators (*Murray & Peartson*).
4180. Oliver, W. S. ..... Weighing & advertising machine.
4554. Kieser, W. ..... Firing of ordnance on board ship.
4723. Howe, C. J. ..... Railway signal appliances.
4795. Lee, F. F. ..... Direct motor wheel for the driving of carriages, dynamos, or machinery.
4956. Bousfield & Gibbs ... Harvesting machines.
4982. Bousfield, M. ..... Corrugated bottom grate.
5184. Ross & Bilbie ..... Boot and shoe machinery.
5885. Wileman, A. F. ..... Sewing machines.
5932. Heginbottom, J. ..... Flyer frames.
5985. Wallace, J. ..... Spinning machinery.
6058. Thwaite, B. H. ..... Casting steel for projectiles and heavy ordnance.
6165. Casson, R. S. ..... Manufacture of steel or ingot iron and phosphate of lime.
6314. Fleming, A. ..... Signalling in foggy weather upon railways.
6326. Thompson, W. P. ..... Grain binders (*McCormick*).
6329. Hargreaves, W..... Adjustable pedestals for rotating shafts.
6411. Smith, T. W. ..... Permanent way of railways.
6416. Whitehead & Emley... Boilers.
6433. Elce, J..... Opening & cleaning cotton fibre.
6450. Griffiths, J. ..... Steam generators.
6557. Schofield, J. W..... Rolling mills.
6563. Brown, R..... Paper making machines.
6641. Greenall & Heaton ... Washing machines.
6709. Shepherd, G. ..... Chambers for drying timber.
6736. Robinson, J. R. ..... Type writers.
6814. Shaw, E. ..... Hoisting machinery.
6897. Hibbert, G. ..... Manufacture of paper.
6903. Pater, C. W. ..... Lifeboat.
6908. Horne, A..... Pumping apparatus.
6978. Boucher, W. ..... Buffers for railway vehicles.
7039. Sykes, H. ..... Wind mills.
7233. Edge & Tweedale ..... Ring spinning & doubling frames.
7243. Knemeyer, L. G..... Artificial stone work.
7266. Rogerson, J., & others Water tight doors for sea vessels.
7292. Barker & Beall..... Printing machines.
7406. Lancaster, W..... Machinery for sizing yarn.
7478. Shearman & Galley... Doors in bulkheads on board ships.
7494. Gilchrist, P. C..... Manufacture of steel or ingot iron by the basic process.
7864. Longsdon, H. C. ..... Washing & mangling machines.
8124. Parkes & Harkness ... Anchors.
8729. Tomlinson, J. D..... Engine cleaning waste machines.
9514. Leinwather & Glaser A portable railway.
9659. Hothersall, J. ..... Manufacture of cotton cloth.
10965. Finch, B. ..... Boiler furnaces.
11702. Webster, H. R. I. ..... Wire ropes.
12953. Ellis & Longfellow... Machinery for curling and cleaning flocks.
13681. Armstrong & Caiger... Protecting marine propeller shafts.
14034. Casper, E. ..... Treating rhea or China grass.
14180. Raymond & Raymond... Couplings for railway vehicles.
14365. Binnington, B. ..... Bottle cleaning machinery.
15055. Vogelsang, A..... Screw propellers.
15810. McQueen, D. ..... Boiler furnaces.
15918. Combe, A. ..... Twisting frames.
16250. Richmond & Whiting... Envelope making machines.
17513. Fownes & Fownes ..... Crank shafts.
17. Eckardt, E. M. ..... Pumps.
147. Flohr, O..... Friction clutches.
387. Burgess, H., & others... Looms.
1020. Anthon, H. J. ..... Manufacturing wood wool.
1831. Imray, O. ..... Embroidering machines (*Smith*).
2017. Gaskell, J. ..... Cranes.
2094. Cockshott & Jowett... Shaft couplings.
2134. Urquhart, W., & others Cloth finishing machines.
2237. Logan, W. P. ..... Anchors.
2528. Wallace, J. ..... Machinery for preparing flax.
2572. Thompson, W. P..... Valve mechanism for air compressors (*Reynolds*).
2580. Lake, H. H. ..... Gun carriages (*Hill*).
2598. Hodgson, A..... Car couplings and brakes.
2669. Gerdes, H. ..... Manufacture of carding teeth and carding cloth.
2704. Hargrave, F. ..... Apparatus for disengaging ships' boats.
2727. Taylor, W. H..... Loom temples.

ELECTRICITY.

24th March, 1888.

4116. St. George & Bonne ... Electric incandescent lamps.
4214. Alison, J. G..... Indicating the direction and speed of engines (*Lambinet*).
5862. Blenheim, W. ..... Simultaneous driving of a number of clocks by magneto-electricity.
5958. Clark, A. M. ..... Dynamo-electric machines (*Maiche*).
6754. Crompton&Swinburne Dynamo-electric machines.
6917. Mordey & Webber..... Electric transformers.
6987. Siemens, A. ..... Electric arc lamps.
7021. Scarlett, G. ..... Dynamo-electric machines.
15056. Betts, J. A. ..... Electric cable.
112. Joel, H. F. ..... Incandescence lamp holders and switches.
506. Dorman & Smith..... Suspension fittings for incandescent electric lamps.
750. Lake, H. H. ..... Electric railways (*Weems*).

CHEMISTRY.

24th March, 1888.

5257. Abel, C. D. ..... Colouring matters (*Farbwerke vormals Meister, Lucius, and Bruning*).
6687-8. Abel, C. D. ..... Production of azo colours (*Actiengesellschaft für Anilin Fabrikation*).
7277. Takamine, J. ..... Manufacture of alcoholic liquids.
7278. McArthur, J., & others.. Treating ores.
7370. Thompson, W. P..... Amalgamators (*Sperry*).
2584. Baldwin, W. A. ..... Extracting aluminium.

MISCELLANEOUS.

24th March, 1888.

2477. Jones, A. S. ..... Combustion of petroleum.
3987. Bigsby, J. A..... Preparing a gummy varnish.
4204. Hayhurst, W. ..... Joiners' cramps.
4307. Comings, W. R..... Improvements in dies.
5354. Thwaite, B. H..... Incandescence gas lamps.
5887. Brianthe, A. S. H..... Wet gas meters.
6636. McIlquham, A. ..... Wire mattress.
6652. Thwaite, B. H. ..... Combustion of liquid hydrocarbons.
7067. Beck, W. H. ..... Production of carburetted air gas (*Krieger*).
7156. Keith, J. ..... Manufacturing oil gas.
7158. Whitley, N., & others... Covering of cylinders with card fillets.
7179. Stanbrook, M. ..... Cooling air for use in refrigerating
7182. Walters, W. M. ..... Anemometer.
7258. Putzey, E..... Syphons.
7341. McKibbin, H. ..... Hinges.
7376. Crane, F. ..... Lacquers and varnishes (*Hale and Field*).
7411. Busch, A. ..... Cement.
7466. Nelson, T..... Filters.
7469. Capito, C. A. A. ..... Ship logs and current meters (*Prytz & Rung*).
7597. Smith, J. T. ..... Bottles.
7924. Jackson, W. G. ..... Miners' safety lamps.
8082. Baugh, B..... Designs on enamelled surfaces.
8312. Hopkinson&Hopkinson Stop cocks.
9306. Brown, T..... Connecting the ends of driving belts.
9536. Allen & The Allen Machine Company ... Apparatus for spreading liquid upon paper.
10298. Christian, J., & others Horseshoes.
10603. Fletcher & Clare..... Incandescent gas fires.
12961. Clifford, H. ..... Extinguishing of fire.
18020. Thornton, J. ..... Pipe coupling.
88. Thompson, W. P..... Dies for making wood type (*Setchell*).
1165. Schütz, A., & others ... Screws and screw nuts.
1513. Davidson, S. C. ..... Manufacture of boxes.
1667. Preston, E. ..... Tools for moulding wood.
1836. Jewell, O. H. ..... Purifying and filtering water.
2162. Hawkins & Barton ... Regulating gas burners.
2361. Pearce, W. J. S. ..... Apparatus for drawing off the surface of liquids from cooling vats.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 17th December, 1887, inclusive.)

Year 1883.

5697. Ganster, G. P. ..... Lighting, &c., illuminating flames.
5698. Blanchard, V. W. ..... Producing heat, &c.
5699. Allison, H. J. ..... Steam generators (*Culver*).
5701. Craven, T. E. ..... Steam engines (*Price*).
5703. Blödner, O., & another. Hose or flexible pipes.
5708. Boult, A. J. ..... Insulating electrical conductors (*Hyde*).
5714. Clark, A. M. ..... Electric lighting for surgical operations (*Trouve*).
5717. Clark, A. M. ..... Electric low water alarms (*McKenna & another*).
5719. Horsefall, W. ..... Forging bolts, &c.
5720. Lones, J., & others ..... Puddling furnaces.
5721. Mills, E. C. ..... Gas motor engines.
5724. Couper, P., & another... Distillation of coal.
5726. Heslop, M., & another.. Automatic ironing machine.
5727. Tooth, W. H. ..... Measuring water, &c.
5733. Gossage, F. H..... Galvanic batteries.
5739. Gawthorp, W., & others Carding machines.
5740. Richardson, W. ..... Carding engines.
5747. Tyzack, G. ..... Anchors.
5756. Overbeck, Baron de G. Aluminium (*Niewerth*).
5759. Henderson, A. C. ..... Secondary electric batteries (*Basset*).
5760. Pieper, C..... Winding apparatus (*Lindenberg*).
5761. Gedge, W. E. ..... Carbonate of ammonia (*Glaser*).
5762. Butcher, J. ..... Cyclometers.
5768. Coulthard, T..... Spinning, &c., fibrous substances.

Year 1882.

5902. Hannay, J. B. ..... Preventing corrosion, &c., of ships' bottoms.
5920. Baker, J. C. ..... Air pumps, &c.
5968. Sharpe, A. H. B., & ano. Vertical steam boilers.
5986. Hannan, R. ..... Explosives for blasting.
5997. Oldershaw, H. A. ..... An ironing and pressing machine.

Year 1881.

5480. Lake, W. R..... Embroidering apparatus (*Chilton*).
5482. Gardiner, R. M..... Blasting cartridges.
5483. Griffin, S. ..... Gas motor engines.
5490. Lake, W. R. ..... Electric lamps (*Mondos*).
5919. Johnson, J. H..... Mechanical pens (*Henestrosa*).
5541. Bowen, W. ..... Tip vans.

Year 1880.

5192. Fell, J. C..... Spinning machinery.
5206. Allison, H. J. ..... Steam generators (*Nicol*).
5263. Johnson, J. H..... Colouring matters (*Baeyer*).
5264. Trotman, F..... Bottles for aerated liquids.
5276. Davis, G. D. ..... Windlasses for ships.
5281. Hughes, J. S. ..... Working traffic over inclined planes.
5283. Lake, W. R. ..... Snatch and pulley blocks (*Loud*).
5288. Justice, P. S. ..... Iron (*Dupuy*).
5291. Pickles, J. H. ..... Shuttles of looms for weaving.
5293. Alexander, E. P. ..... Furnaces (*Nikiphoroff*).
5300. Pitt, S. ..... Iron and steel (*Rollet*).
5302. Harfield, W. H..... Coiling wire ropes on board ship.
5303. Rowan, T..... Ventilating sewers, &c.
5305. Minns, H. R..... Forming sheet metal.
5306. Goodson, T. H. ..... Preventing waste of water (*Goodson*).

Year 1879.

5133. Howard, J. ..... Ploughs.
5161. Lake, H. H. ..... Machine guns (*Parkhurst*).

Year 1877.

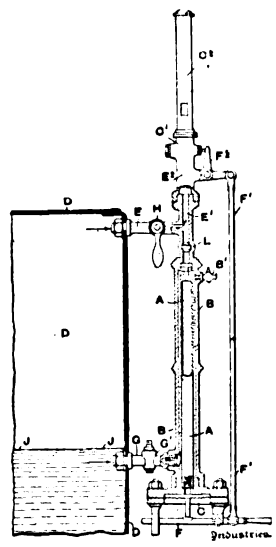
4732. Cahuc, R. ..... A blasting powder.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Regulating the Level of Water in Boilers.—*J. Murrie, Glasgow.*—Certain improvements are here introduced into the construction of the apparatus described in Patents No. 303 of 1885, and No. 2520 of 1886. The object of the apparatus is to indicate and regulate the temperature and pressure of the water, and is particularly applicable for regulating the level of water in boilers. One form of the indicator is shown in section in the accompanying diagram. The expansion chamber A and the heating chamber B are placed vertically, and the latter is connected near its lower end by a single tube and port G to the boiler D at the point of the lowest water level desired. The tube E connects the steam space in the boiler D with the tube E^1, which leads to the branch E^2 of the valve C^1; the



whistle C^2, giving an audible indication when the water falls below the level of the tube G, is also connected with the tube E^1. The tube E^1 is also in communication with the top of the heater B, and the taps H L are fitted in the tubes E E^1 for the purposes of testing the working of the apparatus from time to time. The cock B^1 on the top of the heating chamber B allows the testing of the circulation of fluid within it. The action of this apparatus is as follows: On the water falling below the tube G, the steam enters and displaces the whole of the water in the upper part of B, and suddenly heats the fluid contained in the vessel A. The vapour thereby generated in the upper part of A presses down the liquid in the chamber of the diaphragm C, which being deflected outwards depresses the lever F, and raises the rod and bell crank lever F^1 F^2. The valve C^1 is thus opened, and the steam enters from the boiler through the pipes E E^1 E^2, and sounds the whistle C^2. Four claims are made for this apparatus and for several modifications.—No. 1770. February 4th, 1887. 8*d.*

Looms for Cutting Pile Fabrics.—*J. Oswald, Manchester.*—A new cutting motion for cutting the pile in the manufacture of plush, &c., is introduced by this invention for the object of saving labour. A knife extends horizontally from one side of the fabric to the other, and is caused to reciprocate in a curvilinear path. This curved path is obtained by means of a series of curved slots in the knife, through each of which passes a stud fixed to the frame. The reciprocating motion is effected by connecting the end of the knife to a revolving crank pin operated by bevel gearing on one of the shafts of the loom. Two claims are made for the employment of the reciprocating knife guided in the way described.—No. 7301. May 19th, 1887. 8*d.*

Grinding and Crushing Mills.—*W. N. Nicholson & W. Mather, Newark, Nottingham.*—This invention relates to the rollers of grinding and crushing mills, which are made up of a series of discs placed upon a square shaft. The discs are made to interlock with each other by lateral projections being formed upon the face of one disc, and recesses being made in the face of the disc next adjoining. The projections fit into the recesses, and thus relieve the longitudinal binding bolts from shearing

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and bending. Instead of the discs being mounted directly upon the shaft, the holes in the discs are increased in size and a bushing is fitted in the hole, and the shaft passes through the centre of the bushing. By these means the discs have no tendency to cut into the shaft. Two claims are made for the lateral projections and for the use of the bushing.—No. 5571. April 16th, 1887. 6*d*.

Gas Engines.—*J. Y. Johnson, London. (La Société des Tissages et Ateliers de Construction Diederichs, Paris.)*—According to this invention, the residual heat of each compression and explosion of the gas is utilised for the purpose of igniting the succeeding charge. The method of carrying out this invention will be seen by reference to the accompanying diagrams. Fig. 1 represents a vertical section of the combustion chamber, and Fig. 2 an enlarged section of the igniting device. The platinum capsule B is held in position by the flange C, which is embedded in the

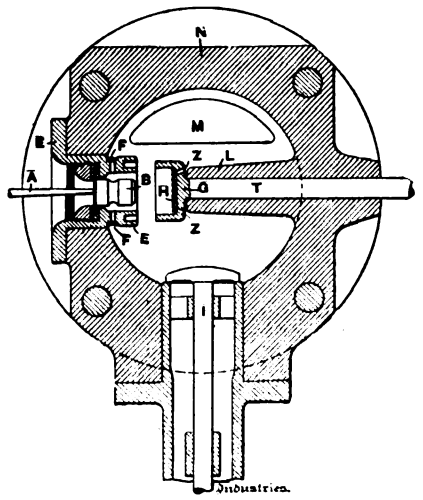


Fig. 1.

non-conducting packing P. The box E, which holds the screw D and flange C, is fitted in the side of the combustion chamber N. The part of E which projects into the interior of the chamber is provided with holes X covered with wire gauze F. This arrangement prevents the passage of flame, but allows a free circulation of the gas around the capsule. The inner end of the box E is closed by an iron cap G, whose circular edge enters a groove in E, as shown in Fig. 2. The cap G is attached to the end of the rod T, which slides in a tubular socket sleeve L. The wire gauze H protects the holes Z, in the same way as the gauze F protects the holes X. The lower part of the chamber N is provided with two valves I, one of which is shown in Fig. 1, for the admission and exhaust of gas. In working the apparatus, a reciprocating

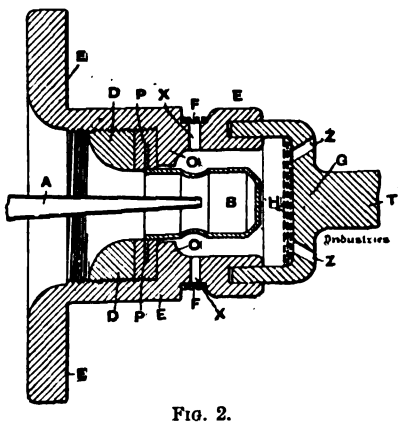


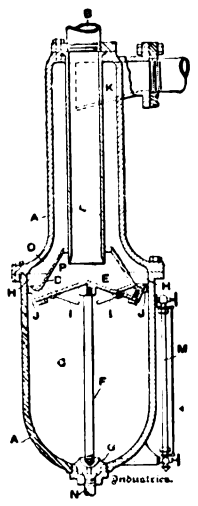
Fig. 2.

motion is given to the cap G by the rod T, in such a manner as to uncover the capsule B at the moment when the explosion is to be produced. In starting the engine when the capsule is cold, a blow pipe A is introduced into the box E, and the capsule is soon heated to incandescence. The gases circulating round it become ignited, and when the cap G is removed from its seat the flame is communicated to the gases in the chamber N, and the first explosion takes place. When the engine has commenced running, the blow pipe is removed, and the ignition of the succeeding charges is produced automatically by the waste heat of the preceding explosion keeping up the incandescence of the capsule. Five claims are made for the igniting device as described.—No. 5095. April 5th, 1887. 8*d*.

Carding Engines.—*W. Cunningham, Selkirk.*—The object of this invention is to make better provision for straightening and laying the fibres on the doffer. A small roller is placed in contact with the doffer, preferably underneath it, and in proximity to the carding cylinder. The roller is driven with a greater surface velocity than the doffer, so that the fibre is laid in comparatively straight lines on the doffer. The covering of the roller consists of wire cloth, but it may be dispensed with altogether if desired. The inventor claims the combination with the carding cylinder and doffer of a fibre straightening and laying roller, fitted as described.—No. 5666. April 19th, 1887. 6*d*.

Lace Machines.—*J. Jardine, Nottingham.*—The great number of warp beams and the smallness of the bobbins render it difficult to adjust the tension correctly as the diameter of the wound thread diminishes. In order to obtain a more regular tension the inventor makes the usual perforated tension plate laterally movable in a trough-shaped frame. This motion is imparted to the plate by two eccentrics, on which it rests. A disc on the end of the axles which support the eccentrics carries a crank pin. A connecting rod joins the two pins, so that the discs are capable of being moved through half a revolution. The eccentricity is sufficiently gradual to keep the warp threads always in a state of tension. The adjustable plate is held in every position quite as securely as the fixed one is, by the eccentric being the full width of the plate. The plate and the discs may be locked at any time, and the machine may be used as it was before the introduction of this improvement. The inventor claims the method of modifying the tension at both ends of the machine, by making the tension plates movable by means of the mechanism described.—No. 5447. April 14th, 1887. 8*d*.

Steam Traps.—*E. P. Stratton, College Point, New York.*—The accompanying diagram illustrates the inventor's improvements in the construction of steam traps. The shell A is composed of two separable sections of cylindrical form. The steam enters through the tangential opening K, and leaves through the delivery pipe B. The lower section of the apparatus constitutes the water repository C; the water gauge M indicates the quantity of water deposited, and the drainage pipe N is provided for the periodic removal of the accumulated water. The improved deflecting shield D is made of conical form, and extends for a distance above and beneath the lower end of the nozzle L, thus making an annular steam and water passage O and a steam passage P. The lower edge of D is provided with a lip which forms the channel H, and the water carried through O is mostly deposited in it. The channel is provided with drainage tubes I, which pass through the diaphragm E into the trap C. The shield is supported by being centred by means of the projections J, whose ends fit to the diameter of C, while the upright support F holds the shield in its place. The lower end of F is threaded into the webbed casting G, which allows the drainage to take place through the pipe N. The saturated steam is introduced through K into the cylindrical space surrounding the pipe L; the water particles are thrown down by centrifugal action and pass through the orifice O, while the current of steam



travels to the interior of the shield, and thence up the pipe B. The channel H intercepts the downward flow of the saturated steam as it is thrown upon the conical surface and collects the condensed portions. The water is conveyed through I into the trap C, while the drier portions are drawn through the space beneath the channel and above the diaphragm E. The diaphragm also prevents the volume of water contained in the trap from being suddenly carried upwards with the steam in the event of an unusual use of the steam. The inventor makes four claims for the arrangement for producing a centrifugal motion of the steam, and for the disposition of shield and diaphragm, as described.—No. 17808. December 27th, 1887. 8*d*.

Removing Slag from Furnaces.—*W. Hawdon, Middleshrough.*—This invention relates to improvements in the apparatus employed in removing molten slag and scoria from furnaces, and afterwards cooling them and depositing them in suitable receptacles. One or more endless bands of wire rope work over two or more series of wheels, to one of which series a rotary motion is imparted by an engine. Attached to the outer face of the ropes is a continuous succession of cast iron moulds for the reception of the molten material. After the moulds have received their contents, they are made to dip into a reservoir of running water, in which a series of jets of water play on the upper surface of the moulds. The inventor claims the construction of the apparatus, which consists of a series of moulds carried by an endless rope for the purpose specified, and for the cooling of the moulds as described.—No. 14803. October 31st, 1887. 8*d*.

Hydrocarbon Engines.—*W. D. Priestman & S. Priestman, Hull.*—This invention introduces improvements into the construction of the engines described in Patent No. 1394 of 1886 and No. 16,779 of 1886 granted to the same patentees. The valve for regulating and controlling the air and liquid hydrocarbon pipes consists of a four-way valve, which is so arranged that in one position it allows the air and oil to be conveyed to the vapour burning lamp while they are shut off from the main vaporiser. In another position of the valve this communication is reversed; while in a third position the supply of air and oil is shut off from both the igniting lamp and from the main vaporiser. Escape from the petroleum reservoir being thus prevented, the pressure in it may be regulated either by means of a small hand pump or by turning the engine, and so operating the pump which supplies the oil reservoir with compressed air. The four-way valve is furnished with a lever which works in connection an indicator showing the various positions appropriate for the valve. In order to obviate the formation of a gummy deposit in the minute passages of the vaporiser, the vapour chamber is divided into two parts; the first serves as an ante-chamber for the reception of the vapour, whilst the heating of the vapour is accomplished in the second compartment. The division is made by a board of asbestos, which prevents the transmission of heat. In order to facilitate the cleaning of the inlet and exhaust valves, they and their seats are arranged so that they may be bodily removed without disturbing the inlet and exhaust connections, and without breaking the cylinder cover joint. Each valve is mounted on a hollow plug, which is fitted into a conical recess formed in the cylinder cover; a lateral orifice in the plug affords communication between its interior and the inlet or exhaust passage. The inner extremity of the plug is open, and forms the valve seat, while the outer end is provided with a stuffing box and gland. Four claims are made.—No. 5951. April 23rd, 1887. 8*d*.

Steam Engines.—*W. P. Thompson, Liverpool.* (*G. Smith, New York.*)—The construction of the cylinder and pistons will be understood by reference to the accompanying diagrams. Fig. 1 represents a sectional elevation at right angles to the crank shaft, and Fig. 2 shows a cross section in a plane passing through

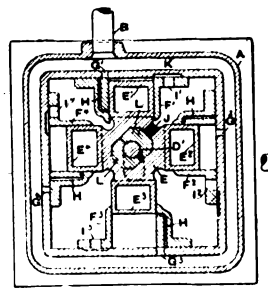


Fig. 1.

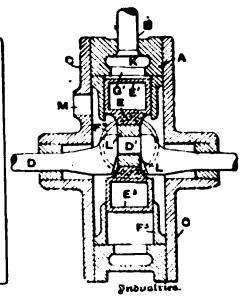


Fig. 2.

the shaft. The outside square box A contains a channel K within it, through which the steam is conducted to the exhaust pipe B. The crank shaft D and crank pin D¹ have motion given to them by the four-sided piston E, which is boxed to the crank pin by the brass box L. The piston has four projecting parts E¹ E² E³ E⁴, which enter the four cylinders F¹ F² F³ F⁴ respectively. The cylinders bear upon the inner faces of the square box, and in their lateral travel act also as valves. The steam is admittted to the interior of the casing through the aperture M, and the pressure of the steam on the surface of the cylinders holds them upon their seats. In the position of the parts as shown in Fig. 1, the full steam is supposed to be entering at the port I⁴. With the further movement of the piston the steam is admitted to the outer faces of the portions E² E³ in succession, and the exhaust ports G¹ G² G³ G⁴ are also opened in consecutive order. The cylinders are provided with the auxiliary exhaust passages H. Each section of the piston travels back and forward within its cylinder through a distance equal to twice the radius of the crank, and also through a similar lateral distance along the side of the box Each point of the piston, therefore, traces out a circular path. This shape of engine is designed with a view to simplicity of construction, and also to obviate the usual dead centre. Three claims are made for the shape of the piston, and for the cylinders which act as valves, as described.—No. 4663. March 29th, 1887. 8*d*.

ELECTRICITY.

Electric Incandescent Lamps.—*A. Featherstonhaugh, London.*—This inventor states that his improvement consists in placing, inside the glass globe of an incandescent lamp, two or more filaments of any kind, close to each other, so that the heat from each reinforces that from the others, and there is less loss of heat by radiation. For these reasons more light is produced by each filament by a given strength of current in each. In carrying out this invention two or more filaments are employed before carbonisation, and are arranged by being twisted round each other in their whole length or in any part of it. The compound element so formed is carbonised in the usual manner, and the subsequent operations of placing it in a glass globe are the same as in ordinary cases. The inventor claims: In all electric incandescent lamps where multiple filaments or wires are used, arranging these filaments or wires so that they are close together, whereby a saving of heat is effected, and there is an increased amount of light produced to what would otherwise be the case.—No. 4549. March 26th, 1887. 4*d*.

Dynamos.—*J. G. Statter, London.*—The object of this improvement is the maintenance of a constant current through a variable resistance, or a constant current when the machine is driven at varying speeds. In carrying these principles into effect it is found necessary to maintain constant the product of the magnetic intensity affecting the armature coils, and the length of the conductors of such coils. With a ring armature constructed in the usual way, the following operations are proceeded with. The brushes are set at the position where no sparking occurs. An exploring apparatus, which consists of a voltmeter with conductors having two small brushes at their extremities, is then employed for obtaining relative indications of the electromotive force of the current flowing through the coils, whose circuit is completed by the explorer. This is done by bringing the brushes in contact with adjacent segments of the revolving commutator. These indications enable the operator to alter the shape of the pole pieces in such a way that when the pole pieces are altered the product of the magnetic intensity affecting those coils of the armature passing under the brushes, into the length of the conductor of such coils directly acted upon by the field magnets, shall be constant. This alteration is effected by boring the pole pieces so as to produce cavities in them. The inventor makes four claims—for the device for altering the position of the brushes, for the pole pieces cut away in the manner described, and for certain specific forms of pole piece for the object of maintaining the current constant at different speeds and through varying resistances.—No. 2825. February 23rd, 1887. 11*d*.

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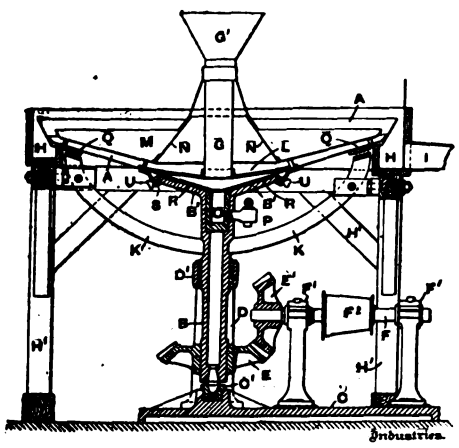
COMBINED DYNAMO AND GAS ENGINE.—*F. W. Crossley, Manchester.*—According to this arrangement the dynamo is mounted on the upper side of the cylinder; on the spindle of the dynamo is a pulley, which is driven by a belt passing round the fly wheel of the gas engine. The cylinder is horizontal, and is placed at one end of the engine frame, while the fly wheel shaft revolves in bearings near the other end. The connecting band is necessarily short, so that in order to tighten it and extend its bearing on the pulley, a lever or slide pivoted to the engine frame carries a tightening pulley that bears against the under side of the band between the fly wheel and the pulley of the dynamo machine. One claim is made for this arrangement.—No. 5833. April 21st, 1887. 6*d.*

ELECTRICAL DISTRIBUTION. — *W. Lowrie & C. J. Hall, London.*—This invention relates to the distribution of electrical energy for the purposes of locomotion. A conductor of small area conveys alternating currents of high tension from the source throughout the primary circuit. One or more low tension conductors of large area are used throughout the circuit in which the tractive force is to be applied. Each of the connections between the two conductors passes through an induction apparatus, such as is described in Patent No. 10765 of 1886. These converters, or secondary generators, reduce the potential of the high tension conductor. As this potential is constant, it follows that the reduced potential of the low tension conductor will be constant also. The secondary circuit may consist of the line of railway or telpherage, or a separate series of wires may be laid for the purpose. Seven claims are made for this system of distribution.—No. 5199. April 7th, 1887. 8*d.*

BRUSHES OF DYNAMOS AND ELECTROMOTORS.—*M. Immisch, London.*—The objects of this invention are to insure a more perfect contact between the brushes and the commutator, and to provide a better arrangement which will allow the electromotor to be reversed. One end of a holder frame is pivoted to the frame of the machine, and from each end of this frame an arm projects outwards, and forms bearings for trunnions on the brush holder. A spring is caused to bear towards the end of each brush, and it can be adjusted so as to regulate the pressure of the brush on the commutator. Two positive brush holders are arranged on one side, and two negative holders on the opposite side of the commutator. One of the positive brushes is connected to one arm of a double armed lever, which is pivoted at its centre to a fixed point of the frame on one side of the commutator, and the other positive brush is connected to the other arm of the lever, so that the two brushes are situated one above and the other below the commutator, and the two holders are connected together with metal. The two negative brushes are similarly carried, and are also connected together by metal. A link connects the two levers, and is provided with a projection to which a piece in the shape of an anchor is pivoted. The anchor moves over a slide formed with a notch at each extremity, and forms the handle for reversing the brushes. When one of its arms engages with the notch, one of the positive brushes is in contact with the upper side of the commutator, and one of the negative brushes with the under side of the commutator. In reversing, the anchor piece is turned on its pivot, thus engaging with the notch at the other end of the slide. This movement causes the double armed levers to rock, and the position of the brushes is altered as desired. The inventor makes three claims for the arrangement.—No. 4032. March 17th, 1887. 8*d.*

CHEMISTRY.

EXTRACTION OF GOLD FROM ITS ORES.—*W. R. Lake, London.* (*A. Vogelmann, Magdeburg.*)—This invention relates to the construction of mercury amalgamators which are used for the purpose of extracting gold from crushed quartz. The annexed diagram shows a vertical section of the improved apparatus. The conical pan A is firmly secured to a flange B^1 at the upper end of the vertical shaft B. The bearings D^1 and C^1 in the upright



standard D and in the base plate C respectively support the shaft B, which is rotated by means of the driving gear F^2 E^1 E. The central part of the bottom of the pan A is provided with a perforated plate L, and the pan A is filled with mercury to a height of a few centimetres above the plate L. The pipe G terminates at the centre of the grating, and is provided at its upper end with the funnel G^1. The conical plate M is fixed in A, and the cone N is tightly fitted to M. The wooden box O is fitted in the shaft B for the collection of the amalgam. The circular trough H is designed to receive the quartz slime which flows over the edge of A. The crushed quartz is mixed with water and fed into the hopper G^1; in its passage through the layer of mercury, during the rotation of the pan, the gold becomes amalgamated with the mercury. The shape of the various parts are so arranged that the slime is kept constantly in contact with the layer of mercury. The amalgam settles into the box O when the machine is stopped, and it is drawn off through the tap P. The rapid rotation, however, while insuring a complete amalgamation, also causes the thickening of the mercury. This defect is obviated in the present invention by conducting electric currents through the mercury. The horseshoe magnets K are placed in the position shown, and the copper ring Q is fixed to the under side of the pan. The current is generated by the rapid rotation of the ring over the poles of the magnets. Between the shaft B and the pan A is placed an insulating layer of felt R. The inventor makes three claims for the employment of the cones M N, which compel the slime to pass in close contact over the surface of the mercury; for the employment of the electric device for the purpose described, and for the general construction of the machine.—No. 16495. November 30th, 1887. 8*d.*

ALKALI MANUFACTURE.—*E. W. Parnell & J. Simpson, Liverpool.*—The object of this invention is to treat gypsum and sulphate of barium so as to render them available as substitutes for the Le Blanc alkali waste in the production of alkali and sulphuretted hydrogen. The sulphate is first converted into sulphide by the method of roasting with carbonaceous matter in a revolving black ash furnace. The subsequent application of the sulphuret is similar to that of the alkali waste as described in Patents No. 381, 1937, and 8440 of 1885, and 47 of 1886, granted to the same patentees. Two claims are made for the process of production and for the application of the sulphides.—No. 5853. April 22nd, 1887. 6*d.*

MISCELLANEOUS.

AIR PUMP FOR REFRIGERATING MACHINES.—*A. Conacher, Augusta, Georgia, U.S.A.*—Fig. 1 represents a vertical section through the pump, and Fig. 2 an enlarged section through the valves. The two perpendicular pump barrels A rest on the chamber B, through which the crank shaft C passes. The tops of the barrels are domed at A^1, and the metal plate F contains

FIG. 1.

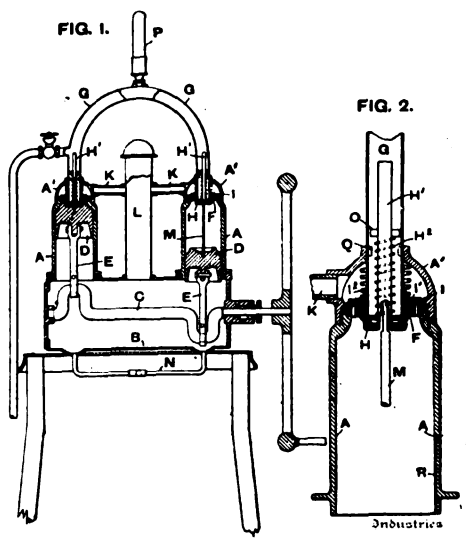


FIG. 2.

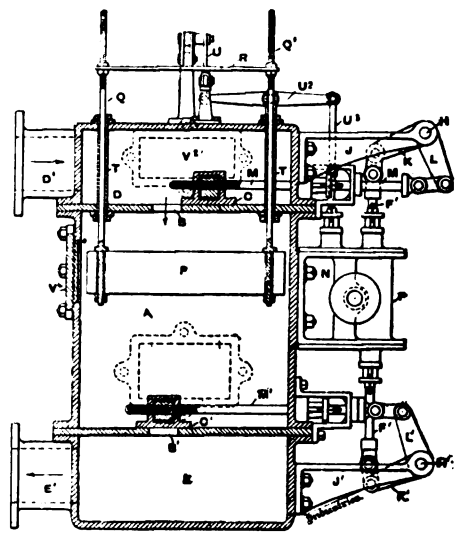
the seats of the suction and discharge valves. The vacuum pipe G is bored into a recess in these plates, and a vacuum gauge is placed at P. The suction valve H is made of a metal plate faced with leather or other material which is not affected by hydrocarbon oils, and its tubular stem H^1 passes through the plate and ascends to a height greater than the length of the stroke of the piston D. The discharge valve I consists of a disc of leather which rests on the top of the plate F, and the discharge pipe K is slightly above the level of F. This pipe leads to a trap cylinder L, which is fitted to the vessel B. In the centre of the piston D is a recess, into which the rod M fits; the other end of this rod enters into the hollow stem H^1, as is shown in Fig. 2 The valve H is held in its seat by a helical spring H^2, and the travel of the suction valve is limited by the stop O, which is fixed to H^1. In operating the pump some hydrocarbon oil is poured in until it fills the whole interior space up to the under sides of the pistons. At each stroke of the piston a minute quantity of oil passes through the groove R, and towards the end of the stroke this oil fills up the space between the top of the piston and the interior of the dome A^1. Every particle of air and vapour is discharged though the valve I. The suction valve H is mechanically opened at the beginning of the downward stroke by the rod M. The springs on M press against the interior of H^1, and pull the suction valve open; but, just before the end of the downstroke, the rod M passes so far out of the stem H^1 that the springs on M cease to act, and the helical spring H^2 then pushes the valve H to its seat; while the cup, forming a raised rim round H, insures the valve seat being covered with oil, so as to prevent any air escaping through the suction valve. The inventor makes six claims.—No. 1181. January 25th, 1887. 8*d.*

SEPARATING REFUSE METALS.—*J. E. T. Woods, London.*—The object of this invention is to separate from refuse metallic substances, such as tin scrap, old cases of tea, preserved meat and vegetable tins, the tin, lead, and antimony from the iron, and to render the latter marketable for soft scrap. The cans are first immersed in a boiling solution of caustic soda or potash, which dissolves the whole of the tin, lead, and antimony. The lead can be separated from the solution in the form of white carbonate of lead, by means of a current of carbonic acid, which is sent through the solution; and the tin can be recovered, either in the form of a crystallised stannate, or it may be thrown down by electric deposition. Iron, copper, or porcelain vessels can be used for carrying out this process; and the rough soap and glycerine in the mother liquors, formed from the fatty matters adhering to the tins, may be recovered after the separation of the metals. The inventor makes one claim for this process.—No. 4434. March 24th, 1887. 6*d.*

ARTIFICIAL LEATHER.—*H. House, Ripon.*—The object of this invention is to utilise leather waste by manufacturing it into a substance resembling leather in texture and composition. The leather scraps are first treated in a disintegrating machine, which reduces them to a fibrous powder. This powder is then mixed thoroughly with a naphtha solution of rubber, and afterwards worked into a dough with a small proportion of glycerine. This material is stamped into thin slabs by a ram, and rolled out into sheets of half an inch thickness. Seven claims are made for this process and for the machinery employed.—No. 5741. April 20th, 1887. 6*d.*

GAS PRODUCERS.—*A. Harris, Middlesbrough.*—When gas producers, which are constructed with solid hearths and tuyeres, and arranged with a bridge over the tuyeres and two entry doors, are being cleaned, the bridge is liable to be knocked down. In order to prevent such an accident, the inventor proposes to employ three doors arranged equi-distantly, and from the walls of the producer to carry up an arch which shall form a second bottom for the producer. A free passage is allowed for the upward travel of the gases, and a solid back of brick work is insured for the poking bar to strike against. The doors are thus comparatively cool, and the bridge forms a substantial mass not liable to be damaged in cleaning. When the nature of the fuel permits, the inventor also employs a movable grate or row of bars opposite the doors, one end of each of which is hinged to the bridge. The opposite ends are supported when the doors are closed, and are allowed to fall when the doors are opened for cleaning. The fuel may thus be held up from the doors and the tuyeres, while the ashes may be shot out when the doors are opened. Two claims are made for the construction of the bridge and doors, and for the arrangement of the set of fire bars.—No. 5530. April 15th, 1887. 8*d.*

FEED WATER MEASURER.—*J. Heslop, Sunderland.*—This invention consists of an apparatus for automatically measuring the amount of feed water supplied to a steam boiler. The accompanying figure represents a vertical section taken through one part of the apparatus. There are two separate similar chambers A, through one of which the section is taken, while the other is placed behind in the drawing. Their capacities are most conveniently from one to five gallons each, according to the size of the engine. Each chamber is provided with an inlet port B and an outlet port B^1, which are opened and closed by the slide valves C C^1 respectively. The water enters from the hot well through the pipe D^1, and leaves for the injector through the chamber E and the pipe E^1. The slide valves are operated by a steam cylinder F and piston rod F^1, whose motion is imparted to the valves by means of the intermediate mechanism K H L M. The links L L^1 and the rock shafts H H^1 are arranged so that both the inlet and outlet ports B and B^1 shall be open alternately. The floats P are suspended within the chambers A, by means of the rods Q Q^1 and cross bar R, from one end of the rocking



beam S. The rods Q Q^1 pass through the tubes T. The piston valve N, which regulates the steam in F, is operated from the rocking beam S, by means of the system of beams U. The doors V^2 V^4 allow access to the inner parts of the apparatus for the purposes of cleaning. When both floats P are supported by the water in the chambers A, they will be in equilibrium, and the rocking beam S will be horizontal, and the piston valve N will be in a central position, and will therefore cut off the steam from the cylinder F. As soon as one chamber has become empty the float will descend and move the rocking beam in such a way that the valve N will admit steam to one end of the cylinder F; the position of the slide valves will then be reversed. The water will thus enter and leave the two chambers alternately, as will be easily understood. The inventor makes one claim for this apparatus for automatically measuring the feed water.—No. 4958. April 2nd, 1887. 8*d.*

SAFETY FUSE FOR BLASTING.—*F. J. Shand, Cambuslang, Lanark.*—A flexible covering is applied to the main body of the fuse, and is made by felting together a thin layer of cotton wool heated with a solution of rubber. This water proof material is wound helically round the fuse in narrow strips, or it may be wound round the combustible composition, or round the fibrous core. The inventor claims the application of the water proof covering formed and fixed on the fuse as described.—No. 542. January 13th, 1888. 4*d.*

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GRAIN CLEANING AND SEPARATING MILLS.—*M. Grollimund, Fergus Falls, Minnesota, U.S.A.*—This invention relates to the construction of fanning mills used in separating and cleaning grain. Fig. 1 is a vertical section of the improved mill, and Fig. 2 shows in detail a section of the lower gang of sieves. The frame work A B is constructed in the usual way with a hopper at the upper end. The grain is delivered to the gang of sieves D situated at the upper part of the mill. The vibration of the sieves and the blast of the fan separate the chaff from the grain, which is then delivered upon the uppermost of the gang of vibrating sieves G. The meshes in the series of sieves J J^1 J^2 J^3 are arranged in order of fineness, and each sieve is shorter than the one above it. The detachable diagonal spout A^1 is mounted on the lower end of J for the purpose of concentrating the flow of grain. The cross piece E fits in a diagonal groove in F, and extends somewhat beyond the sides of the sieves through an elongated opening cut in the side of the shoe of the sieve. The

FIG. 1

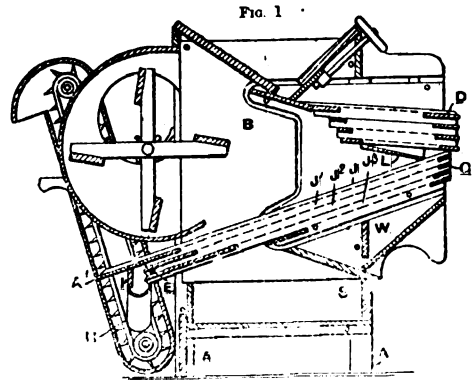
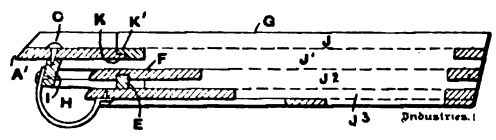


FIG. 2.



seed falling through this sieve is received in the bin W, and the receptacle S is filled by the grain which falls over its edge. The rest of the grain is deposited in the inclined trough H. The large grain of the first grade that remains on the sieve J is shaken down its face upon the spout A^1, and thence into a suitable receptacle. Smaller grain is carried down the trough H; while the third grade grain is received on the sieve J^2, whence it passes along the cross piece E, and through the opening in the side of the shoe into its receptacle. The grass seed is deposited on the lower sieve of the gang G, and it falls through into the bin W; while the cockle is carried into the receptacle S. The three grades of grain and the grass seeds and cockle are thus entirely separated. If at any time it is desired to mix the first and second grades, the spout A^1 is removed, and the first grade will fall into the trough H along with the second. The inventor claims the combination of the piece E and the opening in the side of the shoe, with the series of sieves and the spout H, for the purpose described.—No. 31. January 2nd, 1888. 8*d.*

GAS APPARATUS.—*J. Elliott, Ludlow.*—The object of this invention is the construction of apparatus whereby the carbonisation of coal for the production of gas may be carried on continuously without the front door of the retort being opened for the introduction of coal and for the withdrawal of the coke. A hopper is attached to the mouthpiece of the retort; a contrivance of a series of revolving blades is placed on the mouthpiece, and when turned it causes the coal in the hopper to fall into a scoop inserted in the mouthpiece. The scoop is attached to a rod that passes through the lid of the retort, and terminates outside with a handle. To the opposite end of the retort there is also a kind of mouthpiece, from which the ascension pipe rises, and which is provided with a hand hole and lid for cleaning the pipe. The mouthpiece has an opening in its lower part, which corresponds with an opening in a short cylinder that is pivoted to arms attached to the mouthpiece. Above and below the opening in the mouthpiece are saddle flanges made to a true semi-circular curve, so that when the cylinder is brought close against them it may revolve in close contact with the flanges, and so insure a gas tight joint. When the hopper has been charged with coal, a handle in front of the hopper is turned, whereupon coal will fall into the scoop in the mouthpiece. The rod is then thrust in to its full length, and then turned round. The coal will thus be deposited on the bottom of the retort. A second charge is then conveyed to the retort, and so on until there is sufficient coal in. By repeating these operations the coke is pushed to the other end of the retort, and will fall into the cylinder, from whence it falls at intervals into a barrow. Four claims are made for this improved apparatus.—No. 5519. April 15th, 1887. 8*d.*

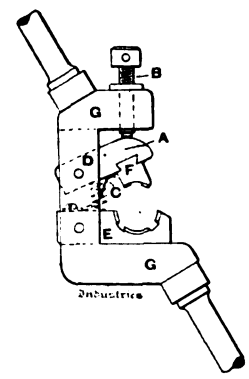
TUBE CUTTERS.—*A. J. Marquand & S. Williams, Cardiff.*—This invention relates to an improved construction of rotary cutters for severing boiler tubes when in position in the boiler. A tubular boss is made to fit approximately the bore of the tube to be cut, and it has a certain number of holes, aligned in a circle, cut in it. A fixed or movable cutter is provided for each hole. The series of cutters or cutter arms are engaged by a taper mandrel, which can be moved axially through the tubular boss in either direction. For the purpose of effecting this engagement longitudinal slots are cut in the periphery of the mandrel, in order to receive the correspondingly shaped inner ends of the cutters or of their arms. A guide is also provided to regulate the radial travel of the cutters. A movable collar is fixed around the mandrel and tubular boss to bear against the boiler plate, and a nut outside the collar provides for the rotation of the mandrel and cutters by a spanner or other equivalent device. The inventor makes two claims: (1) For the combination of tapered and grooved mandrel and cutters adapted to be engaged by the mandrel; and (2) for the combination of tapered and grooved mandrel, cutters adapted to be engaged by the grooves in the mandrel, tubular boss and guide plate, as described.—No. 5198. April 7th, 1887. 8*d.*

TREATING HIDES.—*J. S. Hooper, London.*—The method here pursued in treating hides is to expose them to the successive attacks of gases from ignited charcoal and sulphur. This process takes place after the hides have come from the lime vat, where the hairs have been removed from them. Twenty to thirty skins are hung in a tight room, in which is placed a vessel containing the substance to be burnt. Twelve hours of exposure to the action of these fumes removes all traces of lime or any taint which may happen to be present in the skin. The hides are then ready for tanning. Two claims are made.—No. 6914. May 14th, 1887. 4*d.*

TREATING RHEA BARK.—*G. I. J. Wells & S. L. Howard, London.*—The ribbons of the fibrous material are suspended on rails of wood in rows close together, so as to fill the whole chamber. The chamber is to be made of wood, iron, or lead, and a false perforated roof of porcelain or earthenware is fixed below the real roof, in order to effect a thorough distribution of liquid. The cold liquids to be used are raised to the roof by a pump, and the hot liquids by a vacuum injector, while a fan forces a current of air through the chamber to dry the suspended rhea after its treatment by the sprayed chemicals. Gaseous elements are introduced into the chamber from stills, and a chimney shaft is built in order to take off the surplus gas. In treating the rhea in this apparatus, water is first caused to flow in a continuous rain over the fibre to wash it and free it from dust. Caustic soda or potash is next sprinkled through the false roof. Afterwards the same operation is performed with hydrochloric acid, and another shower of cold water washes away all trace of these agents. The contents are then rained upon by a mixture of soda and oleic acid, during which operation the temperature is gradually raised. A third shower of water finally cleanses the rhea, which is then dried by a current of air. Further bleaching may be effected if desired by applying an ordinary bleaching powder. Five claims are made for the process and apparatus.—No. 2423. February 16th, 1887. 8*d.*

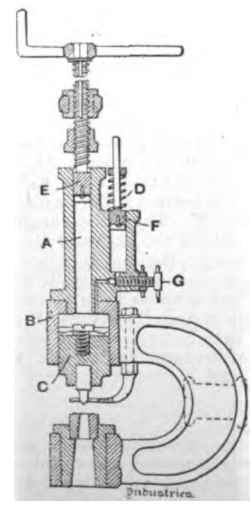
GERMAN PATENT ABSTRACTS.

GUIDE SCREW STOCK.—*E. Engels & B. Weselmann, Remscheid.*—This invention represents a novel form of guide screw stocks. One of the dies E is fixed in a suitable manner to the frame G,



while the other die F is attached to an arm A, which is pivoted at D. This arm is actuated by the screw B, while a spring C presses A against B.—No. 42128. April 2nd, 1887.

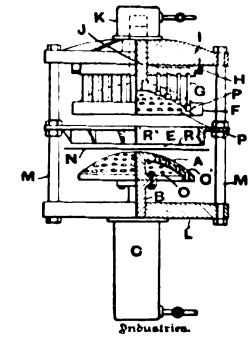
HYDRAULIC PRESS.—*Karl Prell, Vienna.*—This invention relates to a portable hydraulic punching and riveting machine, actuated by hand. The cylinder consists of two parts A and B, fitted with the pistons E and C respectively. The space between



C and E is filled with liquid. In order to replenish the cylinder, the valve G is opened, and the piston F, actuated by a spring D, forces the necessary amount of liquid into the space between C and E. The valve G is then closed again, and the apparatus is ready for working.—No. 41982. November 3rd, 1886.

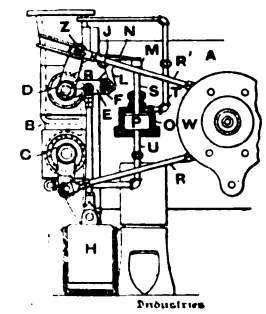
UNITED STATES PATENT ABSTRACTS.

BOILER ENDS.—*H. Warden, Philadelphia.*—This invention relates to a new design for the ends of boilers, and to the apparatus for forming them. The end of the boiler is of dished shape, having flat bottomed indentations in it, which are perforated for the reception of the tubes. The accompanying figure shows the machine employed in their manufacture, partly in section and partly in elevation. The frame work M L carries a stationary die E; the movable former A is supported by the ram B, which works in the cylinder C, and the guiding



die F is attached to the ram J. The punches G are fixed rigidly to the plate H, and pass through the annular flat faced dies P in the movable die F. The former A is provided with the perforations O, which are surrounded by the flat die surfaces O^1. The plate to be operated on is placed at N; the die A rises and forms a flange on N; with an increase of pressure the die F gives way, and the punches G stamp the dished plate as required. Nine claims are made for the shape of the boiler end, and nine for the apparatus described.—Nos. 377791 and 377792, dated 14th February, 1888.

VALVE GEAR FOR AIR COMPRESSORS.—*E. Reynolds, Milwaukee, Wisconsin.*—The accompanying diagram shows an elevation of the improved mechanism. The two valves C and D for inlet and delivery respectively are placed at the side of the air cylinder A. The two rods R R^1 connect the wrist plate W with the two valve spindles, and so supply their necessary motion. The weighted arm E is also attached to the spindle of D, and the pin F is pressed by the pivoted catch L, which is provided with



a tail M. The auxiliary cylinder O is fitted with the piston P and the rod S, which extends to a point just below the tail M; the pipes T and U connect the opposite sides of the piston with the air receiver and the air cylinders. The rod R^1 has a slotted end, in which works the pin Z. When R^1 is moved in one direction it closes the valve D, and the catch L keeps the valve shut. When the pressure from the air cylinder reaches a prescribed proportion to that in the receiver, the rod S causes the hook L to release the valve D, which then opens by the weight of the lever E. The spring N serves to press the hook L against the pin F. Ten claims are made for this apparatus for operating the delivery valve.—No. 378336, dated 21st February, 1888.

MANUFACTURE OF WATER GAS.—*R. Boeklen, Brooklyn.*—By the process here described the crude petroleum is fed gradually into the top of a furnace or retort. In its course down the interior of the retort it is subjected to successive degrees of heat; the light vapours are thus eliminated by contact with the superheated steam and the gases which are the result of the decomposition of the steam and oil in contact with the fuel. The light vapours are passed through a heated tile fixing chamber, and the remaining petroleum is subjected to a body of incandescent fuel into which steam is delivered. The gases thus evolved are conducted through the fixing chamber at the same time as the other gases. One claim is made.—No. 378490, dated 28th February, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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COMBINED ENGINES AND BOILERS.

CONSTRUCTED BY MESSRS. RANSOMES, SIMS, & JEFFERIES, LIMITED, AGRICULTURAL ENGINEERS, IPSWICH.

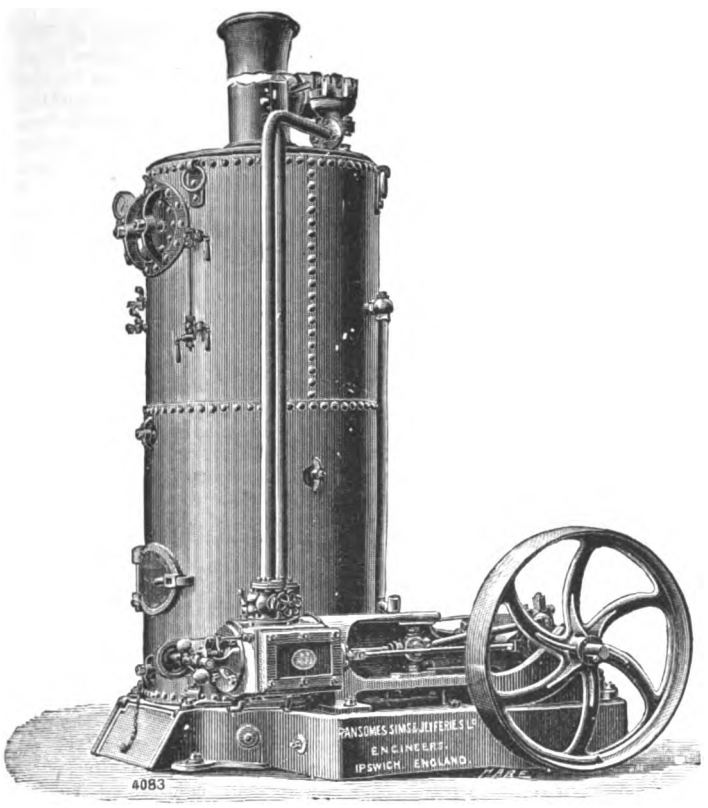


FIG. 1.

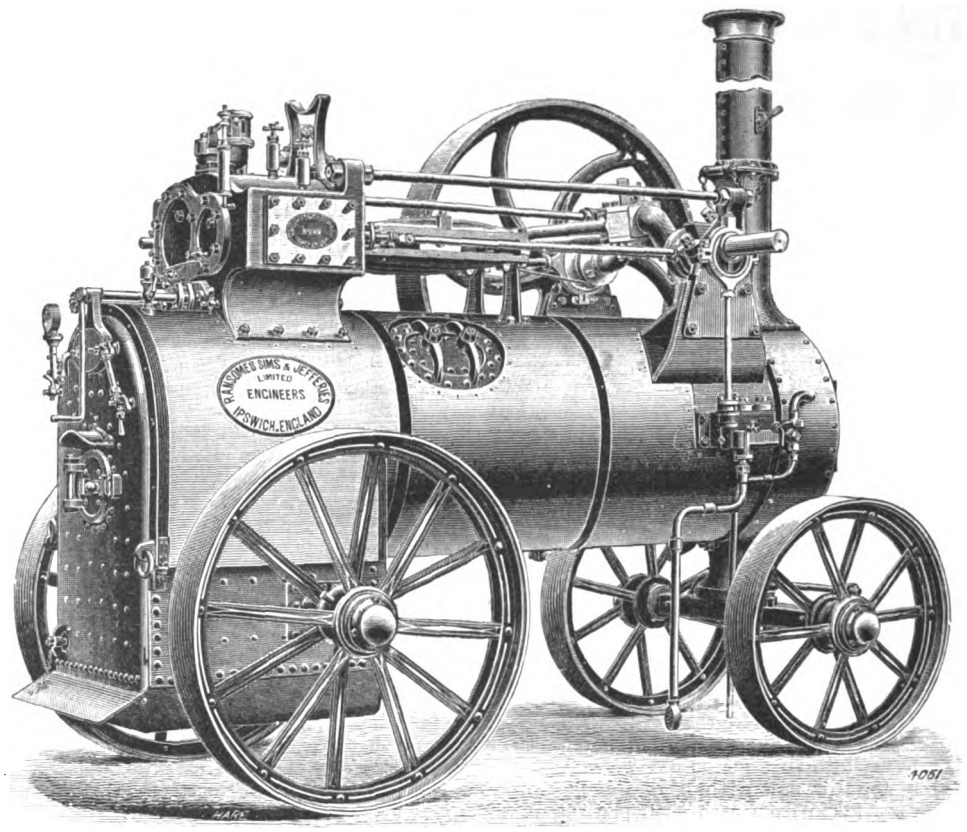


FIG. 2.

COMBINED ENGINES AND BOILERS.

THE accompanying illustrations show different types of engines and boilers, now put on the market by Messrs. Ransomes, Sims, & Jefferies, Limited, agricultural engineers, Ipswich. Fig. 1 shows a horizontal engine with a vertical boiler on the same base plate. The engine is of simple and compact design, and the boiler is one of the cross tube type, and is intended for a working pressure of 80lb. per square inch. The bed plate forms an ash pan and tank for the feed water, which is heated by the exhaust steam. Fig. 2 represents one of the non-condensing compound portable engines made by the same firm. These engines are made from 8 h.p. to 20 h.p. nominal, the cylinders are placed side by side, and made with the outer shell and valve chest in one casting, the inner working barrels are made of special hard iron, the boiler is made of mild steel, and is capable of working at 120lb. per square inch. The crank shaft brackets are of wrought iron and firmly riveted to the boiler, and also stayed to the cylinder by two strong iron tie rods, thereby helping to relieve the boiler of strain. A convenient arrangement is shown in Fig. 3, in which a compound engine is provided with separate boilers. The engine is a 25 h.p. nominal, has a high pressure cylinder 10in. diam., and a low pressure cylinder 16in. diam., each having 18in. stroke; a special expansion valve is fitted to the high pressure cylinder, so that the admission of steam can be adjusted to any point desired. The entire engine is mounted upon a strong wrought iron frame of channel section, which when taken to pieces is in a handy form for packing or shipment. The separate boilers are found more convenient than one large one, on account of the greater facility for transport. They are arranged for a working pressure of 120lb. per square inch, and are constructed of mild steel, with extra large fire boxes for burning an inferior kind of fuel. The connecting steam and other pipes are made of wrought iron, giving lightness and strength. To each boiler is attached a suitable donkey pump, which draws the feed water from a separate tank, and by utilising a portion of the exhaust steam, the water is heated to a considerable temperature before entering the boiler. An injector is also supplied, and in some cases a separate surface heater capable of raising the temperature of the water to boiling point. This is found extremely useful in purifying the water when impregnated with lime or other foreign matter. The workmanship of these engines and boilers is of high class, and the various details have evidently been well thought out, with the object of uniting mechanical efficiency with simplicity of design.

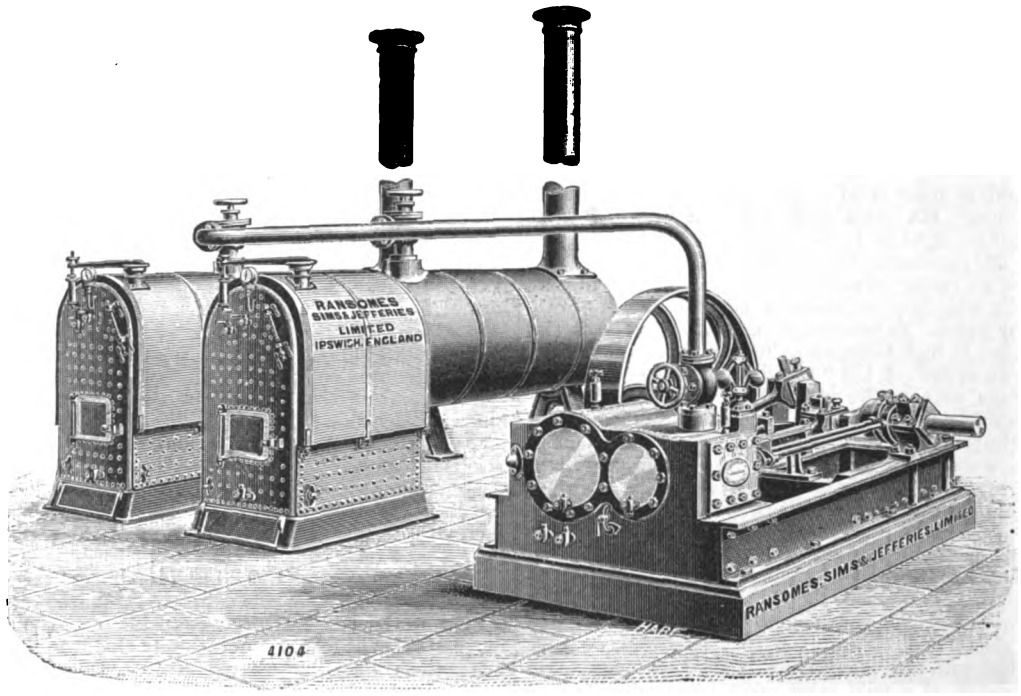


FIG. 3.

INSTITUTION OF NAVAL ARCHITECTS.

(Continued from page 312.)

The first paper read on Thursday morning the 22nd ult., was by Mr. R. Sennett, R.N., on the

WORKING AND TEST PRESSURE FOR MARINE BOILERS.

The factor of safety was defined as the ratio in which the ultimate strength of a boiler exceeds the working stress, being a somewhat rough and ready method of allowing for stresses, strains, and conditions which can neither be exactly calculated nor otherwise ascertained. It is to a great extent an allowance for want of knowledge, and until comparatively recently marine boilers contained so many unknown quantities that high factors of safety were justifiable. Since the introduction of high steam pressures and steel plates, much greater attention has, however, been paid to materials and the arrangement of details, and the necessity for large factors therefore no longer exists. Thus, in ordinary practice, it has been reduced within a few years from 6 to 8 to from 4 to 5. The present Admiralty rules provide that the stress produced by the water pressure test shall not exceed $\frac{4}{5}$ths of the ultimate strength of the shell of the boiler, which consequently has a factor of $2\frac{1}{2}$ at test pressure. Instead of reducing the working pressure to half the test pressure, it is fixed at 90lb. per square inch below the test pressure, which, Mr. Sennett maintained, affords ample margin for safety. The advantages gained by this arrangement are that the weight and cost of boilers are reduced, and working at higher pressures is not so severely handicapped as under the old regulations. The boilers of H.M. ships "Medea" and "Medusa" are 12ft. in diameter, and are designed for a working pressure of 155lb. per square inch. The water pressure test, in accordance with the new rule, was 245lb. per square inch, and at this pressure the shells

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have a factor of safety of 2¼. This requires a thickness of shell plates of $\frac{2}{3}\frac{9}{2}$in. By Lloyd's rules they would require to be $1\frac{5}{32}$in. thick, and by the Board of Trade rules 1¼in. The working pressure for these boilers according to Lloyd's rules would be 123lb. per square inch, and by the Board of Trade rules 110lb. The thickness of shell plates required by Lloyd's rules for this working pressure of 155lb. would be by the Admiralty rule sufficient for one of 220lb., and the minimum thickness required by the Board of Trade rules for a steam pressure of 155lb. would suffice by the Admiralty rules for one of 250lb., or more than 60 per cent. greater. The total weight of the shell plates in the boilers of the "Medea" is 52 tons, that is, 14 tons less than would be required by Lloyd's, and 19 tons less than by the Board of Trade rules. The paper concluded by a quotation from Sir F. Bramwell, stating that if the rules for marine boilers were enforced for locomotives, the ordinary working pressure of 140lb. would be reduced to so low a point that the whole railway service of the country would be paralysed.

As was to be expected from the great importance of the question raised in this paper, the discussion on it was of unusual length and importance, the speakers ranging themselves into two opposite parties, one maintaining that the new Admiralty rules are scientific, logical, and safe, whilst the other would not agree to a relaxation of the custom of testing boilers by water to twice their working pressure. The discussion was opened by Mr. Kirk, who regarded this as an exceptionally important paper, the value of which lay in its dealing with an accomplished fact, and not with an abstract proposition. He had previously pointed out that some improvement had been effected by the introduction of high pressure steam, and owing to building by Lloyd's rules rather than by those of the Board of Trade. Subsequently, he had corresponded with the Board of Trade, and urged that for a boiler working at 70lb. pressure there should be a factor of safety of 5; at 100lb., one of 4½; and at 150lb., one of 4. He believed that the factor of safety for higher pressures might be reduced, because the elements that necessitate that factor become of less importance. Bad material is now a thing of the past, as four test pieces are taken from each shell plate at an extra cost of £1 per ton, an expense only grudged because no advantage is allowed to be taken for it. The strains are now well known, and allowed for by the rules both of Lloyd's and the Board of Trade An equally small factor is required for inferior workmanship, especially as the boilers are supervised during their manufacture. It was contended that there is practically no corrosion in a well managed boiler, and if it occurs it is due to the carelessness of the engineers or the stinginess of the owners, and that the whole profession should be handicapped by having to pay for a uselessly strong boiler, and constantly have to carry about so much dead weight, was characterised as a monstrosity. Mr. Kirk protested that the Board of Trade had no right to bother about the duration of the boiler; its certificate lasted but twelve months, and therefore its factor of safety should be lower than that of Lloyd's, who have to consider that the boilers must last many years. In conclusion, he pointed out that the main object of high factors was to guard against such a breakdown as that of the "Livadia;" but as these cracks and defects were in the plates from the beginning, no factor of safety would guard against them.

Mr. Marshall felt the absurdity of keeping a double pressure water test under our better knowledge, and pointed out that Mr. Sennett had taken the Board of Trade rules indirectly into account.

Mr. Cowper maintained that each boiler maker should be allowed to judge for himself and take the responsibility for his boiler. He dissented entirely from the principle that the working pressure should be calculated from the ultimate strength of the boiler. It ought to be based on the elastic limit, because, if that is passed, we have not to deal with the same boiler as we had before. He quoted a case of a mild steel boiler which after several years' work withstood a test of 420lb., and this had restored the confidence that was shaken by the "Livadia." He thought boilers should be tested to double the working pressure, as that was within the elastic limit. He objected to Sir F. Bramwell's comparison of locomotive and marine boilers, as the former can be inspected every day, are half their time in the shops, and thus often last for twenty-four years. When years ago he had argued in favour of surface condensers, it was objected that copper went over to the boiler and corroded it. The fact was that under such pressures the grease turned from neutral to acid grease, and in that way the damage was done.

Professor Kennedy said that all the common sense of this question is certainly not on the side of Mr. Sennett; he had read the paper carefully, and it seemed to him that the proposal was simply this: we require to use high pressures, and thick shells are inconvenient, therefore let us use thin ones. This position seemed analogous to that of people who object to pay their debts, and prefer to write them off. He objected to Mr. Sennett's statement that progress has been owing to modifications of rules, and thought that it ought to be obtained from improvement in designs, and better knowledge of strength of materials. Mr. Sennett's proposition that the boiler should not be tested to twice its working pressure the speaker thought to be a matter of opinion; but he objected to making the working pressure so near the strength according to the hydraulic test, as the two strains are not comparable. The high temperature introduces stresses not present in the water test. Should we, he asked, place a higher strain upon boiler plates than is done upon certain leading parts of engines, such as the crank shaft, &c., when the boiler is subjected to much more uncertain stresses, and when accident would be so much more dangerous? Mr. Sennett said that we can apply exact calculations to boiler shells, but Professor Kennedy denied this, as we have too little knowledge of the resistance of riveted joints. During recent tests he had found materials to be shockingly unreliable; thus in one case of two specimens of supposed equal strength one gave 18 tons and the other 24 tons, and in another case one specimen gave 15 tons and the other 26 tons. Nor do we know how the strains are altered by plates being perforated, and there are local inequalities we cannot estimate accurately at the flanged joints at the ends. The speaker maintained that 28-ton plates should not be subjected to an 8-ton stress, and that boilers are the last things in which the stress should be overdone. In the illustration from locomotives Mr. Sennett was mistaken, as in the Webb engines with 175lb. pressure, or the Worsdell working at 170lb., the stress was only 5¼ tons per square inch with ½in. plates, about which we know much more than we do about 1in. plates; hence locomotive practice does not justify this alteration.

Mr. Stromeyer objected to Mr. Sennett's rules being applied to the merchant service, and pointed out that the choice of this 90lb. pressure was quite as arbitrary as the old standard. He thought a new standard should be fixed, but that the test pressure should not be lower than one and a half times the working pressure. He pointed out that with increased working pressures, and therefore increased temperatures, we approach a dangerous limit in the strength of the steel. He further insisted that a new rule should be more comprehensive, and include high and low pressures, that is, a rule to show how the factor of safety varies for different pressures.

Mr. Daniel Adamson referred to his extensive experience of steel boilers, and said their great advantage was due to the equal strength of steel in all directions. He objected to applying formulæ that act admirably for short boilers, to long or complex ones, and illustrated his point by reference to the bursting of one on the London and North-Western Railway locomotives, in which the disaster was aided by the sudden alterations in temperature, and if a high temperature produced such results with ⅜in. plates, what might be its effect on 1in. plates. In reply to Mr. White he explained that the factor of safety of his own boilers is 5, and he had adopted as much as 7 in some that vary greatly in temperature. He thought both the 90lb. and the rule for double pressure test to be unwise, and he should prefer to see a *pro rata* rule adopted.

Mr. Reynolds, after correcting some loose statements as to the rising of phosphorus in ingots made by the last speaker, pointed out that the great danger of the present paper was from the tendency of the mercantile marine following this lead. He first had suggested constructing boilers of layers of thin plates, and maintained that this principle might well have been used in the "Medea" plates.

Mr. Alex. Taylor, speaking as a shipowner and a member of Lloyd's Committee, thought that few shipowners would care to see the factor of safety reduced, and that they expect their boilers to last at least fifteen years, and would strongly object to having to take up their decks and disarrange the whole vessel every five or ten years. He pointed out that the navy practice and that of the mercantile marine were not closely analogous, as in the latter the engines are worked at full pressure for days and weeks together, whereas in the navy the work is not nearly so constant.

Mr. Parker, the Chief Engineer-Surveyor of Lloyd's, considered the paper dangerous. Mr. Sennett's first proposition seemed to be that the strength of the riveted seam is the test pressure, and 90lb. below that is the working pressure. The speaker referred to his experiments on the elastic limit of steel made during the last year, and quoted Sir F. Bramwell's statement that the elastic limit of a material was usually supposed to be a line which if crossed would destroy the material, but that he (Sir Frederick) did not know what that limit was. The speaker had found that the limit of elasticity of a plate was lowered by working from 14·8 tons to 10 tons, and therefore if Mr. Sennett is trusting to the limit of elasticity he is treading on dangerous ground. We do not know much about the strength of joints, their strength being obtained only by calculation, and the speaker had found in every case he had tested that the strength was below the theoretical value. Further, the steam pressure accumulates when the vessel stops, and this accumulation often reaches 10 per cent. Again, Mr. Sennett made no allowance for corrosion; but to show that such is not an imaginary danger, he exhibited plates which had been reduced to two-thirds of their thickness by this cause. Moreover, the stresses in a boiler vary greatly with the firing; thus at times one part may be at 1100°, and another part at 300°. From all these causes, and remembering that latent defects are always likely to be present, Mr. Parker insisted that a large factor of safety was absolutely necessary, and the adoption of Mr. Sennett's limit would be a serious matter. To show what the result of an accident would be, he referred to the explosion of a steam pipe at Southampton at the working pressure. It had been tested by hydraulic pressure to two and a half times the working pressure, and had a factor of safety of 10. Nevertheless, by one of these latent defects it burst, and killed ten persons. Mr. Parker felt sure that the bursting of a boiler would send any ship to the bottom. He next asked whether the advantage gained is worth the risk, as by adopting the new rule only a small saving in weight was secured. In regard to Mr. Sennett's statement about locomotives, he had certainly been misinformed. Mr. Parker had recently been in correspondence with all the leading locomotive superintendents in the kingdom, and found they unanimously agreed that they would not work below a factor of safety of 5 or 6, whereas Mr. Sennett was adopting one of only 3. A letter was read from Mr. Deane, the manager of the works at Swindon, who was specially emphatic on this point. Mr. Parker concluded by saying that Lloyd's Register would be willing to confer with the owners if any considerable section of them were anxious for a change in the regulations on this subject.

Admiral de Horsey admitted that in the Admiralty everything was sacrificed to speed; but naval boilers would not compare with those in the mercantile marine, which run for days and weeks at the same pressure, whereas in the navy, when such is attempted, the tubes choke, the boilers leak, and everything goes wrong. The surging of the water in the boiler during a gale must try it greatly, and the fate of some of the ships of the navy that had left port and never since been heard of was perhaps to be explained by reference to the boilers.

Mr. Seaton considered himself committed to Mr. Sennett's policy, as he had published the same conclusions years ago. He did not think there was such a difference between the navy and the merchant service as previous speakers had assumed. Though the former did not often require to go at maximum speed for long, they might have to do so. In regard to the corrosion of shell plates, he had examined hundreds of disabled boilers, and less than 5 per cent. were condemned from defects in the shell; and as the plates are 22 to 24 per cent. stronger than the seams, he thought that allowed sufficiently for corrosion. Mr. Parker's argument that we can place greater confidence in ⅜in. plate than in the 1in. plates told more in favour of reducing the thickness than against it. He advocated the hydraulic pressure test to be applied at a temperature of 212°.

Several subsequent speakers objected to the application of this rule to the merchant service, as by it the boilers would probably not last so long nor be so safe. Mr. List and Mr. Jones thought there is little corrosion if the boiler is properly looked after, and Mr. Gray was not alarmed at the limit of elasticity, as he knew of a case in which a boiler had its steam dome blown off, and though the limit of elasticity must have been passed, a new dome was put on, and the boiler had worked well ever since.

Mr. White considered Mr. Sennett's innovation both scientific and safe. Not one of the speakers had consistently assailed his position or defended a test of twice the working pressure, and no one who knew the Admiralty specifications had opposed them. The hydraulic test was not an assurance of safety, but only a test for imperfect workmanship. To get such an assurance, Mr. Sennett proposed to abolish the method of multiplication, and the discussion showed that this has been already done by many of our best engineers in their own practices. Professor Kennedy, with studied moderation, had told them what he regarded as the plain English of their propositions, and laid before them some figures; but though fully admitting Professor Kennedy's authority on that point, he could not attach much importance to them till he knew on what they were based. Mr. White protested that the navy boilers were not the grotesque failures Admiral de Horsey represented. In the days of auxiliary steaming the boilers were subjected to terribly trying conditions; but they have vastly improved with the abandonment of sails, and recently ships were tried steaming continuously night and day for four days in distant parts of the world, and were found to give from 70 to 80 per cent. of their speed on the measured mile.

Mr. Sennett, in replying to the discussion, said he had not intended to attack Lloyd's rules. He protested that it was absurd to maintain a high factor of safety destined to cover unknown quantities when the unknown quantities had one by one been eliminated. Mr. Parker had gone

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INSTITUTION OF NAVAL ARCHITECTS.

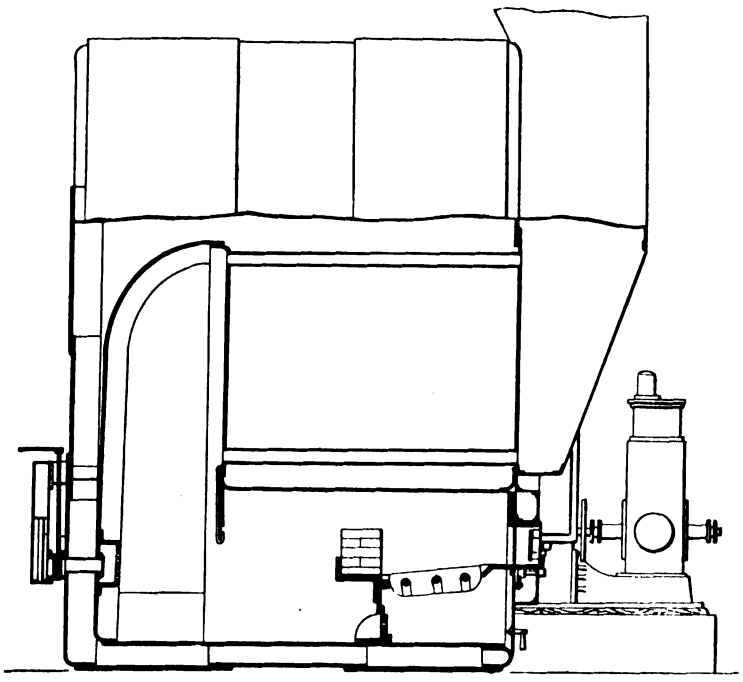


Fig. 1.

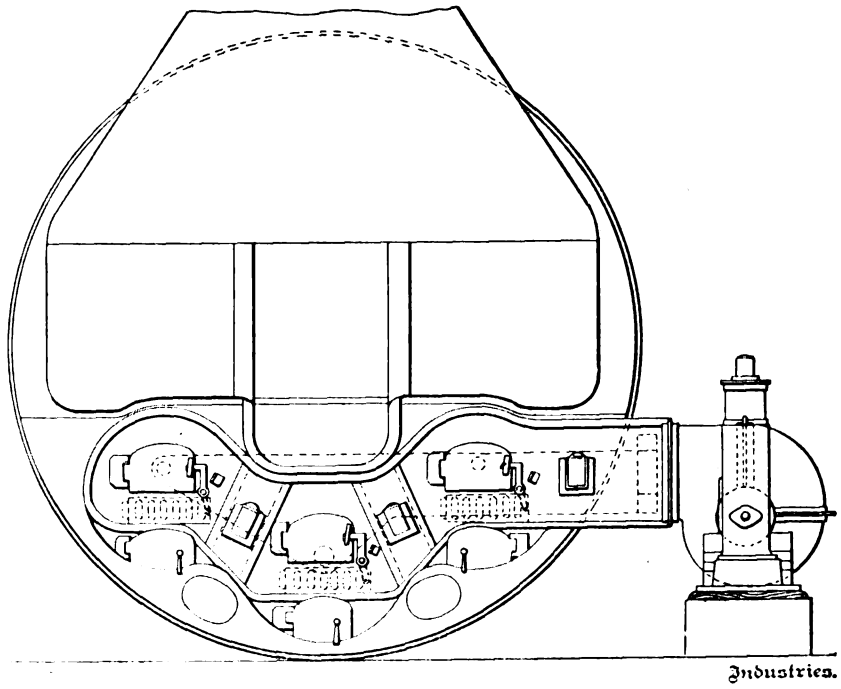


Fig. 2.

back from the position he held in 1887, when he believed in reducing the factor of safety to three—at least he probably concurred with Mr. Milton's paper advocating that step. The French Admiralty have adopted the same policy as the author had done.

The next paper read was by Mr. A. F. Yarrow, on

The Possible Advantage of using Highly Volatile Liquids in Lieu of Water for the Purposes of Propulsion.

The author had recently completed a steam launch 36ft. in length by 6ft. beam, and fitted her with an engine working with a highly volatile hydrocarbon. The weight of the hull is 14cwt., and that of the machinery 6cwt., making a total of only 1 ton. The engine is of the ordinary direct acting inverted type, provided with the usual link motion, feed pumps, &c., and the working fluid is a highly volatile hydrocarbon having a specific gravity of ·725 to ·730. This is evaporated in a generator consisting of a copper coil which is enclosed in a double sheet iron casing, the intermediate space between the casings being filled with asbestos. Below the coil is a ring-shaped Bunsen burner, through which a mixture of hydrocarbon and air is forced and ignited on issuing through the holes. In the bow of the boat is a 40-gallon air tight copper tank containing the hydrocarbon, and care is taken to make the bulkhead aft of it perfectly tight, so as to prevent the danger of the liquid finding its way into the central portions of the boat. This tank is placed in communication with the feed pumps by means of a pipe passing outside the boat close to the keel, and the feed pumps deliver into the bottom of the generator coil, whilst the exhaust from the engine passes by means of two condensing pipes also placed outside the boat and on either side of the keel into the top of the tank in the bow. These pipes, therefore, form a surface condenser. In addition to the engine pumps there are two hand pumps, one having its suction in connection with the tank and its delivery joining the delivery pipe from the engine pump; the other forcing air into the top of the tank, which becomes charged with vapour, and is passed by a separate small pipe to a supplementary Bunsen burner placed below the main burner. To start the launch the air pump is first worked by hand, and as soon as air charged with vapour finds its way to the supplementary burner it is ignited by means of a taper and heats the copper coil. After working the air pump for some minutes a few strokes are given with the hand feed pump, so as to send the hydrocarbon into the copper coil, which has meanwhile been heated up. The pressure immediately rises, and a communication is made by opening a valve between the upper part of the coil and the main burner, allowing a small quantity of the vapour to pass into the burner together with a suitable amount of air which is drawn in with it, and the mixture is ignited from the flame of the supplementary burner. When the main burner is fairly started the hand air pump and the hand feed pump may be stopped, and the engine can now be started, the main feed pumps keeping up the circulation of the hydrocarbon through the coil. From this moment the action is automatic, and neither engine nor generator require any further attention. The working pressure in the launch described can easily be maintained at 70lb. per square inch. After the feed has left the engine it passes through the exhaust pipes, is condensed and forced by the engine back into the tank, where it arrives in its original fluid form. The boat can run at a speed of from seven to eight miles per hour for several hours, with no other attention than that required to lubricate the bearings. The advantages claimed for this system are that the average time from lighting up until the launch is started at full speed does not exceed five minutes; that the entire central portion of the boat is available for passenger accommodation, which is about twice that of a steam launch of equal size; that there is a large saving in weight, owing to the small size of the vapour generator; that the fuel supply requires no attention; and that the whole arrangement is extremely clean. One person can take entire charge both of the steering and management of the machinery, and to stop the boat all that is required is to cut off the supply of vapour. The author has given the name of "Zephyr" to this type of launch. As regards the first cost, it is about equal to that of a steam propelled launch, and the cost for fuel may be calculated from the fact that, with a speed of from seven to eight miles an hour, the consumption of hydrocarbon is about 1¼ gallons per hour.

The discussion which followed was somewhat meagre, considering the great scientific, and possibly also great practical importance of this new type of vapour engine, not only for launches, but also for stationary purposes where small gas engines are now employed. Professor Lambert referred to some experiments in which he took part when a model of a steam engine was worked with steam and with hydrocarbon vapour. The fact that the specific heat of hydrocarbon is very much lower than that of water, and that the temperature corresponding to equal pressures is also lower, necessitates the employment of larger cylinder volumes as compared with steam engines working at the same pressure. The most important contribution during the discussion was made by Mr. White, of the Admiralty, who suggested that propelling machinery of this type might be adapted to lifeboats, where mechanical propulsion of one sort or another is very desirable, so as to leave the men fresh by the time they arrive at the wreck.

Two more papers were set down on the programme for the morning meeting; one by Mons. J. A. Normand, "On the Fineness of Vessels in Relation to Size and Speed," and the other by Mr. A. Blechynden, "On a Method of Approximately Determining the Mean Girth of a Ship;" but as neither author was present, and as the long discussion on Mr. Sennett's paper seemed to have exhausted the energy of the meeting, these two papers were taken as read.

The first paper read at the evening meeting on the 22nd March was by Mr. J. R. Fothergill, on

Forced Draught.

The system of supplying boilers with air above atmospheric pressure has long been known, having been introduced by John Ericcson in 1830 on the steamer "Corsair," trading between Liverpool and Belfast; but it is only during the past few years that it has met with commercial success, and some ship owners are even now reluctant to adopt it. The author prefers the closed ash pit to the closed stoke hold system. The quantity of air at 62°F. required for the combustion of 1lb. of coal is 140·6 cub. ft., or 10·7lb.; but in an ordinary multitubular furnace under natural draught, from 20lb. to 24lb. must be supplied to insure perfect combustion. With a funnel temperature of 600° this excess carries away about 20 per cent. of the heat units generated, and if the supply of air be restricted, only carbonic oxide is formed, giving 4400 units of heat per pound of carbon, instead of 14,500 units when carbonic acid is formed. These defects cannot be remedied under natural draught. A successful forced draught system must not be too expensive, must stand rough usage, suit present stoking arrangements, and admit of the use of natural draught should the machinery break down. The author's system is as follows: Across the boiler front (see Figs. 1 and 2) is a casing made of separate parts, and into this the air is forced by the fan, entering the ash pits through gridiron valves, shown dotted in Fig. 2. These valves are actuated by the movement of the furnace door latch. Another casing extends across the back of the boiler, and is connected with the front casing by a pipe running along the boiler side. The air supply is regulated by an air scoop in the front of the tube. Connected with the back casing are air pipes running through the boiler and opening by jets into the combustion chambers. At the end of the grate is the usual brick bridge, and behind is a gas deflector. The air leaves the fan at a water gauge pressure of 3in. to 3½in., and at the ash pits the pressure is from ·5in. to ·7in. Air is admitted through a perforated plate under the bridge to the combustion chamber. In all cases the air is admitted in small streams. As the gases leave the fire and pass over the bridge they are deflected, and the air from the back casing, rushing at great velocity through the perforated plate in very small streams, acts, as it were, like so many air pokers, stirring up the gases, commingling and uniting with them most effectively. The quantity of air so admitted can be supplemented from the ash pit through the air box under the bridge. The author did not think that the advantages derived from heating the air were worth the trouble and expense. The fan and driving engine that had been found most convenient were Chandler's combination of high speed engine and fan; that on the "Hypatia" had run for twenty-four days without stopping, passing 8000 cub. ft. to 10,000 cub. ft. of air per minute. Turning to the commercial advantages of the system, tables were quoted

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INSTITUTION OF NAVAL ARCHITECTS.

	Orlando.*	Undaunted.*	Australia.†	Galatea.†	Narcissus.‡	Immortalité.‡
Diameter of boiler (external)	14ft. 10½in.	14ft. 10½in.	14ft. 8½in.	14ft. 8½in.	14ft. 8½in.	14ft. 8½in.
Length of boiler	16ft. 6in.	16ft. 6in.	16ft. 9in.	16ft. 9in.	17ft. 6in.	16ft. 6in.
Fire grate area, in square feet (total)	540	540	500	500	534	488
Tube surface, in square feet (total)	13,845	13,845	13,480	13,480	13,340	13,152
Mean i.h.p. during the four hours' trial	8,739	8,670	8,876	9,219	8,589	8,737
Maximum i.h.p. for one half hour	9,120	9,092	9,130	9,653	8,827	9,362
Steam pressure in boiler (mean)	129	126	132	138	131	126
Air pressure in stoke holds (mean)	1·05	1·87	1·75	1·15	2·03	2
I.H.P. per square foot of grate (mean)	16·18	16·05	17·75	18·44	16·08	17·90
" " " (maximum)	16·88	16·83	18·26	19·30	16·53	19·18

Makers of engines: * Palmer's Company, Jarrow. † R. Napier & Sons, Glasgow. ‡ Earle's Company, Hull.

of steamers from 1250 tons to 3600 tons, with boilers working at from 65lb. to 160lb. steam pressure. These steamers are in the Indian, Mediterranean, and South of Spain trades. In the case of the s.s. "Marmora," which was fitted with the author's forced draught arrangement in 1884, a saving of £367 in the coal bill per annum resulted from the possibility of using inferior coal. In the s.s. "Dania" the introduction of forced draught reduced the coal consumption in the main boilers by 20 per cent. without material alteration of speed, whilst in the s.s. "Etna" an increase in speed of ·8 knots per hour (from 7·58 with natural to 8·38 with forced draught) was accompanied by a saving of 4·3 per cent. in the quantity of coal consumed for all purposes. In the case of the "Hypatia," which has just concluded her third Indian voyage, there is a slight increase of speed, and a saving of 13 per cent. in the consumption. The author concluded by calling attention to the fact that the "Marmora" sailed from the Tees on the 3rd October, 1884, whereas the "New York City" did not sail till the 13th of the same month, so the claim made that the latter was the first steamer ever worked at sea with forced draught cannot be sustained.

The next paper was by Mr. T. Soper, R.N., on

Boilers under Forced Draught on the Closed Stoke Hold System.

The author pointed out that this system had first been brought to the notice of members of the Institution in a paper by Mr. Butler in 1883, in which the results on the "Satellite" and "Conqueror" were given. It was then feared that the durability of boilers would be diminished; but now that the trial has lasted several years, it has been found that boilers are as good under forced draught as under the old system. The "Polyphemus" had her eight boilers fitted in 1884. The stoke holds are closed and air is supplied by four fans, and though the ship has since been engaged on very trying service, the boilers are still in a most satisfactory state, and capable of working with the original pressure of 110lb. Double distillers were fitted in 1887, as the deposition of scale during distillation led to the tubes leaking. In regard to torpedo boats, they are fitted with closed stoke holds, and when steaming down channel last May only two boilers gave trouble, and these not in any way owing to forced draught. Up to the present fifty vessels, representing a total i.h.p. of 254,000, had been fitted with this system, and the only cases in which difficulty was experienced were in three vessels of the "Archer" class, in which the boiler tubes leaked owing to local causes unconnected with forced draught. Recently, the "Porpoise," one of this class, had made a continuous run of ninety-six hours, at full power, with most satisfactory results. One advantage of the closed stoke hold in the navy is that the openings to the engine and boiler rooms can be reduced in size. Thus in the cruisers "Amphion" and "Orlando" the area of the air opening in the former is 207 sq. ft. for 5600 i.h.p., while in the latter it is only 103 sq. ft. for 8700 i.h.p. As the "Rattlesnake" is the only vessel in the navy worked continuously with more than one locomotive boiler, the results obtained with her are of interest. She has four boilers having a diameter of 5ft. 10in., and a length of 16ft. 6in., and a total grate area of 126 sq. ft., with a tube surface of 4085 sq. ft. The mean i.h.p. recorded on a three hours trial was 2740 i.h.p., and the speed of the vessel 19·5 knots, the engines working at a pressure of 135lb. and a mean air pressure of 2·39in. in the boiler rooms. The ship has been since engaged on most trying work, and the boilers work admirably. The only trouble was the burning of fire bars; but this has been completely remedied by the introduction of water pans in the ash pits, as usual with torpedo boat boilers. As the trials for maximum power under forced draught last for four hours, no reliable results have been obtained as to the consumption of coal. Mr. Soper then called attention to six of the belted cruisers, which are the largest vessels in the navy, and which up to the present have been tried with triple expansion engines, and six of these have within the past year completed their official trials. These six vessels were engined by three firms—Messrs. Napier, Palmer's Company, and Earle's Company. The engines are horizontal, and excepting details of construction, are practically the same in the different vessels. There are four double-ended boilers to each vessel, and each boiler is fitted with six furnaces, three at each end; in the "Orlando" and "Undaunted," by Palmer's Company, and the "Narcissus" and "Immortalité," by Earle's Company, there is one combustion chamber to each opposite pair of furnaces—that is, three combustion chambers, with waterways running fore and aft the boilers between them. In the "Australia" and "Galatea," by Messrs. Napier, there is one combustion chamber only to the six furnaces. The results obtained by the single combustion chamber boiler are superior to the others, as will be seen from the above table.

The discussion on these two papers was taken together.

Mr. James Howden differed from Mr. Fothergill, as he attached more value to the heating of the air supply. He denied that the cases described in the paper were really those of forced draughts. Thus the "Stella" has 3498 sq. ft. of heating area of boiler to an i.h.p. of 853, and the "Marmora" has 1700 sq. ft. with 396 i.h.p., both of which the speaker characterised as extravagant heating areas for natural draughts. His idea of the real meaning of forced draught was that it enables us to reduce boiler surface and increase horse power. In regard to the question of priority, he said that though the "Marmora" had gone to sea on the 3rd of October, 1884, and the "City of New York" not till the 13th of the same month, yet Mr. Fothergill had not applied this method to the old boilers of the "Marmora" till months after the speaker's paper before the Institution, and the "City of New York" had actually made a trial run in September of the same year. He pointed out that the illustrations accompanying Mr. Fothergill's paper were almost identical with those published by the speaker in 1884. In regard to Mr. Soper's paper, he objected that the trials were not so conclusive as a continuous run across the Atlantic.

Mr. Frank Marshall regarded the data of the working of merchant vessels given by Mr. Fothergill as of great value. He also pointed out the great collateral advantages of forced draught, such as cleanliness, lower temperature in the stoke hold, and that the speed is maintained while the furnaces are being cleared. As to the question of priority, it should be remembered that the method had been used by George Stephenson, and by Messrs. Thorneycroft and Yarrow, years ago. He claimed to have first applied it to large war vessels, viz., three large cruisers built for the Chinese Government in 1879, and he used the open stoke hold system, thus differing from both Messrs. Howden and Fothergill. He would substitute fire brick for the deflector, because if made of iron it could not escape being burnt away; and he would lengthen the fire bars more than Mr. Fothergill had done, so that more air could be taken through the fuel. Boilers used on this system both in the Italian and Russian navies had worked well. He also advocated a large combustion chamber, and illustrated his point by reference to the boilers of two Guion Line vessels that he had built eighteen years ago, and which he had recently been assured were as good now as they had ever been. Their dimensions were 15ft. 6in. diam. by 19ft. long, of 1¼in. plate. There were six furnaces and one large combustion chamber. Mr. A. Holt had adopted the same system. The Flora Rubbattino Company, of Italy, had thirty vessels worked on the Ferando system of forced draught, which only in unimportant details differs from Mr. Fothergill's. The ships work almost continuously, and their speed from Naples to Malta has increased from 11 or 11½ knots to 13 or 14 knots.

Mr. Linington called attention to the fact that fans were used to drive air into the furnace in a ship built thirty to thirty-five years ago. The advantage of closed ash pit over closed stoke hold depends on the number of boilers; and if there is but one the closed stoke hold system is simplicity itself.

Mr. Parker rose to state what had been done on this subject in the mercantile marine. Up to the present sixteen vessels had been fitted, mostly on Mr. Howden's system. In five cases it had been taken out for unexplained reasons, but in the remainder it was doing well. It is important to remember that these five vessels were fitted by contract, and as they were not such a success as the owner had anticipated, the forced draught apparatus was removed. The White Star Line had spent from £5,000 to £6,000 on experiments on the "Celtic," with the result that she now does better with eight boilers than previously with ten, representing an increase of 260 tons of cargo capacity.

Mr. Kirk pointed out that there is a great difference between the practice in the navy and mercantile marine. In the former it is required at an emergency to get the very utmost out of the machinery, and therefore much higher rates of combustion are required. Thus the Admiralty adopt a 2in. pressure, whereas in the merchant service only one of ½in. is used. He regarded the combustion chamber of the "Galatea" as excellent, because it allowed a better mixture of the gases.

Mr. Sennett defined forced draught to include only cases in which the air is forced down by fans. He pointed out that in the navy much greater horse power is required out of the same material than in the mercantile marine; thus, to take the case of the "Etna," the navy would require 1200 horse power, whereas it really only has 485. He remarked that the only objections to the system came from those who had had no practical experience of it.

Mr. Scott said that in addition to the sixteen vessels with forced draught noticed by Mr. Parker, there were six more under the management of Mr. Holt. The system was explained as of especial value, because securing regularity in Indian waters when during the monsoon season the vessel is travelling at the same rate as the wind.

Admiral de Horsey had used an iron deflector, and though it went into the ash pit once a month, it was so useful in saving the tubes that it was worth renewal. He remarked that the funnel damper had a great influence in dealing with forced draught.

Mr. Bevis explained that the Holyhead boats had been fitted with a closed stoke hold with excellent results.

Mr. Fotheringill, in reply, objected that Mr. Howden had not caught his meaning. He did not think that heating the air was worth the cost, and Mr. Spence pointed out in his paper at Newcastle that the only gain he obtained was 4 per cent. In reference to the heating area of the boiler, he explained that those described were of the ordinary mercantile marine class with the ordinary heating surface, and the object of his paper was to show that boilers not designed for forced draught could be easily adapted, and would pay the cost of alteration in twelve months' running. As the air in these ships is mechanically driven, he thought it ought to be called forced draught. Mr. Marshall's fear that the baffles would not stand was needless, because they had stood. They had tried fire brick, asbestos, &c., for the deflector; but these materials had all failed, owing to accumulation of clinkers. They used iron plates, which burnt away every six weeks, but were readily renewed. In regard to the admission of the air at the bridge, as alluded to by Mr. Marshall, the system had been tried and failed. Mr. Sennett had overlooked the difference between forced draught and a high chimney, viz., that in the former the velocity of the gases can be kept down to a minimum. The quantity of air admitted is in round figures 18lb. of air per pound of coal, but the exact proportions cannot be easily ascertained.

(To be continued.)

SOME RECENT OFFICIAL REPORTS ON BOILER EXPLOSIONS.

Report No. 249 refers to an explosion which occurred shortly after three p.m. on the 29th November, 1887, to the larger cylinder of a "Slasher" sizing machine at the Washford Towel Mills, Buglawton, near Macclesfield. The explosion, fortunately, did not cause any serious injury to any person. The machine had been purchased second hand, by Mr. W. Hoyle, Primrose Vale Mills, and sold by him to Mr. Robert Calvert during last year. A new safety valve had been fixed and one longitudinal stay replaced since it came into Mr. Calvert's possession. This machine was fitted with two cylinders for the purpose of drying cotton yarn after being passed through size. One cylinder was 40in. diam., and the other, which exploded, 60in. diam., both being about 4ft. 11in. in length. The shell of the larger cylinder was made of five tinned sheet iron plates, from ·036in. to ·04in. in thickness at the fracture, and arranged longitudinally, with lap soldered, double riveted seams; rivets about 1¼in. diam. and 1in. pitch. Three hoops of T iron, 1in. by 1in. by ⅛in., placed about equal distances apart, secured by straps of hoop iron, soldered to the cylinder at each longitudinal seam, were fitted to the cylinder to resist collapse. The ends were $\frac{5}{16}$in. thick, flanged outwards 1¾in., and supported by nine longitudinal stays, ⅞in. diam., collared and riveted. Trunnions, 5¼in. in length, and 2⅜in. diam., with flanges 20in. diam., were secured at each end by thirty-eight ½in. bolts, and upon

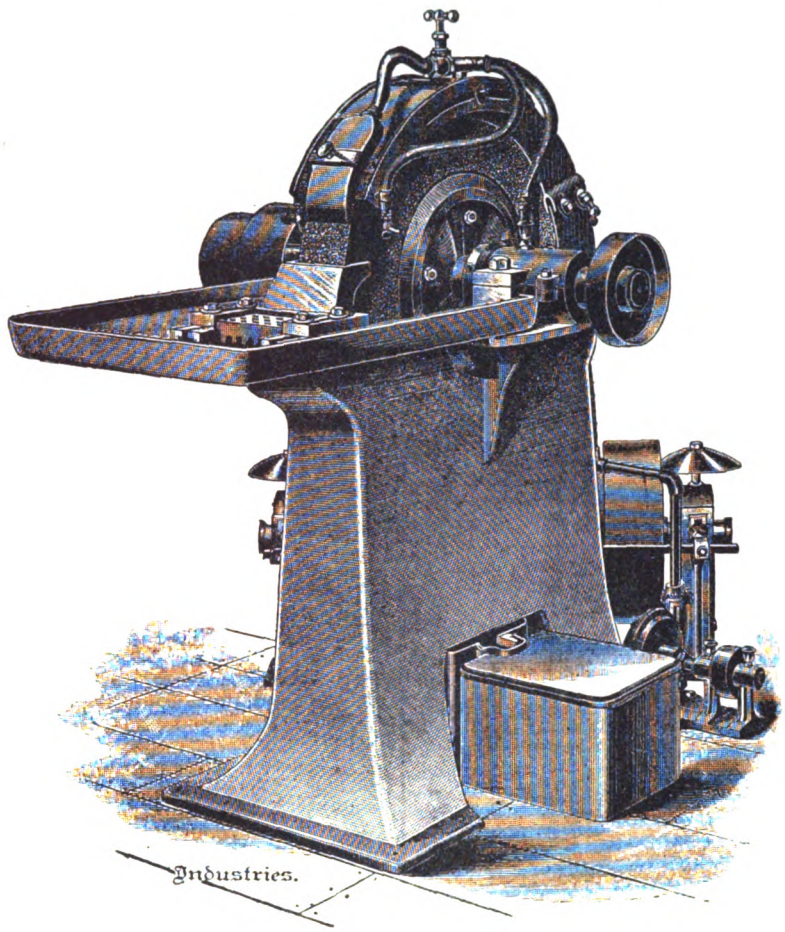
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these trunnions the cylinder revolved. The hole through each trunnion was $\frac{3}{4}\frac{1}{2}$in. diam., one being somewhat diminished in area by a tin tube for the purpose of removing the water formed by condensation. The machine was fitted with a pressure gauge graduated to 200lb., one safety valve $\frac{3}{4}\frac{3}{2}$in. diam., loaded by a dead weight to 14lb., and a small extra horseshoe shaped weight of $\frac{1}{4}$lb.; one vacuum valve at each end of each cylinder, $1\frac{3}{4}$in. diam., held in position by spiral springs; one water trap, with a ball escape valve, having a vacuum valve in its cover. The cylinders were supplied with steam from a Cornish boiler working at 50lb. per square inch, about twenty-five yards distant, through wrought iron pipes 1in. diam. There was no reducing valve, steam admission being regulated by a cock. Owing to Mr. Calvert having failed to give notice of the explosion to the Board of Trade authorities, as required by the Boiler Explosions Act, 1882, the inspector did not examine the cylinder until about ten days after the accident, and the machine had then been removed to Accrington, and taken to pieces for repair. It appeared that the cylindrical portion of the larger cylinder ruptured throughout its whole length, the fracture running about $4\frac{1}{2}$in. to 12in. from one of the longitudinal seams, then extending round each end. From the evidence it appeared that the safety valve did not commence to blow off until the pressure gauge indicated about 18lb., or about 4lb. more than the calculated load per square inch upon the valve. From tests made of the tensile strength per square inch of the tinned sheet iron plates, it was shown that of ten strips from the circumferential direction of the cylinder the mean breaking load was 46,141lb., which, taking the pressure at 20lb. per square inch, shows the cylinder to have been working with a factor of safety of 2·75. Taking the lowest test of tensile strength obtained, viz., 40,780lb., the factor would only be 2·45, even assuming the joints or seams to be as strong as the solid sheet. The inspector concludes that the explosion was due to the cylinder having been worked at a higher pressure than it was fit for; and observes, "it is fortunate for the owner that the explosion was unattended by serious consequences, as he appears to have taken no steps to satisfy himself as to the fitness of the cylinder for what he regarded as its working pressure." The Engineer Surveyor-in-Chief, Mr. Traill, while confirming the opinion of the inspector, adds: "This is another illustration which shows how little some men apparently think of the importance of taking reasonable steps to satisfy themselves that a vessel is capable of withstanding the pressure to which they subject it, from time to time." The owner in his evidence expressed a conviction that the safety valve was inoperative, and allowed the cylinder to receive the full boiler pressure (at the time 40lb.); but the inspector's report does not confirm this view, and there is little doubt that this explosion is entirely due to the improper manner in which the maker of the "Slasher" arranged for steam admission and escape. The inlet pipe was 1in. diam., and the safety valve being only $\frac{3}{4}\frac{3}{2}$in. diam., was unable to discharge more than a fraction of the steam supplied from the boiler; therefore as at any time there might accidentally be a stoppage of the passage of wet yarn over the cylinders, the supply of steam would exceed the condensation, and allow the pressure to increase. From the inspector's calculation the boiler pressure would just about equal the bursting pressure of the larger cylinder; and in the event of a stoppage of the machine there does not appear to be much doubt that pressure might rise to the full boiler pressure. The remedy in all such cases is obvious: the area of the inlet pipe should be properly proportioned to the area of the safety valve, so that the discharging capacity and power of the safety valve shall at least equal the steam supplying power of the inlet pipe.

On the 27th November, 1887, about 11 a.m., the boiler of a small steam coaster blew up, and fell into the sea, off Burntisland, in the Firth of Forth, severely scalding, but not fatally, the master and engineman. The vessel, which belonged to Mr. John Lindsay, High St. Anthony's Boat-building Yard, Newcastle-on-Tyne, was much injured, but was afterwards towed into Leith. From such particulars as could be obtained, the boiler not being forthcoming, it having sunk in from 5 to 21 fathoms of water, it appears to have been an ordinary vertical cylindrical with a fire box provided with two cross tubes. The shell was 11ft. high and 5ft. diam., fire box about 4ft. diam., and of the unusual height of 8ft., leaving only 2ft. 9in. for steam and water space. The uptake was 18in. diam., lined with fire brick; there were also four stays $1\frac{1}{8}$in. diam. between the fire box top and crown of the shell. It was made by Mr. Wm. Horsley, White Hill Point, North Shields, in 1876. The boiler had been proposed for insurance to an insurance company, but found in bad condition. The insurance was then deferred by the company on the 12th April, 1887, until the boiler was properly repaired both in the fire box and the shell, and for Mr. Lindsay to enter into an undertaking to feed only with fresh water instead of using salt water, as had previously been the custom. Although reminded, and so recently as the 24th of last October, of the importance of immediate attendance to these suggestions, the owner appears to have continued to work the boiler in its known bad condition, and with salt water, until it finally exploded. The engineman stated that the load on the safety valve was not constant, as he "used to shift the weight along the lever according to what he considered requisite." He admitted using a pressure of 60lb., but as the load with the weights at the end of the levers would be 70lb. per square inch, it is possible the pressure may occasionally have reached that amount. One statement of the engineman seems worthy of record: "I used to guess," he said, "at the saltness, and sometimes I tried a potato in the water. I never saw a potato float." There is little doubt that the explosion was due to the defective condition of the fire box, which was worn out. These particulars are taken from Report No 250.

Report No. 251 does not deal with the explosion either of a steam boiler, generator, or vessel intended for the use of steam under pressure, but with the explosion of a vessel used only for the purpose of heating water to the boiling point, for the purpose of cask washing, at the brewery of Messrs. Greatorex Brothers, Brooks' Bar, Manchester. The explosion occurred on the 29th of December, 1887, about 3 p.m., and resulted in the death of one man, who was a barrel washer. The water heater was a plain cylindrical vessel 4ft. 5in. diam., 19ft. 4in. in length, with flat ends, made throughout of $\frac{3}{8}$in. plates, single riveted, except the upper part of the front end, which was $\frac{7}{16}$in. thick. The ends were secured by light angle iron $2\frac{1}{2}$in. by $2\frac{1}{2}$in. by $\frac{3}{8}$in., the back end being in one piece, and the front end (which gave way) in two. A longitudinal stay, $1\frac{1}{2}$in. square, was fitted in the centre, and secured by pins 1in. diam. to short pieces of angle iron 3in. by 3in. by $\frac{5}{8}$in., riveted on. The heater was provided with a glass water gauge; one alarm, or very small safety valve, only $\frac{1}{4}$in. diam., loaded to 2lb. per square inch, and provided with an escape pipe $\frac{1}{4}$in. diam., 8ft. in length; a filling and an emptying pipe; a cock for drawing off hot water, and a pipe to admit steam for heating the water. The heater was twenty-eight years old, having been made by Messrs. Gadd & Hill, engineers, Salford, in 1860. The stay pin of the front end appears to have given way, and the end being flawed at the root nearly all the way round, then gave way—blowing out, but with no great force, as the heater was only pushed backwards about 3ft. 6in. The boiler from which the steam was supplied usually worked at about 50lb., with the safety valves loaded to 60lb. per square inch. As no means whatever, beyond the very small safety valve—which it was admitted was only intended to show when steam was forming—was provided, pressure could and did rise in the heater, as was shown in the evidence by the fact that the feed water had on several previous occasions been forced back into a tank 36ft. above the heater. Although this explosion does not refer either to a steam boiler, generator, or vessel intended to work under pressure, yet the lesson it conveys is an extremely valuable one, and the facts should not be overlooked by persons who may be using steam for similar or other purposes. It would be well if all who have apparatus of a like nature were to have them examined and take advice as to their safety or otherwise. Accidents could be cheaply avoided. In this case absolute safety might have been secured by fixing to the water heater an open stand pipe of sufficient diameter.

IMPROVED TOOL GRINDING MACHINE.



IMPROVED TOOL GRINDING MACHINE.

We are indebted to our contemporary the *American Manufacturer* for the accompanying illustration showing an improved tool grinding machine, constructed by the Springfield Glue and Emery Wheel Company, Springfield, Mass. The novel feature in this machine is the use of a specially designed "water proof" emery wheel, instead of the stones usually employed. It is claimed for this emery wheel that it employs less space, makes less dirt, and does not wear so quickly into ruts or grooves as the grindstone does, besides doing the work much quicker. The grade of coarseness of the grit and the degree of hardness of the emery wheel may be varied to suit the work under operation. The emery wheel is surrounded by a hood, except at the place where the tool is ground; and this arrangement prevents the water from splashing. The hood is adjustable to compensate for the wear of the emery wheel. The water is introduced by a tube into a brass chamber shown in our illustration, from where it is evenly distributed over the whole face of the grinding wheel, and the sides of it are supplied with water by means of small india-rubber tubes. The waste water from the wheel falls into an iron tank, where the particles of steel and emery settle. From this tank the overflow, which is comparatively free from suspended matter, is conducted to a second tank, from which it is again conveyed to the grinding wheel by means of a centrifugal pump, the supply being regulated by a valve. As the first tank has no pipe connections it may be easily removed and cleaned.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 3rd April, 1888.

The Iron Market.—The iron market here is still kept in a wavering and uncertain state by the timid attitude of the merchants. Nominally quotations are unaltered, but many dealings take place below official prices. The weather still delays building operations, and the resignation of the Government has introduced another element of uncertainty into the situation. These influences are, however, scarcely appreciable in the provinces, where there is a moderately good demand for most classes of iron goods. The representatives of the Nord and the Centre meet again this week to settle the boundaries of their respective districts. When the two syndicates have come to an agreement on this point we may expect an advance in prices, and probably the advance will lead to increased activity. The most remarkable feature of the present time is the steady rise which is taking place in the price of heavy castings. Pipes also are considerably higher. The rumour which credited a French firm as having obtained a large order for pipes for the transport of petroleum from the wells at Baku to Batoum, has been officially denied. The pipes required for that purpose are, it is now said, to be of wrought iron or steel. On the whole the outlook is cheering.

Discovery of Iron Ore in Algeria.—Discoveries of iron ore deposits have been made in Algeria, in the province of Oran, which are reported by the experts sent to investigate the matter to be of great value, rivalling the famous deposits of Mokta-el-Hadid. The ore averages 65 per cent. of iron. The deposits, which are of large extent, are situated within seven miles of the railway station of Bou-Tlelis, at the mouth of the Madagre river, where there is a good harbour and facilities for shipping the ore. This discovery is likely to be of immense importance to the French iron industry.

The Metal Market.—The action of the syndicate, coupled with the necessity which is forcing consumers into the market, keeps up the price of copper; but stocks are steadily increasing, both in France and in England. Consumers buy only sufficient for the needs of the moment, and these are becoming less week by week, in consequence of the restriction of trade by the prevailing high prices. Chili bars are quoted at £80. There is but little doing in tin; consumption is steadily diminishing, and it is becoming clear that the syndicate cannot much longer keep up the price. Banca is quoted £176. Lead is quiet at £15. Spelter is weak, Silesian being quoted at £20. 18s.

Foreign Workmen.—In a report of the commission appointed to examine the question of foreign workmen in France, it is stated that in the Department of the Nord, out of a total population of 1,670,184, there are 305,524 foreigners, chiefly Belgians, a proportion of 182 per 1000. In the Pas-de-Calais and the Oise the proportion is 30 per 1000. The Germans predominate in the north-east. In the Meurthe-et-Moselle, out of 431,693 persons, 32,884 are of foreign origin, or 76 per 1000. At Belfort the foreign element amounts to 104 per 1000; in the Department of the Seine to 70 per 1000.

BERLIN, 2nd April, 1888.

The Coal Market.—Since my last report the market as regards coal for domestic purposes has become somewhat weaker, but there still remains a large number of orders to be filled. In consequence of the recent snow drifts, considerable difficulty has been experienced in the transport of coal; and the scarcity of waggons has again made itself evident. The active business which was done during the first half of March has only benefited the dealers, but not the colliery owners, since at the beginning of that month the cheap summer prices were already ruling, whilst the consumers had to pay the higher winter prices, owing to the difficulties of transport.

Railway Tariff on Cotton Goods.—Cotton and cotton goods imported into Russia from England and America are either sent by sea direct or landed in a German port and then forwarded by rail. Of late the traffic in cotton over the German railways has shown a tendency to decrease, and with a view to prevent the entire loss of this business the German railway administrators have, partly on the initiative of the Bremen Cotton Exchange, reduced their freight charges on cotton and cotton goods sent to the Polish frontier from German ports in consignments of not less than 10 tons. By this means German railway companies hope to retain at least a portion of the traffic in cotton going to Russia.

The Iron Market.—Indications are not wanting that sooner or later struggles and difficulties will arise between the various syndicates and outsiders who have steadily refused to join them. It is owing to the action of the rolled iron syndicate that within a few months the price of bar iron has risen from 110s. to 125s., whilst the prices of other kinds of finished iron have proportionately increased. If the international iron market remains firm, the syndicates will probably retain their leading position. The method at present adopted by them in their struggle against outsiders is to make special concessions to large dealers, provided the latter will agree not to deal with non-syndicated works; but should dealers disregard the wishes of the syndicate, the latter would either treat them as ordinary customers, or even go so far as to refuse to supply them on any terms. Blast furnaces are well employed, and orders for forge pig are plentiful at 50s., with an upward tendency. Some brands of foundry pig have risen even to 59s. The home trade in all branches is fairly brisk, but the export trade is languishing, which is partly due to the depreciation of Russian paper money. The Westphalian rolled iron syndicate have booked up to the 18th of March, orders for over 57,000 tons of finished iron, including some small orders standing over from last year. The orders booked during March are likely to exceed 7000 tons.

The Spirit Industry.—Our exports of spirits to Spain, *vid* Hamburg, have never been so insignificant as at the present time. This decrease in the export trade to Spain is due to the small exports of Spanish wines, to the unfavourable condition of the Spanish Customs tariffs as regards German imports, and to the great competition of the Carlsham spirit manufactory in Sweden. Large cargoes of Swedish spirits are constantly being shipped to Spain, the result being that most of the ports in that country are flooded with the Swedish article, which is sold at a very low price. The competition of Sweden has not only reduced our exports to Spain, but is also the cause of the present low prices obtainable for spirits in the home market.

Underground Cables.—Some time ago a committee was appointed in this town to carry out a comprehensive series of experiments with underground cables as used for electric lighting purposes. The experiments were made partly with sections of cables used in the various central station supply systems, and partly with cables specially laid for the purpose in the works of Messrs. Siemens and Halske. The experiments are now nearly completed, and the results will be communicated at an early date in the form of a paper on underground conductors to the Berlin Society of Electricians.

VIENNA, 2nd April, 1888.

The Iron Market.—A slight improvement has taken place during the past week in merchant bars and building iron, but on the whole the market remains without animation. Hungarian iron masters are beginning to consider the spring season as practically lost; and even the good condition of the crops does not seem to infuse any animation into the engine trades. In the northern parts of the empire iron founders are endeavouring to arrange for a more uniform scale of prices. For rough castings, such as fire bars and stove plates, the base price will probably be 80fl. per ton. It has been already reported that a small arms factory is in course of construction in Buda-Pesth. An additional proposal for the erection of a large engineering works and waggon factory has now been brought forward. There is also a proposal for the establishment of a gigantic beet sugar factory in Hungary; but the details have not yet been elaborated. The Hungarian State Railway works have secured an order for ten locomotives for the Oriental railways, which are to be delivered within the year.

Ballooning Exhibition.—An Exhibition of Balloons and Aëronautical Appliances was opened here yesterday. There are in all twelve inflated balloons of various shapes. Safety valves, steering apparatus, scientific instruments used in ballooning, and a few flying machines are also shown. There is no aëronautical department in our army, though possibly this Exhibition may draw attention to the importance of the subject.

Electric Lighting.—Some alterations are being made in the central station from which the Opera is supplied. When the steam dynamos were first erected, the vibration communicated through the walls to the adjoining buildings was so great that in some rooms it was impossible to write, and the owners of the property commenced legal proceedings, with the result that the Gas Association was ordered to discontinue the nuisance on a penalty of 5,000fl. for each infringement of this order. To overcome the difficulty, the company have laid down an enormous foundation block of concrete, on which the steam dynamos are placed. This block is completely detached from the walls of the building, so that no vibration of any kind will be communicated to the neighbouring houses. In Buda-Pesth there is now a fair number of large electric light installations. Amongst these I may mention the National Theatre with 2040 lamps, the Post and Telegraph Offices with 200 lamps, a number of large mills each with 300 to 400 lamps, the Academy with 29 arcs, the station, workshops, and round house of the State Railway with 70 arc and 700 glow lamps, and the engineering works of the same railway with 50 arc and 200 glow lamps. Most of these installations have been carried out by Messrs. Ganz and Co., of Buda-Pesth, and in that for the railway there are used three large steam dynamos supplying alternating currents. Messrs. Ganz & Co. are very busy with alternators and transformers, and will shortly supply some more machinery to the installation at Rome. This installation is the largest hitherto erected by the firm, and although you have already given a plan of the machinery as it will eventually be installed, the following particulars of the present condition of the station may be of interest: There are now erected four steam dynamos, two of 75 kilo.-watts (150 i.h.p.) each, and two of 320 kilo.-watts (600 i.h.p.) each. The small machines run at 250 revolutions per minute, have twenty poles, and are self exerting. The large machines are separately excited, have forty poles, and run at 125 revolutions per minute. The current is supplied at 1800 to 2000 volts, and the transformers have a reducing factor of 18 to 1 or 36 to 1, according as the lamps used are 100 or 50 volt lamps. The present capacity of the station is 1500 i.h.p.; but when the work now in hand is completed the capacity will be 2700 i.h.p. Steam is supplied by Babcock & Wilcox boilers, which are fired with coke. The current is conducted in three principal circuits supplying theatres, shops, and large establishments in various parts of the town. The total cost of the station when completed will amount to about £60,000.

BRUSSELS, 3rd April, 1888.

The Coal Market.—Delivery is now being rapidly made of the supplies of coal which mine owners have been forced to keep back on account of the stoppage of canal traffic and of the scarcity of rolling stock. The prospect of fresh contracts is producing greater animation in the market. Negotiations are in progress for the formation of a coke syndicate between the Westphalian and Belgian producers, the districts in which it will operate being to the east of France and the Grand Duchy of Luxembourg. The Germans are greatly in favour of this arrangement, as they will derive most benefit from it. The Société de Monceau-Fontaine et Martinet has obtained an order for 1500 to 2000 tons of coal required for the Copenhagen Exhibition, the order having been secured by M. Firmin Riehe, the manager of the colliery, who personally visited Denmark. The Mariemont and Bascoup collieries have already been in treaty for imports of coal into Denmark, but their prices were too high. The Monceau-Fontaine et Martinet Colliery intend to ship the coal to Denmark by sailing vessels which arrive at Ghent with timber from the Baltic. The same company hopes to do business with the Danish State railways in briquettes. The balance sheet of the Hornu et Wasmes Colliery, which has a capital of £144,000, shows a net profit for last year of £8,400. The Grand-Mambourg-Sablonnière Colliery, with a capital of £149,000, shows a profit of £8,464 on last year's working, of which £4,800 has been paid in dividends.

The Metal Market.—There have been some fluctuations in the metal market, but pig iron continues firm, though there are some complaints as to the quality. In spite of the new tariff which has come into force in Italy, orders are being constantly received from that country. The tariff has, however, had the effect of keeping out Belgian merchant bars and rolled iron of small sections, which are now being made by Italian works; but for large sections, and especially for girders, purchases are likely to be made from Belgium for a long time to come. This country has almost a monopoly in the export of girders, even England being unable to compete in this line. A good trade is being done in waggons and material for the same. In plates we are likely to be beaten by the Germans, as Krupp is now delivering 100 tons of plates to the Belgian State Railway Works at Malines. A private firm here has also placed an order for sheets in Germany. Several engineering works are very busy. Iron manufacturers have decided to press the Minister of Finance to allow, for a time at least, a drawback on forge pig obtained from abroad. Considering the high price of crude iron, this demand of the manufacturers of finished iron can hardly be called unreasonable, although it may somewhat prejudice the position of the blast furnaces. These, in their turn, would therefore ask for some concession in freights or in another direction. The Ougrée iron works have contracted to supply several hundred tons of steel plates for England.

The Glass Trade.—Prices are still weak, and the production exceeds the demand. The *fours-à-bassin* are certainly very economical in their working, but they have assisted in bringing about the present overproduction, it being now considered the proper thing for all works to have such furnaces. Among those who have erected or are erecting them are the Jumet and Gosselies works, and the firms of L. Mondron, L. Lambert, and Foucalt-Frison. Complaints are made that the convention is not being strictly adhered to.

Electric Traction at Brussels.—The annual report of the Administrative Council of the Tramway Company states that the working of three cars electrically during 1887 has resulted in a loss of £635. The service was commenced on the 17th of April, 1885, with one car running between the Place Royale and the Rue Belliard. A second car was run on the 8th May, and a third on the 19th September. These cars are at present running in the Rue de la Loi. The electric cars covered last year 34,500 miles. The financial failure, although not officially so stated, is due to the rapid wearing out of the accumulators. The depreciation of these is calculated at 22 centimes per kilometre—or say 3½d. per car mile; and as this estimate does not allow for general charges, nor for the cost of power, it is evident that the total working expenses must be considerable. The destruction of the plates is ascribed to the continual surging of the acid among them, coupled with the vibration to which the cells are exposed. M. Julien proposes to remedy the defect by placing a number of rubber rings round the plates, the rubbers to act as separators, and at the same time to sub-divide the acid into smaller quantities, and so limit the surging action.

DÜSSELDORF, 2nd April, 1888.

The Iron Market.—The calm which showed itself in certain branches of the iron trade a week ago has since spread over the whole. In some degree it is, no doubt, attributable to the season of Easter; but it is impossible to overlook the fact that the trade, oppressed by the

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weight of high prices, is wanting in much of the life and vigour which distinguished it at the beginning of the year. Judged only from the published market reports, an outsider would be led to believe that the situation has in no way changed; but a very little intercourse with manufacturers is sufficient to convince the most sceptical that confidence has been weakened, and that an uneasy and anxious feeling prevails everywhere. The syndicate system is less enthusiastically talked about; indeed, it is easy to discern a lurking suspicion that this hobby has been ridden too fast and too far, and that the large profits which have been made in the course of the last eight months are in reality nothing better than a mortgage on the trade of the future. The market for pig iron is much less animated. The calm affects all classes, but is most marked in forge pig. The fact that the stocks in hand, small though they be, have been greater at the end of February than at the close of the preceding month, is regarded as significant of a changed order of things. The production of pig in February amounted to 338,841 tons, an average of 11,684 tons a day, against 346,962 tons, and a daily average of 11,192 tons in January last, and 270,726 tons in February of 1887. The markets for finished iron and steel are also dull. There is no life in the business in bars, and owing perhaps to the wintry weather, joists are not in good demand. The prices for bars are now £6. 5s. for the inner zone, and £6. 7s. 6d. for the outer. Hoops are less eagerly sought after, and sheets share in the general dulness. A fair amount of business is being done in common plates. The statistics of production issued by the plate syndicate of Western Germany show an output of 9220 tons in February, against 9224 tons in January. The deliveries in the same periods were 9409 tons and 8469 tons respectively. For the Portuguese railway contracts for 11,000 tons of steel rails, for which the Ebbw Vale Company tendered lowest with £4. 6s. 6d., and the Cockerill Company followed next with £4. 11s. 5d., the Bochum Verein tendered £4. 12s. 4d., Krupp £4. 13s. 7d., and the Gutheffnungshütte £5 a ton.

The Price of German Iron.—Now, when the question of the extinction of the export trade in German iron is being forced upon public attention, it will be interesting to give a few facts tending to show that the present high prices are not likely soon to be reduced. Since the year 1886, the market price of finished iron has risen nearly 40 per cent., while that of crude iron has advanced only about 30 per cent. The rates for finished iron leave only a moderate margin for profits; therefore if a reduction is to be effected, it must first be made in pig iron. But the cost of production has nearly kept pace with the advance in pig iron. Coke is 55 per cent. dearer now than it was in 1886, and ore has risen in price about 30 per cent. It appears certain from these facts that no downward movement is possible for some time to come.

Linen Yarns.—Though the trade in linen woven goods is somewhat languid, the spinning mills are kept in a state of activity. The report received this week from Bielefeld describes the yarn market as fairly animated, and prices as very firm.

Another Coffee "Ring."—Another ring has been formed at Frankfort, for the purpose of "cornering" coffee. The announcement of the establishment of this speculative syndicate has caused general indignation throughout the country, and the attention of the Government has been directed to this new attempt to fleece the working classes for the benefit of a ring of speculators.

LILLE, 3rd April, 1888.

Textile Manufactures.—The week immediately preceding Easter brought, as was expected, a great increase of business to the textile goods trade. The holidays will cause the present week to be a period of inactivity. This holiday effect will be intensified by the fresh evidence of instability afforded by the resignation of the Government. It is vain to hope for better trade so long as ministerial crises are of frequent occurrence. Apart from these influences, circumstances are favourable to a revival of business. For the manufacturers of linen goods the week has been a period of disappointment. The inclemency of the season has delayed the spring trade; retail buyers being unable to estimate the probable duration of the season. If the bad weather continues for another fortnight it is certain that all spring goods will be a drag in the market. This prospect has a very depressing effect in the woollen trade of the Roubaix district. Goods for women's wear are neglected, and prices are very low. Merinos sell at 5 centimes per metre less than in 1886, though wool, the raw material, is 20 per cent. dearer. During the last week business has revived a little at Roubaix, orders coming to hand pretty freely; but it is yet too early to discern whether this is more than a temporary spurt, and the current week must necessarily be a dull one for business. In another week it will be easier to estimate what the true tendencies of trade are.

Flax and Yarn Markets.—There is still a good course of business in home grown flax, Walloon and Douai produce being in brisk demand at firm prices. Russian produce has been less dealt in, and the market is unsteady. The business in yarns is animated. In the course of the past week large dealings have taken place both on home and on foreign account. Prices, however, remain unaltered. Jute goods are very active, and there are indications of continued life in this direction.

The Iron Market.—Business in iron is by no means active, and for the moment only small dealings take place. This comparative calm is, however, to be attributed to the fact that consumers have, in many instances, provided for their wants for some time to come. There is no question of lower rates, as manufacturers evince no disposition to tempt buyers with concessions in prices. The action of the Paris merchants in underselling the market tends to make manufacturers deal directly with consumers, a practice which is now well established in this district. So far from prices giving way, a further rise seems certain. In a few months pig iron has advanced from 34s. to 40s. a ton, and coal for metallurgical purposes, which three months ago could be bought for 6s. 8d. a ton, now sells at 8s. 9d.

AMSTERDAM, 3rd April, 1888.

The Drainage of the Zuyder Zee.—The Zuyder Zee Association proposes to seriously take this work in hand by building a mole between the islands of North Holland, or between Medemblik, in Holland, and Stavoren, in Friesland, and pumping out the sea water by powerful engines. The Association was formed to consider how the gigantic work could be best accomplished, and thus to pave the way for a public company to carry it out. The Association now appeals for subscriptions to a loan of 90,000 guilders, to be repaid when the company is formed. With the money so raised they propose to appoint a staff of engineers in order to execute a series of experiments in a thorough manner. Experts have no doubt that the Zuyder Zee can be drained; but many believe that the State alone is able to cope with the many engineering and financial difficulties which must be overcome before the task is completed. The drainage of Haarlem Lake in 1849-53 was considered a wonderful affair at the time, for the sea covered 45,000 acres, and an enormous quantity of water had to be pumped back into the ocean. This, however, was only a small affair compared with that of draining the Zuyder Zee.

Mail Steamers.—The Government Bill for carrying out a contract with a Dutch syndicate, which is to establish a subsidised mail service in the Dutch East Indies, to which I recently referred, has passed the First Chamber of the States-General, and now lies before the King for his sanction. The past year's working has proved sufficiently profitable to enable the Royal West Indian Steamship Company to announce a dividend of 3½ per cent. to the shareholders. There was a good increase in the general traffic, notably with the British Colonies and Venezuela. The boats of this company keep up a monthly steam service between Amsterdam and Surinam, calling at different ports on the way, and carrying the Royal mails, for which it receives a State subsidy. More capital has been raised lately, with the view to establish a new line of steamers between Dutch Guiana and New York, *viâ* Curaçao and Port-au-Prince, Hayti.

WINTERTHUR, 2nd April, 1888.

Tariff Changes.—The fiscal policy of Switzerland has hitherto been of a free trade nature, but a change is to be made owing to the clamour of some who desire protection for their own industries, though they do not want protection for general trade. The following are among the alterations in the duties which will come into force on the 1st of May: Articles made of wrought and malleable cast iron, steel, tinned sheets and wire—polished or tinned, 150fr. instead of 70fr. per ton; cotton yarns, three or more ply, dyed, in skeins, 350fr. instead of 110fr.; cotton yarns in small skeins, or on spools intended for the retail trade, 350fr. instead of 200fr.; cotton covers, embroidered, 500fr. instead of 300fr.; cotton hosiery 500fr. instead of 250fr.; boots and shoes, superior, 1500fr. instead of 800fr.; boots and shoes, coarse, 500fr. instead of 350fr.; basket work, of rough rushes, 40fr. instead of 20fr.; fine basket work 120fr. instead of 80fr.

Foreign Trade.—The imports during 1887 amounted in round figures to £26,000,000, and the exports to £24,000,000. Among the latter the items of manufactured cotton goods and silk, and machinery, are prominent, in spite of the fact that we have to obtain our raw material abroad, and that heavy protective duties exist in the surrounding countries. The following are the values last year:—

	Imports.	Exports.
Cotton goods	£1,131,693	£6,275,357
Silk goods	478,940	4,865,776
Machinery	313,226	743,693

Other important items of our foreign trade are the following:—

	Imports.	Exports.
Watches and clocks	£104,061	£3,227,128
Cheese	82,584	1,627,109
Condensed milk	24	432,276

In all other articles the balance is against us, especially in food stuffs. Thus the imports of flour amounted to £3,553,336, and the exports to £59,443.

MADRID, 2nd April, 1888.

Iron Ore Mines.—An English company has acquired the mines of Calasparra, in the province of Murcia, and will build a private railway to connect them with the general railway system. The ore from these mines will be among the best shipped from Spain; but owing to the fact that shipment will take place from the Mediterranean, the supplies are more likely to go to America than to Europe, so long as Bilbao maintains its present output.

Shipbuilding.—The contract for building three large cruisers for the Spanish Government, at a cost of about £2,000,000, is exciting much interest in industrial circles. The last day for the receipt of tenders was the 28th ult., and it is understood that nine proposals have been made, five coming from English firms with Spanish connections.

Electric Lighting.—The Municipality of Caceres, the capital of a province celebrated for its phosphate mines, invites tenders for the electric lighting of the town, which contains about 13,000 inhabitants.

Coal Mining.—No sooner had traffic been re-opened on the Asturian railways than a fresh snow storm of unexampled severity has completely blocked the lines. The coal mines in this part of the country are worked by adits opened on the side of the mountains, and the coal is brought down inclined planes to the valley. The fall of snow renders it impossible to use these, and there is great distress in the district in consequence.

NEW YORK, 24th March, 1888.

The Coal Market.—A dispute has arisen between the Lehigh and other companies about the inequality of production during the strike. As the allotment of percentages of tonnage expires on April 1st, and as the Lehigh companies are now delivering coal in New York at less than the regular rates, the trade will be disorganised unless an agreement is soon reached.

The Iron and Steel Market.—During the week there has been a much larger business in pig iron than for some time past. Several large sales of inferior grade irons have been made to pipe founders at extremely low figures, which will relieve the market for some time to come. The furnace owners who were forced to suspend work during the late strike have mostly blown out, and there has been considerable shrinkage in the production of charcoal iron. A decrease of 5½ per cent. in one month and 25½ per cent. since November last in the quantity of iron produced, implies important changes in many branches of manufacture. In the better qualities of iron the conditions of the market are unchanged, the supply being about equal to the demand, which is still light. Prices are $20·50 to $21 per ton for No. 1 foundry, $19 for No. 2, and $17 to $17·50 for grey forge. Special brands bring a little more money, but anything new or doubtful sells at from 50 cents to a dollar less per ton. Business in manufactured iron is very unsatisfactory. There is a fair amount of business done, but at low prices. It is not possible to determine how much business has been sent abroad, as buyers do not care to be prominently known as consumers of foreign metal; but the absence of a demand for certain kinds of iron is due to the fact that foreign iron has been sold here, duty paid, at $2 per ton less than our manufacturers have been able to quote. To reduce the cost is the only way to meet the situation, and this will have to be done sooner or later. Prices are nominally at 1·9 cents to 2 cents per lb. for best refined bars, 2·1 cents to 2·15 cents for plates, and 2·15 cents to 2·20 cents for angles, although most of the business has been done at $\frac{1}{10}$ cent lower than the lowest figure quoted. The steel rail market has been quiet. Within the last ten days orders have been placed for 18,000 tons in small lots at $31·50 to $32 per ton, but large contracts are not likely to be placed while the tariff agitation continues. The King Iron and Bridge Company have purchased nine acres of land in Cleveland, for the purpose of removing their present works and increasing their facilities. Building has already commenced. The new works will have three times the capacity of the old, and the plant will cost about £200,000.

Puddling Furnaces.—The North Chicago Rolling Mill Company, at their Milwaukee works, have been making some experiments in puddling blast furnace metal which have been very successful. There are now six puddling furnaces in use on this process. No changes were made in the puddling furnaces, except to put in a trough to carry the liquid metal into the furnace from the ladle. The liquid metal is brought from the blast furnace into the puddle mill by a small locomotive. The track is so laid that the top of the ladle when on the truck is a short distance below the level of the pig bed in the casting house. The ladle holds 4400lb., which is enough to charge two puddling furnaces. Each furnace is worked through four doors by four men, and is of four times the capacity of the single furnace. The 2200lb. of metal require about an hour for the complete process, making ten balls. The time required for the five heats of a shift is now seven working hours, and two shifts are made a day. The blast furnace itself is working very well, although tapped once an hour for the metal for the puddling furnaces. Once a day the surplus metal is run into pigs, which seem to be of as good a quality as before the direct puddling process was introduced. The saving thus far has been about one-fourth the fuel (Indiana block) used by the old process, at the same works. The metal is obtained very much clearer than heretofore. The muck bars work very well in the rolls, and seem to be of as high a quality as could be desired, and at no stage in the operation does there seem to be any trouble from the new process.

Canals.—A vote of £296,000 is asked by the Canadian Government to increase the depth of the St. Lawrence canals to 14ft., and of £200,000 for the canal at Sault Ste. Marie. A canal has been proposed between Lake Michigan and Lake Superior, the estimated cost being £1,000,000; but thorough surveys have not been made.

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IMPROVED EXPANDING PULLEYS.

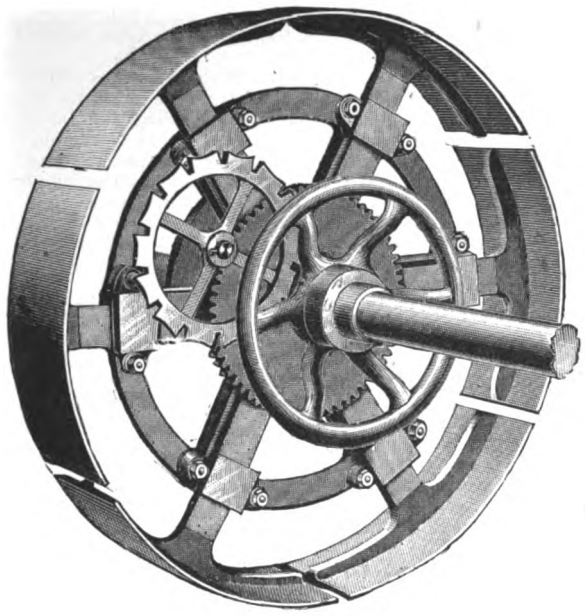


FIG. 1.

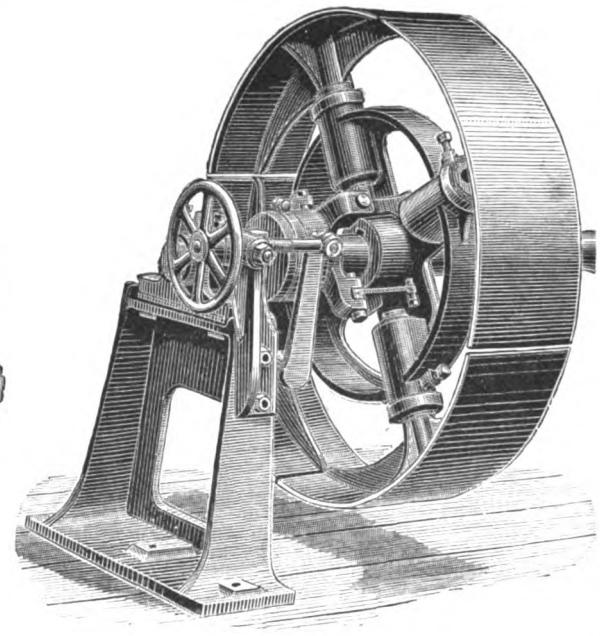


FIG. 2.

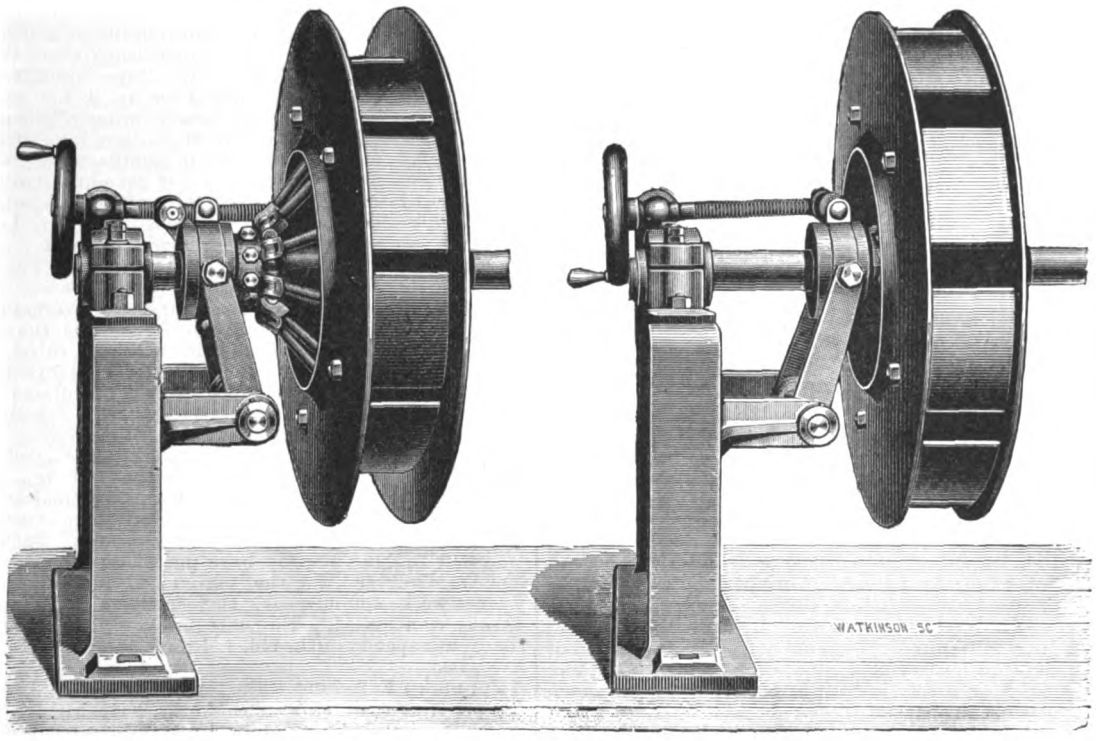


FIG. 3.

IMPROVED EXPANDING PULLEYS.

THE above illustrations show some improved expanding pulleys made by Messrs. Bentley & Jackson, engineers and iron founders, Bury, near Manchester. The pulley shown in Fig. 1 is intended for machines where exactitude of speed is required, or where the relative speeds require adjusting to suit the nature, moisture, or temperature of the material operated upon. The diameter of this pulley can be increased or decreased as desired, the total variation being about 2in.; the change is effected by moving the hand wheel shown in the illustration. The segments of the pulley themselves slide in brackets, and are actuated by the hand wheel just referred to. Fig. 2 represents another example of an improved expanding pulley by the same makers. This pulley is constructed so that its diameter may be increased or diminished whilst the pulley is in motion. The movement requires but little effort, and is made without any danger. This pulley may be applied to machines where small adjustments of speeds are frequently required; the change in size is effected by moving a hand wheel in connection with a screw and levers, as shown in the illustration. The four segments of this pulley when thrown out to the required size can be fixed in their place by set screws, tapped into bosses which form part of the inside fixture. Fig. 3 shows a pulley of the "umbrella pattern." This pulley can also be increased or diminished in diameter while in motion, the total variation obtainable being about 6in. The illustration represents the pulley as seen at its greatest and least diameters; the variation is effected by means of the hand wheel and screw. The nut on the hand wheel screw is attached by means of an iron strap to the sliding bush. The bush has two levers to keep it in its place, attached by carriers to the upright pedestal; on the bush are also coupled several knuckle bolts, fastened at the other end to the segments of the pulley. The hand wheel on being turned forces the bush towards the pulley and expands the segments between the parallel discs, the discs thus forming flanges to the pulley.

SPANISH RAILWAYS.—For the last thirty-three years the Spanish Government has encouraged the building of railways by paying subsidies during the progress of laying down the line. A Bill has, however, now been introduced which will alter this arrangement, and which is intended to develop secondary lines of one-metre gauge. It is proposed to assist these by guaranteeing the payment of 5 per cent. interest on the capital invested. The cost is not to exceed £3,200 per kilometre. It is expected that the passing of this Bill will give a great impetus to the construction of lines of this nature.

THE ADMIRALTY PROGRAMME.

IN a previous issue we considered some of the more general questions connected with the Navy Estimates. In this we propose to give an outline of the more strictly engineering and shipbuilding programme which the Admiralty has proposed for the current year. But first we may glance at the increase which was made to the fleet in 1887-88. At the beginning of that year it was anticipated that during its course twenty-five ships, having an aggregate displacement tonnage of upwards of ninety thousand tons, would be completed and passed into the First Reserve as ready for service in forty-eight hours. Of these ships ten were armoured, two protected, and thirteen unprotected. This programme has been very nearly realised, and would have been actually carried out but for delays in the delivery of contract built ships, the non-completion of guns by the promised dates, and the difficulties that have arisen in completing some of the contractors' steam trials. Among the armoured ships were five belted cruisers, two of which are now practically complete, and one of these, the "Orlando," is to be the new flagship on the Australian station, and the remaining three, for the reasons given above, will have to be completed in the earlier months of the financial year 1888-89. The "Rodney," "Benbow," and "Hero" are complete, except for gun trials and certain modifications of torpedo net defence. The "Warspite" and the "Howe" are also practically complete. All the protected and unprotected vessels will be completed as proposed in 1887-88. These fifteen vessels include two protected eighteen knot cruisers ("Mersey" class), seven torpedo cruisers ("Archer" and "Fearless" class) of seventeen knots, three torpedo gunboats ("Rattlesnake" class) of nineteen knots, one composite sloop, and two gunboats. The completion of the "Archer" had to be deferred to 1887-88 on account of steam trials, so that sixteen vessels will have been practically added in that financial year. In addition to ships completed during the year, a large amount of work has been done in advancing other new ships, as yet incomplete. The armoured ships "Camperdown," "Anson," and "Immortalité" are rapidly approaching completion, and good progress has been made with the protected cruiser "Forth," the last of the "Mersey" class, and the "Aurora," the last of the belted cruisers; while the progress of the "Trafalgar" and "Nile" has been exceptionally rapid, and it is believed that the former will be completed in the year 1889-90. Of the new vessels laid down in 1887-88 in the dockyards, the two twenty knot protected cruisers building at Chatham have been pushed forward nearly to the stage of launching; the similar but sheathed cruiser at Portsmouth has been advanced considerably beyond what was contemplated in the Estimates for 1887-88. The two composite sloops ("Nymphe" and "Daphne") are almost ready for launching, and the six gunboats of the "Pheasant" class have been advanced as was intended. Moreover, during the year four ships not contained in the Estimates were laid down. These vessels were required for relief and special service, and consisted of three gunboats and a paddle steamer for surveying service.

The work being done by contract in 1887-88 has also very nearly kept pace with the programme. Of the five belted cruisers the "Orlando" and "Undaunted" were delivered within the contract time; the remaining vessels were not delivered until the contract times had been exceeded. The "Victoria," formerly "Renown," is expected to be completed six months within the guaranteed time, and the sister ship "Sanspareil," it is anticipated, will also be delivered within the period allowed by the contract. The completion of these two powerful ironclads will bring to an end the special programme of 1885 originated by Lord Northbrook, so that it may be anticipated that the expenditure involved in carrying out that programme will be almost concluded during the year 1888-89. During the year 1887-88 the only new vessels ordered by contract were the sheathed protected cruisers "Magicienne" and "Marathon," which are being built by the Fairfield Company, Glasgow, the engines being supplied by Messrs. Hawthorn, Leslie, & Co. The Admiralty officials acknowledge the assistance and co-operation of the most emiment private firms of marine engineers who have contracted for the machinery, and this has led to the design and construction of engines of ever increasing power and the introduction of successive improvements, and they are of opinion that the decision to adopt triple expansion engines has been amply justified by the results so far attained. In not a few cases the engine power and speeds estimated in the stage of design have been considerably exceeded on trial.

During the year 1887-88, twenty first class torpedo boats have been built, and at the close of 1887-88 we shall possess eighty first class torpedo boats and sixty-three second class boats, of which latter twelve are built of wood and fifty-one of steel. The Board of Admiralty have been supported in their decision to discontinue the building of torpedo boats for sea-going purposes, and to substitute

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vessels of a much larger displacement, similar to the torpedo gunboat "Rattlesnake," which has been an undoubted success. Accordingly, a design has been approved for a larger and swifter vessel than the "Rattlesnake," and one—the "Sharpshooter"—has been provided for in the Estimates of 1887-88, and has been commenced at Devonport, and arrangements have been made for building six other vessels of the type at Devonport and Chatham in 1888. After completing the seven armoured ships above mentioned, there will remain in hand the following armoured vessels when the next financial year closes: "Victoria," "Sanspariel," "Aurora," "Nile," "Trafalgar;" and of these the first three will be approaching completion, while considerable expenditure will still have to be incurred on the "Nile" and "Trafalgar." The Board have therefore decided not to lay down during 1888-89 any new ironclads. They propose, however, to re-engine the "Superb" and the "Thunderer," and re-arm the latter, and to build the following new vessels: Protected ships—first class cruisers, two; torpedo depôt ship and torpedo boat cruiser, one; third class cruisers, steel bottomed, two; sheathed and coppered, four. Unprotected ships—Sloops ("Buzzard" type), two; gunboats ("Rattler" type improved), six; torpedo gunboats ("Sharpshooter" type), six; sailing brig (training boys), one—total, twenty-four. All these vessels, with the exception of one first class and one third class cruiser, and two composite gunboats, will be built in the dockyards. There are, however, in addition the seven vessels intended for service in Australasian waters, consisting of five protected cruisers (new design), and two torpedo gunboats ("Sharpshooter" type). These it is proposed to construct by contract. The total number to be laid down is thirty-one, comprising an aggregate displacement of sixty thousand tons, and it is estimated that the following is the amount of displacement tonnage which for the three years ending April, 1890, will be passed into the fleet ready for commission: 1887-88, seventy-five thousand; 1888-89, seventy-seven thousand; 1889-90, seventy-five thousand.

The memorandum which has been issued along with the Navy Estimates states that the programme of new construction to be undertaken in the coming financial year has been most thoroughly considered and discussed by the Board, and that in framing it, full consideration has been bestowed upon the requirements of the fleet in relation to reliefs, the various special services required of Her Majesty's ships on foreign stations, and the "waste" of the navy resulting from ships becoming obsolete through age or the progress of invention. A careful examination was also made into the composition of the squadrons abroad, and a standard of strength was fixed, both for reserves at home as well as for stations abroad, up to which the fleet should always be maintained, and the condition and character of the ships already in progress, as well as their state of advancement, have also been kept in view. Moreover, a careful examination has also been made of the shipbuilding policy now being pursued by foreign navies, the progress made on ships yet incomplete belonging to these navies, and the liabilities yet remaining to be discharged. The consideration of how far the Board has in our opinion been successful in carrying out their intentions, and also of the designs which they have made for the various classes of ships, must be left for a future occasion.

THE FORTH BRIDGE.

We illustrate this week, on page 348, the crane specially designed for building the top members of the Forth Bridge, as it stood complete in the building yard before being removed to its working position. The illustrations accompanying Mr. A. S. Biggart's paper in our last week's issue very clearly illustrate the application of this crane to the erection of the bridge. It consists of a 3-ton steam crane, with a boiler 4ft. 6in. diam. by 8ft. high, working at a pressure of 40lb. per square inch. The winch engine has two cylinders of 7in. diam. by 11in. stroke, and the lifting drum is 2ft. diam. The jib is of steel, 35ft. long, and capable of moving through an angle of 230°. The hoisting cable passes over a pulley, carried by a cradle which travels along the horizontal boom of the jib; thus while it can raise its load 200ft., it can also, if necessary, simultaneously move it backward or forward through 35ft. The crane is mounted on cross girders, resting on both top members, and the frame work is all of steel. On a bracket, fixed to the cross girders behind the steam crane, there is a hydraulic crane, with a jib 27ft. long, worked by a 4in. ram, at 1000lb. pressure per square inch. This crane carries the riveting machine, and has a lift of 6ft. with a 3-ton load. Suspended by angle bars from the frame work of the crane are four box lattice girders, carrying a staging 76ft. by 45ft. for the men working immediately under the top member. The whole crane with its staging weighs 58 tons, and when the outer jib has plated a section and the inner jib has riveted one, it is slipped down over the completed portion to commence a new section.

Notices of Meetings.

THIS WEEK.

Geologists' Association.—Friday, 6th April, 8 p.m. Papers to be read on "The Influence of Geology on the Early Settlements and Roads," by Mr. F. J. Bennett, F.G.S.; and on "The Discovery of Elephas primigenius associated with Flint Implements at Southall," by Mr. J. Allen Brown, F.G.S.

NEXT WEEK.

Society of Arts.—Monday, 9th April, 8 p.m. Cantor lecture on "Milk Supply, and Butter and Cheese Making."—Wednesday, 11th April, 8 p.m. Ordinary meeting. Paper to be read on "Recent Legislation concerning the Pollution of Air or Water," by Mr. Alfred E. Fletcher, Chief Inspector of Alkali, &c., Works.—Friday, 13th April, 8 p.m. Indian Section. Paper to be read on "The Experiences of Twenty Years in Conducting Agricultural Inquiries in Southern India," by Mr. W. R. Robertson, M.R.A.C.

Society of Chemical Industry.—Monday, 9th April. Paper to be read on "The Present Position and Prospects of the Coal Gas Industry," by Mr. Lewis T. Wright.

Royal Institute of British Architects.—Monday, 9th April. Ordinary meeting. Ballot for new members. Discussion of any professional questions, &c.

Institution of Civil Engineers.—Tuesday, 10th April, 8 p.m. Paper to be read on "Compressed Oil Gas and its Applications," by Mr. Arthur Ayres, M.Inst.C.E.

Civil and Mechanical Engineers' Society.—Wednesday, 11th April. Paper to be read on "Theatres and other Public Buildings," by Mr. Walter Emden.

North-East Coast Institution of Engineers and Shipbuilders.—Wednesday, 11th April, 7-30 p.m. Adjourned discussion on Mr. J. T. Milton's paper on "Slide Valve Gears." Adjourned discussion on Mr. G. W. Sivewright's paper on "Stockless Anchors and Fittings." Paper to be read on "The Construction of Pontoon Dry Docks," by Mr. A. Taylor.

Royal Institution of Great Britain.—Thursday, 12th April, 3 p.m. Lecture on "The Chemical Arts," by Professor Dewar.

Society of Telegraph Engineers and Electricians.—Thursday, 12th April, 8 p.m. Paper to be read on "Central Station Lighting (Tranformers v. Accumulators)," by Mr. R. E. Crompton, M.Inst.C.E.

Physical Society.—Saturday, 14th April, 3 p.m. Papers to be read on "The Measurement of the e.m.f. of Dynamos," by Professor W. E. Ayrton, F.R.S., and Professor J. Perry, F.R.S.; "The Variation of the Co-efficients of Induction," by Mr. W. E. Sumpner, B.Sc.; "Some Experiments on Soap Bubbles," by Mr. C. V. Boys; and "Electromotive Forces by Contact," by Mr. C. V. Burton, B.Sc.

PRICES CURRENT, 5th April.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3	32/0	Cash	
Scotch Warrants, m/n	39/2½	"	
Hematite Warrants, m/n	42/3	"	
Stocks in Stores. Scotch	967,797—Inc. for week,	4336	Tons
Middlesbro'	321,795—Dec. "	531	"
Hematite	210,858—Dec. "	500	"

Exclusive of stocks in makers' yards.

Market continues firm, but without life.

Scotch shipments 6024 tons, against 4784 tons for same week last year.

	No. 1.	No. 3.	
Coltness	47/9	42/–	f.o.b. Glasgow.
Gartsherrie	44/9	41/3	" "
Dalmellington	39/9	38/3	" Ardrossan
Eglinton	39/–	37/–	" "
Glengarnock	43/9	39/9	" "
*Derbyshire	—	35/6	f.o.t. Works.
*Lincolnshire	—	32/6	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 17 6	5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 2 6	5 12 6	Manch'r.
" Angles	5 12 6	6 2 6	"
Crown Sheets	6 5 0	6 10 0	"
" Hoops	5 5 0	6 5 0	"
"Siemens-Martin" Steel Boiler Plates		7 17 6	"
" Ship and Girder		7 12 6	"

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

No. 1 Selected.	No. 3.	No. 4.
Prices, per ton 53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/–
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/–
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/–

METALS.

Spelter: Ordinary	£19 5 0 to	£19 10 0	
Copper: British Cakes and Ingots	80 0 0 "	——	
" Chili Bars	80 0 0 "	80 10 0	
" Manufactured (strong)	90 0 0 "	——	
Lead: Common Pig	15 0 0 "	——	
" English Sheet	16 0 0 "	——	
Tin: Straits	166 0 0 "	166 5 0	
" Australian	167 0 0 "	167 5 0	
" English Ingots	157 0 0 "	158 0 0	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—During Easter holidays Chili quotations have been very steady at £80 to £80. 10s. per ton for Gobs, at which a moderate business has been done for sharp cash parcels. Three months is held for £79. 12s. 6d. to £79. 15s. Manufactured is still slow of sale, both for home and export.

Tin.—Spot parcels continue to find buyers at £166 per ton, and a fair business is reported thereat. Forward delivery varies according to date, full three months down to £125 per ton, with buyers rather than sellers.

Lead.—Spanish is quoted £14 to £14. 5s. per ton.

Spelter.—Quotations are unaltered.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	27 10 0
" Ceylon	"	24 10 0
Cottonseed	"	20 10 0
Cod	"	19 0 0
Lard	"	40 0 0
Linseed	"	18 12 6
Palm, Lagos	"	21 10 0
Rapeseed: English	"	23 10 0
Seal: Pale	"	23 10 0
" Brown	"	17 0 0
Sperm	"	42 0 0
Whale	"	14 0 0
Turpentine	per cwt.	1 8 9
Coal	per gal.	0 0 6
Petroleum (Refined)	"	0 0 6 1/16
" Spirit	"	0 0 8

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 1 2¾ to		0 1 3
" " Liquid	gal.	0 1 2 —		0 1 6
" Citric	lb.	0 1 7 —		0 1 8
" Oxalic	"	0 0 3½ —		0 0 4
" Sulphuric	ton	1 5 0 —		1 10 0
" Tartaric	lb.	0 1 6¼ —		0 1 6½
Alum: Lump (powder 10/- ex.)	ton	4 17 6 —		5 0 0
Ammonia: Carbonate	lb.	0 0 3¼ —		.....
" Muriate (Grey)	ton	23 0 0 —		.....
" " (White)	"	26 0 0 —		.....
" Sulphate	"	11 17 6 —		12 0 0
" Liquor	lb.	0 0 3¼ —		.....
Bleaching Powder	ton	7 7 6 —		7 10 0
Bisulphide of Carbon	"	12 0 0 —		12 10 0
Borax	"	30 0 0 —		31 0 0
Benzole (90%)	gal	0 3 6 —		0 3 8
" (50/90%)	"	0 2 4 —		0 2 6
Copper Sulphate	ton	20 10 0 —		21 10 0
Copperas	"	1 10 0 —		2 0 0
Kieserit	"	1 12 6 —		.....
Lead: Nitrate	"	23 0 0 —		23 10 0
" White Sugar	"	27 10 0 —		29 0 0
" Brown "	"	23 0 0 —		24 0 0
Potash: Bichromate	lb.	0 0 4½ —		.....
" Caustic	ton	22 0 0 —		.....
" Carbonate	"	17 15 0 —		.....
" Chlorate	lb.	0 0 5¾ —		0 0 5¾
" Prussiate (Yellow)	"	0 0 7 —		0 0 7¼
" Sulphate (Basis 90%)	ton	8 15 0 —		9 0 0
Precipitate: Red	lb.	0 4 1 —		0 4 2
" White	"	0 4 0 —		0 4 1
Salts: Epsom Bags	ton	2 10 0 —		2 12 6
Salts: Epsom Casks	"	3 5 0 —		3 10 0
" Glauber	"	1 5 0 —		1 10 0
Sulphur: Sublimed Flowers	"	9 0 0 —		9 10 0
" Recovered	"	4 10 0 —		4 12 6
Soda: Ash	deg.	0 0 1 —		0 0 1⅛
" Caustic (White, 70%)	ton	6 15 0 —		.....
" " (" 60%)	"	5 15 0 —		.....
" " (Cream, 60%)	"	5 13 9 —		.....
" Crystals	"	2 10 0 —		.....
" Bicarbonate	"	5 10 0 —		.....
" Hyposulphite	"	6 5 0 —		.....
Solvent Naphtha	gal	0 1 1 —		0 1 2
Tartar, Cream of	cwt.	6 7 6 —		6 10 0
Zinc Sulphate	ton	7 10 0 —		8 0 0

COMPOUND TELEPHONE AND TELEGRAPH WIRES.

An old idea, first tried in America some years ago, has been revived by Messrs. Kareis & Bondy, Vienna, who have patented iron or steel wires covered with a spiral serving of copper wire or ribbon of very small thickness. These wires are now being tested at the laboratory of the Electrotechnical Institute in Vienna, and have so far given fairly good results. The object of the invention is to provide aërial wires having less self induction and resistance than ordinary iron or steel wires, without sensibly diminishing the mechanical strength. The wire is intended for use with currents of rapid period, such as occur in telephony or in high speed telegraphy, and as through self induction the flow of current is displaced from the centre to the circumference, the inventors argue that it would be useless to make the centre of a material having a high conductivity.

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HOME INDUSTRIES.

MANCHESTER, 5th April, 1888.

The Metal Trade.—In consequence of the holidays very little business has been done, and makers are so well sold that there is not much forcing of business on their part. A steady demand is experienced, and, generally speaking, there is no slackness at the works. The prices of pig iron are practically stationary, and are not expected to go much lower. No great business in wrought iron is expected until after the results of the iron masters' quarterly meetings have become known. These will be held next week, and it is not probable that any material change will be made in the state of trade so far as quotations are concerned. At present iron bars are quoted at £5. 2s. 6d. per ton for delivery in this district, but can be purchased for less. A fair trade is being done in steel bars for shafting purposes. In a recent specification for steel shafting, the steel used was specified to have a tensile strength of 28 tons, with 30 per cent. contraction of area and ·346 per cent. of carbon. This is a test which may cause some difficulty. Other steel goods, such as plates for boiler purposes, are in good demand, and are being very freely sold. The continued high price of copper is having the effect which was looked for. Many large users are trying other metals in place of it, and it is in consequence very difficult to effect sales of any large amount. In all departments in which copper and brass are used this contraction is taking place, but signs are not wanting that people are getting accustomed to the prices, and are disposed to order somewhat more freely.

The Engineering Trades.—During the holidays there has been a little more business doing in repairs, but with this exception there is nothing special to note. In Bolton the engineers are fully employed, as is the case generally in the larger centres. The trade which is being done is principally with the East, as our Continental trade is now much reduced by German, French, and Belgian competition. Boiler makers are still fully employed, although prices have been considerably reduced. Tool makers are not finding much improvement, and competition for orders is very keen. Cotton machinists are still fully employed, and to all appearances will continue to be so for some months to come. Spinning continues to be profitable, and many orders for replacements are being given. Any orders for new mills are coming principally from India, Japan, Brazil, and Mexico, and with all these countries a fair trade is being done. In the miscellaneous and special businesses, such as brass founding, a moderate amount of work is being done.

The Hat Trade.—During the past few months a series of lectures has been delivered to the Hat Manufacturers' Association, by Mr. Watson Smith, F.C.S. These lectures have been of great value, and have attracted considerable interest. The greater knowledge of the art of dyeing, consequent on careful chemical training, has enabled the Germans to secure a large proportion of the business. From this point of view the value of the lectures cannot be over-estimated. It is, however, gratifying to record that this competition is being at present effectually met, and that in the more delicate shades of colour great progress is being made and an increasing trade done.

The Silk Association of Great Britain and Ireland.—A meeting of the provisional committee of this Association was held at Manchester, on Thursday, the 29th ult., Mr. Thomas Wardle, the President, in the chair. A code of rules was adopted, in which the objects of the Association were stated to be as follow: The promotion and maintenance of the silk industry of Great Britain and Ireland in all its branches; to encourage the production of raw silk in India and the Colonies; to collect and disseminate among the members useful information and statistics connected with the manufacture of and commerce in silk; and to promote technical education and parliamentary legislation on subjects affecting the silk industry. The membership is to be open to all silk manufacturers, merchants, dyers, and finishers; and any Chamber of Commerce may become affiliated with the Association, and have the power to appoint a representative to sit on the Council every year.

LONDON, 5th April, 1888.

The Money Market.—The incidence of the Consols settlement, which was naturally heavy on account of dealings due to the Conversion Scheme, caused money to be in fairly good demand at the close of the holidays this week. Rates remain very much as they have been for a time past. The Stock Exchange took some little time to get fairly into the run of business after Easter, and the tone has been rather languid since. The markets re-opened with a distinctly better disposition, but there was no substantial support to it. There have been signs of a renewal of the activity in copper shares, and American railways show an inclination, though not sustained, to make good the expectations long entertained of an improvement in them. Home railways are fairly buoyant.

Companies.—During the past month there were registered 209 companies, with an aggregate capital of £17,804,400. Since our last report, the following new companies have been registered: Thomas Turner & Co., Limited, with a capital of £60,000, to carry on the business of glass bottle manufacturers; the Mysore Reefs Company, Limited, with a capital of £150,000; the Troy Gold Mine, Limited (North Carolina), with a capital of £20,000; Spreacombe Vall Mine, Limited, with a capital of £30,000; Spirometer Company, Limited, with a capital of £10,000; the Egyptian Lakes Reclamation Company, Limited, with a capital of £300,000; Felix Hadley & Co., Limited, with a capital of £70,000, to acquire a nail, tack, staple, and rivet manufacturing business in Birmingham; James Davies & Co., Limited, with a capital of £10,000, to purchase an ironmonger and hot water engineer's business at Croydon; John & Samuel Taylor, Limited, with a capital of £30,000, to acquire a cotton spinning business at Oldham: Jacoby Brothers & Co., Limited, with a capital of £50,000, to acquire a lace manufacturing business; the Goldfields of North Queensland, Limited, with a capital of £100,000; and D. Watney & Son, Limited, with a capital of £200,000, to carry on business as brewers, &c.

Copper.—The stocks of copper in England and France at the close of last month are given by Messrs. Henry R. Merton & Co. at 51,797 tons, or with the quantities advised from Chili and Australia, 58,747 tons. At the close of February, the figures were 44,943 tons and 52,593 tons, so that there has been a considerable increase in the stocks in hand.

Chemicals.—Business in chemicals is dull, and prices generally show a tendency to fall. Bleaching powder, soda ash, and most qualities of caustic soda are lower, and ammonia salts are weak. Carbolic acid is firm, though there is but little inquiry. The prices obtained for sulphate of copper are considerably lower than the nominal quotations.

Wool.—The second series of Colonial wool sales commences to-day, and will last till 15th May. Since the last series the tone of the market has been somewhat depressed; but Continental reports having been more favourable, greater firmness is now shown, and there is more inquiry for tops.

Produce.—Business in the sugar market has been very quiet, and prices are rather weaker. Coffee shows a heavier sale, and better rates have been obtained. Rice is in better demand.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 25th March, amounted to £1,104,462 on 15,850¼ miles, as compared with £1,127,196 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 141½ miles, or 0·8 per cent., and a decrease in the receipts of 2 per cent.

The Sugar Bounties Conference.—The International Conference on Sugar Bounties is to re-assemble to-day at the Foreign Office, under the presidency of Baron Henry de Worms. The London Trades Council has passed a resolution condemning the bounties as an attack on free trade principles.

The Navy.—The "Benbow," built by the Thames Iron Works Company, and delivered by them in October, 1886, was completed for sea on Saturday. She is 325ft. in length, has a displacement of 10,600 tons, and carries two 110-ton guns. Her engines are of 11,500 h.p., and she can steam 17 knots an hour.

The North Baltic Canal.—The Foreign Office announces that the Imperial North Sea and Baltic Canal Commission have invited tenders for the supply of two steam dredgers and seven steam barges for use in the construction of the North Baltic Canal. The conditions of tender can be obtained upon payment of two marks, in cash or by postal order, to the Imperial Canal Committee, No. 61, Muhlinsstrasse, Hamburg.

Registration of Firms.—The proposal which Sir Albert Rollit, M.P., has placed before Parliament for the compulsory registration of firm names provides that every firm carrying on business under a name not consisting of the full or usual names of all the partners or all the acting partners shall be registered. The register is to be kept by the registrar of joint stock companies, who will send abstracts of the statements to the registrars of county courts in whose district the places of business are. The statements thus registered are to be open to anyone's inspection on payment of a small fee.

Factories and Workshops.—The report of Mr. Redgrave, C.B., the chief inspector of factories and workshops, for the year ended October 31st, 1887, has been issued as a Parliamentary blue book. There is also supplemental information from other inspectors on the state of trade, wages, the sweating system, and the employment of children. Mr. Henderson, inspector of Scotland and the four northern counties of England, gives a table of wages in the shipbuilding trade, from which it appears that they were at their highest in 1882, when the largest tonnage on record was launched. In 1881 a fitter could earn £1. 9s. 3d. a week; in 1882, £1. 11s. 6d.; while the amount has gradually sunk since, until in 1887 it was £1. 4s. 9d., a reduction of 15 per cent. in six years.

Exhibitions.—Nearly 3000 applications have been received for space at the forthcoming Italian Exhibition to be held at Brompton. Venetian glass blowing and the Tuscan straw industry will be represented.—An Anglo-Danish Exhibition is to be opened early next month at South Kensington.

GLASGOW, 5th April, 1888.

General Business.—The coincidence of Easter Monday with the Glasgow Spring Holiday has caused an extreme slackness during the early part of the week. On Tuesday and Wednesday there was comparatively little being done in any of the markets. During the past week pig iron shipments were fairly brisk, the total showing an increase over the corresponding period last year of about 50 per cent. Coal shipments on the other hand fell from 71,775 tons to 66,372 tons.

Shipping Trade.—The quarterly report of the Clyde shipping trade shows that 326 vessels, of an aggregate tonnage of 305,594 tons, arrived in the river from foreign ports during January, February, and March. This is a falling off of upwards of 25,000 tons as compared with last quarter. The quarter ending in December last was, however, an exceptional one, the arrivals being 366 vessels of 330,862 tons. The returns of the first quarter of this year shows an increase over those of last year of 25,000 tons, and over those of 1886 of 31,000. The departures to foreign ports from the Clyde during the quarter were of considerably greater tonnage than the arrivals, though relatively to the periods with which the arrivals are compared above, they show much the same variation from the figures of previous years. The total of foreign departures for the quarter just closed was 390,913 tons, against 424,093 tons for the December quarter, 1887, and 334,643 tons for the March quarter, 1887, and 300,888 tons for the March quarter of 1886. The value of the exports has in the important items been nearly maintained. Cotton goods, though less in total value than they were in the March quarter of 1887, are fully 10 per cent. more than in the December quarter. Linen has increased by 50 per cent; steel has decreased from £106,000 to £78,000. Iron is less in total value, and general machinery shows a falling off of about 15 per cent.

Shipbuilding.—Messrs. Wm. Hamilton & Co., Port Glasgow, have booked a contract for a sailing vessel of 2000 tons. Contracts for new vessels are being placed very slowly, the demand that sprang up towards the close of the year having apparently expended itself.

Extensive Raid upon Alleged Smugglers.—The Customs authorities at Greenock have effected the capture of a large quantity of contraband tobacco, and have apparently put a stop to the most extensive and ingenious system of smuggling that has been discovered for some time. In carrying on this contraband traffic, the tobacco was packed in cases and hermetically sealed, and was shipped to the Clyde by a steamer or steamers. When a vessel containing the contraband cases arrived in the Firth of Clyde, the cases were attached to long lines, to which were also attached cork floats. The freight was then thrown overboard, and boats from the shore, while ostensibly engaged in deep sea fishing, secured the tins during the night. The tobacco was then landed by the boats upon an unfrequented part of the coast, where a cab waited to convey the contraband goods to Greenock. The quantity seized has been about half a ton; but it is understood that the traffic has been going on for a long time, and that elaborate arrangements for disposing of the tobacco existed throughout the country. The number of persons necessarily implicated in so large a scheme has been fatal to its continuance, for it is understood that the discovery has been made by the aid of an informer. A number of arrests have been effected, and the prisoners will in due time be tried at Edinburgh.

(From our own Correspondents.)

LIVERPOOL, 4th April, 1888.

The New Brighton Railway.—The remaining portion of the new line from Wallasey to New Brighton was inspected last Thursday by Major-General Hutchinson, on behalf of the Board of Trade, and passed for traffic. Passengers can now travel from the James'-street Station, in Liverpool, to New Brighton, without changing, and there will consequently be sharp competition between the railway company and the Ferry Commissioners for the immense summer traffic to this favourite resort. The railway has a double line throughout; it leaves the Hoylake Railway at the Docks Station, takes a long curve through Bidston Marsh, reaches Wallasey Station at the foot of Grove Road; it then passes through the sandhills to Warren Down Station—not yet completed—and on through a deep cutting in the red sandstone between Victoria Road and the river, to the terminus at Atherton-street, in New Brighton. On Good Friday over 4500 passengers travelled along the new line, and though a large proportion of these would be travelling for curiosity, there is no doubt that the line will be well patronised in the future. The engineer for the line is Mr. Francis Fox, M.Inst.C.E.

Trial of a New Patent Marine Engine.—A novel marine engine and steam generator has been patented by Mr. Henry Turner, of Liverpool, and one constructed on this principle by Messrs. George Bayliff & Son, Wirral Foundry, Birkenhead, was recently tested in the presence of a large number of engineers and others interested in the question. Steam at a high pressure is used on the atmospheric principle, and it is so arranged that the walls of the cylinders, pistons, &c., are heated and maintained at a temperature equal to that of the steam by means of heated air, which is admitted to and expelled from the atmospheric end of the cylinder by each stroke of the engine. The air for the above purpose is heated by the waste gases from the steam generator, and taken from a receiver in the uptake by the engine, thus forming an automatic forced draught. The engine was single acting, with one crank; the cylinders were 6in. and 17½in. diam. respectively, and 10½in. stroke. The total heating surface of the boiler was 88 sq. ft. With steam at 225lb. and 300 revolutions, 65 h.p. was indicated, with an extremely small consumption of coal.

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SHEFFIELD, 4th April, 1888.

Iron and Steel.—Most of the heavy material producing works have been closed for the Easter holidays. Considerable satisfaction has been felt in Sheffield at the result of the armour plate trials at Messrs. Cammell & Co.'s Works. The resistance of their compound plate to the chilled forged steel projectiles was exceedingly satisfactory, and it is not improbable that the other local firms in the competition will come well out of the ordeal. Messrs. John Brown and Co., Messrs. Vickers & Co., and Messrs. W. Jessop & Sons, have sent carefully made plates, either compound or of solid steel, and it is believed that the decision of the experts will result in very remunerative orders to one or other of these Sheffield houses.

Coal.—A satisfactory trade is being done in nearly all sorts of coal, and new collieries are being opened out. One of these is at Dronfield, where Mr. Sheard, colliery owner, has bought the coal under 100 acres, and is making arrangements to work it. The coal owners of South Yorkshire are looking forward with great interest to the coming fight before the Committee of the House of Lords against the Midland Railway Company, who are seeking to work the Hull and Barnsley Railway. The latter line has been taking coal to the port at a reduction of 6d. per ton. The Midland have declined to give a guarantee that they will continue to convey the coal at the reduced rate, and the coal owners are up in arms, especially as 6d. per ton on 1,790,000 tons—the amount sent last year—is well worth fighting about. Since the reduction from 3s. 1d. to 2s. 7d. per ton, the coal traffic to Hull has enormously increased from the South Yorkshire coal field, the tonnage in 1884 being 1,300,000 tons.

LEEDS, 4th April, 1888.

The Heavy Industries.—Trade in heavy material continues satisfactory in Leeds. The demand for iron and steel is still extensive, and the engineers are busy in nearly all departments. The bulk of the work turned out has not been so great during the past few days owing to the holidays; but makers of Bessemer and iron founders have good orders on their books. Heavy machinery for ships, pumping, and colliery purposes is in greater demand, and agricultural machinery, which for some time past has been nearly a drug on the market, is selling more freely. Railway material is in demand, chiefly on foreign account, and one or two profitable lines are on hand for axles and tyres. Engines, both locomotive and stationary, are in slightly better request; and for tram work the supply is extending. The tram engines now in use in Leeds are not handsome; and it is surprising that in these days of scientific and industrial enterprise something more comely has not been designed. Appearance has been more considered in the construction of the cars; and a few days ago, a new car, built by Mr. Milnes of Birkenhead, made a trial trip from Boar Lane to Kirkstall. The car, which is on the bogie principle, is comfortable, prettily decorated, and is fitted on the top with seats having reversible backs. It is an improvement on the old style of vehicle, and will no doubt give great satisfaction on the Headingley and Wortley routes. Fencing and roofing are more eagerly inquired for; and for engineers' tools the call is brisk. Cut nails find a ready market; and the iron and steel industries generally are in a healthy condition.

NORTH STAFFORDSHIRE, 4th April, 1888.

The Iron Trade.—The holidays are in full operation, and most of the mills and forges are still standing. In some instances work will be resumed to-day, but in others the works will lie idle until Monday next. There is a general feeling of despondency amongst members of the trade, and no appreciable improvement is anticipated under any circumstances until the autumn. Contracts for pig iron have recently been entered at prices below the level of 1887, and some 4s. per ton below the rates quoted at the January quarterly meetings.

The Coal Trade.—Considerable difficulty has been experienced in supplying current requirements during the past few days. Owing to the continued severity of the weather fuel has been in great demand, and it is always impossible to get colliers to work during holiday time.

North Staffordshire Miners' Permanent Relief Society.—The annual meeting was held at Stoke on Monday last. On account of certain reductions in the benefits allowed to members, made on the recommendation of the actuary who was called in to investigate the financial position of the society, over 1000 miners seceded from membership last year, and at the close of 1887 the number on the books stood at 4172. The income for the year amounted to £3,961. 10s. 9d., and the expenditure to £3,626. 2s.

SOUTH WALES, 4th April, 1888.

Mannesmann Tube Works.—The process for the manufacture of metal tubes, which was described in last week's issue of *Industries*, is being introduced into Swansea. Messrs. Krupp & Mannesmann have taken the old steel works at Landore recently vacated by the Siemens Company. It is intended to manufacture both steel and copper tubes by the Mannesmann process.

Reduction in Railway Rates.—A substantial reduction in the carriage of coal from the Monmouthshire valleys to Cardiff has been made through a working arrangement recently arrived at between the Great Western and the Taff Vale Railway Companies. In the case of one large colliery firm the concession will result in a saving of 5d. a ton on all coal sent to the East Dock.

Strike at the Panteg Works.—The strike at Messrs. Wright & Butler's Elba Works has extended to the works at Panteg belonging to the same firm. The customers have hitherto been kept together by the supplies from the latter place; but the firm will now have to take into serious consideration the question of the advance of wages demanded by the men.

BARROW-IN-FURNESS, 4th April, 1888.

Iron and Steel.—There is a steady tone in the hematite pig iron trade of this district, and the improvement noted last week is fully maintained. There is an improved demand for both Bessemer and ordinary hematite qualities of pig iron, and makers are becoming more and more firm in their transactions. They are already very well off for orders, and are beginning to experience the advantage of a growing shipping trade. There is a steady market in ordinary forge, but the trade in Bessemer is continually growing as the wants of steel makers are increasing. Last week's quotations for pig iron are adhered to, and it is believed that after the Easter holidays the demand will so improve on local, general, and Continental account as to enable makers to secure more than present rates, viz.: 43s. 6d. for Bessemer in parcels of mixed numbers, or 42s. 6d. for No. 3 forge and foundry iron. Stocks of iron are large in the hands of holders and merchants generally, and it is evident that these will remain so long as prices are as low as they are at present. There is a brisk tone in the steel trade, and the demand for rails is still very active; £4 per ton is the quotation for heavy sections. A continuance of the better trade in steel for shipbuilding purposes is maintained, and plates are quoted at £7 per ton, and angles at £6. 10s. net f.o.b. Billets and bars are in full demand.

A New Gas.—The Local Board of Dalton-in-Furness recently determined to experiment at Askam-in-Furness with a new gas for the purposes of street lighting, house illumination, &c., and with this view put down a Stockport patent apparatus for the production of gas from scrap iron and sulphuric acid. The new gas was produced on Good Friday for the first time, and the streets were brilliantly lighted. The light is bright and steady, and of great illuminating power. So far as can be seen the novel experiment is a great success; but experience alone can determine whether it will prove financially economical. The patentees, however, claim that it is much cheaper and more effective than ordinary coal gas.

MIDDLESBROUGH, 4th April, 1888.

Pig Iron.—The Easter holidays have brought business to a standstill, but the market is very firm, and the price is maintained at 31s. 6d. for early delivery. The exports of pig iron for the month of March amount to 79,465 tons, being the highest monthly record during this or last year. Of these 43,265 tons went coastwise, and 36,200 tons foreign. The increase was chiefly in the foreign exports. The shipments for the first quarter of the year amount to 207,553 tons, as against 172,388 tons for the first quarter of last year.

Wrought Iron and Steel.—There is little or no change in wrought iron and steel. The finished iron makers are asking for orders at lower prices than they have been satisfied with for some time back. The work at the foundries is rather slack, and full advantage of the holidays has accordingly been taken.

Iron and Steel Shipments.—On Saturday night, the return of shipments of pig and manufactured iron and steel for the month of March were issued by the Middlesbrough Customs officials. The total of all kinds was 112,961 tons, being an increase of 10,186 tons over the quantity shipped in the preceding month, 3673 tons of the additional quantity being sent coastwise, and the rest abroad. Of pig iron 79,465 tons were shipped, being 12,565 tons more than in February, the coastwise shipments being 3361 tons more than in the previous month. The remaining 9000 tons went abroad. Holland took 11,861 tons, France 4050 tons, Belgium 3900 tons, Germany 6695 tons, Japan 2770 tons, Sweden 1549 tons, and the United States 1690 tons. No other country took a thousand tons. Of manufactured iron 20,853 tons were shipped, being 437 tons more than in February, and this was wholly in the coastwise shipments, there being a decrease in the quantity sent abroad. Of the 13,868 tons sent foreign India took 8727 tons, Japan 1796 tons, Argentine Republic 1120 tons, and Spain 999 tons. Of steel 12,643 tons were shipped, being 2926 tons less than in February. The foreign shipments of this article showed a falling off of 2176 tons, our only customers abroad during the month being India and the Argentine Republic, the former taking 9764 tons, and the latter 740 tons.

SUNDERLAND, 4th April, 1888.

Shipbuilding.—Just before the holidays a few additional orders were placed with local shipbuilders. During the quarter ending March 31st there have been 16 vessels of 29,771 tons launched by eight shipbuilders on the Wear, including fifteen steamers of 28,317 tons, and a sailing vessel of 1,454 tons.

Shipping.—During the last week the shipments of coal were above the average; 92,368 tons were shipped for home and foreign ports, being 35,009 tons in excess of the previous week. There was also a fair quantity of coke, patent fuel, fire bricks, cement, lime, bottles, &c., shipped. The import trade was also brisk, including 5050 bales of esparto grass, 69,094 pit props, besides considerable quantities of deals, pitch pine, &c., together with twenty-six cargoes of wheat, oats, &c., from home ports. Freights on the whole are better, and there is little unchartered tonnage. It is reasonably anticipated that as soon as the Baltic is open there will be a considerable rise.

Chemical Works.—The chemical works at Seaham Harbour are now being rapidly put in order. They have been acquired by a limited company, of which the leading partners are principals in the firm owning Newburn Steel Works.

NEWCASTLE, 4th April, 1888.

Shipbuilding. — The acquisition of new orders by Tyne shipbuilders is now a comparatively rare occurrence, and there can be no doubt of the fact that since the opening of the year the demand for vessels has been greatly reduced. As the number of orders placed during December, however, was very large, there is assured activity for most of the building yards during the present year, and, in some cases, the briskness is likely to be continued for a much longer period. During March Messrs. Palmer launched a couple of vessels, and have since put down keels in the berths vacated. The firm have now ten vessels, representing in the aggregate a carrying capacity of about 40,000 tons, in course of construction, and the frame turners are still busy with the frames for other vessels to be laid down. Among other orders now in hand Messrs. Richardson have a vessel of first class type to build for the China trade. Messrs. Armstrong, Mitchell, & Co. are filling up their berths, most of which were vacant at the close of last year, with keels for vessels of a large class, and they are now taking on hands in several departments. It has been announced that the armour plated ship "Victoria" will be removed from the Tyne to Chatham in the course of a few days. The vessel was launched from Messrs. Armstrong, Mitchell, and Co.'s Elswick yard about a year ago. There is nothing of a special nature to note in reference to the other yards on the river; but all the repairing establishments are, it may be stated, well provided with work.

Engineering.—The activity at Messrs. Palmer's Engine Works, Jarrow, is quite on a par with the state of business in their shipbuilding department. There are more than twenty sets of engines, several of them of exceptional power, now in progress, and the designs for others are being prepared. The other marine engine works in the district continue extremely busy, and such establishments as are engaged in the production of steam winches, steering gear, &c., are also very fully employed. In locomotive shops dulness is still the feature, and the slackness at the Elswick Ordnance Works is becoming more pronounced. A large number of hands were discharged last week, and it is understood that a good many others will be paid off within the next few days.

BELFAST, 4th April, 1888.

General Trade.—Shipbuilding and engineering firms still continue to be well employed, both on new work and repairs. Foundries and machine shops are better employed than they have been for some time, and in one or two cases have large overhaul jobs and repairs in hand. Manufacturers of felt for roofing and sheathing ships are very busy, chiefly with an export trade. The state of the woollen trade still continues favourable, and the factories lately started have received a fair supply of orders.

Linen Trade.—Owing to the Easter holidays the amount of trade has somewhat diminished, but prices still continue firm. The various spinnings of yarns have been rather quiet, but the prices remain good. Cloths and brown goods have had an improved demand, with an occasional advance in price. The rapidly increasing industries of shirt, pinafore, collar and cuff, and handkerchief making are in a very prosperous condition, and employ a large and increasing number of hands. Some new factories have been started for the manufacture of hem-stitched cotton handkerchiefs, and are doing a large trade. Much dissatisfaction is felt at the high rates charged by the railway companies, whereby manufacturers in inland towns are placed at a very great disadvantage, both coals and manufactured goods having to be conveyed by road or canal, thus causing serious delays.

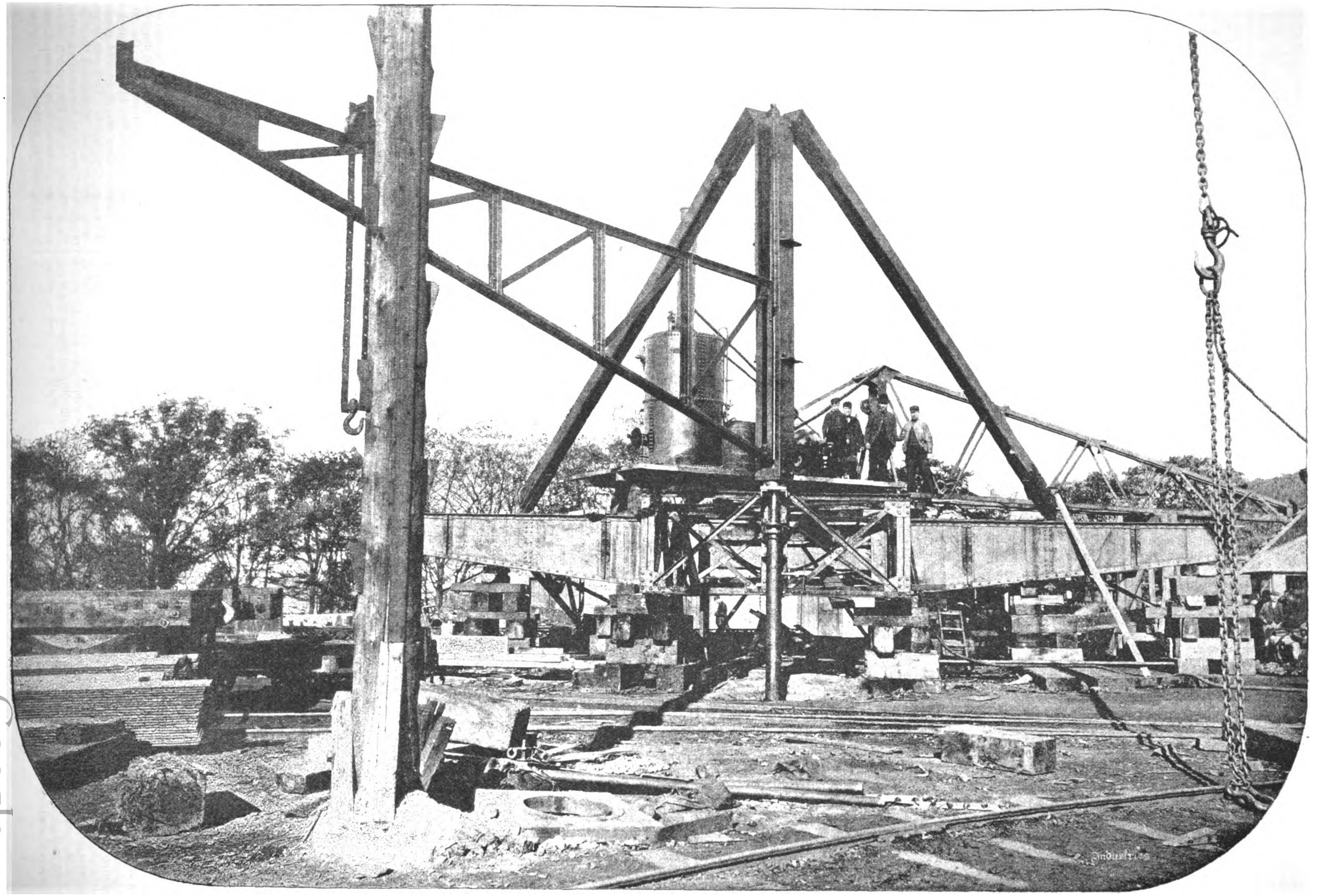
Exhibitions.—Much interest is being taken in the Glasgow Exhibition, and many of the leading firms have obtained space for their exhibits. Messrs. G. & J. Burns have arranged for a special service of steamers at low rates from Belfast to Glasgow during the Exhibition. The Irish Exhibition to be opened in London on the 4th June is not attracting so much attention as it deserves.

Launch of a Caisson.—On the 29th ult. Messrs. Workman, Clark, & Co., Limited, launched the second of two caissons they are at present constructing for Her Majesty's Government. They are intended for use in connection with the extension of the Admiralty works at Queenstown, one being for use at a graving dock, the other for a floating basin. The caisson which was launched about four weeks ago is in a forward condition, and will leave the builders' works in a few weeks.

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THE FORTH BRIDGE.

(For description see page 347.)



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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
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Telegraphic address: "INDUS, MANCHESTER."
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Telephone number: 684, MANCHESTER.
„ „ 2785, LONDON.

Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 6TH APRIL, 1888.

FORCED DRAUGHT.

AMONG the useful results of the recent meeting of Naval Architects, not the least valuable is the clearing away of the doubts and uncertainty which has hitherto enveloped the question of forced draught. So long as it remained a subject of controversy, the system could not recommend itself for general adoption. Engineers, said Mr. Fothergill, hesitate, for want of reliable data gained from actual experience, to accept the doctrines propounded in the numerous papers that have been written on the subject, and shipowners will not move without substantial evidence of a commercial gain. The want here suggested, the authors of the two papers read on the evening of the 23rd ult. have sought to supply. In collecting evidence for this purpose, the mercantile marine afforded a field for inquiry in one case, and in the other the examples were taken from among the different conditions prevailing in the Royal Navy. Thus we have a complete and an authoritative statement of observed facts, sufficient, it may be believed, to produce conviction in the minds of all practical men. Mr. Fothergill's paper treats of the subject of forced draught from the commercial point of view, and shows that in every case which has fallen under his notice, the adoption of the system has resulted in a very considerable gain. Incidentally he testifies also to the absence of destructive effects upon the boiler. Mr. Soper makes this matter the principal topic of his paper, and arrives at the same conclusion respecting the influence of forced draught upon the life of the boiler. This agreement is important; for the draught, which is represented by some ¾in. on the water gauge in merchant vessels, rises to 2in. on board a ship of war. Not less significant of the fuller knowledge we now possess, is the perfect accord which was manifested amongst the large audience of members and visitors present. There was but one opinion, and that was wholly in favour of the system under consideration. Bearing in mind the character of this audience, composed of marine engineers, shipbuilders and shipowners, we are led to believe that forced draught is no longer regarded as a project which must be experimentally investigated, but as an accomplished fact, ready for adoption under all circumstances.

The high importance of having set at rest this warmly controverted question, or, at least, of having led a large representative body like that assembled in the hall of the Society of Arts to a unanimous decision concerning it, will impress itself upon every practical mind. The advantages of supplying air under pressure to marine boilers are many and great. It leads not only to a notable saving of fuel, but to a large reduction of boiler heating surface, whereby space is gained for cargo, and dead weight is lessened. A striking example of this is to be found in the Atlantic passenger steamer "Celtic," of the White Star Line, whose boilers, after the application of forced draught, were reduced from ten to eight in number. This means, besides economy in other directions, a considerable addition to her carrying power. Another incidental advantage of no small importance, inasmuch as it affects the comfort and health of the stokers, is the reduction of temperature in the stoke holds, and the ventilation afforded. It was mentioned in the course of the discussion, that competition among stokers for appointments to ships provided with forced draught is exceedingly keen. All this is sufficiently obvious, and it was generally admitted. But there was thought to be at least one serious counterbalancing evil. The high temperatures consequent on forced draught were commonly believed—on what evidence it does not plainly appear—to be very destructive to the boiler plates. Had this apprehension proved well grounded, the system would have stood condemned for general application, though even in that case it might be of good service under conditions in which, as in the Navy, it is often of paramount importance to obtain the greatest possible power from the engines. But the results of experiments, and the constantly accumulating evidence afforded by actual experience, are opposed to the destructive theory. Much of this evidence was adduced and brought to a point at the meeting of the Institute of Naval Architects, and the result of the discussion must remove all doubts on the subject. The impression which must have been taken away from that meeting was that a great impulse has been given to the system by having brought the problem of forced draught within the range of definite and certain knowledge.

So far as the mercantile marine is concerned, the evidence in favour of the durability of the boilers under forced draught has all the conclusiveness of a demonstration, for not only has Mr. Fothergill given us, in minute details, the results of actual practice in numerous instances extending over considerable periods of time, but his figures throw us back upon old experience. The pressures with which he deals, and which seem to be those commonly used in the merchant service, do not exceed ¾in. water gauge. Now, a moderately tall chimney will give a water gauge pressure of fully ⅝in. Within these limits thousands of land boilers have been for many years worked under forced draught; and as no bad effects have been produced in these cases, it is hard to understand how any can occur to marine boilers whose fires are blown by a fan which produces no greater pressure than is represented by the draught of a large factory chimney. Shipowners may therefore avail themselves of a ¾in. blast in the certainty of suffering no injury from rapidly burned plates. Judging from the tone of the meeting, we are not likely to hear more of this objection. But the practice followed in the Royal Navy carries us much further; and if it be true that no injury is done by a 2in. blast—and Mr. Soper and others boldly affirm that none is done—there is nothing to fear from the adoption of forced draught to even a larger extent than that used by Mr. Fothergill. Evidently the next great step in marine engineering is the general adoption of a forced draught system, and it may be that in a few years we shall have no more of ¾in. water gauges, but rather of 1½in. to 2in. for merchant vessels. With such a blast, another boiler might have been removed from the "Celtic." This development, while adding considerably to the carrying powers of our cargo vessels, will benefit largely the marine engineering trades. The conditions of success are now pretty well known. As usually happens with new systems, the first attempt to apply forced draught frequently ended in failure. But these failures, as one of the speakers who took part in the discussion on Mr. Fothergill's paper showed, were for the most part attributable to a want of earnestness on the part of those who made a

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trial of the system. Whenever it has been taken up with a determination to make the best of it, success has been achieved. Two notable instances are afforded by the "Ohio" and "Celtic," in which the first attempts proved utter failures. But the experiment was persisted in, and the final results were in the highest degree satisfactory. Thanks to a few shipowners of this kind, the engineer now finds himself in a position where he has to deal only with known facts and conditions. The cause of the hesitation alluded to by Mr. Fothergill having now been removed, we may reasonably expect that our leading marine engineering firms will face the question boldly, and that shipowners, convinced of the commercial gain to be acquired, will hasten on the improvement which we have described as the next great step in marine engineering.

THE COTTON TRADE.

Within the past few months public confidence in the shares of cotton spinning and weaving companies has, with the general realisation of successive profits, become more restored, and shares have consequently received more legitimate attention than for many years past. This has had the result of raising prices all round to a slight extent; and where buyers had the market practically at their command some nine or ten months ago, holders in paying concerns are now, almost without exception, above par with their demands. Only a few weeks ago shares in cotton companies had reached the highest point for many years; but since then, owing to the uncertainty and fluctuations characteristic of the yarn and cotton markets, a slight relapse has set in, and quotations are from 1s. to 2s. 6d. lower. In the share markets much difference of opinion exists, as might naturally be expected, in regard to the probable position of holders in the immediate future. If cotton rises in price, if yarn becomes more easily obtainable, or if the consumption does not increase, then there must necessarily be a decline in quotations; but, on the other hand, if the change in these respects be to the advantage of the spinner, a marked advance is sure to be the result. In the working of mills and factories under existing conditions of trade—that is, with modern machinery and good management, there is sufficient room to realise a profitable margin. Mills engaged in medium fine productions are specially favoured at present in this respect, next to which is the medium trade, while the fine trade comes in last to share this advantage.

Out of the cotton trade, industrial companies are generally looked upon as a source of investment, and when one profitable result has been declared the shares rise to a value which reduces the dividend or yield to the next buyer to about five or six per cent. Speculators only tamper with them to an extremely limited extent, as the business being of a comparatively non-speculative character, their tactics can do little to affect their position in the open market. In cotton spinning and weaving companies' shares, however, there is rapidly becoming a change from this rule, which is being brought about by the uncertainty and variation in the working results from quarter to quarter. Many companies have of late declared large profits at one stock taking, and losses at the next, while old concerns have paid dividends, and new and modern ones report adverse balances. Cotton also is subject to rapid variations in price, so that taking all these matters into consideration, cotton shares are looked upon as having a more speculative character than some investments.

In considering the position of cotton concerns and their numerous balance sheets, we may find that they can be divided into three different classes: (1) Those having old or over valued machinery at work; (2) those that endeavour to pay a fair and uniform dividend, and place the balance of profits to a reserve fund; and (3) those that disburse among the shareholders every farthing of profit as soon as it is realised. The shares of the companies which come under the first head are, almost without exception, of little use at any price to either speculators or investors. For example, what advantage is there to be gained in purchasing shares with say £4 out of £5 paid up, at a discount of perhaps 50s. or 60s., when there is a large adverse balance existing, and no prospect of it being cleared off? It is in those companies described under the second head that intending investors should place their capital, as they have there some guarantee of a return, and a prospect of a small dividend, even should trade become so bad that a profit could not be made. It will, however, be found that in examining the balance sheets of such companies from their first issue, that they have never failed to render the working operations profitable through every quarter, so that while profits may be expected, it is safe to assume that they will (unless by accident) be at all times able to maintain their position. With regard to the third class, they should be avoided by mere investors, as the results at each quarter vary considerably, and cause the shares to have a fluctuating value.

The position of producers, we are led to believe from present appearances, will at least continue as good as it now is for several months yet to come, and therefore we look upon the present as a favourable time for investment as regards the shares of the better companies. From information which we have reason to consider reliable, the companies named in the following list are at present doing good business, and are likely to show profitable results at the time of next stock taking. We understand that ring spinning business is doing exceptionally well, and that this will continue for some time, as it is in the hands of only a few concerns, who are becoming desirous of keeping their trading results from public view. They are therefore considering the advisability of discontinuing the publication of balance sheets, and if this system is generally adopted it may exert a favourable influence on their future results.

Company.	Nominal share value. £.	Amount paid up. £.	Present value. £.	Last dividend. Per cent.
Chadderton	100	50	49	6†
*Crompton	5	4⅝	5	8†
*Duke	5	2½	2¾	12†
Dowry	5	2½	2¾	11†
Duchess	5	2½	2½	8†
Garfield	5	2	2	10†
*Haugh	5	3	3¼	10‡
Leesbrook	5	2½	2¾	10†
*Mitchell Hey	5	5	5⅛	12§
*Newhey	5	2½	2¾	10‖
*New Ladyhouse	5	4	4	8‖
Ramsbottom	5	5	5	9†
*Parkside	5	3	3 1/16	10†

* Have reserve balances, which are added to every quarter. † Mule spinning. ‡ Ring spinning and manufacturing. § Mule spinning and manufacturing. ‖ Ring spinning.

THE REGISTRATION OF ARCHITECTS, ENGINEERS, AND SURVEYORS.

We understand that the Bill which has been introduced into Parliament for the Registration of Architects, Engineers, and Surveyors is put down for its second reading on the 12th inst. It has received the support of a considerable number of provincial architectural societies, but is being opposed by the Royal Institute of British Architects and the Institution of Civil Engineers, and the Council of this latter body has prepared a statement of their objections to it, a few of which we will briefly mention. The most obvious objection is, that although the title of the Bill—which is Architects' Registration Bill—seems to imply that it only affects the profession of architects, it really includes all the various departments of engineering, which have little in common with architecture, as is proved by the fact that each of these professions has its own distinct chartered institution. As we mentioned, however, in our previous article on this subject, the engineers and surveyors which the promoters had in view, seemed to include, not the men who carried out engineering works in the proper sense of the term, but only those who were usually associated with architects and builders in laying out roads, drains, &c. It seems to be very much the custom for men who have got a smattering of building and surveying knowledge, suddenly to develop into architects, civil engineers, and surveyors, and their only diplomas are the huge brass plates in front of their doors. No doubt this is an evil to be guarded against; but the proposed Bill is too pretentious, and, as we have said, includes every department of engineering. Now, architecture is a well defined department, and there should be no difficulty in laying down the conditions of admission to the profession. Surveying is almost equally well defined, and the qualifications for admission to a surveyors' institute could easily be made to include the elements of construction necessary in connection with building operations. There would, moreover, be no great difficulty in the same men qualifying in both these departments, and they might put themselves forth as architects and surveyors, especially in country districts; but the term civil engineer is too big to be tacked on in addition.

The Council of the Institution of Civil Engineers denies the statement in the preamble of the Bill, that it is expedient that persons requiring professional aid in architecture, civil engineering, or surveying, should be able to distinguish qualified from unqualified practitioners, and therefore it is necessary that all properly qualified persons should be registered, but on the contrary it is of opinion that the Bill, should it pass, will not only be of no public benefit, but would be absolutely disadvantageous not only to engineers as a body, but to the public at large. The Council mentions that the Institution of Civil Engineers has on its roll representatives of all branches of engineering except military engineering. The members and associate members number at the present moment over four thousand. There is no restriction as to numbers, and all persons of fitting age, who can produce adequate proof of their competency in the profession, are admitted, either at once to the class of "member" or to that of "associate member," according to their qualifications; and in the case of the latter, when they have attained to a well recognised standing in the profession, they are, after full consideration by the Council, transferred to the class of member. In addition to the members and associates, the Institution has attached to it a class of students who are or have been pupils of corporate members of the Institution. The Council states that the Institution has from the first exercised extreme care in ascertaining that persons admitted as members or associate members of the Institution are worthy of their respective positions, and the result has been that membership of the Institution is recognised as evidence of the competency of the practitioner. The Council is of opinion that the system has been tested by the experience of sixty years, and with results eminently satisfactory, both to the profession and to the public. It is during this period of sixty years that all the great works have been executed and the improvements in mechanical science attained by which the present age will ever be distinguished, and in which the profession of civil engineering has been raised to its present high position, and the Council ventures to think that the House of Commons will hesitate before interfering with a system so well established, and found to be effective and of approved sufficiency.

BRITISH AND FOREIGN SHIPBUILDING.

It has become apparently a recognised necessity of the times that if England is to secure the work of foreign countries, she must go to those countries and establish in them factories in which the work can be carried on. The latest development of this system is witnessed in the new shipbuilding company that has been formed, under the chairmanship of the Marquis of Hartington, and with Lord Brassey and Mr. Nordenfelt on the Board of Control, in Barrow, with an auxiliary establishment in Spain. The latter departure has been induced by the fact that the Spanish Government are, as we have already informed our readers, about to undertake the re-construction of their navy; and as the movement is not confined to the Barrow Company, but is equally followed by the well known Palmer Shipbuilding and Iron Company, at Jarrow-on-the-Tyne, it is interesting, from an economic and business point of view, to consider how far it is likely to be carried, and what are likely to be its ultimate effects on British industry.

No one can blame the ministers of foreign States for desiring to establish within their own borders such industrial works as shall render them independent of external assistance, which may possibly fail them in their hour of greatest need. This requirement is now apparently a *sine quâ non* with all Continental States; and it is especially to be approved in reference to dockyards and arsenals, which give to a foreign power the entire command over their own vessels and munitions of war, since it may easily enough happen that hostilities may occur between the country that is dependent and the nation on which it depends. The question of founding such establishments within the limits of each European State is, therefore, one of national expediency, and is not necessarily, and may probably in nowise be one of profit and loss. It is in this view that the matter is usually regarded by Continental Governments. Whatever the ultimate cost may be, considerations of national safety and expediency prescribe the course that has been followed in Italy, and is now being followed in Spain. There are people who look upon such a movement as calculated to jeopardise the stability and prosperity of our great national industry of shipbuilding. They apprehend that by degrees these countries will not only supply the whole of their own wants, but will be competing with England in neutral markets, and deprive us of our shipbuilding trade. This would be a serious matter if the inference were true; but they must know very little of the primary requirements of the shipbuilding industry who fear for the future of England on this score. Our shipbuilding supremacy is the first condition of our shipbuilding prosperity. That alone will always keep us well to the front; but, apart from this, we have to a fuller extent than any other nation the other essentials of success in this industry, which are—(1) A widespread and profound knowledge of the art; (2) the command of cheap materials of construction; (3) the most highly skilled and experienced body of artisans in the world; (4) entire freedom from tariff duties, bounties, or any other artificial system, whereby freedom of trade is hampered and restrained. It is, no doubt, quite possible that these essential conditions may equally become the

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possession of other countries. It does not, however, appear to be very likely at present. Spain could probably produce pig iron (and if pig iron, why not manufactured iron and steel?) as cheaply as our own country, if the same capacity, skill, and experience were brought to bear on the industry. One and a half million tons of pig iron are now annually produced in this country from Spanish ores. It might seem that this iron should be produced more cheaply in Spain itself, seeing that Spain has the ores on the spot; but yet only comparatively very small quantities of pig iron are produced in Spain. The reason is that in Spain the machinery does not exist for the production of iron and steel on a large scale. By machinery, we do not mean merely certain engines, tools, and appliances, but also a scientific knowledge of the process of manufacture and proper organisation. The Spanish workman is ill adapted for this class of work. The climate is against him, and he has not been accustomed, as the English workman has been, to mechanical labour at high pressure, and he has not the aptitude of the English workman for taking up and mastering the conditions of such employment. Nor is he disposed to work for much lower wages, although his services are usually worth very much less. An official report, recently issued by the United States Government on labour in Europe, states that at the Cadiz works of the Havana Line of Transatlantic mail steamers, where some one hundred men are employed, the hours of labour average 9½ per day, and the average rate of wages paid to general mechanics is $10, or 40s. per week; while blacksmiths' helpers only get 16s., and coppersmiths' helpers 18s. 9d. per week. In regard to other wages, they do not appear to be much under those ruling on the Clyde.

Foreign shipbuilding is, moreover, handicapped by duties and by bounties. Many examples of the onerous and irksome taxes that are levied, either directly or indirectly, upon the American shipping and shipbuilding interests, might be quoted. A very striking illustration of this is given in a report of the Special Commissioner of Revenue. Mr. S. C. Blanchard, of Yarmouth, Maine, stated that in a ship which he had built at a cost of 136,000 dols. (£28,000), 81,000 dols. (£17,000) was paid for materials, 30,000 dols. (£6,000) for labour, and 25,000 dols. (£5,000) to the State for taxes in various forms. It appears, then, that in this case 18 per cent. of the total cost of the ship went for meeting charges in restraint of industry. The case is similar in regard to other foreign countries. They have all tariffs which artificially enhance the cost of the materials required for shipbuilding, and so long as this continues their successful competition with free trade England is out of the question. It will be appropriate in this connection to consider how far the shipbuilding of England, for her own merchant marine, exceeds that of other countries, and how far, therefore, our great shipbuilding industry is fed by our own requirements. For this purpose we have compiled the above table, which shows the tonnage added to the registers of those countries that compete to any extent in the carrying trade of the world.

The great secret of England's supremacy in shipbuilding is contained in the fact that her own vast commerce necessitates the employment of a much larger merchant navy than that of any other country. The tonnage of vessels that have entered and cleared from the ports of the United Kingdom increased from 42,500,000 tons in 1872 to 64,250,000 tons in 1885. In the former year, the British tonnage—or rather the tonnage that entered and cleared from British ports—was 38 per cent. of the whole tonnage of the eleven chief countries of the world. In the latter year, it was 33 per cent. of such tonnage. If, therefore, Great Britain did not build a ton of shipping for any other country, she would still require to provide for 30 to 35 per cent. of practically the whole shipping trade of the world in meeting her own exceptional wants. We may therefore take it for granted that England is not to be dispossessed of her shipbuilding industry, even if a few of her great ship yards establish branches abroad. No doubt it would be more satisfactory if the works that are being, or are about to be, erected in other countries by English firms, could be kept here; but there appears to be no choice in this matter. It is not a question with the Governments of those countries whether the work can be better or more economically done at home. The ships must be so produced, cost what it may, and therefore in providing such works the great shipbuilders who have undertaken their construction are taking the only possible means of securing the contracts for themselves. The profits on those contracts will come to England; and although English labour will not be wholly employed, it may be taken for granted that every such establishment erected in a foreign country will employ a certain number of English artisans, at a considerable improvement on English rates of pay.

TENDERS for 5460 shares in Cassell & Co., Limited, were opened on the 26th ult. 13,568 shares in all were applied for, the average price of accepted tenders being £14.

BRITISH AND FOREIGN SHIPBUILDING.

Statement showing the Tonnage added to the Registers of the principal maritime countries of the world, 1875-85.

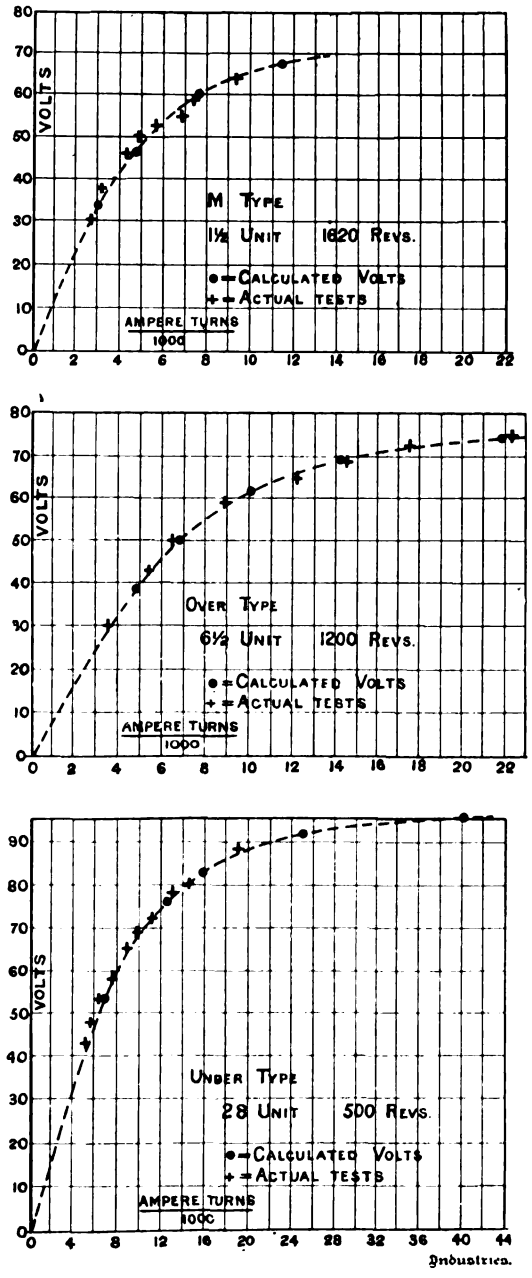
Year.	United Kingdom. Tons.	Germany. Tons.	France. Tons.	Italy. Tons.	Norway, Sweden, and Denmark. Tons.	Holland. Tons.	Total. Tons.
1875	502,585	72,709	64,209	88,678	176,269	21,882	926,332
1876	427,982	69,166	58,719	78,035	144,351	24,404	802,657
1877	493,932	67,768	50,900	44,884	128,824	16,055	802,363
1878	464,511	73,356	44,859	39,080	89,278	22,238	733,322
1879	410,804	90,490	43,728	40,497	73,685	18,178	677,382
1880	411,736	80,827	46,830	31,863	96,852	14,690	682,798
1881	561,750	88,537	55,644	41,090	115,477	18,883	881,381
1882	714,521	118,728	135,206	43,548	107,093	23,777	1,142,873
1883	751,950	128,145	84,610	41,055	126,771	27,560	1,160,091
1884	549,896	85,919	77,634	39,619	128,787	17,032	898,887
1885	423,711	90,160	81,360	29,600	120,000	13,433	758,264
Totals...	5,713,378	965,805	743,699	517,949	1,307,387	218,132	9,466,350

Letters to the Editor.

THE MAGNETIC CIRCUIT OF DYNAMO MACHINES.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Professors Ayrton and Perry have pointed out at the Physical Society that it is practically impossible to calculate the characteristic of a continuous current dynamo from the drawings. I am glad to be able to point out to them that the means of calculating the characteristic can be obtained from the papers on the subject by Mr. Kapp, and from the reports of the discussions on them. I enclose several curves showing the



calculated and actual volts and excitation. I may say that I have lately designed a complete series of dynamos of a new type, and have never had a preliminary test, and though numbers have been made with considerable modifications in the design, the volts at the calculated speed have always been within 2 per cent. of the mean. In many cases the dynamos have not been tested at the factory, but have been fitted on to the bed plate by the engine maker, the allowance made for the effect of the proximity of the engine and fly wheel being found correct. This has been done, not in a lecture room or study, but as part of the duties of a factory manager; and I need hardly point out that the saving of time and expense in being able to build machines without preliminary tests or alterations is immense. The methods I use are simply those given by Mr. Kapp, with the exception of the loss from leakage, in which case I use Professor Forbes' lemmas.

Yours, &c.,
Halifax, 26th March, 1888. HENRY W. RAVENSHAW.

EDISON TUBES IN MILAN.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Referring to the letter of your Milan correspondent in your issue of the 9th inst., no trouble whatever has been experienced with the Edison tubes in Milan, nor have there been any difficulties with leakage of the current. Since the first Edison tubes were laid in 1882 up to date, only fifteen or sixteen tubes out of the 2000 or more actually in use have been taken up, and but few of these had their insulation affected.

Yours, &c.,
Edison Station, Milan, J. W. LIEB.
31st March, 1888.

Legal Proceedings.

MORGAN & COMPANY v. WINDOVER & COMPANY.

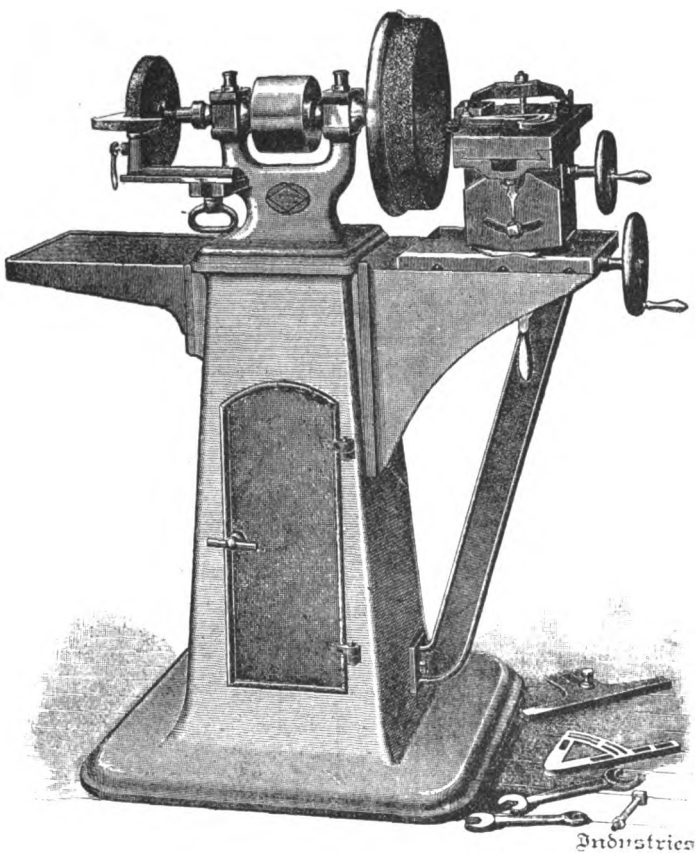
The Court of Appeal gave judgment on Friday, the 23rd ult., in favour of the plaintiffs, thus confirming the judgment of Mr. Justice Kekewich. In 1876 a patent (No. 4216 of 1876) was granted to George Henry Morgan for "improvements in carriages." The action was for infringement of this patent. At the date of this patent there were two ways in which the carriage was supported—(1) By elliptic or bow springs; (2) by C springs. The object in either case is to effect easy motion, and to obviate sudden shocks. There are, however, distinctions between the two methods which require notice. First, as to the action. In the elliptic or closed spring, the action of the spring is vertical, whereas in the C spring there is a horizontal as well as a vertical action. Now, as to the mechanical differences between the construction of the two kinds of carriage. In the carriage which has elliptic springs, it is possible to obtain a full lock. Where C springs are used a half lock only is possible, because of the perch—the perch forming the connection between the back and front wheels. When elliptic springs are used, the carriage itself connects the back and front wheels.

The plaintiffs' case was that, before 1876, no carriage had been constructed with C springs fore and aft without a perch, and that the front spring gave a sensible longitudinal motion. The patentee claimed that he obtained by his invention the advantages of the C spring, dispensed with the perch, and thereby obtained a full lock. The defendants denied the validity of the patent, alleging prior specifications and prior users. The defendants nearly succeeded in one of the prior users set up by them in 1848; but the majority of the Court of Appeal (chiefly on account of the distance of time) would not rely on the memories of the witnesses, and looked on it as an abandoned experiment.

The real interest to inventors in this case centred in the point as to the amount of invention necessary to support letters patent. The objections to the patent took the following form: (*a*) That the plaintiffs' spring was a mechanical equivalent of an elliptic spring; (*b*) that the plaintiffs' spring produced no different effect from an elliptic spring in regard to the support or behaviour of the carriage; (*c*) that there was no novelty in the invention, or no subject matter for a patent, inasmuch as it consisted in using a known article for an analogous purpose to that for which the article was designed. In July last Mr. Justice Kekewich held that the invention had not been anticipated, and also that "the method of application required the exercise of the inventive faculties," and granted to the plaintiffs the injunction and other relief prayed for. The defendants appealed. With the exception of the one prior user referred to, the Court of Appeal were unanimous in their judgment. The judgment was delivered by Lord Justice Cotton, to the effect that the invention was admittedly useful, and that the one point to consider was whether the patent was valid. There was no proof of prior user before 1876 (except the abandoned experiment in 1848), therefore the invention was novel. What, then, asked Lord Justice Cotton, was the true meaning of Mr. Moulton's objection that there was no horizontal motion in the carriages patented by Morgan? If this was an attack on utility, utility has been distinctly proved. If, on the other hand, it was an attack on subject matter, the production of a carriage whereby the perch was got rid of and shocks were obviated, formed the proper subject matter of letters patent. There was horizontal motion, it may be slight, nevertheless

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UNIVERSAL GRINDING MACHINE.



sufficient to lessen shocks. With regard to the objection of insufficiency of invention, that the springs were old, and admittedly had been used on the back wheels, the Court held that the selection of a proper spring, and the adaptation of it in a proper way, did constitute sufficient invention, especially bearing in mind that carriage builders had for many years been trying to obviate the difficulties. The validity of the patent was therefore upheld, and the appeal dismissed.—Sir Richard Webster, Attorney-General, Mr. Aston, Q.C., and Mr. Chadwyck Healey represented the plaintiffs; Mr. Moulton, Q.C., and Mr. John Cutler were for the defendants.

BOILER EXPLOSIONS IN AMERICA.

The *Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Company, Hartford, Connecticut, states that no less than 198 boiler explosions occurred in the United States during the year 1887, by which 264 persons lost their lives, and 388 were seriously injured; making a grand total of 652 persons killed or badly hurt. They are classified as follows:—

Saw mills and other wood working establishments	73
Locomotives	14
Steamships, tugs, and other steam vessels	14
Portable boilers, crane boilers, and agricultural engines	20
Mines, oil wells, and collieries	13
Paper mills, bleacheries, digesters, &c.	5
Rolling mills and iron works	15
Distilleries, breweries, dye works, sugar houses, and rendering works	9
Flour mills and grain elevators	7
Textile manufactories	1
Miscellaneous	27
Total	198

Nearly 37 per cent. of the whole number of explosions were, as usual, furnished by saw mill boilers. Portable boilers, crane boilers, and agricultural boilers came next, but their number forms little more than one-fourth of those occurring in saw mills. Rolling mills follow with fifteen explosions, while locomotives and steam vessels tie for the fourth place, the other classes supplying about the usual number of explosions. The number of explosions in the United States during the year 1886 was 185, killing 254 persons, and injuring 314; there is therefore a slight increase in the year 1887, both in the number of explosions and also of the killed and injured. The Americans are certainly far and away before us for frequency and fatality of boiler explosions. Our list for the year 1886-1887, of 24 boiler explosions, causing 37 deaths and 44 injuries, has a lean and beggarly look beside the fat and plethoric one given above. It is a list which can scarcely be viewed with feelings of complacency by American engineers, and it certainly should receive their careful and serious attention.

UNIVERSAL FACE AND ANGLE GRINDING MACHINE.

The above illustration, for which we are indebted to our comtemporary the *American Machinist*, represents a new universal face and angle grinding machine, recently introduced by the Diamond Machine Company, Providence, R.I. This machine is intended for the grinding of a large variety of work where only a small amount of metal has to be removed and a flat and true surface is required. It is claimed that this machine does the work of light planing and milling machines much quicker than the latter, besides giving a better surface to the work under operation. The work is secured either direct or by means of special devices to a slide rest, which is adjustable to any required angle in the vertical plane, and carries a pointer and graduated scale, to enable the operator to set or re-set the slide rest to a given angle for grinding bevel surfaces true and exactly alike. The slide rest is supported by a pivot on a graduated plate, so that it can be made to form any angle in the horizontal plane with the axis of the shaft on which the grinding wheels are fixed. One of the grinding wheels shown in our illustration is of an annular or cup shape, and has a diameter of 12 inches.

SHIPBUILDING NOTES.

A few days ago there was launched from the yard of the Sunderland Shipbuilding Company, Limited, South Docks, Sunderland, the steel screw steamer "Chanzy," built to the order of a firm at Caen, France. The dimensions of the steamer are: Length between perpendiculars, 190ft.; breadth, 30ft.; and depth of hold, 14ft. The vessel is classed 100 A1 at Lloyd's, under special survey, and has a long raised quarter deck, extending to the fore end of the boiler space; short hurricane house, in which there is accommodation for the captain and officers, and topgallant forecastle, with crew accommodation. Patent windlass, two steam winches, wheel and pinion steering gear amidships, and screw steering gear aft, are included in the deck outfit. The vessel has been specially designed to carry a large cargo upon a small net register tonnage, and will be employed in the coal trade between Wales and Caen, and has three large cargo hatches fitted with patent cleats. The main, quarter, and forecastle decks are of iron, and the hurricane house deck of wood. The engines—on the triple expansion system—are being fitted by the North-Eastern Marine Engineering Company, Limited, Sunderland, and have cylinders 16in., 26in., and 43in. in diameter, 30in. length of stroke. The boiler is of steel, and of 150lb. per square inch working pressure.

Two small steel screw steamers for passenger service in the Mediterranean were launched by Messrs. William Simons & Co., of Renfrew, on the 24th ult. The vessels are fitted with engines of 85 h.p., the boilers being constructed for a working pressure of 120lb.—On the same date, Messrs. Russell & Co., Port Glasgow, launched the "Victoria" steel screw steamer—298ft. long, 38ft. 5in broad; 1600 tons net register; carrying capacity, 3600 tons. The vessel has been built to the order of Mr. F. Woods, London, and the construction has been superintended by Mr. David Pollock, naval architect, Glasgow. The engines, which are to be of the triple expansion type, will be supplied by Messrs. James Howden & Co., Glasgow.

On Tuesday afternoon, the 27th ult., there was successfully launched from the yard of Messrs. William Doxford and Sons, Pallion, the new screw steamer "Julio," built for the Compania Bilbaina de Navegacion, Bilbao. The "Julio" is built of steel, her dimensions being: Length, 275ft.; width, 36ft.; depth of hold, 23½ft. The vessel is intended for the wine trade. Her engines have triple expansion cylinders, 20in., 33in., and 54in. diam., and 36in. stroke. The vessel will carry 2800 tons cargo on 19ft. draught, and is in every way fitted with the most modern arrangements for economical trading.

A twin screw steamer, the "Neptune," built from the model and plans and under the superintendence of Mr. William Glove, of Liverpool, for the Mersey Docks and Harbour Board, was launched on the 26th ult. from the yard of Messrs. R. & J. Evans & Co., Brunswick Dock. The vessel was then taken to the Sandon Graving Dock to receive the engines and machinery, made by Messrs. D. Rollo & Sons. The vessel is to act as a dock tug, and will also be fitted with a Merryweather fire engine, capable of throwing a jet of water 190ft. high at the rate of 750 gallons per minute.

On Monday, the 2nd inst., there was launched from the yard of the Fairfield Shipbuilding and Engineering Company, Glasgow, the "Lady Torfrida" screw steam yacht for Sir William Pearce, Bart., M.P. The new "Lady Torfrida" is larger than the former vessel of the same name. The tonnage yacht measurement is 735 tons. The length of the vessel is 216½ft., breadth 27ft., and the moulded depth 19ft. The engines, which are of the triple expansion type, are to indicate 1400 h.p. The yacht will be lighted throughout by electricity, and the appointments will be of the most luxurious description.

On the 28th ult. there was launched from the yard of Messrs. S. P. Austin & Son, Sunderland, the screw steamer "Orkla," built to the order of a Leith firm. The vessel has been constructed of Siemens-Martin steel, and is of the following dimensions: Length between perpendiculars, 282ft.; breadth, 38ft.; depth, 19ft. 3in. There is a full poop, long hurricane house to fore hatch, topgallant forecastle, iron masts, and cellular bottom for water ballast. The engines are of the triple expansion type, and are of 200 n.h.p.; they have been built by Mr. George Clark, of the Southwick Engine Works.

On the 28th ult. there was launched from the yard of Messrs. Jos. L. Thompson & Sons, North Sands Shipbuilding Yard, Sunderland, the steel steamer "Resolution," which has been built to the order of Messrs. Rowland and Marwood, of Whitby. The vessel is of the well-decked type; length between perpendiculars, 284ft.; breadth, 37ft. 10in.; depth, 20ft. 10in.; and has a dead weight capacity of 3050 tons on a light draught. The engines are given as 181 h.p., and are of the triple expansion type. They were built by Messrs. Thomas Richardson & Sons, of West Hartlepool.

On Tuesday morning, the 3rd inst., Messrs. Raylton, Dixon, & Co. launched from the Cleveland Dockyard, Middlesbrough, a fine steel screw steamer, named the "Guy Colin," which has been built to the order of G. E. Bowring, Esq., of London. Her dimensions are: Length, 300ft.; breadth, 38ft. 2in.; depth, 20ft. 6in.; having a dead weight capacity of about 3350 tons. The engines will be fitted by Messrs. Richardson & Sons, of Hartlepool.

Messrs. W. Richardson & Co., Newcastle, launched, on March 29th, a fine steamer, named the "Alfonso XII.," which is intended for the mail and passenger service between Spain and the Antilles. The vessel, which has stood on the stocks in a nearly completed state for four years, was purchased by the present owners a few months ago, and has since been greatly altered to suit their requirements. The vessel is 426ft. long, 47½ft. wide, and 36ft. deep, and has a carrying capacity of over 5000 tons. She will be elaborately fitted out, and is likely to take rank with the very finest ships afloat.

Messrs. Alexander Stephen & Sons launched last week from their yard at Linthouse, Glasgow, a steel screw steamer of 2500 tons carrying capacity. This vessel has been built to the order of Messrs. Maclay & MacIntyre, Glasgow. The engines are to be triple expansion, the cylinders being respectively 18in., 29in., and 46in. diam.

Reviews.

Dictionnaire d'Électricité et de Magnétisme. By Ernest Jacquez. Paris: Libraire C. Klincksieck.

This is the second edition of a work which originally appeared in 1883. We learn from the preface that over four hundred words have been added in order to bring the book up to the present date. The book is a dictionary of French terms used in connection with applied electricity and magnetism, and the German and English terms are also added. At the end of the volume is a German-French and an English-French dictionary of electrical

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terms, by which addition the book is rendered useful not only to French, but also to German and English readers. The explanations given are generally clear and correct, but in many cases not sufficiently detailed; whilst in the historical portion of the work there is a certain tendency to give rather more than a due share of credit to the French scientists, whereas the work done by other nations is often omitted. Thus, for instance, we read in the chapter on thermopiles that the laws of thermo-electricity were discovered by Becquerel, whereas in reality the most important contributions to this science were made by Thomson and Tait. In the chapter on dynamo machines the credit of having established their theory is similarly given to Marcel Deprez, and not to the German and English physicists who have done the greater portion of this work. Practical electricians will be disappointed if they expect to find short descriptions of modern dynamos in this book. Under the title "dynamo-electrique," mention is made of the Siemens, Wheatstone, Gramme, and Wilde machines; but the names of Bürgin, Brush, Crompton, Weston, Edison, Hopkinson, &c., are conspicuous by their absence. The paragraph on electric transmission of energy is a long way behind the times, being mainly a general discourse on the experiments made by Marcel Deprez, and the old exploded theories that the ratio of speed between generator and motor is a measure of the efficiency, and that the efficiency is independent of the distance of transmission, are again set forth at great length. The paragraphs which deal with purely scientific matters, and especially those devoted to the absolute system of measurement, are, however, very well written; but it is evident that the author of this dictionary is more at home in the physical laboratory than in the workshop of a practical electrician.

The Theory and Practice of Electric Deposition. By Dr. G. Gore, F.R.S. New Edition. London: Charles & Co.

In this well known little book the student is guided by a strictly inductive exposition from the first principles of the subject to a familiar knowledge of all the practical details of the electrolytic art. It is at all times somewhat hard to decide on the best arrangement of an elementary text book; how far the strict sequence of the phenomena and their deductions are to be followed, and how much, and at what points, light from a more advanced stage is to be admitted. In the present work much care and thought have evidently been expended upon this point, the outcome of which is that the author divides his subject into three heads, viz.: (1) The facts observed in electrolysis; (2) The principles underlying these results; (3) Practical recipes and rules for use in the workshop. The first of these is divided into seven sub-headings on the different modes of deposition, viz.: by (1) One metal and one liquid; (2) Two metals and one liquid; (3) One metal and two liquids; (4) Two metals and two liquids; (5) By using any of the above, except the first, as a source of e.m.f. and connecting to a separate depositing liquid; (6) Same as above, but with some other source of e.m.f., and (7) Combinations of the foregoing. Seven conditions of deposition are also named under the second heading of "Principles." The above arrangement of the subject is quoted by the author as having been marked by much success in the lecture room, and this is apparently the chief reason advanced for its adoption in the present work. That it should be best to follow a strictly inductive progress in a class where experimental demonstration can be resorted to, and where the interest of pupils can be sustained by personal influence, we have no doubt whatever, but we are by no means so sure that the same course should be followed in a text book. By such a system the student is presented with a mass of phenomena occurring under certain conditions, and also with an equally voluminous list in which the results are negative. These he wades through and laboriously strives to fix upon his memory; but in all probability only succeeds in reducing them to a state of chaos in his mind. Here we certainly think it would have been better to introduce the electro-chemical law at the outset, together with the calorific principles involved in the decomposition of an electrolyte. From thence it would have been an easy step to the true conception of e.m.f., thus paving the way to a quantitative treatment in the electrical branch of the subject. Having once grasped the idea of the close alliance between, or we might almost say, the identity of e.m.f. and chemical tension, the student would experience a new interest in his study, and would also be equipped with a powerful mental tool wherewith to handle the somewhat complex questions arising in practical work. We do not wish by these remarks to detract in any way from the undeniable merits of the book, considered merely as a popular treatise on electrolysis. As a text book for students it might be improved; as a popular treatise it is highly commendable, both in clearness of style and thoroughness of detail, whilst the practical information contained will prove of great value to those engaged in electrolytic processes.

The Practical Engineer's Hand Book. By Walter Hutton. London: Crosby Lockwood & Co., 1887.

This volume is designed as a companion to the author's book, "The Works Manager's Hand Book," which we have already noticed, and the two works form a most valuable compendium of mechanical engineering knowledge, as they both contain a good synopsis of the chief departments of applied science, in simple language, and in a concise and condensed form, as well as the results of recent researches and experience in the various branches of engineering, a considerable quantity of which has not been published before, but collected for the author's use in the course of his own work. The whole has been exceedingly well arranged, and is certain to find a place in many drawing offices. The following synopsis of the contents of the volume now under consideration will give some idea of their range: Air, gas, and water; air motors, gas engines, and water motors; fuel, combustion, products of combustion; heating power and evaporative power of fuel, evaporation of water to steam; heat and heat energy; methods of burning liquid fuel and refuse fuels; evaporative effect of natural draught and forced draught in the furnaces of steam boilers; propulsion of modern steamships, with description of, and rules for, various propellers; evaporative performance of various kinds of modern steam boilers; boiler explosions, their causes, and the usual manner in which boilers explode; rules and practical data for the construction of modern locomotive, stationary, and marine engines and boilers; rules and practical data for triple expansion and quadruple expansion engines; strength and specific gravity of a variety of materials, collated from careful experimental data. Such a wide range of subjects might be supposed to necessitate very shallow treatment; but this is by no means the case, as each department is treated with a completeness which will be found to fully meet the wants of the majority of practical men. The part on boilers of different kinds is of considerable value, embodying, as it does, all recent experience, combined with a good outline of the principles involved, while that on the design of engines is about the best practical guide which we have yet seen. The only critical observation which we may offer is that in some cases the rules given are too numerous, and no sufficient opinion given as to which is to be preferred, and so the young engineer is apt to be confused. We have outgrown the ordinary pocket book crammed full of formulæ of all kinds, with no statement as to how they have been derived. On the other hand, the text books are beginning to develop in the direction of putting their results into practical shape, so that they may be used by engineers. Mr. Hutton's books are intermediate between the pocket books and the text books, and represents the tendency of their development in opposite directions—the one in the direction of more science, and the other in that of more practice. The ultimate form will thus be one which we have often indicated, and will contain sufficient science to show the general principles which underlie all cases, for which rational formulæ will be deducted, and from these, by the substitution of the contents representing current practice, empirical expressions will be obtained, which can be immediately applied.

Sewage Treatment: Purification and Utilisation. G. W. Slater. London: Whittaker & Co.

The sewage question is to science in this country what the Irish question is to politics, in the sense and result of begetting a good deal of barren controversy, and promoting active dissensions amongst a body of men holding perhaps identical views on a great number of cognate subjects. Whilst, however, chemists have been engaged in fighting the great "battle of the standards," the practical habit and sanitary instinct of the nation have accomplished very much in the establishment of effective house drainage, and have given us a very efficient system for the immediate disposal of the interesting and complex waste products, denominated sewage. But every sense of complacency we have in contemplating this partial solution of a great difficulty is dispelled when we confront ourselves with the major problem which survives, viz., How to dispose of the enormous volume of polluted water continually issuing, under this system, from our centres of population. This is the problem dealt with by Mr. Slater in the volume before us. At the outset, we may congratulate the author on the production of a very readable work, not a small merit in these days of dry technical literature. The author's method is the "natural" one. Having enlightened the readers as to the complex nature of sewage, *i.e.*, the multitudinous sources of the products which it may comprise, and as to the how, when, and where of its injuries to animal life, he gives an account of the cesspool system and its transition under the "evolving pressure" of increasing population to our now general system of water carriage. Having thus converted our tribe of tiny demons into the one stupendous giant, we are taken through the armoury of clumsy weapons with which science has equipped us for the combat; but the tour of inspection, we venture to predict, will be found eminently unsatisfactory. The London schemes and their authors, Sir J. Bazalgette and his chemist auxiliaries, are very inconsiderately dealt with. Treating of irrigation with raw sewage, the author points out the acknowledged defects of the system—choking of the soil, the non-removal of disease germs, and the liability to putrescence of vegetables grown under irrigation; admitting, however, that the evils may be minimised by periods of rest. In the chapter on filtration, Professor Frankland and Mr. Bailey Denton, and the schemes they have proposed, are somewhat sarcastically dealt with. In treating of Professor Robinson's proposed scheme (1884), the author falls into a vein of criticism which is quite out of place in a work of this character. In the opening of the chapter on precipitation, the author effectively disposes of the contention that this treatment, while it may clarify the sewage, does not purify the solution. Then follows a succinct account of the various methods which have been proposed and tried. The author's condemnation of lime we cannot indorse on the reasons given, viz., that it gives an alkaline effluent, and therefore favours decomposition. We ask, why not? If decomposable matter is present, why not attack it? And, again, the author's experience, we are sure, has not led him to conclude that atmospheric oxidation, our most powerful natural auxiliary, is most effective in presence of an acid, or, at least, absence of alkaline reaction. A due consideration of this factor would probably mitigate his condemnation. On the contrary, observation and experience shows that the best system of sewage treatment is a lime precipitation, but followed, whenever practicable, by irrigation with the effluent. Is this what the author means by the term "inverse irrigation" (page 107), which, he says, "is included in every properly managed precipitation process, and which gets rid of almost all the objections which can be raised against irrigation direct?" In the same chapter we also find denounced as a "capital mistake" the practice of building sheds over the precipitating tanks. From this we also dissent. The author gives as his reasons, amongst others, that "free contact with air and access of light assist us little in purifying the sewage;" and further, "if the tanks .... give off a bad smell it is a proof that the process is not being satisfactorily worked." To this we object (1) that a still atmosphere above the tanks is a most important auxiliary to precipitation; (2) the amount of possible purification by air and light *in* the tanks is a minimum; and (3) if a bad smell is given off, and is an element in the diagnosis of the working, it is as well to confine it for observation. In this reasoning we are supported by the experience of Mr. C. Jones, C.E., of Ealing, who has come to very definite conclusions upon this particular point.

In the chapter on "deodorising" which follows, various methods of further treatment of sewage effluents are discussed, including the permanganate process adopted by the Metropolitan Board. The author dismisses them as either ineffective or too costly, or both, as in the last mentioned case. "Destruction," the heading of the following chapter, is very cursorily noticed. The disposal of "dust bin" refuse is a very important complement to our sewage schemes, and the difficulty is very efficiently dealt with in the "destructor" system as worked at Ealing, Bournemouth, Southampton, and some twenty other towns in England. It is true that at Ealing the precipitation sludge is also put through the fire and so lost to agriculture excepting indirectly, and in so far as the organic elements are returned in the form of ultimate products of combustion. This is a shock to the earlier idealists no doubt, but to practical men it is purely a question of economy, and the result at Ealing is satisfactory. In the chapter on promiscuous methods—the adjective is not without a touch of sarcasm—we find such processes as distillation, freezing, and the earlier proposals for "electric" treatment. Two of these, in the light of recent advances, may come to have a new significance. Mr. Gargan, the inventor of the new system of evaporation now well known, we are informed, undertook to distil certain polluted water for the City of Chicago, at a cost of 6d. per 1000 gallons. Such a proposition gives a new aspect to the question before us.

The "electric" treatment of sewage has a mysterious ring about it. This vagueness will be removed when the details of two schemes, now fully known to the officials of the Patent Office, are published, viz., those of Mr. Webster and of Mr. Hermite. On the latter we have had some conversation with the inventor, and his method appears to be specifically electrolytic, the purifying agent being electrolytic oxygen. Presuming that water power will be available, the cost of the system will be that of the motor dynamos and electrodes. It would be premature to discuss the proposal; we can only say that the experimental evidence fully demonstrates the efficiency of the agent. The chapter on the "Detection of Sewage Pollution" is well written and full of useful directions for observation. The "common sense" criteria of purity proposed at the conclusion are still arbitrary, yet a

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welcome relief from the strained standards of the Royal Commission of ancient history. They are (*a*) absence of colour and turbidity; (*b*) absence of alkaline reaction—this we should be inclined to qualify for the reasons already given; (c) no turbidity produced by sulphate of alumina, one grain to one pint; and finally (*d*) absence of a persisting froth on shaking. The concluding chapters on the treatment of sludge and on sewage manure need no special comment. The penultimate chapter on sewage patents is an imposing record in more senses perhaps than one. Out of the 454 processes, how many survive? In the last chapter the author reproduces the discussion on Dr. Tidy's paper of May 15th, 1886, before the Society of Arts. We have endeavoured to give a fair outline of the work, and in concluding our notice we give our *general* impression of the book, which is that it is suited to laymen, who will find it very interesting reading, rather than to specialists.

Gun Making in the United States. By Captain Rogers Birnie. Ordnance Department, United States Army.

The above pamphlet is the reproduction of a lecture delivered at the close of last year before the Military Service Institution, and contains a capital summary of the gun question in the United States, gradually tracing events from the period of the cast iron guns of 1860 to the forged steel ordnance of to-day. Many things contributed to the slow progress made by the United States in the development of their artillery, nor was it till quite recently that decisive steps were taken to raise its efficiency. Eight years ago no steel gun had yet been constructed in that country, and the most powerful weapons in the States were converted cast iron guns with steel tubes; guns confessedly of third rate power, and even at the present moment the only ones available for coast defence. But in 1880 the Navy Bureau, being convinced of the necessity of new type guns, turned their attention to steel, and in 1883 a vote of Congress so strengethened the hands of the Ordnance Department, that it entered seriously into the construction of ordnance made from forged steel, and every encouragement was given to the home production of that metal.

Since 1883, this department has procured from American manufacturers some 200 tons of oil tempered and annealed gun steel forgings, which have been supplied principally by the Midvale Steel Company and the Cambria Iron and Steel Works. Of this material, a portion has been used for the manufacture of guns under 13 tons, and with the rest very important experiments have been carried out, with the object of elucidating the principles of gun construction. Amongst these the following may be noted: (1) Shrinkage and specimen tests of steel hoops, to determine qualities of metal best suited for purposes of gun construction, based on methods of treatment in manufacture; (2) construction of a compound cylinder, representing a full section through the reinforce (around chamber) of the 8in. breech loading steel gun; (3) frictional resistance to longitudinal separation of finished steel cylinders, shrunk one over the other, as in gun construction; (4) shrinkage and specimen tests of forged steel trunnion hoop, to determine qualities of metal throughout the forging; (5) examination of the strains produced by oil treatment, and the effect of, after annealing, in removing injurious strains from the forgings. Captain Birnie enters with some detail into a consideration of these and other preliminary experiments, and also sets forth the theoretical formula made use of in America. In an appendix, the subject of initial tensions is treated from a mathematical point of view.

In June, 1886, the Ordnance Department completed their largest gun, the 8in. breech loader of 13½ tons, for which the heavier forgings were supplied by the Whitworth Company. Its projectile weighs 300lb., and its powder charge is 113lb., giving a muzzle velocity of 1852ft., and a muzzle energy of 7133ft.-tons. The pressure is 16 tons. The construction of this gun somewhat resembles that of our 8in. breech loader, Mark III. or IV., but differs entirely from the latest design approved here for this calibre. It consists of a tube with a jacket shrunk over it, which extends to the trunnions. Over the jacket are two layers of hoops, those of each layer breaking joint; there is a trunnion ring, in rear of which the second layer terminates, and in front of the latter the tube is hooped to the muzzle with a second strengthening layer of hoops, extending for 29½in. in front of the jacket. The interrupted screw breech mechanism is adopted for this and all other new type guns. Commencing somewhat earlier, the Navy Yard has accomplished more than the Ordnance Department, and since 1883 have turned out twenty-one 6in. guns, eight 8in. guns, and two 10in. guns. In their main features the Navy and Army steel guns are alike, the most important difference in construction being that in the Navy guns the trunnion hoops are made of oiled, tempered, and annealed castings, and are screwed on cold; while in the others these hoops are forged, and put on by shrinkage.

In addition to the forged steel ordnance, it is proposed to try cast steel, and Captain Birnie argues out very fairly that, even if this system answers for medium calibres, the day is distant when they may hope to manufacture in America heavy ordnance in this way. However that may be, the Navy Department were granted the money last year to purchase three cast steel 6in. guns—one to be of Bessemer steel, one of open hearth (Martin-Siemens), and one of crucible steel. No bid was made to supply the last; but the Pittsburg Steel Casting Company have contracted for the first, and the Standard Steel Casting Company the second.

The main features of the two specifications are as follow:—Casting rough bored and turned Bessemer steel: Cost, $3,300; elastic limit, 40,000lb.; tensile limit, 80,000lb.; ultimate elongation, 7 per cent.; reduction of area, 7 per cent.; weight of finished gun, 11,000lb.; length of finished gun, 193·53in. Casting rough bored and turned open hearth steel: Cost, $5,300; elastic limit, 30,000lb.; tensile limit, 70,000lb.; ultimate elongation, 10 per cent.; reduction of area, 5 per cent.; weight of finished gun, 15,000lb.; length of finished gun, 193·53in. Casting rough bored and turned forging for 7in. steel howitzer (from Cambria Company): Elastic limit, 47,250lb.; tensile limit, 92,750lb.; ultimate elongation, 21·1 per cent.; reduction of area, 29 per cent. The forging is added for purpose of comparison with the castings, which would appear to be inferior in physical qualities.

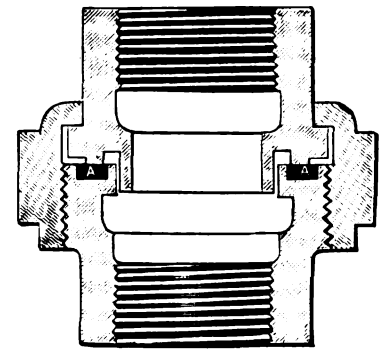
Many interesting features of the pamphlet we have not even touched upon, and we can confidently recommend its perusal to our steel makers as a précis of gun making in the United States.

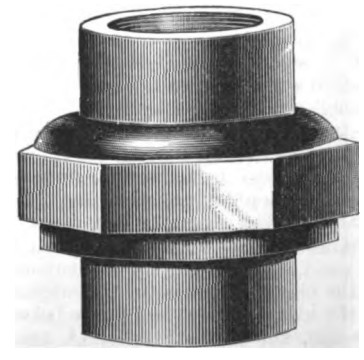
A Text Book of Paper Making. By C. F. Cross and E. J. Bevan. London and New York: E. & F. N. Spon. 1888.

We are glad to see that Messrs. Cross and Bevan have found time to write such a valuable contribution to our knowledge of paper making as the volume now before us. The scientific details of this industry require some one with more than mere technical knowledge to write a satisfactory account of the nature of cellulose, and the different operations required before the crude materials are converted into paper. The chemical and botanical attainments of the authors, and their previous scientific work, have enabled them to produce a text book which may be taken as a model of what an industrial text book should be. In their preface they state that their belief in the importance of a thorough scientific training for paper makers has dictated the style and purpose of the book, and we hope that all engaged in this industry will feel the truth of this statement. On reading the several chapters we are convinced that the majority of those now engaged in paper making will fail to follow the first chapter, which is devoted to a consideration of the chemical properties of typical members of the cellulose group, with reference to their natural history. It is well for the manufacturer to find thus early in the work his own want of knowledge of the fundamental changes, and the nature of the material employed in the work on which he is engaged, if only to show him the value of the work which scientific men from time to time have done towards perfecting and simplifying many of our industries. Chapter V., on the processes for isolating cellulose from plant substances, gives a very complete *résumé* of the various methods for the resolution of pecto- and ligno-celluloses by aqueous alkalies, alkaline sulphides, water, neutral sulphites, acids, and bisulphites. Pictet's method for disintegrating wood by means of sulphurous acid, and Francke's and Graham's processes in which the hydrolysis effected by the sulphurous acid is supplemented by combining the products with bisulphites, are discussed in this chapter. The different special treatment of various fibres, and the boiling processes employed with rags, esparto, and straw form the subject matter of the next chapter, and it is illustrated by figures of the plant employed. The important subject of bleaching is dealt with separately in a short chapter, and in it we have given a brief account of the new process for electrolytic bleaching, which has been recently developed by M. Hermite. This method has already been alluded to in this journal, and the authors having devoted some time to an investigation of its merits, seem very confident that the process will be found both a convenient and economic one. Bleaching effected by the use of the electrolysed magnesium chloride solution used is much more rapid than by the older processes, and the loss of weight which the substances undergo is less, for equal degrees of whiteness obtained. It is an inexplicable, but well confirmed, fact that such an electrolysed solution has a greater bleaching efficiency as measured by arsenious acid, that solutions of bleaching powder in the proportion of five to three; and from the trials which have already been made of this method, it appears that the bleaching of paper pulp can be effected at nearly one half the cost of bleaching powder. The beating of the bleached pulp is next described, and details of new forms of beaters, lately introduced into this country by Messrs. G. & W. Bertram, and of the beater devised by Cooke & Hibbert, are given. The next three chapters are devoted to a description of the methods employed for the mechanical processes of loading, sizing, colouring, calendering, cutting, and finishing, and to a discussion of paper machines and details of the manufacture of hand made paper. The "Fourdrinier" paper machine, with its modern improvements, is carefully described and illustrated, and the newer forms of self cleaning steamers and pulp savers also receive attention. Chapter XII. is an important one, and deals with the recovering of caustic soda and the methods employed for causticising the carbonate of soda; and in an addenda at the end of the volume a description of the Yaryan process for evaporation, as carried out in some of the largest paper mills in the United States, and Messrs. Bremner, Mond, & Co.'s ferric oxide causticising process, is given. The subject of paper testing, and the chemical and microscopical analyses of the materials employed, are discussed in the concluding pages. The chemical identification of the fibres in any paper by means of aniline sulphate has been worked out by the authors themselves, and by its use very small quantities of straw or esparto pulp in a paper can be detected with certainty. The preparation of the Willesden goods by means of the cuprammonium solution, patented by Dr. C. R. Alder Wright, and notes on the choice of a suitable site for the erection of a paper mill in relation to the water supply, and the methods for the purification of water by the Porter-Clark process, and with the Stanhope purifier, conclude the volume. Statistics of the paper industry to the close of 1884, and a catalogue of the more important contributions to the literature of the subject, are also given in the hand book. The chapter on the treatment of wood, we understand from the preface, formed the subject of the prize essay of the Scottish Paper Makers' Association, given in connection with the Edinburgh Forestry Exhibition in 1884. We cannot conclude without strongly recommending this work to all those interested in the subject, and congratulate the authors on the production of such a useful text book.

THE "LANCASTER" PIPE UNION.

The accompanying illustrations show a neat form of socket or union, invented by Messrs. Pancoast & Maule, Philadelphia, United States, for connecting pipes, which is intended to take the place of the flange and socket connection now in use. The sectional view shows the arrangement of the different parts, A A being a ring of non-corrosive metal. The whole of it is made of malleable iron except the ring A A. The advantages claimed are, that the metal packing lasts a long time—as it will not blow out or become oxidised—and that it is simpler than





the connections now in use, and obviates the use of rubber or leather packing. The chief feature of this union is its low price as compared with other connections. We understand that the metal packing will, for all practical purposes, resist the influences of steam, water, gas, acids, oil, ammonia, coal and natural gas, &c.; and the arrangement is therefore likely, considering its low price, to prove useful in many industrial branches. Messrs. Lancaster & Tonge, Lancaster Works, Pendleton, Manchester, are the sole agents for this useful device.

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BROUGH'S AUTOMATIC VALVES.

In the accompanying illustrations, Fig. 1 represents a combined automatic drain and escape valve for steam engine cylinders; while Figs. 2, 3, and 4 show a combined automatic and ordinary water gauge fitting for steam boilers. Both these apparatus have been designed by Mr. Robert Brough, Sunderland. The combined automatic drain and escape valve (Fig. 1) is intended to reduce the danger arising out of the accumulation of water in cylinders, which causes occasionally the breaking of cylinders, cylinder covers, or the bending of piston rods. The valve may be fitted to the cylinders of marine, stationary, or locomotive engines. A A, in Fig 1, are two valve boxes enclosing the valve B and a piston C connected to it. The ends D D of the valve boxes may be attached to the cylinders in the ordinary manner. Both valve boxes are connected by means of a pipe E, into any part of which a hollow plug cock F is fitted. One side of F is in communication with the boiler by means of the tube G, while the other side is open. The area of the piston being greater than that of the valve, the pressure of the steam keeps the latter shut until the pressure caused by the compression of the steam or condensed water in the cylinder becomes excessive, when the valve B is opened and the waste discharged through the pipe H. If it be required to blow through the cock F is turned into such a position as to cut off the pipe G from the pipe E, and to establish a communication between E and the atmosphere, when the valve B will open and remain so until F is turned back to its former position. J are handles fitted with square ends engaging the piston C, and provided with valve seatings L, and passing through stuffing boxes, so that leakage is practically prevented. By means of J the valve B may be turned if it should become leaky.

Figs. 2, 3, and 4 represent a combined automatic and ordinary water gauge valve. This valve is intended for automatically closing the communication between the boiler and gauge glass in case of the latter breaking, thereby preventing the danger to the boiler attendant due to scalding, or damage to the boiler through collapsed furnaces. The water passes from the boiler through N N and the valve O into the gauge glass. Fig. 4, which is a section along the line A B (Fig. 3), shows valve O in section. The valve O, the piston P, and the cam box K are cast in

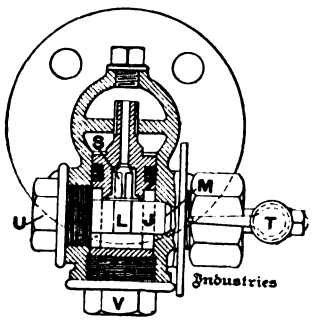


Fig. 4

one piece, the valve O having a perforation, while the piston P is provided with a valve S, shown in Fig. 4. The water passing through N gets through the perforation in O to the back of the piston P, thereby keeping it in equilibrium. As soon as the glass breaks the pressure on the top of P is relieved and the valve O closes, thereby preventing the water from escaping out of the boiler. The cam L and spindle J (see Figs. 2 and 4) are actuated by the handle T, which is provided with a pointer moving over an index plate W. According to the position of T the apparatus may be used either as an automatic one or an ordinary one. If the handle T be turned into the position marked "open" the cam L engages with the plate shown at the end of the cam box L, thereby keeping piston P and valve O open, even if the glass broke. The apparatus is then converted into an ordinary gauge glass. In the position marked "automatic" the cam L is disengaged from P and O, and does not influence either. If the handle be turned into the position marked "shut" the cam L closes the valve O, and also the auxiliary valve S. The plug nut V may then be removed for cleaning purposes. The only part which is liable to leakage is the cam spindle J, which is therefore provided with the valve seating M and a stuffing box (shown in Fig. 2), so that the leakage is rendered inconsiderable.

Engineering.—The royal factory of steam and other engines in Amsterdam is the largest private company in Holland. A short while ago a new loan of 300,000 guilders was raised by them, and the money will enable the directors to go in for big contracts with foreign Governments. The company commenced shipbuilding in 1882, and negotiations for new war vessels of a special type are now pending with Spain, Japan, and other countries.

BROUGH'S AUTOMATIC VALVES.

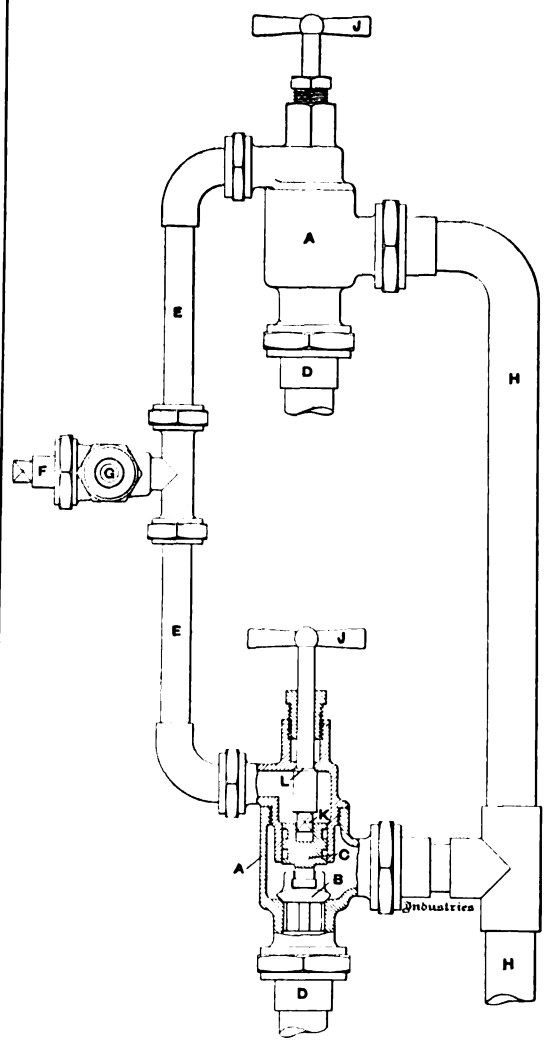


Fig. 1.

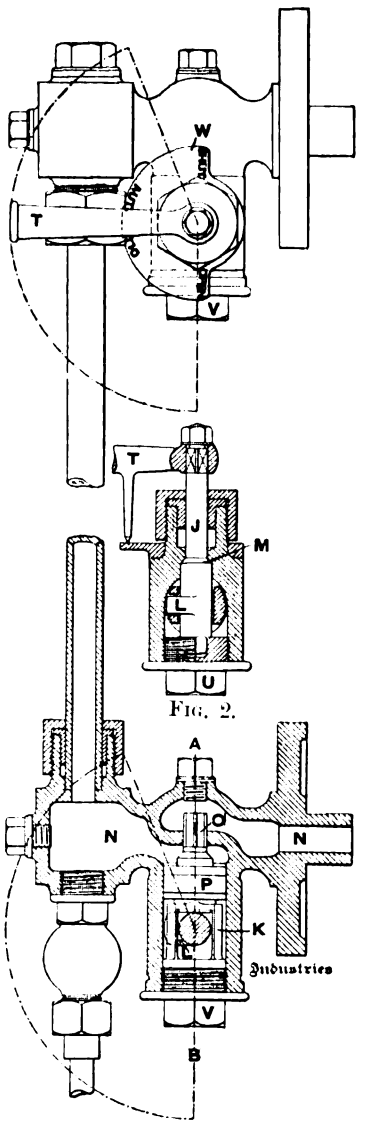


Fig. 3.

Fig. 2.

STEEL SLEEPERS.*

In commencing, the author stated that his paper was not intended to be a complete *résumé* of the many questions involved in the use of iron permanent way; he desired simply to record a few brief notes on some points that have been brought before his notice during some experience gained in the manufacture and use of metal sleepers.

The introduction of iron for timber bearers to carry the rails was a by no means recent event. The late Mr. Greaves was, the writer believed, the first to design the cast iron pot sleeper that has since been employed in various forms, and in which the chair and sleeper were cast in one piece and maintained in gauge by transverse rods. The use of this and other similar forms brought out a fact that might have been anticipated at the outset, viz., that some nicety is essential in fitting and connecting up the line, and that, unless care is observed in making the castings, and adjusting the holes, a great deal of trouble is experienced in laying, especially in a foreign country, where mechanical appliances are not always at hand to remedy the manufacturer's defects. This is the point where timber shows up to such great advantage, and apart from other considerations in its favour, the writer believed it may generally be laid down as an axiom that, if suitable timber can be obtained at a reasonable price, it is not wise to employ either cast or wrought iron or steel in preference to it.

This conclusion would, of course, largely depend on the cost of steel, for the natural advantages of this material, and the perfection to which its manufacture has been brought, entitle it to a preference over wrought or cast iron, and its recent extraordinarily low price must not be regarded as a permanent standard for estimation. The author had not had an opportunity of making comparisons of cost over a series of years; but from abstracts of papers, written by German engineers in 1885, it appeared that one of these gentlemen estimated the life of a wooden sleeper, costing in the first instance 4s., at twelve years, and maintenance being excluded, the charge per annum is reckoned at 5·2d.; similarly, an iron sleeper (presumably wrought and not cast, though it is not stated which material is referred to) costing 8s., with a life of thirty years, works out to 4·9d. This proportion was said to be based on twenty years of practical experience; but the writer did not believe that sufficient time had yet elapsed, or that results from a sufficiently extended number of cases had been obtained, to definitely settle this disputed but very important question. So far as the writer was aware, Mr. F. W. Webb, of the London and North-Western Railway, was the first to design and make use of steel sleepers on anything like an extensive scale in this country. At that time about 32,174 sleepers were at work, which number, Mr. Webb informed the author in a recent letter, had now increased to 82,204, and with this extended experience, covering a period of about six and a half years, Mr. Webb still adhered to his original design, and saw no reason to alter it in any way. This sleeper was, of course, designed for the extremely heavy traffic of the London and North-Western Railway; it weighs 136lb., and is 9ft. long; two chairs and steel linings, to prevent the rail from injuring the sleeper, add 48lb. to this, making a total of 184lb. Brown paper soaked in tar is introduced between the chair and the packing, and the packing and the sleeper, to prevent moisture and sliding, the rail being kept in position by a wooden key in the ordinary way. The chairs are riveted to the sleeper. This method is very different from that adopted on light railways, and though Mr. Webb's system is evidently well designed and effective, it is certainly very expensive, and involves a good deal of labour at the manufacturer's yard. The section of the sleepers is 11in. at the base, narrowing to about 7in. at the rail bearing, and averaging about $\frac{5}{16}$in. thick. The rail is an 84lb. bull headed section, the lining on which it rests receiving the necessary cant of 1 in 20 at the time of stamping. Mr. Webb, in this design—which may be said to represent the latest development for heavy lines—has profited by the mistakes of the Continental engineers, who were the first to use metal sleepers for main lines. The failures which resulted twenty years ago when experimenting with wrought iron were due to using too light a section, and in consequence the 66lb. sleeper of that date was now enlarged to the 136lb. of the North-Western Railway. It appeared that, so far as Europe was concerned, the use of metal sleepers had progressed much more rapidly than in this country, and especially did this appear to be the case in Germany, where, in 1881, 8·1 per cent. of the total mileage was thus laid, and in 1885 this proportion had increased to 17 per cent. Similarly, South America, owing to the absence of timber, had largely adopted metal bearings, whilst in the United States and Canada they had been but slightly, if at all, employed; indeed, the writer was not acquainted with any instance in point in either of these last mentioned countries. In India, for the narrow gauge Government lines, steel appeared to be almost universally and by preference employed, and many thousands of these very excellently designed sleepers had of late years been sent out, and had formed a great source of business to the iron works in various parts of England, but chiefly in South Wales. There were, the author stated, two methods in vogue for the

*Abstract of a paper read before the Civil and Mechanical Engineers' Society, 18th January, 1888, by Mr. H. T. Munday, Assoc.M.Inst.C.E.

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manufacture of steel sleepers; the one consisted of rolling a plate to the required section and form, and cutting it at once under the saw to the specified length; and the other of first rolling in flat plates and sawing, and then re-heating and impressing the necessary form upon a die under hydraulic pressure. The first process was undoubtedly the most expeditious and cheaper of the two, as the amount of handling (a serious item in pricing) is diminished as much as possible; for, after cutting and straightening, the only further operation involved was to punch the bolt holes and file the rough edges, the after process of dipping in solution, if necessary, being common to both. On the other hand, the pressed sleeper was undoubtedly a much more workmanlike production, and possessed an important feature in its favour, inasmuch as the ends could be closed up so as to form a complete trough or box on the under side; moreover, the centre of the sleeper could be deepened under the rail bearing and the ends spread out in a fish tail shape, neither of which advantages could be secured with the rolled trough, for though, of course, the ends could be closed, it could only be done by a separate and troublesome arrangement of riveting on a piece—a process which, though sometimes adopted before pressing became general, would certainly not be followed now. It being admitted, therefore, that, all things considered, a pressed sleeper was the most perfect job, it was obvious this form would be adopted by the Indian Government authorities, acting under the advice of Mr. Rendel. This sleeper was, when formed, 5ft. 6in. long by 4¾in. deep at the centre, and 7¾in. wide, gradually altering at the ends to about 4in. deep just beyond the rail, and splaying out to 13in. wide at the extremity. Originally the plate from which the sleeper is pressed is 5ft. 9in. long by 14in. wide by about $\frac{7}{16}$in. thick, with an increase of metal on the centre line 4in. wide, making a thickness of ⅝in. at this part. After the plate is re-heated in the furnace it is brought to the die and subjected to hydraulic pressure, which not only shaped the sleeper as described, but punched out two clips about 3in. by 2in. each, raised at an angle of nearly 30° above the surface of the sleeper, and between which the rail rested. The fastening was of the simplest. A steel key, tapering in all directions, was driven against the clip and rail flange, and was supposed in this position to hold the rail perfectly tight. When both keys were driven outside the flange, the gauge was obtained; but this could be very conveniently varied by driving one key inside and one outside, or both inside, and it could thus be narrowed or widened as circumstances required. After punching up the clips there was still a narrow strip of metal left on which the rail rested, though not evenly. On completion, the weight of the sleeper was exactly 69lb., and the two keys were 1¼lb. together, making the sleeper and two fastenings 70¼lb. in all.

The field for invention was still a wide one. Putting on one side the question of weight, which should not be restricted if a good solid road was wanted, but which must, of course, vary considerably according to gauge and nature of traffic, the author believed that a good sleeper should combine the following points: (1) Depth and sectional area sufficient to prevent fracture or permanent set under the load likely to come upon it when in unfavourable conditions as regards ballasting and packing. Danger from fracture was at first much feared when metal sleepers were introduced, but it had been found that breakages did not exceed 1½ per cent. on the Continental lines. (2) The metal should be increased at the rail bearing and bolt holes, if any. (3) The ends should by preference be closed, as it was found that with open ends there was a tendency for the ballast to work outwards and leave a hollow space under the sleeper, and this was more especially the case if the sleeper was bowed, so as to give the inward cant of 1 in 20 to the rail, whereas with a closed end the tendency was in the opposite direction, and the labour of keeping the road in order was minimised. (4) The bolts and nuts employed should be as few as possible; riveting, if it could be done at the works, was preferable for the fastenings; but in foreign work, if the rivets had to be put in on the ground, they were better dispensed with, as the work may be badly done by local workmen. Cutting out a portion of the sleeper to form a clip was not theoretically, at any rate, advisable, not only because the sleeper was thereby weakened, but also because, if the clip was accidentally broken off, the sleeper becomes useless, or else labour and trouble was involved in riveting on a substitute, and this was not easily managed in a foreign country; but if this method of fastening was nevertheless preferred, very special care must be taken in manufacture to provide a sufficiently mild steel, and of course very careful inspection was a necessary consequence. (5) Some provision should be made for altering the gauge within slight limits, and so far as the writer was aware, this at the present time could only be accomplished by the wedge system. (6) All sleepers should be dipped in a solution, if possible, when hot (some engineers advocate roughening the surface with sand to increase the friction, but this is scarcely necessary, as it increases the labour at the works). The advantage of dipping when hot was that a rapid drying took place—a small matter, but one of importance in shipping, as carriers very naturally objected to having a vast mass of material on board in a dirty state, and the smell of the solution affected the rest of the cargo; the labourers, too, at the docks gave trouble, as they occasionally refused to handle the slimy materials sometimes brought down in the trucks. Pressed sleepers could always be dipped hot, as they could be taken from the die direct to the dipping tank, though care had to be taken that the inflammable solution was not set on fire. Rolled sleepers, however, unless re-heated, must be dipped cold, and in that case the inspector should see that the dipping solution was kept at boiling point by a coil of steam pipes, and a sufficient quantity for a cargo laid aside some weeks before shipping was commenced. Stacks should never be allowed to be piled too high, not only to give a free circulation of air for drying, but also to prevent injury to the bottom layers. A dipping solution recommended to the author was as follows, and it would do for rails as well as sleepers: 2 gallons of boiled tar, ½ gallon mineral turps, and 1 gallon vegetable oil. The tar is boiled first, and the other ingredients are then well mixed in. The turps constituted the driers in this preparation, and the larger the proportion of this the more rapidly the drying was effected; but as it was also highly inflammable, great care should be taken if the metal be dipped hot.

CHEMICAL SOCIETY.

Dr. A. K. Miller, in examining Guthrie's compound produced when nitric peroxide acts upon commercial amylene, has proved that the body which is formed is derived solely from the hydrocarbon—trimethyl ethylene—and not from any of the other compounds which are present in the crude amylene. Pentane appears to be also present in the commercial body, but it and normal amylene and normal hexylene do not form crystalline products with nitric peroxide. The author has studied this reaction with a view of ascertaining whether the formation of this compound will afford a means of separating the different hydrocarbons which exist in the products of the manufacture of oil gas, shale spirit, and other complicated hydrocarbon mixtures (see *Industries*, Vol. III., page 433), and experiments are progressing in that direction.

A new method for ascertaining the much vexed question as to whether certain alloys are true chemical compounds or not has been described by A. P. Laurie. By using alloys of known percentage composition, as one of the plates in a small battery, he has measured the difference of potential produced by a quadrant electrometer. In the case of the zinc copper alloys, if the alloy contains less zinc than that which corresponds to the formula $CuZn_2$, a very slight difference of potential is observed; but if the alloy contains a small excess of zinc above that corresponding to this formula, the e.m.f. of the cell is suddenly considerably increased. He considers that this sudden rise is due to the presence of free zinc in the plate, as from previous experiments he has shown that a plate of copper to which a small piece of zinc is attached behaves as a zinc plate, even when the zinc is only one-thousandth the weight of the copper employed. More accurate experiments with the copper tin alloys by a similar method have confirmed the results arrived at by Rieche from an examination of the density of these alloys, and by Lodge and Austen, who have examined their electrical resistance and the effects produced by them in a Hughes induction balance. Laurie's experiments show that the alloy Cu_3Sn, when used in a battery in the place of the zinc plate, gives only a small e.m.f.; but when a greater percentage of tin is present, the e.m.f. rapidly increases, and then remains at more or less of a constant value until the composition of the plate used contains no copper. This method of examination does not therefore give any information as to the existence of the alloy Cu_1Sn which has been previously described. He has confirmed these results by showing that when an alloy containing more tin than is expressed by the formula Cu_3Sn is placed in a copper cup, and surrounded by dilute acid in contact with cuprous chloride, the tin is slowly dissolved out of the mass until it reaches the composition of the alloy Cu_3Sn, which then ceases to be acted upon. His experiments seem to conclusively prove that tin and copper, when alloyed in the proportion corresponding with this formula, form a true chemical compound.

THE ORIGIN OF COLOUR.

A paper on the origin of colour, and the chemical constitution of colouring matters generally, was read by Professor Henry E. Armstrong, F.R.S., at a recent meeting of the Chemical Society in London. The origin of colour in bodies was shown to be closely connected with the affinities of the elements composing such coloured bodies, and therefore to depend on the valency of the elementary substances present, if the term valency be used in its broadest sense. Several chemists have endeavoured to unfold the relationship which must necessarily exist between the chemical constitution of compounds and their colours. Graebe, after his investigation on the constitution of quinone, communicated a paper, in conjunction with Liebermann, to the first number of the "Berichte" of the German Chemical Society on this subject, in which they pointed out that, excluding coloured metallic salts, the colour of organic bodies was destroyed by reducing agents, and that the quinones, all of which are more or less coloured, give on reduction colourless hydroxy derivatives. The constitution of quinone may be represented by the formula $C_6H_4\begin{matrix}O\\O\end{matrix}>$ and that of the hydroxy derivative by the symbol $C_6H_4\begin{matrix}OH\\OH\end{matrix}$ so that the union of the oxygen atoms with one another, represented symbolically by $\begin{matrix}O\\O\end{matrix}>$ appears to be the cause which produces the effect of colour in this class of compounds. A withdrawal of two atoms of hydrogen from the hydrazo compounds similarly produced the azo colouring matters. Rosaniline, rosolic acid, and indigo also yield colourless derivatives on reduction. The arrangement of the oxygen and nitrogen atoms in organic colouring matters has therefore an important influence on the tinctorial properties of the body. At the time when these earlier theories were advanced, the constitution and orientation of several of the more important colouring matters were imperfectly understood, and more recently the view advanced by Fittig that quinone may be considered a double ketone, or a body in which the oxygen atoms are not united to one another, but doubly united to different carbon atoms, has gained ground, and hence the intimate contact of the oxygen atoms in these coloured bodies is not an essential condition for the production of colour. Anthraquinone, the corresponding dioxy-derivative of the hydrocarbon anthracene, has, undoubtedly, the constitution of a di-ketone, and as it is a coloured body, it affords additional evidence for a belief in the view just advanced. In 1876, Otto N. Witt contributed to our knowledge of this subject an important paper on the "Bau und Bildung färbender Kohlenstoff verbindungen," in which he summarised the views he then held in the following laws: (1) The tinctorial properties of an aromatic organic compound is due to the presence of a colour giving and a salt forming group in the compound. A colour giving group is called a "chromophore," and he cites the radical NO_2 as an example, while amidogen NH_2 and hydroxyl OH are examples of the salt forming groups. A body containing a chromophore is called a "chromogen," thus in nitraniline $C_6H_4(NO_2)(NH_2)$ and nitrophenol $C_6H_4(NO_2)(OH)$, the chromophore is the NO_2 group, and the chromogen of these bodies is nitrobenzene $C_6H_5(NO_2)$. (2) Bodies which contain a chromophore are more coloured when they are in the form of salts than in the free state. (3) The more stable the salt, the more coloured is the compound—when the same chromophoric base is employed. Aniline, to take a further example, is a colourless base, and contains no chromophore; when nitrated by the introduction of the chromophore NO_2 the coloured nitraniline is produced, and its salts vary in colour with their stability. In colouring matters of this class, it has further been noticed that the two groups present—the NH_2 and NO_2 in the example taken, are in the same position as are the oxygen atoms in quinone, and known to chemists as a "para" or 1 : 4 compound. The two other nitranilines have not the same tinctorial properties as has the para compound. Although chromogenic bodies are converted into dyestuffs by the introduction of such groups as NH_2 or OH, if these groups are altered by substitution of their hydrogen atoms, the colour may be considerably modified. Thus a chromogen containing the group NHAc or OMe in the place of NH_2 or OH is colourless, as the basic nature of the compounds is reduced. If on the other hand the body contains the group NHMe in the place of NH_2, the colour remains, and the compound is still basic. Phenolphthalein does not dye, while fluorescein gives a fugitive yellow colour. If fluorescein, which is a weak acid, be nitrated or brominated, it is thereby converted into a strong acid, and can then form strong and valuable colours, of which the eosins may be taken as a type. Similar reasoning may be applied to the nitrophenylamine and azo colouring matters. The origin of colour may not, however, be due to the same or similar causes which make the body a dyestuff. The dominant idea which seems to underlie these speculations is that the union or valency of the elements present conditions the colour of the compound produced. The paraffins with single affinities are inert and colourless, not only in the visible part of the spectra, but also in the ultra violet and ultra red portions, as shown by the spectroscopical investigations of Abney, Festing, and Hartley. When two atoms of hydrogen are withdrawn from a paraffin and an olefine is obtained we have more active compounds produced and a beginning of colour is manifested spectroscopically, and with a further withdrawal of hydrogen, as in the acetylenes, a still greater absorption of light takes place in the compounds produced. The colour of compounds may therefore be due to a condition of strain within the molecules, as Baeyer some years ago endeavoured to explain the properties of the acetylene compounds by the assumption that the affinity of the elements has direction, so that in compounds in which carbon atoms are "doubly" or "trebly" bonded together there was a displacement of the direction of some of the valency of the carbon atoms, which renders the compound liable to decomposition and capable of readily forming addition products. A carbon atom may, according to Baeyer, have its valency distributed in space in the same way as are the angles of a regular tetrahedron inclosed in a sphere. Ostwald has advanced a similar view, and Armstrong has pointed out in the "Philosophical Magazine" that the saturated hydrocarbons have the valency of their carbon atoms unstrained and therefore free to act in certain directions, while in the unsaturated compounds a strained condition exists, rendering the bodies active and of comparatively easy separation. Water, although viewed by the majority of chemists as a saturated compound, is able to unite as water of crystallisation and in solution by virtue of what is termed residual affinity, and it is coloured as shown by the researches

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of Russell, Abney, and others. Nitric peroxide NO_2 similarly is coloured and unsaturated, while its polymer N_2O_4 is saturated and colourless. The unsaturated body is at a comparatively high potential and runs down, forming the saturated colourless body of low potential. Similarly, oxygen is colourless, while the unstable ozone is coloured. The higher oxides, as a rule, have greater colour than the low oxides of the same metal; as an example, the three oxides of lead may be cited. With the titanium oxides, the stable dioxide TiO_2 is white, while the unstable TiO and TiO_3 are blue and yellow respectively. In the manganates and permanganates the high tinctorial power of these bodies seems to be due in some way to the large amount of oxygen that they contain. In the darkening of sulphur on heating, we have an example of the formation of simpler molecules of high potential. Sulphur, again, unites with sulphuric anhydride to form a blue liquid, while selenium similarly combines with the same body to form a green compound, and tellurium a red one. Many of the coloured iodides of the heavy metals unite with the alkaline iodides to form colourless salts with the evolution of heat, and the coloured metals, gold and copper, similarly alloy with tin, forming colourless chemical compounds. Among the carbon compounds there is no example of a coloured hydrocarbon, and most of the derivatives containing monad radicles are likewise colourless. The strained condition which is, according to the view advanced by Professor Armstrong, necessary for the production of a coloured compound, is fulfilled in the organic dyestuffs, if they be considered all derived from a quinonic type, and the more important groups of colouring matters, viz., the azo compounds, rosaniline and rosolic acid, phthaleïns, methylene blue derivatives, and indigo may be so regarded.

ALLOYS AND THEIR PROPERTIES.

The third and last of the series of Cantor lectures on the above subject, by Professor Roberts-Austen, at the Society ofArts, was delivered on the 26th ult., on the colours of metals and alloys, with illustrations principally derived from Oriental art metal work. Twenty-four years ago the accomplished antiquary, Mr. William Burgess, in a course of Cantor lectures, dealt incidentally with the subject of art metal work. Those lectures were considered so important that the present director of art at South Kensington, Mr. T. Armstrong, made them the text for an address delivered before the Society of Arts in February of last year, in which he reviewed the progress that had been made in applied art in the time which had elapsed since the writings of Burgess.

Professor Roberts-Austen, in considering the principal facts connected with the colours of metals and alloys, gave a brief description of the kind of influence which the colours of metals appear to have exerted on the history of chemical science. The lecturer observed that the colours of the seven metals known to the early metallurgists were believed to be influenced by the seven principal planets, a belief which was not completely abandoned until a comparatively late period. He described the alteration in appearance of tin by the presence of a small quantity of mercury, and also the absence of the yellow colour of gold under the influence of lead or mercury. Gold itself was capable of existing in nearly all the colours of the spectrum—purple to green, yellow, bright red, and dark brown nearly to black.

Besides those colours which belong naturally to metals and to their alloys, certain other tints may be produced on their surfaces by artificial means, and this is especially the case in regard to alloys of copper. The Japanese art metal workers have for centuries used alloys of copper containing small quantities of gold, antimony, cobalt, and other elements, in the manufacture of those beautiful specimens of handicraft for which they are so renowned. The surface tints produced on these alloys are obtained by the action of certain "pickling" solutions, the various compositions of which were given by the author, who, by their aid, had prepared a trophy of richly coloured leaves. A series of paintings showed the different colours produced by the same pickle on copper containing 3 per cent. of specified impurities; and when the impurity was reduced to three-tenths per cent. the effects were, in a modified degree, almost the same. Reference was made to fifty-four plaques from Japan in South Kensington Museum, as showing what can be done in obtaining coloured metallic surfaces by the judicious use of pickling solutions.

Attention was then directed to the singular banded alloy known as Moku-me, or wood-grain, the manufacture of which is now almost abandoned by the Japanese, but which the author is anxious should be introduced into this country. Specimens of this somewhat scarce work were exhibited. Reference was also made to the possibility of depositing coloured alloys by the aid of electrolysis, and it was incidentally stated that one firm deposited annually 6 tons of silver in films of such thinness that if spread out they would cover an area of about 140 acres. The lecture consisted mainly of a plea for colouring metals by the elaborate methods of the Japanese, and for the use in casting, by the method of circ-pendue, complicated alloys which either possess or are capable of receiving rich tints. The formation of the beautifully coloured films obtained on the surface of lead by heating it in air was shown experimentally, and in reference to this the lecturer pointed out the important part it had played in the history of metallurgy, even to the discovery of oxygen. Professor Roberts-Austen, after one or two references to the poets, concluded his lecture with the remark that "it was the coloured show of dross which was the basis of all modern chemistry."

THE CHEMICAL EXAMINATION OF RESINS.

The various resins used in the preparation of varnishes are usually recognised rather by their physical properties of colour, hardness, weight, and melting point than by their chemical reactions. Many chemists have, however, within the last few years been investigating this subject, partly from a theoretical point of view, and partly in the hopes that some simple analytical method may be devised for determining the true value of a sample of any resinous body. The resins include a large class of gums and vegetable products of different chemical composition, and little is at present known with regard to their constitution. The microscopical structure of a resin also often affords a ready means of approximately determining its nature, and has been dealt with, together with so much as was then known of the chemical behaviour of these bodies, in a work by Herr Wiesner, entitled "Die Technisch Verwendeten Harze und Gummiarten." In this book we find enumerated the solubilities of the various resins in different solvents, and their behaviour towards the common alkalies, concentrated sulphuric acid, and the odours described which are obtained on warming and burning most of them. Herr Schmidt and Erbau have endeavoured to develop what we may term the analytical examination of resins, and the methods employed by them, and their more important results, seem to be of importance to those engaged in this branch of technology.

Herr Köttstorfer and V. Hübl drew attention to the fact that the resins are saponified by boiling with a solution of potash dissolved in alcohol, and that a given resin required always approximately the same amount of a standard solution of such alcoholic potash to effect its decomposition. The quantity of potash consumed in this way will be therefore a rough measure of the purity of a given sample of a resin, if one be acquainted with the amount required when a genuine specimen is used. The resins, when dissolved in alcohol, give solutions which are slightly acid, and this acidity can be readily estimated by titration with a standard solution of alcoholic potash. The real amount of potash required to effect the saponification of the resin will therefore be the difference between this number and Köttstorfer's, which obviously gives the amount of potash required to first neutralise and then saponify the resin. A third important reaction has also been put into a quantitative form by Herrn v. Schmidt and Erbau. Resins combine with iodine. Therefore, by adding a standard solution of iodine to a known weight of resin, and determining the amount consumed by titrating the residual quantity of iodine with a standard solution of hyposulphite of soda, we get a third number, which gives us information concerning the quality of the resin under examination. This standard iodine solution is prepared by dissolving 25grm. of pure iodine in 500 cub. cm. of alcohol, free from fusel oil, and adding it to a clear solution of 30grm. of mercuric chloride in the same quantity of alcohol. The other solutions employed are standard solutions of half normal hydrochloric acid and caustic soda, and a solution of hyposulphite of soda, containing about 24grm. in the litre. A semi-normal potash solution in alcohol is also required, and is made by dissolving 25grm. of caustic potash in the least quantity of water, and then diluting with alcohol until the volume is one litre. Phenol-phthalein in alcoholic solution is used as indicator in determining the amount of soda consumed. About 1grm. of the finely powdered resin is sufficient for each experiment. The numbers obtained when titrating the resins with alcoholic soda show a marked difference with different kinds of resin. Colophonium is the most strongly acid, and then follow sandarac, gum benzoin, and storax, while shellac, mastix, and dammar cause only a very slight acid reaction. The copals behave differently fused, white copal from Angola having a greater acidity than the red variety, while that from Zanzibar is neutral. Shellac requires the largest amount of alcoholic potash to effect its saponification, while elemi, Zanzibar copal, asphalt, and fused amber only consume a small quantity of the caustic. Venetian turpentine uses the largest percentage of iodine, and this substance and colophonium are the only two resinous bodies so far examined which consume more than one hundred parts of the iodine solution. Dragon's blood, mastic, storax, and gum benzoin require nearly equal amounts of this reagent, while shellac, fused amber, the copals, and asphalt are represented by low numbers. The resins, when purified from their solutions in alcohol or oil of turpentine, by precipitating them by means of steam, give different numbers, which afford a means of checking those obtained from the natural product. When two or three resins have been mixed together for commercial purposes, a convenient method for qualitatively determining what resins are present is based upon their different behaviour with certain solvents. Alcohol does not dissolve amber or the copals, except red and white fused Angola, which is partly soluble; while mastic, shellac, sandarac, elemi, Venetian turpentine, colophonium, and gum benzoin are readily soluble, while asphalt, dammar, dragon's blood, and storax are only slightly soluble in this solvent. After having effected a partial separation by means of alcohol, the behaviour of other solvents, such as benzole, carbon bisulphide, ether, ligroin, acetone, and amylalcohol is observed, and in this way all the common resins are easily identified. Shellac is the only resin which is not soluble in chloroform. By means of the quantitative method which we have briefly described, it is possible to ascertain the amount of mastic in a mixture of sandarac and mastic, or of shellac, when mixed with colophonium, or the amount of colophonium, dammar, and mastic, in a mixture of the three. Similar results to those of Schmidt and Erbau have been obtained by Dr. Kremel, proving that these methods are reliable, and therefore of commercial value.

Notes.

NATURAL GAS AT NEWCASTLE.

Last June a "blower" of natural gas was struck in the underground workings of the Hebburn Colliery, near Newcastle-on-Tyne, and remained for fully six months a source of annoyance and danger to all in the pit. At the commencement of the present year—as the flow seemed likely to be permanent—it was decided to utilise it by running a 6in. pipe from the "blower" to the surface, and burning the gas in one or more boilers. On the 26th of February the gas was successfully lighted in a large Lancashire boiler, which has continued to work steadily ever since. It is believed that the flow is sufficient to supply four boilers, and three others are accordingly to be connected with the gas main. The gas is introduced to the boiler flue by an annular burner, the flame being afterwards broken up and spread by a brick bridge placed about 7ft. from the front end. The evaporative power of the gas is great, and the arrangement, when complete, is expected to result in a saving for fuel and labour of about £3,000 per annum.

THE ELECTRIC LIGHTING OF THEATRES.

The Riga Theatre has been fitted with an electric light installation of considerable size. The motive power is steam, supplied by three locomotive boilers, each of 760 sq. ft. heating surface, and working at 105lb. pressure. In the engine room are erected three single cylinder high pressure steam engines, with Rider's cut-off gear, each engine developing 65 effective horse power, and driving a glow lamp dynamo of 37 kilo.-watts. The three large dynamos are collectively capable of lighting 1500 20 c.p. glow lamps; but as only 1000 lamps are required for night use the third dynamo is in reserve. For the day service, when only 142 lamps are required, there is provided a separate small dynamo, driven by a 12 h.p. steam engine. The exhaust steam from all the engines is passed through a tank, where a large portion of it is condensed, so as to raise the temperature of the feed water. The boilers are fed either by a steam pump or by three injectors. There are in the theatre three distinct circuits—one for the day service feeding 142 lamps, and the two others for the night service feeding collectively about 1000 lamps, and a switch board is erected by means of which either of the large dynamos can be connected to either of the two night circuits. The lamps are distributed between these two circuits so as to overlap each other, in order that either circuit may form a panic circuit in case of the extinction of the other. The total number of lamps installed considerably exceeds the capacity of the dynamos, but the distributing switches are so arranged that it is impossible to light all the lamps simultaneously. On the stage there are fixed 1162 lamps, of which 550 can be lighted simultaneously, whilst 612 lamps serving for red and blue lights can be switched in when the others are extinguished. The large corona in the auditorium contains 124 lamps, and 56 lamps are distributed round the tiers. In addition to these there are 272 10 c.p. lamps fixed in the engine house and offices, and two 1000 c.p. arcs in front of the theatre.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

23rd March, 1888.

4441. Sage, F. C. — Hansom cabs (*Sage*).
4443. Bamford, S. B. — Wheels and shafts for horse rakes.
4445. Jardine, J. — Bearing for taking up wear and preserving a perfect cylindrical surface.
4450. Barber, F. — Water gauges of steam boilers (*Barclay*).
4451. Darling & Sellers — Machine tools.
4452. Smith, T. F. — Cranes.
4453. Shakeshaft, J. — Railway signalling.
4462. Brown, A. T. G. — Sleepers for railways.
4464. Fear, E. J. C. — Ship's anchor (*Munn*).
4467. Bentall, E. H. — Lawn mowers.
4468. Felt & Felt — Lubricators.
4473. Fox & Lighthall — Tramways.
4474. Dukes, B. — Structures for supporting electric conduits (*Hart*).
4475. Marelle, M. R. — Automatic registering apparatus.
4480. Linnenbrügge, A. W. F. G. — Propelling and steering ships.
4481. Klau, K. — Machine for harvesting potatoes.
4482–3. Leake, C. F., & others — Manufacture of floor cloths.
4486. Woodward, L. — Knitted fabrics.
4488. Rugeroni, A. E. — Dredging apparatus.
4490. Evans & Harrison — Transferring metal from one set of rolls to another.

24th March, 1888.

4497. Hackett & Hackett — Crane.
4499. Cadenhead, G. — Screw propellers.
4500. Jones, E. W. — Injectors.
4503. McConnel & Higginson — Grinding the flats of revolving flat carding engines.
4504. Thornton, J. T. — Machines for shearing cloth.
4505. Ashworth & Ashworth — Flattening or shaping wire for cords.
4514. Whitaker, G. — Propulsion of boats.
4515. Warsop, H. J. — Gas engine.
4516. Robinson, F. — Manufacture of pile fabrics.
4517. Rushworth, S. P. — Steam and hot water heating apparatus.
4520. Longsdon, H. C. — Mangling machines.
4525. Parker, F. — Saw machines.
4526–8. Mann, J. J., & others — Apparatus for dressing stone.
4531. Bourne, J. — Motive power engines.
4539. Correa, F. — Rotary pumps.
4540. Donisthorpe & Towns-end. — Twisting and winding frames.
4543. Gell, W. J. — Apparatus for raising and lowering boats.
4546. Gill, A. — Apparatus for lifting and transporting stone.
4548. Singleton, T. — Brake wheels, stop rod, and strap fork joint for looms.
4551. Haddan, R. — Saw setting and sharpening machines (*Titscher*).
4552. Apraxin, Count A. — Transporting loads by the aid of balloons.
4558. Nation, W. B. — Preparation of fibre from rhea grass.
4560. O'Donnell, J. P. — Railway signalling apparatus.

26th March, 1888.

4565. Smith, W. — Cutting and dividing double piled fabrics.
4570. Howarth & Horrocks — Boiler furnaces.
4572. Hattersley & Hill — Let-off mechanism for looms.
4576. Sowden, A. — Pattern pegs of looms.
4580. Hancock, E. — Hand lever presses for hay.
4582. Lings, W. — Pressing hay by hand power.
4586. Crook, P. — Mules.
4589. Nicholls, A. — Breech loading and machine fire arms.
4590. Dent, R. A. — Prevention of incrustation in steam boilers.
4599. Day & Ward — Ratchet drill brace.
4601. Vering, H. — Dredgers.
4602. Tilden, H. — Heating tube for furnaces.
4603. Boldt & Vogel — Cork sizing machine.
4605. Horsburgh, R. — Burglar and fire proof safes.
4606. Fehlen, A. — Apparatus for generating motive power.
4607. Wallis, J. E. — Thrashing machines.
4615. Sjövall, B. — Valve gear.
4618. Avery, W. B. — Weighing apparatus.
4621. Boult, A. J. — Type writers (*Downey*).
4624. Crossley, F. W. — Governing gear for gas engines.
4633. Tommis & Whitwham — Water gauges of steam boilers.
4637. Tellier, C. — Utilising waste heat for producing motive power.

27th March, 1888.

4646. Harrington, F. T. — Two wheeled road carriages.
4651. Horrocks, D. — Hot water circulating boilers.
4654. Whitehead, J. — Self acting mules.
4657. Yeadon & Middleton — Disintegrators.
4662. Shackleton, R. — Heating feed water.
4664. Petrie & Fielden — Drying textile material in the skein.
4670. Richards, G. B. — Ships' stems and buffers.
4675. Hartley, H. — Dressing and winding-on frames.
4677. Reichling, R. — Vapour condenser and water purifier.
4680. Clark & Reid — Flue tubes for steam boilers.
4681. Eames, H. H. — Pulverising ore.
4689. Rathbone, A. — Machines for heating, cooling, or condensing fluids.
4690. Walsh, G. — Mules.
4698. Bergh, W. — Centrifugal fluid separating machines.
4704. Bruce, W. P. — Manufacture of paper.
4707. Lake, H. H. — Generating steam (*Adams*).
4708-9-10. Lake, H. H. — Generating steam (*Peck*).
4719. Gerry, S. — Registering vacuums in condensers of engines.

28th March, 1888.

4729. Arnold, E. J. — Type writing machines.
4732. Wilkinson, E. — Feeding wool and other fibre to carding machines.
4733. MacLaine, A. — Heating feed water.
4736. Hargreaves & Inglis — Bearings for shafts.
4738. Wilson, J. P. — Ships' boats.
4740. Ridealgh & Fairman — Gas and vapour engines.
4746. Shann, G. — Pendant shafts.
4753. Walsh, J. — Presses for packing hay.
4755. Kenyon, H. B. — Supplying towns with sea water.
4761. Adnet, P. — Manufacture of pitchforks.
4762. Guhl, H. — Sewing machines.
4763. Drde, H. — Railway car couplings.
4768. Hawke, J. — Manufacture of blotting paper.

29th March, 1888.

4775. Row, O. M. — Evaporation and condensation of sea water.
4778. Walker, W. H. — Straightening and tempering circular saw plates.
4779. Inman, C. B. — Bottle washing machines.
4785. Roger, G. — Apparatus for cutting piled fabrics.
4786. Petrie & Petrie — Cleansing wool.
4789. Benton, C. H. — Governing gear for steam engines.
4793. Newell, J., & The Leicester Co-operative Hosiery Manufacturing Society — Taking up and delivering the machine stitch in flat rib fabrics.
4795. Waldecker & Sandt — Sewing machines.
4796. Smith, D. — Straightening and cutting off wire.
4798. Dack & Barlow — Raising vessels from one canal to another.
4799. Livingstone, R. — Core making machines.
4803. Fox, E. — Distributing explosive matters in motive power engines.
4805. Stevens & Major — Lifting and winding machinery.
4812. Murrie, J. — Motive power engines.
4813. O'Neill & O'Neill — Pneumatic tram car locomotives.
4815. Ibeson, S. — Heating and drying chambers.
4817. Jordan, T. N. — Machine for dressing lace.
4821. Gastrell, J. P. H. — Rotary engines.
4822. Newton, P. A. — Improvements in printing type (*McClure & Vivian*).
4826. Bade, C. — Acoustic signalling apparatus.
4828. Wood, A. M. — Life boats.
4829. Wilmott & Wilmott — Wire netting machines.
4836. Hayward, J. W. — Apparatus for signalling.

ELECTRICITY.

23rd March, 1888.

4489. Lauckert & Haensel — Electrical glow lamps.

24th March, 1888.

4523. Kelman, J. — Telegraphic and telephonic apparatus.
4524. Barber-Starkey, W. J. S. — Portable galvanic batteries.
4559. Wolffers, F. de — Electric arc lamps.
4561. Brown, C. A. — Battery jar.

26th March, 1888.

4568. Williams, S. — Conductors for electrical purposes.
4579. Dillon, J. J. — Electrical alarum.
4593. Rawson, F. L. — Electrical batteries.
4596. Von Besserer, G. — Preventing oscillation of saloons on board ship.
4604. Pyke & Barnett — Continuous opening and closing of electric circuits.
4626. Hoepfner, C. — Electrolytic production of metals.
4627. Wells & Goad — Incandescent electric lights.

27th March, 1888.

4659. Schmidt, F. T. — Electrical alarm.
4673. Justice, P. M. — Generation of electric currents (*Heisler*).

28th March, 1888.

18036. Pope, W. R. — Coin operated induction coil. (Received March 28th, 1888. Ante-dated August 31st, 1887, under International Convention).
4730. Venables, G. — Electromagnetic time piece.
4759. Lake, H. H. — Telephonic apparatus (*International Dudley Signal Co.*).
4764. Fry, A. L. — Portable galvanic batteries.

29th March, 1888.

4804. Piper, E. J. — Switching arrangement for electric signalling, &c.

CHEMISTRY.

23rd March, 1888.

4476. Johnson, J. Y. — Blue colouring matters (*Badische Anilin & Sodafabrik*).
4485. Maddick & Greenwood — Extracting gold and silver from ores.
4594. Bennett, J. A. B. — Alloys.
4595. Bennett, J. A. B. — Aluminium chloride.

26th March, 1888.

4625. Abel, C. D. — A new alpha-naphthol-disulphonic acid (*Actien Gesellschaft für Anilin Fabrikation of Berlin*).

27th March, 1888.

4648. Parnell & Simpson — Production of sulphur from sulphuretted hydrogen.
4653. Davis, G. E. — Producing carbonates and hydrates of the alkalies.
4694. Lane & Delmard — Soda water.
4699. Bohm, W. D. — Expulsion of chlorine from solutions.

28th March, 1888.

4765. Hobson, A. H. — Treatment of bones and animal waste for obtaining gelatine, glue, and size.
4767. Kingzett, C. T. — Manufacture of chlorine

29th March, 1888.

4784. Player, F. — Cleaning and polishing tin and terne plates.

MISCELLANEOUS.

23rd March, 1888.

4438. Tomkins, J. D. — Separation of cotton from the husks.
4448. Hammond, J. G — Mounting stereotype.
4455. Nicholls, A. — Tools for the production of tapers for screws or plugs.
4458. Maples, T. W. — Fire proof case for storing explosives.
4459. Kjöllerfeldt & Kolnotsch — Machines for making cigarettes.
4461. Burrage, G. H. — Extinguishers for lamps.
4466. Sykes & Cook — Valve for water.
4471. Bowman, R. D. — Lamps.
4478. Bernreuther and Kumpfmiller — Washing and steeping barley.
4484. Wren, J. E. — Illuminating gas.
4487. Accles, J. G. — Boxes for containing cartridges.
4491. Edwards, E. — Safety lamps (*Verschuren*).
4492. Appleby, C. — Packing for joints between metallic surfaces.
4493. Sizer & Sizer — Ventilators.

24th March, 1888.

4496. Rowbottom, S. — Fastening or joining tapes or belts.
4502. Wenger, A. F. — Process for decorating pottery.
4507. Stewart, W. — Decolorising animal and vegetable oils and fats.
4521. Robinson, L. J. — Manufacture of felt hats.
4537. Germeuil-Bonnaud, J. B. — Photographing in colours.
4544. Bouverie & Balch — Life saving appliances.
4549. Nicoll, D. — Oil lamps.
4554. Taylor, F. E. V. — Nails.
4555. Greaves, T. — Bronzing and polishing pad.
4556. Penn, W. J. — Wind gauge for fire arms.

26th March, 1888.

18035. Kempster, D. E. — Rowing tricycles. (Received March 26th, 1888. Ante-dated September 13th, 1887, under International Convention).
4566. St. George & St. George — Watches and clocks.
4569. Garthwaite, J. S. — Automatic safety gas trap.
4571. Hopkinson & Hopkinson — Velocipedes.
4575. Milnes, J. — Warming railway carriages.
4585. Bennett, H. H. — Cee spring.
4597. Curson & Curson — Door lock furniture.
4608. Arnold, A. E. — Manufacture of compressed leather.
4609. Glew, F. H. — Porous surfaces for the absorption of liquids and gases.
4610. Lloyd & Priest — Velocipedes.
4611. Calvert, E. A. — Fire escapes.
4614. Wehlen, G. P. — Watches and travelling clocks.
4616. Bernreuther & Kumpfmiller — Maceration of barley.
4617. Spence & Spence — Fire resisting materials.
4619. Cavill, F. — Horse shoes.
4620. Black, J. M. — Ticket punches.
4629. Godson, W. D. — Valve tap.
4630. Daniell, H. E. — Metallic packing for pistons.
4632. Cawkwell, H. A. — Manufacture of tiles.
4635. Redfern, G. F. — Plastic composition (*Fabregues*).
4636. Redfern, G. F. — Fire escape (*Des Masures*).
4639. Cox, R. — Manufacture of candles.

27th March, 1888.

4641. Greene & Claffy — Cores for tubes.
4642. Bell, A. C. — Ball or float valves.
4644. Bridge, L. — Sliver cans.
4645. Mackay, F. N. — Ice machines.
4656. Yeadon & Middleton — Briquettes of fuel.
4661. Shackleton, R. — Consuming smoke.
4663. Whittle, W. — Chimney cowls.
4667. Mechan, A. — Flange joints for pipes.
4668. Le Patourel & Hyams — Barometer.
4669. Randell, J. — Key for securing rails in chairs.
4674. Ryland & Green — Packing cases.

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4678. White & Brookes ..... Manufacture of boots.
4679. Clark & Reid ..... Coating of metallic tubes.
4684. Boult, A. J. ..... Fire extinguishing fluid (*Monmon*).
4685. Thompson, W. P..... Watches (*Terstegen*).
4686. Bulpitt, W. H. ..... Lamps.
4688. Horton & Horton..... Straightening steel wire.
4691. Robert, J. L. ..... Bottles.
4693. Friedrich & Graesser. Bottles.
4696. Schenck, U. H. W. ..... Belt shifters.
4697. Howard, R. L., & others Ball cocks for water waste preventers.
4700. Nicol, H. L. S..... Registering the quantity of liquid drawn from casks.
4701. Brown, T..... Bobbins for winding yarns.
4702. Block, W..... Fire escape.
4703. Haddan, H. J. ..... Belt fasteners (*Gingras*).
4705. Kilvert and others ... Making boxes of cardboard.
4713. Bowman, R. D..... Regulator for the supply tubes of liquid hydrocarbon lamps.

28th March, 1888.

4720. Shufflebottom and Brown ..... Bradawls.
4722. Baker, F. R..... Oil lamp burners.
4725. Craven, W. ..... Raising woollen cloths.
4731. Babington, H..... Taps.
4734. Clough, J. ..... Velocipedes.
4735. Walder, C. R..... Vices.
4742. Rickaby, A. A..... Oil can.
4744. Bouverie & Balch..... Rocket apparatus.
4747. Lemaire, V. D. A. ..... Hinges.
4752. Stratford, T..... Iron blocking spindles.
4760. Maignen, P. A..... Automatic separator and purifier.
4766. Johnson & Hutchinson Filter presses.
4769. Radelet, F. ..... Heater for railway carriages.
4773. White, W. J. ..... Tiles.

29th March, 1888.

4777. Button & Binner ..... Glass bottles.
4780. Smith, F. J. ..... Mercury pumps.
4787. Rabbit, W. ..... Automatic fire extinguisher.
4791. Barton, F. A. ..... Diving apparatus.
4797. Enright, J. ..... Oil lamps.
4808. Bulpitt, W. H. ..... Lamps.
4810. Dearlove & Davies ... Velocipedes.
4818. Roger, J. ..... Drying, withering, and re-firing tea leaf.
4823. Phillips & Stephan ... Photo-lithography.
4824. Bohm, W. D..... Accelerating the passage of liquids through filter beds.
4827. Bade, C..... Extinguishing fire.
4831. Nickels, B. ..... Filtering funnels.
4833. Lindsay, W. ..... Manufacture of artificial fuel.
4835. Schröder & Stuart ... Telescopes.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

31st March, 1888.

4444. Holden, J. ..... Brake wheel and loom side for looms.
4843. Stevens, E. ..... Gas engines.
6173. Hadfield, R. A. ..... Toughening steel.
6254. Tolson, G..... Drying fabrics and fibres.
6355. Bown, W. ..... Wheels.
6446. Ross, W. ..... Boot and shoe machinery.
6456. Wright, S. ..... Preparing and jointing staves for casks.
6457. Wright, S..... Making casks and barrels.
6499. Lake, H. H. ..... Coupling railway vehicles (*Tamm and Bührlen*).
6558. Sellars, J. C. ..... Obtaining rotary motion.
6659. Read, R., & others ..... Wiring the rims of sheet metal articles.
6726. Bairstow & Bairstow Distributing oil upon wool whilst being fed to drawing frames.
6768. Bramall, C..... Smelting & converting furnace.
6772. Marsh, F..... Starting tramway vehicles.
6804. Johnson, J. Y..... Sawing stone (*Auguste*).
6846. Myers, F. ..... Type writing machines.
6938. Garvie, J..... Agitators for pumps used in dredging.
6951. Brinjes, J. F. ..... Grinding hard substances.
7091. Robinson, T..... Dressing flax.
7141. Lake, H. H. ..... Grinding mills (*Zonca & Bella*).
7271. Wilson, J. H. ..... Starting of tram cars.
7280. Orr & Brown ..... Metal sheets applicable to the construction of buildings.
7439. Haddan, P..... Machinery for grinding spherical balls (*Richardson*).
7477. Bash & Bash..... Ironing machines.
7507. Lake, H. H. ..... Elevated railways (*Otto*).
7538. March & Dick..... Nail making machines.
7556. Lockwood, K. ..... Dyeing yarns.
7562. Laycock, W. S..... Brakes.
7609. Siemens, F. ..... Ceramic kilns.
7623. Green, Sir E. ..... Scrapers of fuel economisers.
7671. Harrington & Hopper Wheels.
7672. Crossley, F. J..... Propellers.
7716. Evans, P. ..... Steam generators.
7746. Darling, T. ..... Machinery for breaking stones.
7887. Barthel, A. E..... Elevated railway.
7935. Ridley & Blackmore... Landing stages.
7993. Denille, L. A. ..... Manufacture of tacks and rivets.
8042. Ludwig, H. E. ..... Wheels and pulleys.
8054. Little, G..... Pulverisers.
8486. O'Donnell, J. P. ..... Railway signal apparatus.
8633. Kenway, W. E..... Points for tramways.
8865. Edwards, E..... Separating textile fibres from the stalks (*Maizier & Reitz*).
9137. Inman, C. B..... Bottle washing machine.
9270. Girdwood, H. M..... Treating rhea and other fibres.
11666. Robertson, S. ..... Metallic plates.
12878. Marshall, A. D. ..... Automatic steam trap.
14199. Henderson, C. J..... Furnaces.
16529. Bond, S..... Manufacture of bricks, tiles, and quarries.
17798. Lake, H. H. ..... Grinding mills (*Coles*).
1675. Girdwood, H. M..... Treating rhea and other fibres.
2118. Bayrer, W. J. ..... Shears for metal.
2468. Stevens & Stevens ... Harrows.
2531. Boult, A. J. ..... Storm doors for buildings.
2560. Grout & Bowers ..... Sewing machines.
2896. Riley, J. ..... Basic hearth steel furnaces.
2899. Riley, J. ..... Regenerative furnaces for steel making.
3082. Fouquemberg, N. ..... Machinery for agglomerating fuel.

ELECTRICITY.

31st March, 1888.

4220. King, J. W. ..... Measuring electric currents.
4447. Elwell, P. B. ..... Apparatus for measuring, indicating, and recording currents of electricity.
4832. Liepmann, H. ..... Electrodes for primary batteries.
3097. Drake & Gorham ..... Secondary batteries.

CHEMISTRY.

31st March, 1888.

7504. Typke, P. G. W. ..... By-products from phosphorus compounds.
7833. Johnson, J. Y..... Preparation of naphthazarine (*The Badische Anilin und Soda Fabrik*).
16329. Rainbow, F..... Manufacture of soaps.
17925. Groth, L. A..... Black liquids for dyeing (*Collin and Errani*).

MISCELLANEOUS.

31st March, 1888.

4458. Barker, W. ..... Die for brick making machines.
4490. Seegrün, O..... Regenerative gas lamps.
4915. Trenemen, W..... Photographs in colours.
5016. Neumann & Kühne..... Scissors, shears, and tongs.
5035. Jefferies, H. ..... Manufacture of coal gases.
5129. Taylor, J. M. ..... Velocipedes.
5188. Syer, M. ..... Water waste preventer.'
5425. Bertram, W. ..... Mechanism for drying paper.
5815. Lodge, T. H..... Portland cement.
5940. Easthope, A. ..... Velocipedes.
6028. Schanschieff, A..... Miners' safety lamps.
6261. Buchanan, J. ..... Drying and granulating sugar and salt.
6300. Bethell, W..... Packing for stuffing boxes.
6342. Downing, G..... Coke ovens (*Bauer*).
6583. Hutchinson, R. ..... Polishing powder.
6796. Tissier, P. ..... Stoppering of bottles.
7094. Tatham, W. ..... Belts for cone drums.
7113. Horne & Hollyman ... Warming and ventilating houses.
7238. Abbey, F. F..... Circulation of air in main drains.
7275. Bird, J..... Water draught and dust proof joint.
7279. Watson, J. D. ..... Enamelling of metallic surfaces.
7608. Lake, H. H. ..... Explosives (*Wohanka & Co.*)
7696. Heys, W. E. ..... Ventilating fans (*Steinberg*).
7792. Hall & Hall ..... Fire extinguishers.
7813. Bosshardt, F. ..... Filtering and refining sugar (*Bocquet*).
7867. Fraser & Snodgrass... Distilling apparatus for shale.
8024. Stevenson, J. ..... Preservation of woods (*Salvat*).
9939. Born, P..... Cooling the air in rooms (*Maring*).
12099. Toy, J. ..... Bicycles.
17002. Lowdon, J. C. ..... Check punches.
17103. Lanvin-Schraen, E. I... Tanning.
201. Thompson, W. P..... Wood type (*Setchell*).
838. Sayer, R. C..... Rain water filtering and storing apparatus.
1597. Seebold, M..... Belt fasteners.
2258. Fowler, A. B. ..... Heel burnishing machines.
2353. Zahn, W. ..... Tanning.
2434. Peebles, D. B..... Regulating the pressure of gas.
2597. Lake, H. H. ..... Manufacture of gas (*Humphreys*).
2692. Henderson, N. M. ..... Miners' safety lamps.
2702. Fletcher & Clare..... Gas fires.
2748. Baldwin, E. S..... Nail for corrugated plates (*Davenport*).
2864. Johnson, T. ..... Serving rope for the rigging of ships.
3021. Blakesley, T. H..... Barometer.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 24th December, 1887, inclusive.)

Year 1883.

5772. Clymer, D. R..... Ceilings and floors of buildings.
5775. Alison, H. J. ..... Transmitters for printing telegraphs (*Field*).
5777. Alison, H. J. ..... Circuits for electrical apparatus (*Allen*).
5779. Johnson, J. H..... Automatic holders for knives, &c. (*Berolzheimer*).
5782. Magowan, F. A., & ano. Pottery, &c.
5790. Lake, H. H. ..... Electrical conductors (*Goebel and another*).
5791. Lake, W. R..... Middlings purifiers (*Walter*).
5792. Lake, W. R..... Printing machines (*Nowell*).
5801. Anderson, J..... Cleaning seed, &c. (*Lyall & ors.*).
5807. Brydges, E. A..... Telegraph transmitters (*McCarty*).
5811. Glaser, F. C. ..... Treatment of hops (*Kempe*).
5815. Pocock, F. A., & others Regulating supply of steam, &c.
5817. Hodgkins, J..... Metallic wheels.
5819. Hoyle, G..... Card grinding machines.
5820. Fox, C. J. ..... Lowering, &c., ships' boats.
5821. Morgan, G. M..... Working of marble, &c.
5822. Clarke, W. ..... Winches.
5826. Croall, R. ..... Springs in carriages.
5827. Lardeur, G. E. ..... Transferred designs.
5832. Pouschkareff, N. L.... Lighting by means of hydrocarbon vapour.
5834. Howard, G..... Fixing flooring.
5836. Morrison, J. C., and another..... Oil burners.
5837. Coltman, T..... Knitting machines.
5838. Tatham, W. ..... Spinning, &c., fibrous materials.
5842. Booth, J., & another ... Thread winding machines.
5845. Clark, J. L. ..... Materials for insulating purposes.
5846. Mumford, T. W. B., and another..... Grinding ores, &c.
5847. Price, A. P. ..... Obtaining tin from tinned metallic surfaces.
5850. Herbert, F..... Treatment of sewage.
5852. Nichols, C. H..... Loom shuttles.
5853. Sillavan, J..... Manufacture of pile fabrics (*Marcon*).
5856. Thompson, W. P..... Electric batteries (*Himmer*).
5858. Boult, A. J. ..... Driving mechanism (*Tennent*).

Year 1882.

6025. Chadwick, T., & ano. Sewing machines.
6068. Hollands, E. R. ..... Fire grates.
6109. Crommelin, W. A., and others..... Ovens heated by gas.
6127. Coleman, J., & another. Railway fog signal apparatus.
6142. Plunkett, J. W. ..... Gas for cooking, &c.

Year 1881.

5584. Lake, H. H. ..... An explosive compound (*Divine*).
5596. Lake, H. H. ..... Cartridges for blasting rocks (*Divine*).
5629. Power, E. J..... Shifting grain, &c., in the hold of vessels, &c. (*Power*).
5641. Mills, B. J. B..... Rotary engines (*Orto*).

Year 1880.

5313. Dick, G. A. ..... Metallic alloys (*Dick*).
5347. Robinson, S..... Steam engines, &c.
5361. Lake, W. R. ..... Wood turning machine (*Hanson*).
5363. Newton, H. E..... Guns, &c., for submarine warfare (*Ericsson*).
5367. Lake, W. R. ..... Wood turning machinery (*Hanson*).
5369. Smith, A. ..... Combing machines.
5381. Morgan-Brown, W. ... Producing barrels (*Holmes*).
5403. Fraser, D..... Breech loading mechanism, &c.
5408. Street, E. E. ..... Kilns.
5435. Wylie, A. C..... Moving cylinder steam hammers.
5436. Wylie, A. C., & ano..... Furnaces.

Year 1878.

5219. Marsh, T., & another... Spindles of spinning machines, &c.
5253. Wood, W..... Bobbins.

Year 1877.

4824. Hunt, B..... Insulating telegraph wires, &c. (*Brooks*).
4837. Cranston, W. McI..... Combined reaping and grain straw binding machines (*Wood*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Compound Engines.—*A. G. Brown, Cathcart, N.B.*—In a quadruple expansion engine the inventor leads the exhaust steam from the first high pressure cylinder to the top of the second low pressure cylinder. Thence the steam goes to the bottom of the second low pressure cylinder, and then finally exhausts to the condenser or to waste. The exhaust from the top of the second high pressure cylinder acts in the same way upon the first low pressure cylinder, and thus a final exhaust is obtained, pulling in the same direction and at the same time as the piston moves in the high pressure cylinder. A convenient construction of piston is one formed of a solid bar fitting the top or high pressure cylinder, passing thence to and through the low pressure cylinder, and carrying a piston therein. A similar construction is applicable for a triple expansion, except that to produce a difference of area between the top and bottom of the low pressure piston, the rod from the bottom is considerably reduced in area, and passes through a suitable stuffing box before being attached to the connecting rod. The valves which are most satisfactory for this arrangement are of a Maltese cross section, and work in cylindrical pressure chests. They perform only a partial rotation, and are provided with a groove which momentarily opens communication between the cylinders. The inventor claims the arrangement by which the exhaust from the high pressure cylinder passes to the top of the piston in the low pressure cylinder, and thence to the bottom of the same before being finally exhausted.—No. 5135. April 6th, 1887. 8*d*.

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VALVE GEAR.—*J. C. Simpson, Hull.*—The inventor dispenses with the slide valve of a steam engine, and substitutes a circular valve and a disc or plate for producing the requisite degree of expansion. The whole is operated by a rotating or oscillating movement, instead of by a sliding movement. The cylinder face on which the valve works has a port leading to each end of the cylinder in the usual way; the valve is a circular disc turning on its axis, having one port through from back to face. The steam passes to each end of the cylinder alternately through this passage as the valve is turned round. Diametrically opposite to this port is an exhaust port, which passes only through the face of the valve; the exhaust steam passes away through the interior of the valve to the low pressure cylinder. On the back of this valve is an expansion valve, working on the main valve spindle; it is connected to a speed governor by a small rod passing through a stuffing box. As the governor rises, the cut-off edge of the expansion valve meets the cut-off edge of the main valve, and cuts off the steam earlier or later automatically. Three claims are made.—No. 5588. April 16th, 1887. 8*d*.

GAS ENGINES.—*W. Bernhardt, Vienna.*—A valve held closed by a spring is inserted in the pipe leading from the slide valve box to the gas supply pipe. Between the stem of this valve and the lever which acts on it intermittently, is a movable piece, which is raised or lowered by the governor, so that when the maximum speed of the engine is exceeded the governor withdraws the movable piece from between the valve stem and the lever, and the latter no longer opens the former. This arrangement will be understood by reference to the accompanying drawings. Fig. 1 shows a side view of a gas engine, to which the present improvement is applied; and Fig. 2 shows an end view of the same. The slide C is worked in the usual way from the toothed wheel Z. The branch pipe through which the gas

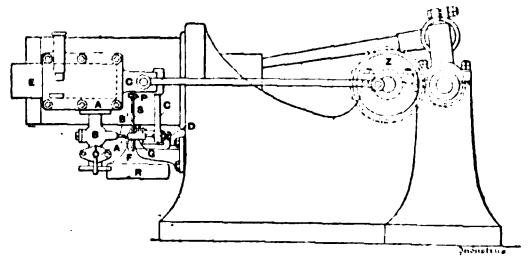


FIG. 1.

passes into the valve chest A contains a shut-off cock A^1 and a conical valve B that is held closed by a spring; the stem B^1 of B passes through a stuffing box in a direction parallel to the motion of the piston. The cock A^1 is opened when the engine is started, and is at other times closed. The slide C carries a rigid arm C^1, which has at its lower end an adjusting screw D; this screw accurately regulates the extent of the space between the valve stem B and the part connected to the slide C, which affects its inward pressure. The intermediate piece F transmits the motion of C^1 to the stem B^1, and consists of a bolt capable of sliding in a socket G. The socket G is carried by an arm H, which turns on a pivot. This pivot also carries a two-armed lever L, one of whose ends is connected to the bell R of a centrifugal governor, while the other end rests against a screw K, passing through a lateral lug on H. By means of K the bolt F can be adjusted in position between the valve stem B^1 and the adjusting screw D for any desired position of the bell R. If R

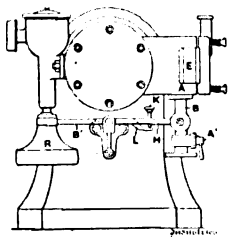
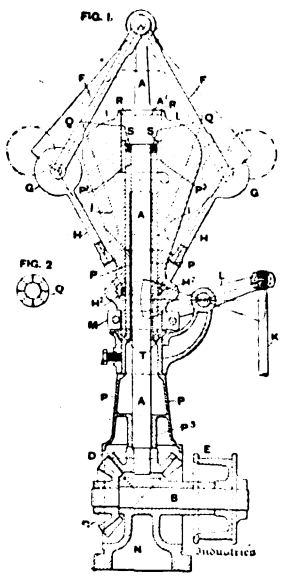


FIG. 2.

sinks below a certain position, or rises above a certain maximum, the bolt F will be correspondingly raised or lowered; consequently the valve stem B cannot be pressed back, and no gas is admitted into the slide chest. In order to start the engine, the bolt F must be lowered to the level of B^1. To effect this a catch S is pivoted to the engine frame, having its point of suspension nearer the suspension line of the engine than the socket G; when the catch hangs down free it does not interfere with the socket. When, after starting the engine, the speed for the first time rises above the normal, the socket G will be lowered and the catch S will fall back. By means of the levers L and H it is possible to arrange the engine to work with a lower minimum speed. In order to do this a weight may be attached to H, whereby the weight of R will be to some extent counterbalanced. The weight R will rise at a less speed than that at which it was originally intended to cut off the gas supply. The inventor makes six claims for the governing apparatus.—No. 5336. April 12th, 1887. 8*d*.

STEAM DRIERS AND WATER EJECTORS.—*G. G. Picking & W. Hopkins, London.*—The object for which this invention is designed is to insure the more perfect collection of the fine particles of water contained in the steam than is effected by any automatic apparatus at present employed for discharging the water of condensation from steam tubes and the like. The vessel is by preference of a cylindrical form, and is divided at its middle by a perforated diaphragm. The steam and water enter at one side of the upper part, and are directed by an internal pipe so that the stream dashes on the perforated diaphragm. The water passes through the holes and is deposited in the lower chamber. The upper division of the vessel is divided by a vertical partition; the steam which has been partly freed from its water in the first division passes through a pipe into the second division of the upper chamber. The issuing jet again impinges on the diaphragm; this further frees the steam from the particles of water that might escape the first operation, and the steam issues from the opposite side near the top of the vessel free from any water of condensation. The water collected in the lower vessel is automatically discharged by a float or cistern working on a trunnion. A valve is drawn off the end of the discharge pipe when the cistern sinks by reason of the accumulated water. When the water from the cistern is discharged through the water pipe, the cistern rises and closes the valve, which remains closed until sufficient water again accumulates. The inventors make six claims for the arrangement of the steam drier, and for the movable cistern for evacuating the accumulated water.—No. 6144. April 27th, 1887. 8*d*.

GOVERNORS.—*J. H. Street, Workington, and Tangyes, Limited, Birmingham.*—This invention relates to certain improvements in the construction of Porter's governor; the accompanying Fig. 1 illustrates such a governor containing the present improvements. A is the vertical spindle driven from the horizontal shaft B by the bevel and mitre wheels C and D; the shaft B receives its rotating motion by means of the band pulley E. The pair of links F are jointed to the upper end of the spindle A; the balls G are jointed to these links, and also to the links H which turn on the pins H^2. The weight I is suspended by the links H, and rotates with the spindle A. The rising and falling motion of the arms and weights is transmitted to the regulating valve through the rod K and lever L, which is jointed to the collar M. The driving gear C D of the governor is supported on the cast iron base N, which is surmounted by the hollow pillar P. The spindle works in bearings P^2 and P^3, which consist of portions of the hollow pillar of less diameter than the intermediate parts; the shaft A is thus only in contact with P at these bearings. The part A^2 is enlarged, and forms a shoulder which works upon and is supported by a series of washers Q. In Fig. 2 one of these washers is represented; it will be seen that radial grooves are cut in the faces in order to facilitate lubrication; the friction of the washers is reduced by distribution over a



number of working faces. The simultaneous rotation of the shaft A and the weight I is effected by the cotter R, which passes through the shoulder A^2, and whose projecting ends engage in the slots S at opposite sides of the weight I. The top of the hollow pillar is preferably higher than the centre of gravity of the weight I and the balls G. By this disposition of the centre of gravity the defect of "wobbling" is obviated to a large extent. The inventors make three claims for the arrangement of the hollow pillar, for supporting the spindle on the pillar, and for the system of anti-friction washers as described.—No. 6013. April 25th, 1887. 8*d*.

GRINDING MACHINERY.—*W. F. Goreham, Wallsend, and M. Watson, Newcastle-on-Tyne.*—This invention relates more particularly to mills for grinding cement, but it is applicable also to other mills. Instead of using ordinary stones, the inventors employ a runner and a bed constructed with discs of cast iron or steel. These discs are formed of a series of separate concentric rings, so that the greater wear of the outer portions of the face may be compensated for by means of screws. Instead of forming the grooves which constitute the faces of the runner and the bed of the ordinary depth, the inventors form radial slots through the plate. In order to prevent material escaping unground through the slots, these are cast in each disc so that they take a sloping direction from the face of the plates; the grinding edge of each thus forms an acute angle. This construction of the plates requires no further dressing, but they will continue to work efficiently until requiring renewal. Any loss in the weight of the upper disc is made up for by the addition of loose weights. Eight claims are made for the adjustably constructed bed and runner, and for the dressing consisting of slots as described.—No. 6281. April 29th, 1887. 8*d*.

TRAVERSE WARP MACHINES.—*J. Carver & J. Newton, Nottingham.*—Hitherto in imparting lateral motion to certain parts of plain net machines, viz., the comb bar, guide bars, and point bars, it has been customary to employ a separate vertical shaft fixed at one end of the machine, driven by bevel wheels from the main shaft, and provided with suitable cams and levers. The object of this invention is to arrange these levers and cams so as to insure a more dependable motion at high speeds. The usual vertical cam shaft is dispensed with entirely, and the horizontal shaft is provided with extra cams. Each of these cams is in contact with revolving trucks, in order to reduce the friction. To each end of the main driving shaft are fixed spur wheels which gear with similar wheels on separate shafts. On each spur wheel are concentric projections on the outer faces, which impart the required lateral motion to the guide bars and point bars by means of levers. These levers are provided with a truck which runs on its cam, and the other end of the lever is attached to the bar which it is to move laterally. The cam on the face of the driven wheel at the left hand end of the machine is employed to move the front guide bar; the corresponding wheel at the other end is employed for "shogging" the front point bar, while the driving wheel which is on the main shaft at the same end of the machine is employed to impart movement to the back guide bar; and the driving wheel at the left hand end moves the back point bar. The opposite ends of each of these levers have springs attached to them, in order to make them return to their normal position. The front comb bar receives its lateral motion from face cams fixed to the ordinary cam shafts. These cams impart motion to levers suitably fulcrumed to the frame; one end of each lever is provided with a truck as before. The left hand end cam is a counter to the right hand end cam, and thus the machine can be run at a greater rate than hitherto. Three claims are made for this re-arrangement of cams and levers.—No. 5970. April 25th, 1887. 8*d*.

DISC PUMPS AND BLOWERS.—*J. Bowns, Sheffield.*—The present improvements relate to that class of pumps and blowers in which a flat disc works in a cylindrical casing between two conical ends. The apparatus constructed according to this invention is represented in cross section in Fig. 1; and in

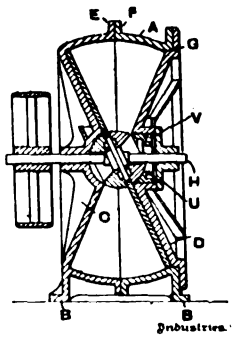


FIG. 1.

Fig. 2 an enlarged view of the disc is seen. The cylinder A rests upon the feet B; the ends of the cylinder are conical in shape, as shown in Fig. 1. One cone C is cast in the same piece with one half of the cylinder, while the other cone D is separate, and is bolted to the cylinder A by means of the flange G. The straight shaft H is supported in bearings in the conical ends of the cylinder, and on it is formed the flat disc or collar I and the bosses K L, which are inclined to the axis of H. The two hemispherical bosses M and N surround the disc I and bosses K L, and they are recessed so as to enclose and fit the disc when bolted together at O; their ends are bored sufficiently to clear the shaft H. On the edges of the two hemispheres a groove is turned, in which the large disc or piston P is secured by the bolts O. The piston P is slotted along one radius from the spherical boss to the circumference, and a partition plate is inserted therein to divide the inlet and outlet ports from one another. This partition plate holds the disc and prevents it from rotating, and when the shaft H is revolved by the pulley T the piston rolls on the cones and draws the air or liquid in alongside of the partition plate and expels it on the other side.

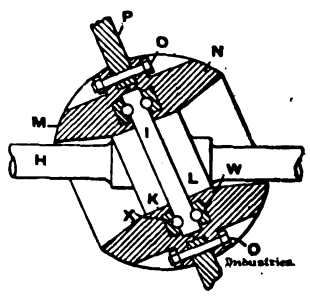


FIG. 2.

The bearings for the shaft may be cast solid with the cylinder ends, as shown on the left hand side of Fig. 1; or they may be separate and attached by bolts, as shown on the right hand side. An adjustable cylindrical bush U is inserted into one cylinder end, and is pressed by springs V against the spherical boss, in order to take up the wear. Balls are inserted between the disc I and the bosses M N, so as to form ball bearings. The hard metal rings W and X are placed in grooves in the bosses M N, and the balls run in the semi-circular grooves, as shown in Fig. 2. The cast iron or vulcanite piston is sometimes covered with india-rubber or leather, for the purpose of insuring a more perfect fit against the conical ends of the cylinder. The inventor makes three claims for the disposition of the shaft H, carrying the collar I working in the bosses M N, and for the use of ball bearings between I and M N.—No. 5794. April 21st, 1887. 8*d*.

GAS ENGINES.—*E. Casper, London.*—The object of this invention is to prevent the waste of heat which usually escapes through the exhaust, and through the walls and jacket. This object is attained by injecting water, in the form of a spray, into the cylinder at certain times between the explosions; this spray is converted into steam, which is utilised for driving the engine. This arrangement makes it possible to dispense with the water jacket. Valves and other apparatus are employed for

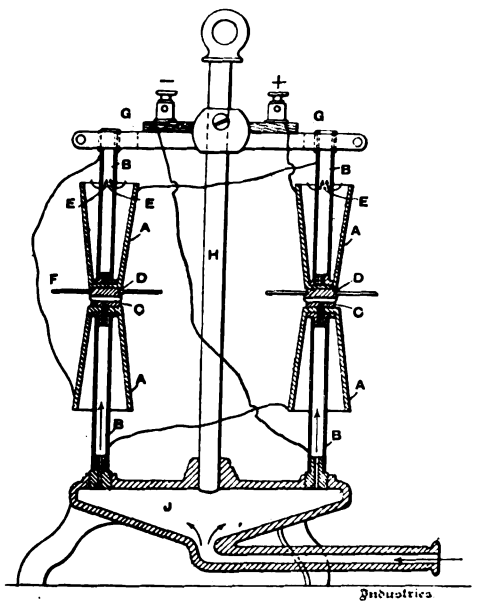
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admitting the gas and for exhausting the products of combustion as usual; a valve is also arranged for admitting water under pressure from a pump, and is operated by mechanism fitted on the shaft of the engine. The piston at its innermost position is ready to draw in the explosive mixture; the explosion takes place at some time during the succeeding stroke; the return stroke causes the ejection of the spent gases. At the beginning of the next stroke a spray of water is admitted, which, when it comes in contact with the hot sides of the cylinder and piston, becomes vaporised, and yields enough expansive force to cause the next outstroke. During the return of the piston the steam is exhausted, and the admission of the explosive gas takes place again at the conclusion of the stroke. It will thus be seen that one stroke of a different character is interpolated between the two ordinary strokes of the gas engine, and the heat which is usually conducted away through the jacket is made use of in driving the engine. A saving of gas is thus effected. Three claims are made.—No. 4757. March 30th, 1887. 8*d*.

Carding Engines.—*J. H. Johnson, London. (La Société Alsacienne de Constructions Mécaniques, Belfort, France.)*—This invention relates to the adjustment of the flats of carding engines. The side frames of the engines are provided with a projecting flange, whose outer surface is truly concentric with the axis of the cylinder. A rigid adjustable segment is placed upon this flange, with its under surface corresponding exactly with the outer surface of the flange; the outer surface of the segment, however, assumes a spiral outline. The arch which forms the support of the flats rests upon this segment, and is made sufficiently flexible to enable it to accommodate itself to the varying curvatures at different parts of the segment. The piece forming the arch must be made thicker at one end than at the other, in order to keep its outer surface invariably concentric with the cylinder. By shifting the segment in a circular direction upon the fixed concentric flange, by means of a rack and pinion, the arch supporting the ends of the flats is caused to move radially towards or away from the axis of the cylinder; and when thus adjusted to the required distance, it can be secured in its position by bolts and nuts. The inventor makes two claims for the application of the eccentric segment for the purpose described.—No. 5857. April 22nd, 1887. 8*d*.

ELECTRICITY.

Thermopiles.— *R. J. Gülcher & J. Pintsch, Berlin.*— The inventors have discovered that the efficiency of the pile is increased by making the elements hollow, and so arranged that the smallest base surfaces are used for heating, while all the other surfaces are used in cooling the elements. This form of element also allows a considerable reduction in the necessary length of the bars, so that a saving is made of material, and the electric resistance is diminished. Several shapes of elements are designed, the one shown in the figure at A is made up of a hollow frustum of a cone in combination with a cylindrical element B. The action of this combined element is further increased by providing air holes E in the inner body. There is thus produced in each pair of elements a continuous circulation of air that assists in the cooling. These bodies are arranged so that they can be made to serve as their own heating apparatus. The hollow body of each pair of elements is used for the conduction of the combustible gases, and the ends of both the

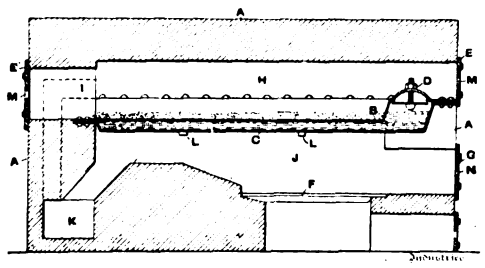


hollow bodies to be heated are provided with one or more openings communicating with the inner hollow body; the gases pass through these holes and burn at the ends of the hollow bodies. This method is illustrated in the figure annexed; two pairs of elements A are placed end to end, and a plate of mica F is inserted for the protection of the upper part of A from the radiated heat of the flame. The hollow stand J is connected by a nozzle to the gas supply, and the gas passes into the several lower inner hollow bodies B; the corresponding set of upper elements are suspended from the standard H. The flat blue flame burns between the plates C and D, and at the same time heats the upper and lower pairs of elements. The electric wires are connected as shown in the figure. Seven claims are made.—No. 623. January 14th, 1888. 8*d*.

CHEMISTRY.

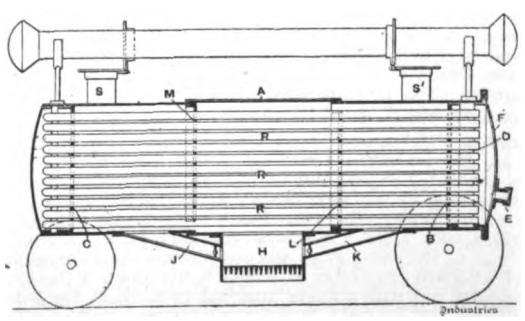
Coating Metal Plates with Tin.—*A. Gutensohn, London, and E. Cox, Datchet, Windsor.*—The present invention relates to the process of coating metal with tin by the use of grease. The plates to be tinned are cleaned by pickling with acid; they are then immersed in an organic solution obtained by pouring boiling water upon ordinary flour or other substance containing starch. Other organic substances may be substituted for starch, such as glucose and gelatine. The plates are afterwards pressed through melted grease, which is in sufficient quantity and thickness over the surface of the molten tin; the plates pass through the boiling grease directly into the tin. The preliminary treatment of the plates renders them capable of receiving the grease upon their surface at once, and the presence of the latter ensures the immediate and uniform adherence of the tin. The inventors make one claim for the use of the solution containing starch or glucose capable of combining with the greasy matters.—No. 4846. March 31st, 1887. 6*d*.

Extraction of Gold from its Ores.—*J. Weirich, Béziers, France.*—This invention provides a new process for abstracting the sulphur from the ore before submitting it to the mercury process. The pulverised mineral is heated in the presence of a feeble current of air to a temperature of 400°C.; the gold is freed and the sulphur is partly eliminated by volatilisation. The figure represents a vertical longitudinal section of the apparatus constructed for the purpose of carrying out this invention. The arrangement consists essentially of a furnace of ordinary construction, whose interior is divided horizontally into two distinct chambers H and J, by two pans of strong sheet iron B C. These pans are riveted together all round their edges; near the front end of the upper chamber the pan B is pierced with an opening



D, fitted with a tight cover. The outer end of the coupled pan rests on a shoulder within the furnace, and for greater security the lower pan rests on bars L. The upper pan receives the pyrites to be treated, which is introduced through E¹ and spread out in a layer. The pans are made at the hinder end with no projection above the upper pan B, to facilitate the charging and discharging of the furnace. The lower pan C receives the lead, which forms a bath for heating the pan B. The lead is introduced in a molten state through D. Under the influence of the fire in F, the lead is kept at a temperature of 350°—400°C. The fire at F is fed with fuel through a door G; air enters through the perforation N, and also underneath the fire bars. The products of combustion leave for the chimney through the flue K. The desulphurising current of air is admitted through the perforation M in the door E, and is drawn by the current of air in the chimney over the surface of the ore, and down the channel I into the flue. The inventor makes two claims for thus eliminating the sulphur without ignition.—No. 7657. May 26th, 1888. 7*d*.

Production of Hydrogen.—*W. Majert & G. Richter, Grünau, Germany.*—The object of this invention is to produce hydrogen gas for military purposes. The principle on which it is based is that finely divided zinc, when brought in contact with water and heated, becomes oxidised and releases the hydrogen from the water. Cartridges are made of zinc dust and dry hydrated lime or magnesia, or doubly hydrated chloride of calcium, enclosed in a yielding case of sheet iron, about 20cm. in diameter and 70 cm. long. The accompanying illustration shows a section of a convenient apparatus for carrying out the object of this invention. A number of tubes R are fitted into the ends B and C of the retort A. The tubes may be open at both ends, or they may be open at one end as shown; their ends project into a chamber D, which is closed by a cover F; an outlet pipe is provided at E. The tubes R are closely fitted in the tube plate B, so that the space D is quite shut off from the other part of the retort. The heat from the furnace H passes into the vessel A and circulates around the tubes R; baffle plates L and M are arranged so as to retain the heat in the retort. The tubes J and K, with suitable throttle valves, pass from the furnace to the retort in order to permit the heat to circulate

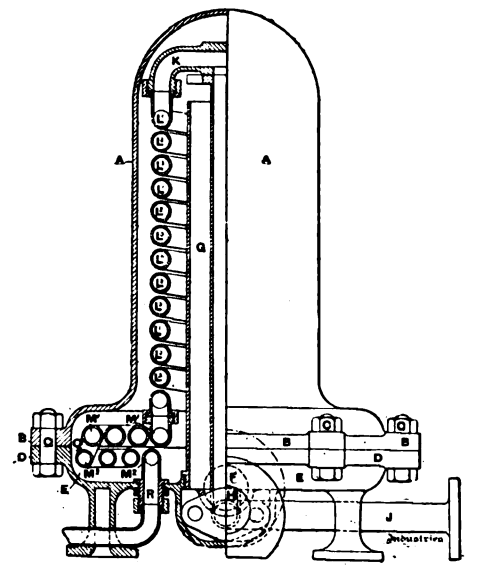


quickly, and the chimneys S and S¹ serve to carry off the products of combustion. In using the apparatus, the tubes R, after the cover F has been opened, are filled with the cartridges specially prepared, and then the cover F is closed. The heat of the furnace is now applied; the soldering of the cartridges melts, and the hydrogen is liberated and collects in the chamber D, from whence it is led off through the outlet E. The whole apparatus is mounted on wheels, and the chimneys are hinged, in order to facilitate its carriage in the field. Four claims are made for the method of preparing the hydrogen, for the construction of the cartridges, and for the apparatus as described.—No. 4881. April 1st, 1887. 8*d*.

Extraction of Gold from Ores.—*A. Woodhouse, London.*—This process relates to the method of amalgamating the gold contained in the ores without mechanical agitation. The ore is first to be crushed to a fine powder by a usual pulveriser, and the crushed products, after admixture with mercury, are washed by a suitable stream of water, in order to insure their uniform delivery into a canister provided with a perforated bottom. The ore is then delivered upon a dropping amalgamator or a silver-plated copper table. The ore is then discharged over the usual ripples and corrugated plates. In an amalgamating box a series of check plates are provided, which consist of vertical plates placed transversely to the flow of the amalgamated ore; orifices with side projecting wings are so arranged as to flank each other in the successive check gates The inventor claims: (1) The combination of a pulveriser, perforated distributor, inclined amalgamating plates and ripples, with an amalgamating box; and (2) the construction of the amalgamating box, consisting of a series of vertical plates placed transversely to the flow, and provided with the orifices as described.—No. 5627. April 18th, 1887. 8*d*.

MISCELLANEOUS.

Sea Water Distillers.—*G. Gravely, London.*—The improvement in condensers for sea water distillers, included in this invention, enable the condenser to be easily opened for examination. The sea water discharge pipe is connected with the base of the apparatus, the steam pipe is carried through the sea water discharge pipe, and spiral condensing coils are combined with volute refrigerating coils. The construction of the condenser is shown in section and elevation in the annexed figure. The shell A is formed at the bottom with a flange B, which is connected by the bolts C to a corresponding flange on the base E. The sea water pipe F is connected to the base E at one side; by its means the whole of the shell is kept filled with sea water. The sea water discharge pipe G is placed vertically in the centre of the condenser, extending from the base upwards; at its lower end it communicates with an outlet H. The steam pipe J enters the



outlet H and passes up through the centre of the discharge pipe G; when it emerges from the discharge pipe it divides into three branches K, which communicate respectively with the three condensing coils L^1 L^2 L^3. The inmost turn of the first refrigerating coil M^1 has three sockets, which respectively receive the lower ends of the three coils L^1 L^2 L^3. The second volute refrigerating coil M^2 is connected at Q in its outermost turn with the same turn of M^1. The fresh water discharge pipe R is connected to the inmost turn of the coil M^2. It will be seen that all the inlets and outlets are at the base at the apparatus, and are below the line of connection of the shell A and the base E; hence, by merely unscrewing the bolts C, the shell can be lifted off without disconnecting any pipes or valves. The inventor makes five claims for the disposition of the various coils as described and shown in the drawing.—No. 5841. April 21st, 1887. 8*d*.

Preparation of Gelatinised Grain.—*J. Death & A. S. Tomkins, London.*—This invention relates to the preparation of gelatinised grain, such as is frequently used in brewing, distilling, and vinegar making, and its object is to obviate the disadvantages attendant on the passage of the steam through the grain. The grain is to be first moistened, and then heated in the usual way by means of a current of hot air. Into the moist grain thus heated is passed a current of steam at atmospheric pressure until gelatinisation is effected. The steam may be superheated, and it may be passed into the hot moist grain either continuously or intermittently, and may be alternated with currents of hot moist air. One claim is made.—No. 12188. September 8th, 1887. 4*d*.

Fulling and Washing Machines.—*E. Kempe, Leeds.*—The object of this invention is to improve the construction of combined fulling and washing machines, in which the fabrics are treated while in a rope form. The ropes of cloth are passed between a pair of fulling bowls or rollers, which are pressed together by springs; one of the rollers is provided with deep end flanges, to prevent the rope of fabric from escaping from between the rollers at their ends. According to this invention, all the rollers are made of compressed cloth formed by threading numerous discs of cloth side by side on to a metal bar adapted to serve as an axis of the roller, and then compressing the assemblage of discs by means of a powerful press. The machine may not only be provided with a pair of fulling rollers, but also with other rollers for washing the fabric if desired. Two claims are made.—No. 5961. April 23rd, 1887. 6*d*.

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POLISHING AND LACQUERING TUBES AND BARS.—*R. J. Edwards and A. Edwards, London.*—In constructing apparatus for grinding and polishing tubes and bars, the inventors arrange two rotating discs face to face, mounted on separate spindles. The opposing faces of the discs are prepared with a soft material such as felt; one or more strips are attached to the face of the disc by glue or cement, in a spiral form, leaving a narrow space between each succeeding coil. The opposite faces of the discs are not to be exactly parallel, but one of them is arranged so that its revolving face is vertical, whilst the other is inclined more or less, so that while its lower edge nearly touches the first disc, their upper edges may be separated, and thus leave an angular space between them. The bearings supporting the spindles are made adjustable, so that they may revolve at any required distance apart. One of the shafts is made hollow, and the abrasive powder is fed through it. The whole apparatus is inclosed in a case, and the tube to be polished is inserted through a hole in the side of the case, in order to be operated on between the two discs. In lacquering the tube, the inventors use an annular brush of felt, through which the tube passes as it leaves the discs. The brush is fitted into a hollow chamber, whose lower part contains a supply of varnish at a suitable temperature, and the entire device is passed rapidly along the tube while the brush is rotated. Five claims are made.—No. 2558. February 18th, 1887. 8*d.*

TIN BOXES.—*G. F. Griffin, London.*—These tins are constructed in such a manner that they shall offer no obstruction to the extraction of the contents, and that the cover shall be removable by a lever. The body is made in one piece, from one end of which a circular piece is cut. The flange which is thus left is folded inwards; the top of the fold is pressed outwards to form an annular recess, and the edge acts as a fulcrum for the raising lever. The bottom of the fold serves as a clip or spring against the lower part of the neck of the lid when in position; and the opposite end of the body is fitted with a bottom in the usual way. There are several modifications described in the specification; but the above is the one preferred by the inventor. Four claims are made for the various forms.—No. 6232. April 28th, 1887. 8*d.*

BORING AND DRILLING MACHINES.—*T. Bower, R. W. Bower, J. Blackburn, Woodlesford, & F. Mori, Leeds.*—These improvements relate to the employment of an electromotor for imparting motion to machines for boring, drilling, and under-cutting minerals. For this purpose a dynamo of high tension is used, from which the electromotive force is transmitted through cables to a motor attached to the boring machine. When used for drilling or boring only, any required number of spindles may be employed, and the motor connected by suitable gearing so as to bring all the tools into simultaneous operation. A cut-off motion is placed between the motor and in connection with the cables, in order to regulate the speed of the motor. Two claims are made for the application of the electromotor for the purposes of imparting motion to the rock drill.—No. 7662. May 26th, 1887. 8*d.*

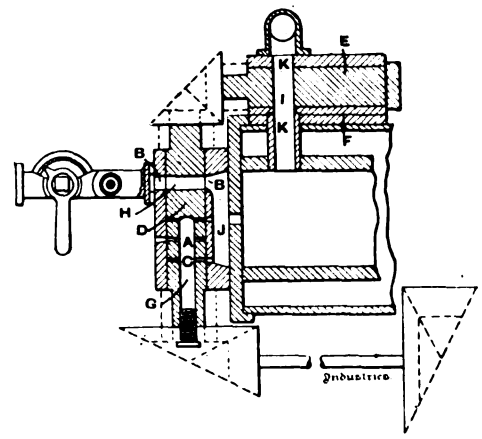
SELF ADJUSTING DIE FOR SCREW MAKING MACHINES.—*C. D. Rogers, Providence, Rhode Island, U.S.A.*—The present invention relates to machines for automatically forming the threads of wooden screws, and introduces an improvement into the adjustment of various parts, and an automatic accommodation to each other of the thread forming dies. The stationary die is secured in a holder which is both laterally and longitudinally adjustable. The holder has an elastic support which maintains the die in its normal relation to the travelling die, and permits a slight downward movement of the holder against the resistance of the spring. If this movement is exceeded a fixed stop prevents further action of the die in this direction; an adjustable stop is also provided for limiting the upward motion of the holder. The extreme vertical movement of the holder need not ordinarily exceed one thirty-second of an inch. This small up and down movement of the holder, while rolling the threads, is produced by the slight inequalities of the dies, which for the instant do not always exactly register. By means of this arrangement the automatic adjustment of the die is made possible. Three claims are made for the automatic adjustment described.—No. 17831. December 28th, 1887. 8*d.*

SOFTENING AND PURIFYING WATER.—*G. E. Davis, Manchester.*—In order to remove the lime out of well water, the inventor employs the tribasic phosphate of soda for effecting the precipitation of the lime salts. The residue left at the bottom of the water may be used as manure, as it contains a large quantity of phosphate of lime. The inventor claims the use of phosphate of soda in softening water.—No. 5655. April 19th, 1887. 4*d.*

MANUFACTURE OF ROPE FOR HARVESTERS.—*W. M. Cranston, London. (The Walter A. Wood Mowing and Reaping Machine Company, Hoosick Falls, New York.)*—This apparatus is attached to a harvester, and is adapted for the making of rope used for tying bundles of grain while the machine is at work in the field. A cradle is provided for this purpose, in which straws of a given length are inserted. A disc in the lower end of the cradle has a reciprocating circular motion imparted to it by a crank and bar. The bar carries a blade, which passes through the side of the cradle and knocks the straws up to prevent them from matting. The disc is intended to keep the butt end of the straws in position. Entering into the slot in the bottom of the cradle is a toothed picker wheel, to which rotary motion is given; the teeth take straws in succession and put them in the path of a pusher. The picker wheel is in frictional contact with a spring which pushes it round. When the straws arrive against a dog plate, the pusher feeds them through an opening in one side of a drum, which carries a hook for laying the straws between a pair of rollers. These rollers in rotating draw the straws in between them, and press them against a cup shaped piece of the outer plate, which turns the straws through a right angle. The drum is mounted on a frame, and its rotation gives the twist to the straws while partially within the drum; the twist is completed between the drum and the outside pair of draw rollers. The twisted straws are then led off and wound on a reeling mechanism. After each motion forward of the toothed picker wheel, the wheel has a backward motion imparted to it by a pawl; each tooth in succession thus clears itself and prevents entanglement. As each bundle is bound, the fall over of a lever stops the twisting mechanism; but as soon as sufficient straws are gathered to form a fresh bundle, the lever is moved back again. This motion acting upon a clutch causes the twisting mechanism to be thrown into gear again. Four claims are made for the parts, as described.—No. 6352. April 30th, 1887. 8*d.*

GERMAN PATENT ABSTRACTS.

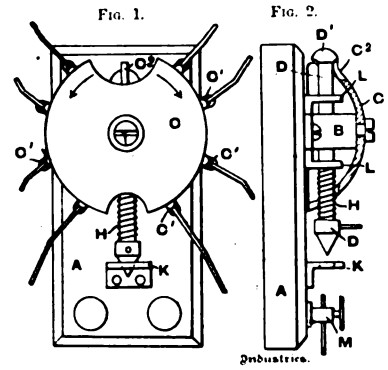
GAS ENGINES.—*C. G. Schranze, Riesa-a-d-Elbe.*—The valve D, which is revolved by means of bevel wheels in proportion of 4 to 1 to the crank shaft, is provided with perforations H corresponding to openings in B in the valve casing J for admitting the mixture of gas and air. D is also fitted with a cylindrical



recess G having the perforations A and C. In G the flame for igniting the gas burns, the ignition taking place through A and C. D actuates the valve E through the openings I and K, of which the exhaust is effected.—No. 42530. August 14th, 1887.

ALARUM APPARATUS.—*E. Bettelheim, Milan.*—The bell C, which turns freely on a pivot B secured to the plate A, is provided with loops into which strings are secured. These strings are provided with hooks, by means of which the apparatus may be secured to a net spread before the window or door to be secured against burglarious attempts. A metallic bolt D, provided with a head D, slides freely in the guide L. When putting the appara-

FIG. 1. FIG. 2.



tus up this bolt is secured by a small hook C_2, which is fastened to the bell C. As soon as somebody touches the net, C_2 becomes disengaged and the bolt D is forced by the spring H against the contact K, thereby establishing an electric circuit in an alarum bell, one wire of which is clamped to K, the other one being fastened at M.—No. 42504. May 27th, 1887.

UNITED STATES PATENT ABSTRACTS.

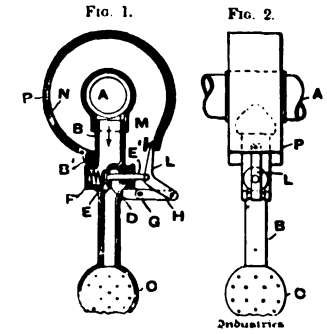
SPIRAL GIRDER.—*W. W. Green, Chicago.*—The girder which is the subject of this invention consists mainly of a helicoidal sheet of metal. Four tie rods extend from breast plate to breast plate, and penetrate each successive helix of the girder. Between each helix, and surrounding the tie rods, are compression bars, and a series of rods or cables extend from breast plate to breast plate, passing diagonally between each coil of the girder. The inventor makes two claims for this form of girder.—No. 379217, dated 13th March, 1888.

LET-OFF MECHANISM FOR LOOMS.—*H. Litchfield, North Adams, Massachusetts.*—According to this invention a shoe or yoke is pivoted at one end to the loom frame, and encircles a pulley geared to the warp beam. At its free end on the other side of the pulley, the yoke has a weight attached and is provided with a slot. A flexible friction strap is also fixed to this end of the yoke, from whence it passes round the pulley, and is attached at its other extremity to the frame of the loom. A weighted rod, with a finger attached to work in the before mentioned slot, regulates the pressure of the belt on the pulley, and thus controls the speed of the letting-off mechanism. One claim is made for this apparatus regulating let-off mechanisms.—No. 379173, dated 6th March, 1888.

STEAM BOILER.—*A. Catchpole, Geneva, New York.*—This invention relates to that class of steam boilers in which the water and steam is contained in tubes exposed to the direct action of the flames. The outer shell of the boiler and of the furnace below it is made of cylindrical form. Inside the exterior shell are two series of annular concentric tubes, which communicate with one another alternately. Above these tubes is one large tube, at the outside of which is a flange. This tube rests on the top of the outer casing by means of the flange, and is riveted down in position by rods which pass vertically through all the tubes. An annular casing surrounds the furnace in which the fuel burns, and the water contained in it communicates with that in the tubes. This water is exposed to the direct influence of the fire, while the water and steam in the tubes are superheated by the products of combustion circulating between the tubes. The connections made between the different sets of pipes and the vessel surrounding the fire insures a constant circulation of the water, while the steam collects in a heated condition in the uppermost tube ready for use. Three claims are made.—No. 379048, dated 6th March, 1888.

FIRE EXTINGUISHER.—*W. G. Brown, Atlanta, Georgia.*—The accompanying illustrations represent a cross section and a side elevation of the fire extinguisher here described. The main water supply pipe is shown at A, and the branch pipe B is coupled to it in the manner represented in the diagram. The valve E is pressed against its seat by the spring F, and ordinarily prevents the passage of water to the sprinkling rose C. A compound plate of metal P N is pivoted at B to B^1, and its other end is loosely connected to the lever L by the screw M; the link H is pivoted to the fixed projection G and to the lever L;

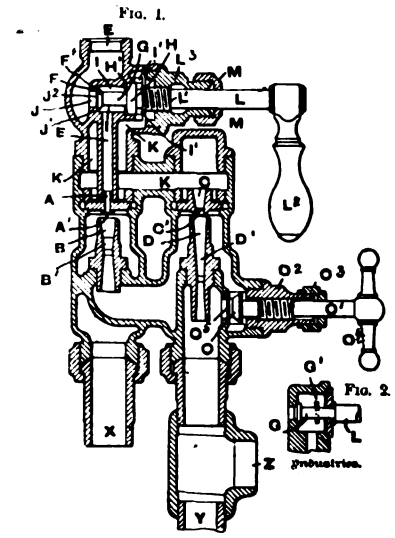
FIG. 1. FIG. 2.



the stem of the valve E passes through a stuffing box and presses against a hollow in the elbow of L. The plate P N is made of two different metals, the outer one of which expands more by heat than the inner one. The result is that when there is a fire in the neighbourhood of this apparatus, the plate presses the elbow lever L towards the pipe B, and so opens the valve E against the pressure of the spring F; the water thus gains access to the sprinkler and escapes through the perforations. One claim is made for this method of automatically operating the sprinkler.—No. 378285, dated 21st February, 1888.

INJECTOR.—*C. E. Randall, Boston, Massachusetts.*—The accompanying section of the injector indicates the improvements in the arrangement of the steam inlet valve. The steam enters at E, the suction is at X, and the delivery at Z, while Y represents the overflow pipe. The steam port J communicates with the passage I, into which enters the lifter steam jet tube E^1, and the ports I^1 allow the steam to pass into the forcer steam jet tube K

FIG. 1.



The two valves F^1 and H controlling the entering steam are mounted on the same spindle L, to which is attached the operating handle L^2. The valve H is adapted to close the ports I^1, and to keep them closed until the valve F^1 is moved sufficiently to open the port J, and to unclose them upon further movement of the valves. Five claims are made for this disposition of the steam inlet valve. No. 378403, dated 21st February, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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INSTITUTION OF NAVAL ARCHITECTS.

(Concluded from page 340.)

THE proceedings on Friday morning, the 23rd March, opened with the reading of a paper by Mr. R. E. Froude, on

THE CONSTANT SYSTEM OF NOTATION OF RESULTS OF EXPERIMENTS ON MODELS USED AT THE ADMIRALTY EXPERIMENT WORKS.

At the Admiralty Experiment Works the resistance of models is ascertained for a variety of speeds, and generally for three different draughts and fore and aft trims. The results obtained in the past with miscellaneous models may be valuable for the future, provided the information is presented in a form under which the performances, proportions, and, as far as possible, the characteristics of shape become directly comparable. For this purpose the author has adopted a system of notation, according to which the proportions and, to some extent, the lines of the hull are characterised by numerical values, representing measurements in terms of a unit dimension proportional to the cube root of the displacement. Thus, for instance, if the displacement be given in cubic feet, the unit dimensions to which all linear measurements are referred would be the side of a cube containing as many cubic feet as the immersed part of the hull. The performance is characterised by two so-called constants K and C, the former denoting speed in terms of a unit speed proportional to the sixth root of the displacement, and the latter the corresponding resistance in the form of the reciprocal of what is known as the Admiralty displacement constant, viz., the horse power divided by the product of the third power of the speed V and the two thirds power of the displacement Δ. The object of the author was to express the constants K and C in such a way that their values should be indeed constant for similar forms at corresponding speeds, whatever the absolute size, and for this purpose he has eliminated the influence of size by the adoption of the relative unit of length, as above mentioned. In other words, he aimed at showing for any particular hull by a variety of curves the value of C as dependent on the value of K. The author exhibited these curves in some wall diagrams. The value of K must be proportional to $\frac{V}{\Delta^{\frac{1}{3}}}$, and for C the author introduces the formula $C=\frac{R}{\Delta K^2}$, which by substituting K becomes $C=\frac{R}{\Delta^{\frac{1}{3}} V^2}$. Since the product of resistance and speed is proportional to effective horse power, the above formula agrees with the Admiralty displacement constant already mentioned. We have $C=\frac{E.h.p.}{\Delta^{\frac{1}{3}} V^3}$. The hull dimensions are expressed in a unit $U=\Delta^{\frac{1}{3}}$ and K expresses the ratio of the speed to a unit or standard speed appropriate to the displacement and proportional to its sixth root; in other words, to a wave having a length proportional to U. For convenience, the author has chosen 2U as the length of a wave, the corresponding speed of which makes K equal to unity, so that $K=\frac{V}{\Delta^{\frac{1}{6}}}\sqrt{\frac{1}{4\pi g}}$; and, thus defined, K becomes unity for a vessel of about 5000 tons at a speed of seven knots. Since the resistance for this value of K is generally rather less than $\frac{1}{1000}$th of the displacement, the author finds it convenient to avoid decimals by writing $C=\frac{1000\,R}{\Delta K^2}$. In order to account for skin friction and influence of length, the author introduces a skin constant which is the wetted area divided by U^2, and a length constant which is the length between perpendiculars divided by U; but the space at our disposal does not permit of our noticing in detail the various connections which he applies to the formulæ by means of these co-efficients. We have only given here a short outline of the author's methods, to show that rational systems of measurement, which in other branches of applied science have been adopted with so much advantage, are now also used in naval architecture.

The discussion was opened by

Mr. Benjamin, who remarked that, in estimating resistance, designers have to use a number of so-called constants which are really not constants, but are left to each designer to settle for himself. The speaker was glad that Mr. Froude had nearly abolished these "variable constants." The resistance had been divided into two parts—first, that not relating to friction; and, secondly, that relating to friction. The former is dependent on the size, speed, and shape of the vessel; the latter mainly on wetted area. It does not depend on the same factors of the vessel as C and K, and the speaker believed skin friction to be much more conjectural than Mr. Froude assumes.

Mr. White expressed his indebtedness to Mr. Froude for the valuable assistance he had often rendered him in matters that went beyond experiment. He hoped that shipowners, especially their friends in Dumbarton and Italy, would plot their records of ship trials as Mr. Froude had done.

Mr. Inglis regretted that shipowners had so few facilities for these experiments. Most shipbuilders try their vessels systematically, using the actual dimensions and the cube root of the displacement as the basis of comparison. He wished they could elucidate certain points by model experiments, but only one tank was held by a private owner. He suggested the erection of a co-operative tank.

Mr. Froude, in reply, said that he had written the paper hoping to induce other workers with either models or full ships to adopt his notation, as it would be a great advantage to have only one system in use.

The next paper read was by Professor A. G. Greenhill, on

A THEORY OF THE SCREW PROPELLER.

In this paper the author gave a new method of calculating the thrust and efficiency of a screw propeller, different in some respects from the methods employed by Rankine, Froude, and Cotterill. In the discussion on Professor Rankine's paper in 1865, Mr. Charles Lamport drew attention to the angular effect of the propeller upon the water, and in his reply Professor Rankine maintained that the loss of work (simply proportional to the slip of the propeller) comprehends the effects of rotating or transverse as well as of backward slip. In the papers of Rankine, Froude, and Cotterill the propulsive thrust is first calculated from the backward motion imparted to the water, and then the turning couple on the propeller is found. In the present paper the order of these operations is reversed; the turning couple L of the propeller is first calculated from the angular momentum imparted to the wake, and then the thrust T is calculated from the formula $Tp=2\pi L$, where p denotes the pitch of the propeller. Fluid friction, wake action, blade displacement, &c., are here left out of account; but the consideration of these disturbing causes, which tend to mask the main principles in question, is taken up in a subsequent part of the paper.

Suppose the wake to leave the propeller with axial velocity v, and let n denote the revolutions of the propeller, then $n-\frac{v}{p}$ is the rotary speed of the wake, and the angular momentum communicated to the wake is

$$L=\frac{w}{g}\left(A^2-B^2\right)v\left(n-\frac{v}{p}\right)$$

when A denotes the disc area of the propeller, B the cross sectional area of the boss, and w the weight in pounds of a cubic foot of water; v is assumed uniform throughout the wake.

Since $B^2 : A^2$ is small in practice it may be neglected; and the thrust given as

$$T=2\pi\frac{w}{g}A^2\frac{v}{p}\left(n-\frac{v}{p}\right)$$

If u denotes the velocity of feed of the propeller, which, neglecting wake action, will be the same as the speed of the vessel, then $np-u$ is the slip velocity of the screw; and the slip ratio $s=(np-u)\div np$.

The efficiency e of the propeller is the ratio of work done by the thrust to the work consumed in turning the propeller; so that

$$e=\frac{Tu}{2\pi Ln}=\frac{u}{np}=1-s.$$

Since for similar screws with given slip ratio s at speed u, the thrust varies as $A^2\div p^2$, that is as A or p^2, it follows that the disc area of a single screw should be double the disc area of each of two similar twin screws required to drive the same vessel at the same speed. The weight of a single screw will thus be $V2 = 1{\cdot}4$ times the weight of the two twin screws, but the revolutions of the twin screws must be V2 times that of the single screw. The reduction of weight in the twin screw system is of great practical advantage in very long vessels, when pitching comes into play. The loss of energy at the rate of foot-pounds per second is

$$2\pi Ln-Tu=2\pi\frac{w}{g}A^2u\left(n-\frac{u}{p}\right)^2$$

half of which represents the energy being communicated to the revolving motion of the wake, the other half being the loss of energy due to the shock of the impulse of the water on blades of uniform pitch. It is impossible to suppress entirely the first loss due to the churning action of the propeller, because it is from this churning action that the thrust of the propeller arises. The second loss of energy may be suppressed by Mr. Bennet Woodcroft's screw of gaining pitch; and then the effective pitch of the propeller is the harmonic mean of the initial pitch $u\div n$ and the final pitch p.

The value of the turning couple is the same as before, $L=\frac{w}{g}A^2u\left(n-\frac{u}{p}\right)$, but thrust is now $T=\pi\frac{w}{g}A^2\left(n^2-\frac{u^2}{p^2}\right)$ In the analogous case of a feathering paddle wheel the plane of a blade on entering the water should be perpendicular to the plane passing through the lower edge of the blade and through the lowest point of the apparent rolling circle, in order that the blade should enter the water edgeways without shock. In order that a blade should leave the water without shock the plane of the blade should be perpendicular to the line joining it with the lowest point of the pitch circle; that is, the plane of the blade should pass through the highest point of the pitch circle. In practice the second only of these requirements is attended to, while the first is disregarded, although of equal practical importance, and attention to it would secure a notable increase of speed in the new Channel packets.

The author next considered the case of double screws, with special reference to the Whitehead torpedo, and found that no gain in efficiency is obtained by double screws of uniform pitch, the loss by shock at the second screw counterbalancing the gain of energy from the rotation of the wake of the first screw; but if the screws are made of increasing pitch there is no loss of energy by shock, and an increase of total thrust. Referring to guide blade propellers, the author thought that the small gain of efficiency and the large weight of the guides will prevent their adoption for use at sea. The stern post and rudder in an ordinary single propeller may be considered to act as a single guide blade of infinite pitch; but this contributes nothing to the propulsion of the vessel, while it has the disadvantage of transmitting vibrations to the hull. Next followed investigations on the effect of fluid friction, and on the pressure in the propeller wake. Regarding the latter, the author pointed out that the pressure increases towards the circumference, and that therefore the propeller tends to draw water forward near the axis, with the result of diminishing the effective thrust, and discharge it backwards at the tips. He recommends that propellers should be so designed as to increase the pressure in the wake towards the centre, which can be effected by diminishing the pitch towards the circumference, and by shaving off the tips of the blades to a point.

The discussion which followed was short and devoid of special interest.

The next paper read was a communication by Mr. J. B. Andreæ, on

EXPERIMENTS WITH FOUR AND TWO BLADED SCREW PROPELLERS.

Three series of experiments were made last year on the "Ceram" and "Flores," two vessels built for the Dutch Indian Navy. The first was with a four bladed screw of 9ft. diam., 13ft. pitch, and 30 sq. ft. blade surface; the second with the same screw, but with the two opposite blades removed; the third with a two bladed propeller of the same diameter, but 11ft. 8in. pitch, and 17 sq. ft. surface. The vessels each measure 152ft. in length, 25ft. 7in. in width, and 15ft. 5in. in depth. The displacement is 566 tons, the immersed midship area is 189 sq. ft., and the wetted surface of the coppered skin 4875 sq. ft. The engines are triple compound, with cylinders, in the "Ceram," of 20in., 29in., and 46in., and in the "Flores" of 20in., 28in., and 46in. diam., the stroke in both being 27in. The boilers are double ended, work at 120lb. pressure, have 65 sq. ft. grate, and 2000 sq. ft. heating surface; they are fitted with forced draught, and the "Ceram" has a closed stoke hold. The vessels are practically the same, and the trials were made under the same conditions of weather and sea. The author presented curves which showed that in the case of the "Ceram" the removal of two of the blades only resulted in a slight increase in the number of revolutions, so that the loss of one half of the propelling surface was more than balanced by the gain in friction and other causes. At a speed above 12 knots the vibrations of the two bladed screw of the "Ceram" became troublesome; but this was less noticeable in the "Flores," the propeller of which had less pitch and more surface. From the curves of revolutions and i.h.p. shown by the author, he has composed the following table, showing the i.h.p. by regular intervals, wanted for a certain number of revolutions with the four bladed and the two bladed screw of the "Ceram:"—

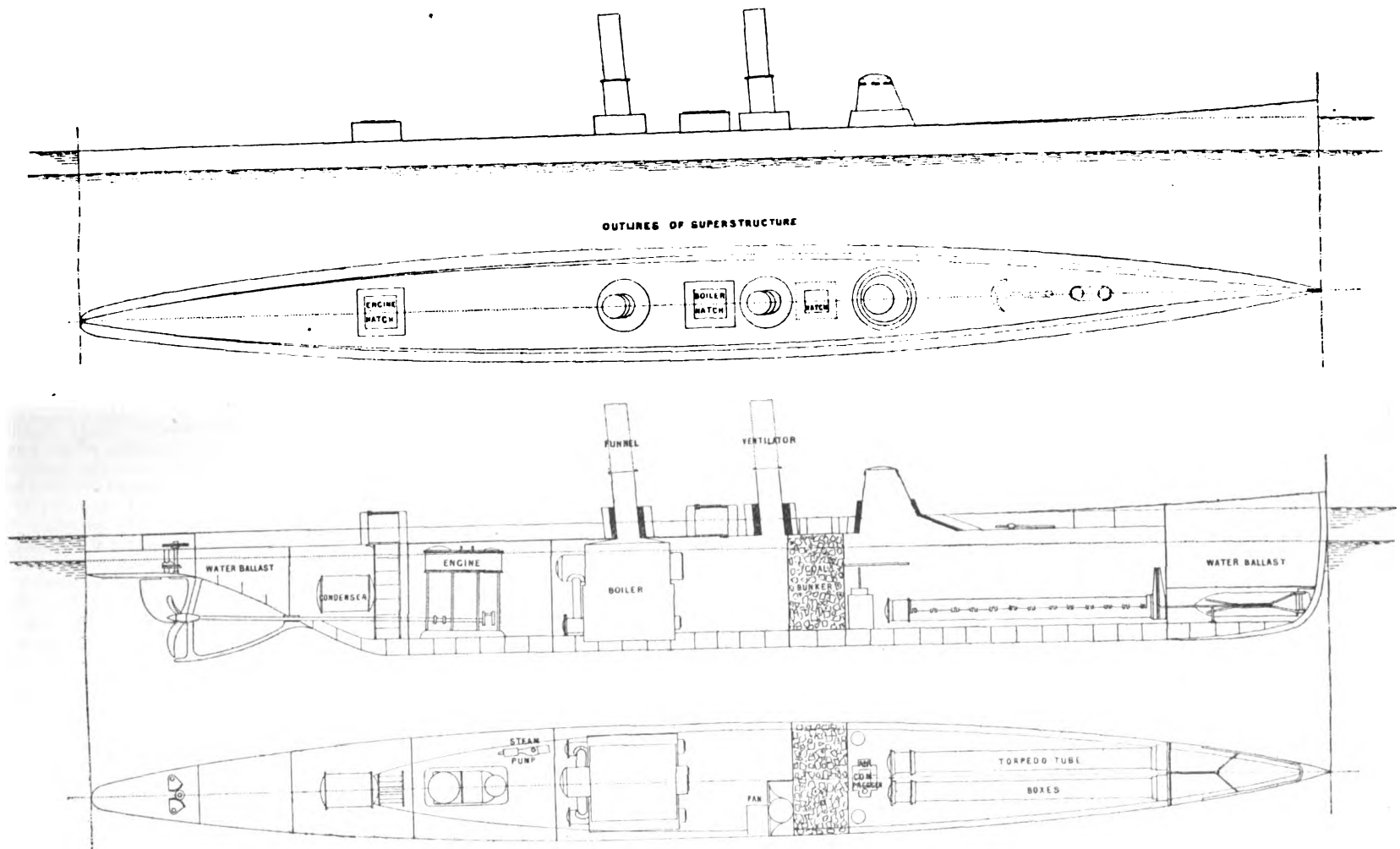
1. Revolutions	80 ...	90 ...	100 ...	108 ...	116 ...	123 ...	128
2. I.H.P. four bladed propeller	200 ...	300 ...	400 ...	500 ...	600 ...	700 ...	800
3. I.H.P. two bladed propeller	140 ...	210 ...	300 ...	375 ...	465 ...	545 ...	625
4. Difference between 2 and 3.....	60 ...	90 ...	100 ...	125 ...	135 ...	155 ...	175
5. Difference in percentage of 2.....	30 ...	30 ...	25 ...	25 ...	22 ...	22 ...	22

From the curves of speed and i.h.p. the following table has been deduced, showing the i.h.p. by regular intervals, wanted for a certain speed of the "Ceram" with the four bladed and the two bladed screw:—

1. Speed in knots.....	8·7 ...	9·7 ...	10·6 ...	11·35 ...	12
2. I.H.P. four bladed propeller.	200 ...	300 ...	400 ...	500 ...	600
3. I.H.P. two bladed propeller.	180 ...	275 ...	375 ...	480 ...	625
4. Difference between 2 and 3.	20 ...	25 ...	25 ...	20 ...	25
5. Difference in percentage of 2.	10 ...	8 ...	6 ...	4 ...	4

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Principal Dimensions

Length overall	78′	Breath ext.	7′
Maximum Displ^t	63 tons	Smallest Displ^t	57 tons
Draught of Water	8′	Draught of Water	forw. 6′ 7″ aft. 6′ 7″
Speed	13 knots	Speed	13 knots

I.H.P. 250

At 11·8 knots speed, the i.h.p. for both screws was the same, viz., 565, and the e.h.p. is then 348.

At the close of the paper, Mr. White said that he was responsible for its having been contributed, and he considered it as of great value. There was, however, no discussion.

At the evening meeting of the same day the first paper read was by Lieut. W. Hovgaard, Royal Danish Navy, on some

Proposed Designs for Surface Boats and Diving Boats.

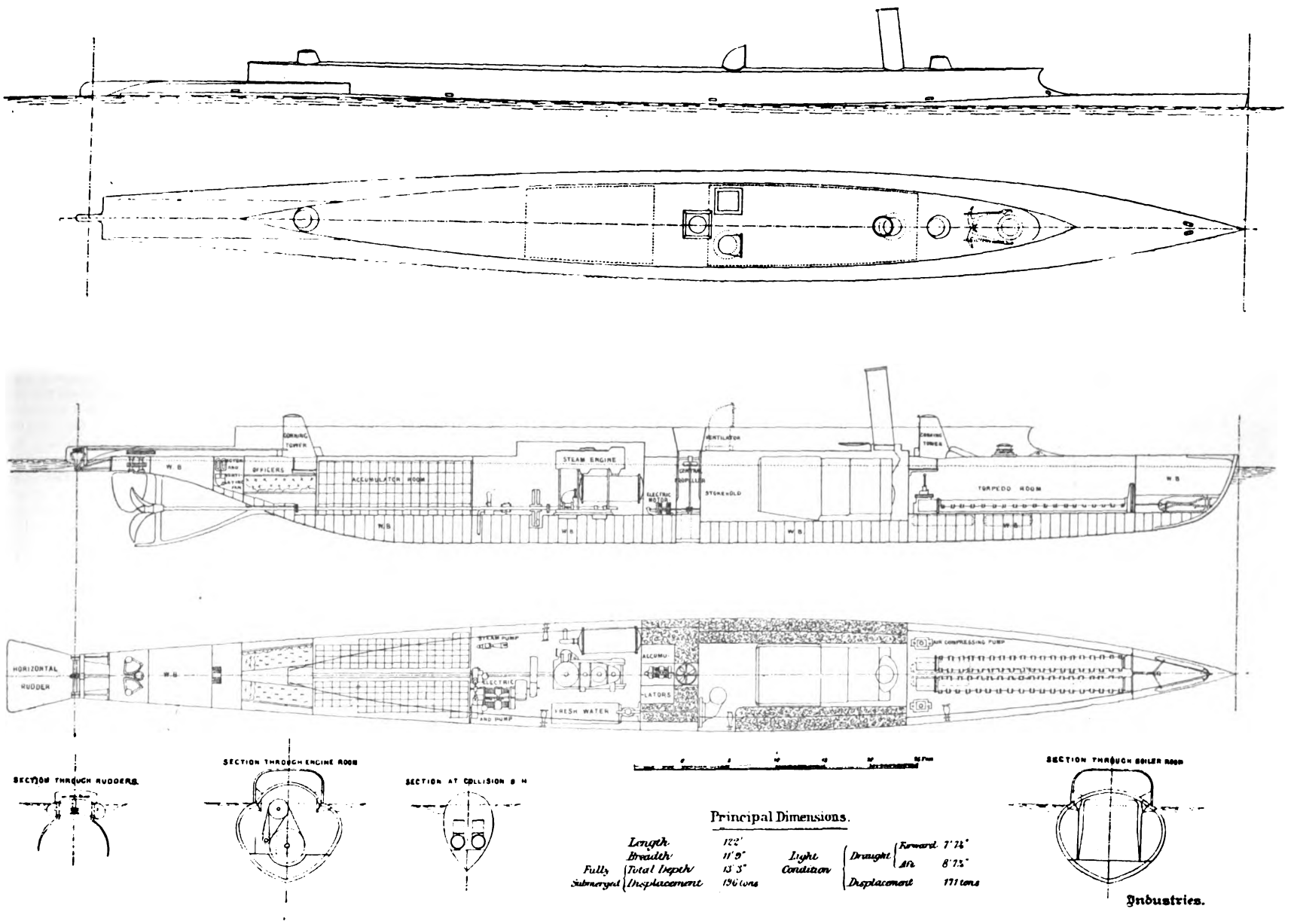
As the title implies, this paper was not a description of boats actually built, but of designs which the author, after six years of study of the subject, suggests as the most appropriate for two classes of boats—one a surface boat, with very little of her hull exposed above the water line, and the other a boat which may swim on the surface or dive below it, as circumstances warrant. The author, in his introductory remarks, hoped there would be a full discussion, by which the general solution of the problem would be advanced; but in this he was disappointed, the discussion being meagre to an extent which was very surprising, when we consider the great importance of the subject, and the ingenuity displayed by the author in his designs. In the surface torpedo boat, which we illustrate above, all the vital parts are placed below the water line, and just sufficient free board is retained to suit local requirements and to keep the connection with the atmosphere. In adopting these principles the author has limited the sphere of action for this boat to harbours and rivers where the water is smooth, and the boat can therefore only serve for the defence of landlocked waters. The following is a list of the qualities which he has endeavoured to obtain in this boat: A cost of not more than a second class torpedo boat; a speed of at least 13 knots; that she should carry two torpedo tubes in the bow; lowness of draught, to avoid mine fields, &c.; and that the top of the hull proper should be well under water, and on and above the water line should be protected by armour. All constant openings leading through the water line should be armoured up to 1ft. above that line, and surrounded by coffer dams. She should carry sufficient water ballast to alter her displacement within tolerably wide limits. At the deepest draught the centre of gravity of the water plane should be well forward, in order to prevent diving. There should be 6ft. head room inside the boat. The motive power should be steam, as connection with the atmosphere is maintained. The author has worked out the following dimensions for such a boat: Length over all, 78ft.; breadth, extreme, 7ft.; depth, 7ft.; maximum displacement, 63 tons; corresponding draught, 8ft.; corresponding speed, 13 knots; smallest displacement, 57 tons; corresponding draught, forward, 6ft. 1in.; corresponding draught, aft, 6ft. 7in.; corresponding speed, 13½ knots; cost, £8,000. The engine is a double compound vertical engine of the ordinary torpedo boat type. It is to develop 250 i.h.p. when running at 320 revolutions and with 130lb. pressure in the boiler. The coal bunker is placed athwartships, and holds 2½ tons of coal, sufficient for steaming a distance of 100 knots at full speed. The torpedo tubes are placed under the water, and are provided with horizontal lids. The top of the hull proper is 1ft. below the water, and is protected by 1in. steel plates above the boiler, engine, and steering gear. The conning tower is of 1in. steel plate, protected by 3in. armour 1ft. above and below the water line. The end and keel compartments are reserved for 6 tons of water ballast. The forward compartment is built up above the water to diminish pitching. Between the top of the hull proper and the deepest water line there is fitted a light superstructure, into which water is admitted when on the deepest water line. When the water is run out it gives a reserve buoyancy of about 8½ tons and 1ft. additional free board. The hull is constructed of ¼in. plating on frames 3in. by 2½in. by ¼in. placed 18in. apart. The weights are distributed as follow:—

	Tons.
Hull	26·0
Keel strengthening and bilge keels	7·5
Armour	5·5
Engine and boiler	9·5
Torpedoes and torpedo gear	4·0
Stores	1·0
Crew and gear	1·0
Various fittings	·5
Coal	2·0
Water ballast	6·0
Maximum displacement	63·0

For the light condition there will be about 2ft. of free board,

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and the top of the funnel and ventilator will be more than 9ft. above the water. The transverse metacentric height will be 7½in., and the longitudinal metacentric height will be 7ft. The boat will usually move about in this condition; but when making an attack she should go down to the deep water line, or as deep as circumstances permit. The top of the conning tower, and of the funnel and ventilator, are 3ft. 3in. above the water at the deep draught. The transverse metacentric height is 9½in., and the longitudinal metacentric height 6ft.

The diving boat, shown in the above illustration, was designed so as to satisfy as far as possible the requirements of the United States Navy Department, as laid down in the circular which was issued last year, inviting proposals for the construction of a steel submarine torpedo boat. The circular stipulated for three conditions of the vessel: (1) Fully submerged to a maximum depth of 150ft., displacement not to exceed 200 tons, and power endurance to be at least two hours at eight knots, all connection with the atmosphere being broken off. (2) The covered condition, when the vessel was to be protected by 3ft. of water, but at the same time to have means of observing the object of attack through air. (3) The light or ordinary surface condition, when the vessel was to have some free board, and a power endurance of at least thirty hours at fifteen knots. The author found it impossible to comply fully with all the conditions, and in view of the great external pressure which would come on the boat when submerged to 150ft., and the corresponding increase in weight of hull, he has limited the submersion to 100ft., whilst the covered condition has been attained by increasing the depth of the superstructure to 3ft.

An interesting feature of the design is that both electricity and steam are used for motive power. The author prefers electricity stored up in accumulators to the hot water arrangement of the Nordenfelt boats, as giving greater speed and greater power of endurance, coupled with the advantage that the energy need not be used at once, but may be kept in store, and will always be ready for use when required. If a diving boat fitted with hot water arrangement has to be kept under water for some hours, the heat is dissipated, and she becomes helpless, whilst the electric energy stored in the cells can be indefinitely retained. For the surface condition, however, steam power is used as being more enduring and cheaper. The steam power is also used to charge the storage cells. The following are the principal dimensions of the vessel:—

	Ft.	In.
Length over all	122	0
Extreme breadth	11	9
Depth of hull proper	9	0
Height of superstructure	3	0
Top of conning towers above superstructure	1	3
Total depth	13	3
Draught in covered condition	12	0
Draught in light condition { Forward	7	7½
Draught in light condition { Aft	8	7½

Displacement, fully immersed.....196 tons.
" covered.....a few cwts. less.
" light conditions .....171 tons.

The distribution of weights is as follows:—

	Tons.
Hull	96·5
Keel strengthenings	6·5
Steam machinery with water	24·5
Electric machinery	3·5
Coal	8·5
Accumulators	19·0
Torpedoes and gear	6·0
Various fittings	2·5
Stores	1·0
Crew and gear	1·5
Water ballast	25·0
Water constantly carried (in screw well, &c.)	2·0
Displacement when fully submerged	196·0

In the fully submerged condition a small amount of reserve buoyancy is retained, the immersion being effected by means of a small propeller, placed amidships, and capable of giving a vertical thrust. When this propeller is stopped, the boat will place herself in the covered condition, *i.e.*, with the top of the superstructure just in the water line, and the conning towers out of water, the superstructure being filled with water. When the water ballast, normally 25 tons, is pumped out, she will gain 4ft. free board, and will trim 12in. lighter forward. The water will have run out of the superstructure through doors placed as low as possible, and if these doors be now closed water tight, the vessel will at once obtain considerable reserve buoyancy. In order to obtain the necessary strength of hull to resist collapsing when the boat is submerged 100ft., the frames are deep and have been put close together. The total capacity of the water ballast tanks is 31 tons, and the capacity of the bunkers is 13¼ tons. The water is admitted to the tanks through several sluice valves, large enough to allow the tanks to be filled and the boat to sink within half a minute, and the water may be pumped out either by electric, steam, or hand power. The steam engine is vertical compound surface condensing developing 600 i.h.p. at 315 revolutions. The boiler is of the ordinary locomotive type, designed for a working pressure of 125lb. The dynamo is connected with the propeller shaft by friction gear. The speed at full power in the light condition is 14 knots, and endurance 19 hours. The dynamo is capable of developing 35 h.p. when supplied from the storage batteries with a current of 245 ampères at a pressure of 148 volts. The speed of the dynamo is 600 revolutions, but this is geared down by means of a counter shaft and belting to 120 revolutions of the propeller shaft, which must be disconnected from the engine when electricity is used for propulsion. In that case the speed of the vessel is 5½ knots and the endurance six hours. The same dynamo when worked from the main engine is also employed for charging 540 storage cells, each weighing 79lb., and giving a discharge current of 35 ampères for six hours. The vessel has even in the

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THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery.

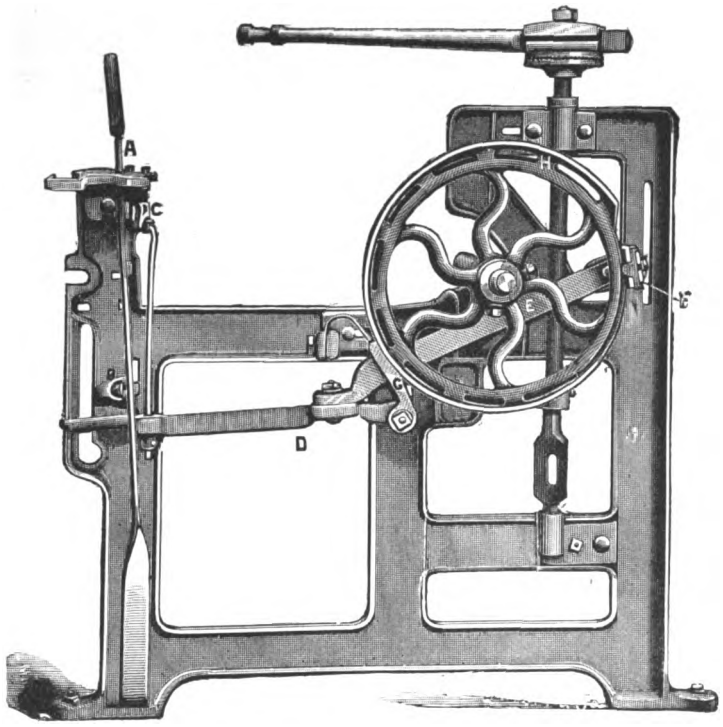


Fig. 66.

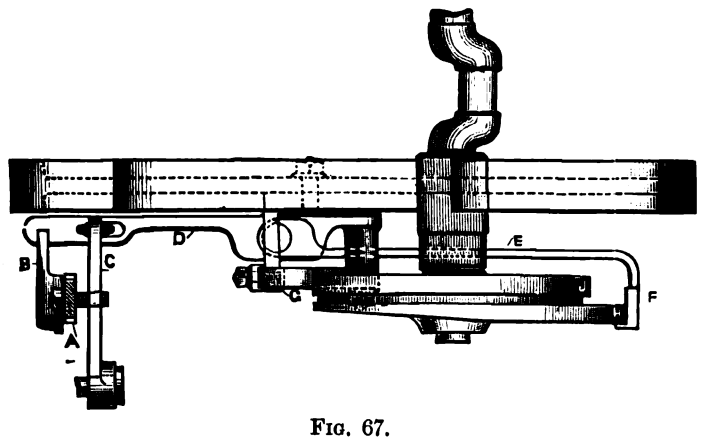


Fig. 67.

submerged condition a slight excess of buoyancy, and downward movement is effected by a small propeller on a vertical shaft working in a tube. This propeller is worked by a 5 h.p. electric motor, and by reversing the current through the armature can be driven either way, so as to make the boat rise or sink. When travelling submerged the reversion of the current is effected automatically through the action of the water pressure on a reversing switch, the instrument being so adjusted as to keep the boat at a certain desired depth of immersion. There is also fitted a horizontal rudder which may be used for rapidly changing the depth of submersion when the boat is travelling. When submerged the air is kept fresh by taking away the carbonic acid produced by exhalation and adding oxygen. For this purpose the air in the boat is circulated through a solution of caustic soda, 300lb. of which would suffice for twelve hours when the boat carries her usual crew. The oxygen is added from a reservoir under pressure. The vessel carries two torpedo tubes, and the torpedo gear and appurtenances are similar to those of a first class torpedo boat.

The discussion was opened by Mr. Nordenfelt, who hoped the author would be successful, but doubted the desirability of using electricity as a motor power. Steam was unquestionably more convenient at the surface, and it would be quite possible to keep up a sufficient pressure of steam for the time the boat remained below. Before such a boat is built it must be clearly settled whether it is intended for harbour or sea work. He admitted that if the vessel were to remain under water for twenty-four hours steam would be useless, but he imagined it would never lie idle for more than a few hours. The weight of the accumulators would be a disadvantage, and as in such a boat simplicity is of the utmost importance, he would prefer to dispense with electricity, even at the cost of limiting the requirements to what steam can do. He believed in the future of these boats, which are now being studied by all the Powers except England and Germany. England would find them convenient for the defence of outlying ports.

Mr. Martell was glad the paper had been read before the Institution, but could not conceive the intention for giving a boat 122ft. long a shell plating $\frac{5}{8}$in. thick, and deep frames spaced 12in. It seemed utterly unreasonable, as such scantling would suffice for a cargo ship of at least 2000 tons. In reply to this speaker,

Mr. McFarlane Gray pointed out that the boat was to be used for submarine work at a pressure of 76lb. per square inch, and therefore strength was necessary.

Mr. Hovgaard, in reply to Mr. Nordenfelt, said that electricity did not compare unfavourably with steam, as the weight of water, if required, would have been 25 tons, while that of the accumulators is only 22·5 tons. The endurance at $5\frac{1}{2}$ knots is six hours. He predicted that Mr. Nordenfelt would be using electricity as a motive power within a few years. In answer to Mr. Martell, he stated that if the scantlings were the same as that of an ordinary torpedo boat it would not withstand the pressure of 10ft. of water, whereas this boat has to resist that of 100ft.

THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery *(continued from page 286)*.—Where yarn used as weft is coloured after being dyed in the hank it is wound on to "pirns," or long thin tubes with inverted conical heads. The winding is first effected on the conical part, which is placed in a cast iron cup shaped to receive it. The pirn is driven by a spindle, formed with two flat sides at the point where it passes through a corresponding slot in a warve conveniently held and driven. The warve has a heavy button at its upper end, which is formed with projections at its under side fitting into notches in the head of the pirn. As the pirn is covered with yarn it lifts slowly, the traverse of the guide being arranged to correspond with the depth of the cup. Only one machine was exhibited of this class, and that was a special one for winding silk, by Messrs. Nightingall Brothers, Paterson, United States. In this case, instead of the pirn or "quill" being placed in a cup, it is held at the end of a round plunger, which is gradually raised, and the yarn wound on by means of the rotation of a flyer eye, through which it passes. Arrangements were made in this machine for winding several ends on to one pirn, and a stop motion of the drop wire type was provided for each spindle, so that in the event of the failure of any of the ends its corresponding pirn was stopped.

Having now referred to all the machines used for the preparation of yarn for weaving, it becomes necessary to deal with the various looms exhibited. It is scarcely requisite to go into any description of the process of weaving, as this is well known; but we may briefly describe the various looms, beginning with the simplest form as shown in the plain calico loom. A typical specimen of this class of loom was exhibited by Mr. George Keighley, Burnley, which was kept working at a very high rate of speed. The reed space was 36in., the slay being the maker's special iron one, which avoids any unevenness in the "race," and prevents the jumping of the shuttle, which often occurs with the ordinary construction. The breast beam over which the cloth passes is dispensed with, the taking-up roller occupying its position. The space between it and the reed being much reduced, a steady pull is put upon the cloth, and "sagging" is entirely avoided. The same firm showed a twill loom, in which the treadles operating the healds are fixed underneath and at the back of the loom, so that no space is occupied unnecessarily. The treadles are arranged to be driven by a pinion on the counter shaft. The spindle carrying the treadles has a pinion at each end, and by putting one of these in gear with that on the counter shaft the necessary movement is obtained. The change is made by disengaging one pair and engaging the other, a different effect being in that way produced. The loom shown by Messrs. Wm. Dickinson & Sons, Blackburn, has an ingenious motion for weaving handkerchiefs. The tappets are, contrary to the usual practice, loose upon the shaft, and are driven by clutches which can be disengaged when desired. They are put out of gear by a set of lattice bars, the pegs in which are arranged for this purpose. In this way a border can be woven first and a plain portion subsequently, for any desired length, the whole being controlled by the pegging of the pattern chain. The lattice barrel is thrown out of action during the weaving of the plain part, and is again thrown into motion by means of a cam, which makes a complete revolution while the requisite length is being woven, a greater or less speed being given to it by change wheels. The cam surface has on it a notch occupying about a quarter of the circumference in length, in which are two movable brackets which divide it into two spaces. When the required plain part has been woven, a lever which rests on the cam drops into the first space and throws the catch of the lattice barrel into gear, thus regulating the treading and forming the pattern. The continued revolution of the cam causes one of the brackets mentioned to lift the measuring lever and stop the motion of the lattice for the necessary time to allow of the weaving of the plain space between the borders of two handkerchiefs. The lever then falls into the second space, and the border of the second handkerchief is woven, when the lever is again raised, and does not come again into operation until the whole of the plain part is finished. This motion is very ingenious and effective, and allows of handkerchiefs being produced without using a drop box motion.

One of the most ingenious of the various contrivances applied to looms was that known as Haythornwaite's automatic brake, which was exhibited on the stand of Messrs. John Dugdale & Sons, Blackburn, and applied to a loom made forty-five years ago. The condition of the loom amply verified its age, and the work which it had performed. This device is illustrated in Figs. 66 and 67 in side elevation and plan. The ordinary fly wheel has a projection H cast on one side of it, gradually rising until it is $\frac{3}{4}$in. higher than the true circumference of the fly wheel. When the weft breaks, the block G is put into contact with the raised surface H. On the other end of the lever E is the block F, the relative positions of F and G being shown in Fig. 66. Now it may be seen that, as long as G is kept out of contact with H, the revolution of the fly wheel is unchecked; but when G is thrown over, the distance between F and G is such that the greater diameter of the wheel across the raised part of H prevents it passing between the two surfaces. The advantage of this arrangement is two-fold. It first arrests the motion of the loom gradually, and it does so always at one point, which can easily be arranged so as

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to be that which is most convenient for the weaver. Being absolutely certain, any wear in the loom does not affect it, and perhaps, on the whole, it is about the best device extant for the purpose.

Among the minor improvements to be noted was one on a loom shown by Messrs. Willan & Mills, Blackburn, and was an improved method of fixing the fly spindle. Instead of fixing the spindle by pushing it into a nipple at one end, and keeping it so fixed by a spring at its outer end, two grippers are used, these being attached to the slay beam. The spindle can be easily slipped into position, and by fastening up the nut is securely held. This, though only a minor improvement, is of considerable value. In the loom shown by Messrs. Butterworth and Dickinson, Burnley, there was an arrangement of the loose reed which gets over many difficulties attending its use ordinarily. The reed is pivoted at the bottom by means of a horizontal rod attached to the slay cap. Two projecting pieces are attached to the rod, which keep the locking pieces in position by means of connecting rods. When the reed is beating up, the locking piece passes on to a strong bar placed vertically, which has a "duck bill" projection formed on it. If an obstruction occurs and the shuttle is caught in the shed, the reed, being pressed at the top by it, readily yields, and the locking piece passes under the duck bill. By this arrangement all the advantages of a fast reed are obtained, and, in addition, the easy manner in which the reed can be pushed back insures that no breakage of the warps will occur, even when fine cloths are being woven.

In the class of looms designed to weave more elaborate fabrics there were several fine exhibits, and in dealing with them there are two main features to be considered, viz., the motions used for giving different colours to the weft, that is, the drop box motions, and those intended

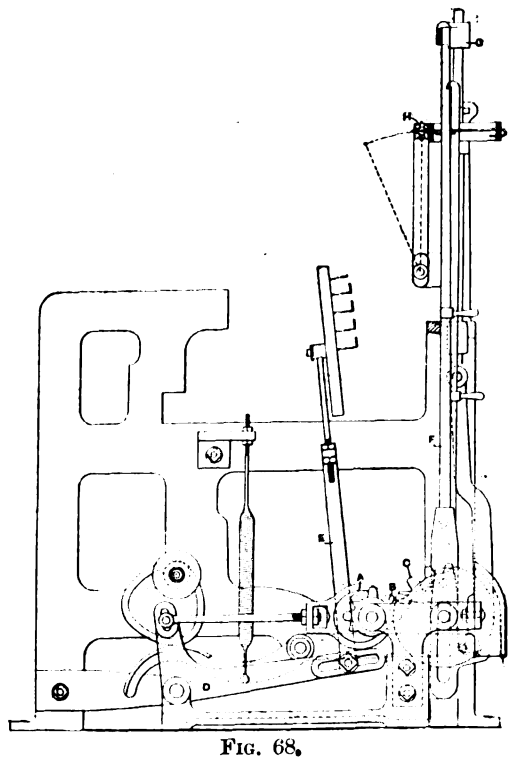


Fig. 68.

to manipulate the warps, which include all the dobbies and Jacquard mechanism. Taking these in order, in Fig. 68 is illustrated a drop box motion, shown by Messrs. Hacking & Co., Bury, which is of great merit. The essential feature of this mechanism is the use of two eccentrics A, one enclosed in the other, by altering the position of which the necessary changes of the boxes are made. The mechanism employed will be presently described. The position of the eccentrics is shown in Fig. 69, as they are when each box, of which there are four, is in its right place, the dotted vertical lines showing the movement of the rod attached to the eccentric straps. The eccentrics do not revolve, but simply oscillate about their forward and back centres. It will be seen that both may be thrown over together, and so make the change from the first to the fourth box, or only one may be moved, with the consequent single change. On one of the eccentrics is a sector B gearing with a second sector C formed on a disc suitably carried on a stud. On the inner surface of C are pins, with which projections formed on the upright rods F engage. The top of F is hooked, and a catch G on the upper end of a vertical rod, having a constantly reciprocating motion, engages with the hook, unless it is pushed out of the way by needles operated from the barrel H. H, as shown by the dotted line, has a swinging movement, and has on it a pattern chain. The motion, as described, is that intended for one eccentric; but a similar arrangement is applied to the other. On the discs attached to the eccentrics are a second set of pins, by which the return oscillation of the eccentric is obtained. The working of this mechanism will be easily understood. When one of the levers F, by reason of the hole in the card, is allowed to remain in its inner position, the vertical movement of G lifts it, and so rotates its

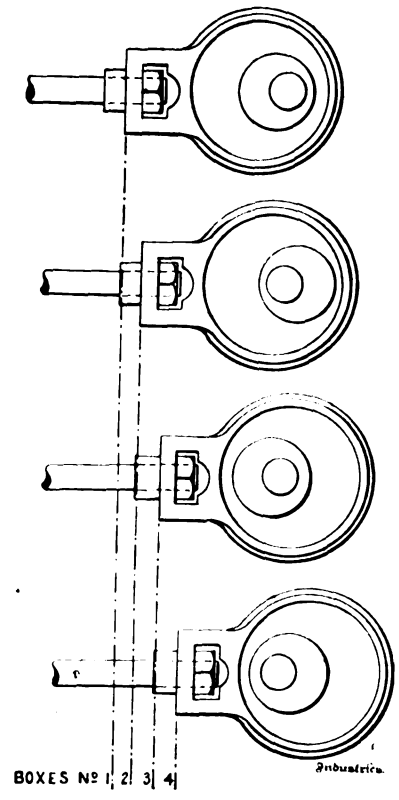


Fig. 69.

special eccentric. If both eccentrics are to be moved, two hooks are raised, and it entirely depends on those raised which of the boxes is brought into position. When the eccentric is so rocked, the lever D is oscillated, and the rod or bar E, by which the boxes are carried, is raised or lowered. By means of the spiral spring shown, the raising of the boxes is aided, their weight being sufficient to bring them down easily. Handles are attached to the rods F, and any desired change can be made by hand.

The folding or plating machine which was exhibited by Messrs. Hacking & Co., Bury, is illustrated in Fig. 70, and has several points of interest. The cloth is folded by blades fixed at the end of a long arm, not shown in the illustration, and pivoted at its lower end, being driven by means of a disc and connecting rod. The novelty in Messrs. Hacking's machine consists in the construction of the grippers A B, which are fixed at the end of diagonal arms C D. On the lower ends of these arms are bowls E, engaging with the inner surface of the cam F, which is

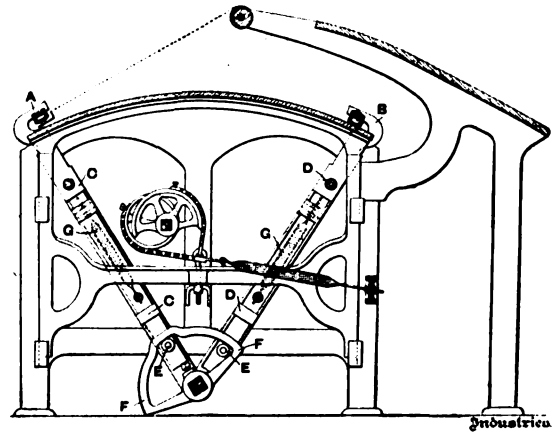


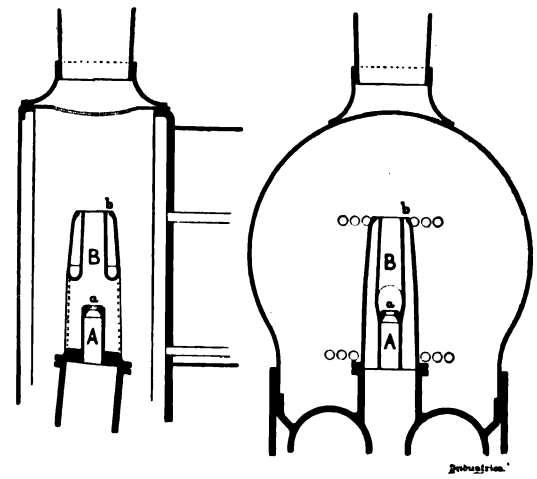
Fig. 70.

attached to and oscillated by the folder arm. The gripper rails A B are arranged to be pulled upward by the spiral spring G, to allow of which there is a recess in the cam F. This upward movement occurs just before the knife passes under the gripper, in this case A, and as soon as the cloth is laid and the blade recedes the cam pulls down the arm again, and so grips the cloth firmly. This motion takes place alternately at each end of the fold, and as the rails are lined with corrugated rubber, no damage occurs even to the finest class of goods.

(To be continued.)

ADAMS' "VORTEX" BLAST PIPE.

The improved "Vortex" blast pipe illustrated herewith, is the invention of Mr. W. Adams, locomotive superintendent of the London and South-Western Railway. The ordinary locomotive blast pipe consists of a central pipe, connected by a breeches pipe to the exhausts from the two cylinders, and the exhaust steam is discharged centrally up the chimney, producing a vacuum in the smoke box, and thereby creating the draught. Mr. Adams, like many other locomotive superintendents, found that the lower tubes in the locomotive boiler were practically ineffective, as they frequently became choked; and in seeking a cure for this defect he tried various forms of blast pipe, and ultimately invented and patented the vortex, which is similar to the arrangement shown in the engraving, but without the central jet. In the vortex the two exhaust pipes are united by an annular chamber or ring, with a central opening through which a portion of the products of combustion is drawn, the principle being similar to that of an injector. The vortex blast pipe was found to improve the draught, to reduce the consumption of coal, and to considerably diminish the choking in the lower tubes; but with a view to completely eliminate the last mentioned evil, Mr. Adams continued his experiments with varying sizes of central openings, and with various heights for the top of the blast pipe. The latest improvement is that shown in our illustration, and consists in the addition of a central nozzle at



a lower level than the main orifice. By thus sub-dividing the ejector into two parts the draught through the lower tubes is considerably improved, and choking becomes almost impossible. The effect of this arrangement is also to greatly improve the steaming power of the boiler, and the remainder of the locomotives on the London and South Western Railway not yet fitted with the ordinary vortex blast pipe will be fitted with this improved type. It has been found that the best height for the top orifice is level with the top of the boiler tubes. In our sketch A is the lower blast pipe, terminating with a nozzle *a*; whilst B is the usual vortex blast pipe, with an annular chamber and annular jet. The combination of the central jet and the annular jet produces a powerful draught, and equalises to a certain extent the pressure throughout the smoke box, so that all the tubes become equally effective.

From a statement prepared by Mr. Adams, we find that out of a total of 534 engines, which were in service at the end of last year, 253 were fitted with vortex blast pipes. The total engine miles made during the half year ending the 31st December, 1887, was 8,528,045, and the cost for fuel was £67,166. In the half year ending with June 30th, 1885, none of the 505 engines then in service were fitted with vortex blast pipes, and the cost of fuel was £72,226, coal being taken in both cases at 13·94s. per ton. The saving attributable to the adoption of the vortex blast pipe is calculated at £9,552 for the last half year. The consumption of fuel per engine mile was 26·3lb., as against 29·9lb. when all the engines were fitted with the ordinary blast pipe.

Trade in Austria.—Notwithstanding the general depression of trade reported to prevail in Austria, we come across some industries which are in a very flourishing condition. The Vienna Brick Making Company have issued their balance sheet, which shows that during the past financial year the net profits amounted to 600,000 florins, on a total capital of 4,000,000 florins. The Perlmooser Cement Factory has an equally satisfactory balance sheet, showing on a total share capital of 22,000,000 florins a net profit during the past year of 191,000 florins, being a dividend of nearly 9 per cent.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 10TH APRIL, 1888.

THE IRON MARKET.—The holidays being over, and the weather having become mild again, building operations have been resumed, and are now being pressed forward vigorously. The effect of this renewed activity is visible in the iron market, which has become animated and firm. Joists are in brisk demand. Manufacturers have utterly ignored the proceedings of the merchants, and advanced the prices to £5. 16s. for bars and £5. 8s. for joists. This resolute action on their part has steadied the market and infused life into business generally. Old rails are still officially quoted at £3. 4s. a ton, but dealings have taken place at higher figures. In the Haute-Marne business has fallen off in bars, but wire remains in good demand. Complaints of lack of orders indicate less life in the Ardennes; but from other centres of the iron industry more cheering reports have been received. Founders are everywhere busy, and the prices of light castings are following the upward movement of the heavy goods. The Compagnie de Commentry-Fourchambault and the Société Metallurgique du Périgord have secured the contracts for several thousand tons of cast iron pipes for the town of Pointe-à-Pitre, South America.

THE METAL MARKET.—The situation grows more and more unfavourable to the maintenance of the abnormally high price of copper. Consumers buy but little, and stocks steadily increase. Tin shows a more marked tendency to weakness, and dealings for future delivery take place at prices considerably below official quotations. But these concessions are not sufficient to tempt consumers, who buy only for present use, in the belief that a collapse of the market is near at hand. Lead is unaltered. Spelter has slightly receded in price.

WORKMEN'S RELIEF FUNDS.—The Chamber of Deputies has under debate a Bill which, as an earnest attempt to improve the material condition of the working classes, and to lessen the tension existing in the relations between capital and labour, is of no little importance to industry, and which will excite interest outside the limits of French territory. The legislation asked for is for the present solely on behalf of the miners, the scheme having emanated from them, and being regarded as an experiment. If, however, it is found to be satisfactory, it is to be extended to all industries. The measure in question provides for the payment, in equal proportions by both employers and employed, of a sum of money monthly into funds established for the relief of the working men in sickness and in old age. These payments are to amount to 5 per cent. of the wages. From the money so contributed, will be maintained (1) a sick fund; (2) a relief fund for cases of accident; and (3) an account with the *Caisse Nationale des Retraites pour la Vieillesse*, from which an annuity will be paid after the age of fifty years has been reached. This annuity is to be in part reversible to the wife in case of decease, and any balance remaining after the death of the latter is to be returned to the next of kin. It will be observed that for the employer the measure involves what is practically an increase of 5 per cent. on the rate of wages paid.

UNDERGROUND ELECTRIC TRAMWAY,—The Third Commission of the Municipal Council of Paris has under consideration a project of an underground electric tramway to connect several of the chief points of this city. The project, due to M. Berlier, a civil engineer of repute, has been examined and reported on favourably by the engineers in the service of the municipal authorities. Considerable interest is felt in this scheme apart from its public utility, on account of the many novel points involved. There are to be three lines running from the Place de la Concorde, one to the Bois de Boulogne, another to the Place de la Bastille by way of the great Boulevards, and the third to the Porte de Vincennes by way of the Rue de Rivoli. All these lines are to run underground for the whole distance. The tunnel, instead of being constructed of masonry in the usual way, will be formed of a cast iron tube of circular section and 6m. in diam. It is proposed to construct these lines without opening the streets at any point. The tunnels, the stations, and the cars are to be lighted by electricity. One great advantage will be the good insulation which it is possible to maintain in an underground line of this character. The estimated cost for the whole length of a little more than 16 kilometres is £2,160,000, an average of £129,400 per kilometre. The Bois de Boulogne line may, it is said, be finished in time for the Great Exhibition of next year. It is proposed to run, if the traffic requires it, a tram car every minute, an interval of time amply sufficient to insure safety with the arrangements to be adopted.

BERLIN, 9TH APRIL, 1888.

THE COAL MARKET.—There is a good demand for coal, especially for household qualities, owing to the exceptionally bad weather which has been experienced this season. There has been an unusual consumption of nuts, and as contracts had been made for large quantities for metallurgical purposes, there has been some difficulty in meeting the demand. Considerable quantities of anthracite have been exported, and this kind finds a ready sale in Upper Silesia for the manufacture of coke. Some imports of Polish coal into the eastern provinces have taken place, but as the best of these are only equal to the second quality of Silesian coal, and as the prices are higher, it is not likely that they will continue to be imported. At a meeting of the large Westphalian collieries connected with the Berlin Discount Company, which has just been held in Berlin, it was decided to establish a coal sales bureau in Westphalia. Other unions of a similar character are now spoken of, and if they be found to work well, it is intended to form the whole into a large syndicate.

THE IRON MARKET.—A fairly active business in crude iron is being done in Upper Silesia. Foundries are well employed, and there is plenty of work in large castings. Rolling mills are also well supplied with orders, and in some cases have to work overtime. The demand for bar iron continues to improve, and there is also great activity in large sections. The outlook for the latter is very favourable, but as far as Russia is concerned business is not satisfactory. Plates are in fairly good request. The iron trade generally is in a satisfactory condition, and an improvement in prices is expected. The syndicate of wire nail manufacturers has been greatly strengthened by the Saxon group having now joined them, and it is expected that those works which have as yet held out will ultimately join.

SUGAR.—The interruptions to traffic caused by the recent heavy snowstorms have had the effect of keeping the sugar market very quiet. The demand for refined sugar is weak. Refineries are only disposed to make purchases at very low rates, and therefore but little business is being transacted, since producers decline to accept orders at prices which would leave a small margin of profit. Exporters are not much interested this year in crystallised sugar, as the prices obtainable abroad for this article are not sufficiently remunerative.

ELECTRIC LIGHTING.—A committee, appointed by the Town Council of Breslau to inquire into the best means of installing the electric light in the town, has reported in favour of a large central station to supply 5000 lamps, distributed throughout an area the boundary of which is at no point farther than 1200 metres from the generating station. It is not intended to ask public tenders for this installation, but to entrust it to Messrs. Siemens and Halske, of Berlin, who will submit an estimate based upon a general plan of the district. The management of the central station will be in the hands of the municipality. These recommendations of the committee have not yet been finally adopted.

PETROLEUM.—Many complaints have lately been made regarding the inferior quality of petroleum which is constantly being placed on the market. With a view to remedy this state of affairs, the Society of Colonial Merchants in Hamburg have remonstrated with the petroleum dealers on the Hamburg Exchange. This protest has had the desired effect, the Hamburg dealers having promised that in future they will not place inferior petroleum on the market.

LEATHER.—The recent severe weather seems to have had a depressing influence on most trades. The leather branch is no exception to the rule, and the condition of the market at the present time is not very satisfactory. This state of affairs is rendered worse by the fact that the large orders for leather military articles, which have hitherto kept manufacturers fairly well employed, have now come to an end. The supplies of most leather articles at present are not very large, but they are still sufficient to exceed the demand, and reductions in price are being made in consequence.

VIENNA, 9TH APRIL, 1888.

THE IRON MARKET.—The exceptionally fine weather of last week has given a considerable impetus to nearly all the branches of the iron trade in Austria, and even in Hungary the situation has improved. Primarily the change affected merchant bars, girders, and building iron of all kinds, but the greater activity in these articles has also had a salutary influence on the crude iron market. Stocks were low before the holidays, and dealers expecting the usual development of business after Easter, have come into the market with fairly good orders. Iron founders have as yet not participated in the improvement, but engineering works are busy with orders for sugar factories and distilleries, and the prospects of the coming summer are better than they were at the same time last year. The small iron and hardware business is also improving; after the enforced idleness of many small works, who suffered from scarcity of water power during the severe winter, the change is very welcome. The Witkowitz works have booked a large order for bolts, nuts, plates, and other accessories for the Galician Railway. The wire syndicate has now been definitely established on lines similar to those adopted by the rolled iron syndicate. No attempt will be made to fix prices, but the works have agreed to a certain proportion of output for each, and in this way the adjustment of prices will be brought about in a more natural manner. Two of the largest Bohemian iron and mining companies have just issued their balance sheets. The Prague Iron Company shows, for the last half year's working, a net profit of 200,000fl. (£15,800), and the Moutan Company shows, for a whole year's working, a net profit of 90,000fl. (£7,100). The original share capital of this company was 2,000,000fl. (£158,000); but half of this has been written off some years ago, so that the net dividend amounts to 5·2 per cent.

RAILWAYS.—The total length of Austro-Hungarian railways open for traffic in February amounted to about 15,000 miles (exclusive of sidings), and during that month there were carried 3,534,099 passengers and 5,300,774 tons of goods. The receipts amounted to 17,398,276fl. (about £1,370,000), or £91 per mile, which is 3·2 per cent. less than the corresponding figure for the same month last year. The volume of traffic has thus increased at a faster rate than the receipts. This is partly due to the keen competition and consequent cutting of rates between rival lines. To mention only one instance: Some time ago the Hungarian State Railway allowed a discount of 30 per cent. on their mileage ticket books on the route Vienna-Bruck-Budapest, if the value exceeded 50fl. This concession did not, however, seem to have had the desired effect of diverting a considerable amount of traffic from the Austrian State Railway on the route Vienna-Marchegg-Budapest, and therefore the Hungarian line reduced the price of ordinary tickets below that charged by the Austrian line, and, moreover, increased the discount on mileage ticket books to nearly 50 per cent.

STEAM BOILER LEGISLATION.—In the beginning of 1883 a law was passed putting boilers erected within the town of Vienna under police regulations; but this law was found to impose too many restrictions upon the owners of small boilers, and thus to damage domestic industries. The owners of small boilers have repeatedly asked for an amendment of the regulations, and now the Vienna Society of Engineers have taken the matter in hand, and at their last meeting they resolved to petition the Ministry to pass a new law which would facilitate the employment of small steam boilers. The following are the more important provisions the adoption of which will be suggested to the Ministry: Boilers constructed entirely of tubes not exceeding 5in. internal diameter may be installed either in dwelling rooms or below them; and in the latter case it is not necessary that the ceiling of the boiler room be arched, a provision which is insisted upon when larger boilers are used. So-called "small boilers," which are not wholly constructed of tubes, but the shell of which does not exceed 4ft. in diameter, the quantity of water up to the working level in the glass does not exceed 1 ton, and the steam pressure does not exceed 120lb. per square inch, may be erected in dwelling houses, provided the room above is not used as a sleeping room. The ceiling of the boiler room may be either arched or may be the ordinary ceiling of dwelling rooms with wooden beams. The boiler must not be less than 6ft. 6in. distant from the walls of neighbouring apartments. Tubular boilers will be classified as "small boilers" if the tubes are not more than 5in. in internal diameter, and if the steam pressure does not exceed 150lb. per square inch. These boilers may be provided with a water leg and steam collector; but the total quantity of water contained in the boiler must not exceed 1 ton, and the largest diameter of any part must not exceed 4ft. The steam collector must not be exposed to the fire gases, nor be bricked or cased in in any way, and must be at all times accessible. Boilers will be classified as "dwarf boilers" if the total amount of water does not exceed half a ton and the greatest diameter does not exceed 3ft., and the highest steam pressure does not exceed 90lb. These boilers will come under the ordinary regulation of domestic stoves, hearths, and fire places. If boilers of the above dimensions contain tubes not more than 4in. in diameter, they will be classified as "dwarf boilers," and a steam pressure up to 120lb. will be permitted. These boilers must not be bricked in, and steam reservoirs must be at all times accessible. Boilers in which the pressure does not exceed 7½lb., and the water in which is in communication with a vertical pipe open at the top, are classified as low pressure boilers, and are exempt from all police regulations. The last clause, if adopted, will be of importance to the makers of low pressure domestic motors.

BRUSSELS, 10TH APRIL, 1888.

THE COAL MARKET.—The Belgian State Railway contracts made last week for 335,000 tons of coal show a marked rise at Liège and Charleroi. As compared with the rates obtained at the contracts made last August, the price at Liège has risen 1s. per ton, and at Charleroi 10d. per ton. The present rates are 1s. 8d. more than those of the great contracts of September, 1886. This shows that the market is very firm, and complaints are now heard of the scarcity of industrial coal, of which the stocks are very low. During the week ending 25th March, the number of waggons on the State Railways carrying coal was 20,943, against 19,151 in the corresponding week of last year. The exports of Belgian coal to the North of France are rapidly increasing, and are driving English coal out of the Boulogne and Dunkirk markets. In addition to the Belgian-Westphalian coke syndicate, to which I referred in my last letter, another is being formed by the coke makers of the Centre, which turns out half of the total Belgian production. The makers in the Mons, Charleroi, and Liège districts have decided to wait till they see what success attends this movement, before they take similar action. The Administration des Mines Belges is experimenting in fiery mines with Settle's safety cartridge.

THE IRON MARKET.—Pig iron continues firm. The Charleroi and Athus works have increased their prices about 4s. per ton since the beginning of the year. Forge pig is quoted at 38s. 5d. at the Athus works, and strong iron at 44s. at Charleroi. These high rates have resulted in large quantities of puddled iron being imported from Cleveland, and are giving an impetus to the demand for the abolition of the duties on crude iron. A deputation of manufacturers of finished iron, who have no blast furnaces of their own, was received last

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week by the Minister of Finance, to whom they pointed out the unfairness of maintaining a duty of 4s. 2d. per ton on forge pig while foundry pig and pig for steel making purposes are admitted free. The Minister referred the deputation to the Department of Public Works. There is, however, little chance of the Government taking steps in the matter, as the existence of duties on food stuffs renders it difficult to abolish duties on industrial material. The price of steel rails has fallen very low, as shown in the contracts for the Portuguese railways. Makers of manufactured iron are beginning to have some difficulty in obtaining fresh orders. French girders are being exported *vid* Antwerp in competition with Belgian girders.

The Brussels Exhibition.—The nearer the time approaches for the opening of the Exhibition the more certain it is that it will not be ready. Difficulties have arisen between the Government and the Exhibition Company which cannot fail to cause delay. The central hall will not be ready, the machinery section is yet without flooring, and the garden pavilions are also in a backward condition. The machinery therefore cannot yet be fixed. The contracts for the electric lighting of the Exhibition are also yet unsettled, and the number of lighting hours now spoken of is ridiculously low.

Small Arms.—The Liège Arms Factory is well supplied with orders, and commissions are expected from the Belgian Government for the manufacture of the new infantry rifle, the War Department having organised a competition in order to decide on the type. The calibre is fixed at eight millimetres, so that the competition only extends to the breech mechanism. Trials are being made with seven kinds of rifles, among which are those of M. Pieper and Captain G. Tua. For the latter rifle it is specially claimed that there is no tendency to disturb the aim by the recoil. It is a magazine rifle, and at the recent trials the charging of the magazine with cartridges only occupied twenty-three seconds. The speed when using the weapon as an ordinary rifle was fifteen rounds a minute, but by using the magazine the fifteen rounds only occupied twenty-five seconds.

DÜSSELDORF, 9th April, 1888.

The Iron Market.—The amount of business now being transacted in the iron market is considerably below the average of the last few months; yet it would be scarcely correct to describe the situation as being in a corresponding degree weaker. Consumers have all bought far forward into the year, so that the same amount of activity is not to be looked for. It was stated at the meeting of the Pig Iron Association, held at Cologne last week, that some of the blast furnace owners have sold the whole of their make of pig down to the end of the current year. Of course, in circumstances like these, and with syndicates in every branch of the trade, prices remain firm. Spiegel pig is in fair demand for home consumption, but only a small business is being done on export account. Forge pig is relatively but little sought after. There is a brisk demand for Bessemer pig, and basic steel pig is being largely dealt in. In this class of iron, English competition is now very keen, Middlesbrough pig being delivered here at from 2s. to 3s. below the prices of native iron. Luxembourg foundry pig is slightly higher in price. The market is, on the whole, quiet for finished iron and steel. Bars are in slightly better demand for home consumption, but sales on foreign account become fewer and less important. The break up of the frost has enabled builders to resume work, and joists are consequently in fairly brisk demand. Plate manufacturers in this locality have plenty to do, but in the Siegen district complaints are heard of a lack of orders. The trade in sheets, however, is dull even here, and some manufacturers have work in hand sufficient only for a very short time to come. The export trade in wire remains languid. The latest tenders for steel rails gave £6 as the lowest price. Engineers are for the most part very busy.

German Iron Abroad.—The Customs returns for the second month of the current year tell the same tale as those for the first. The tendency of the export trade to shrink is very marked, justifying the apprehensions for the future of this trade, founded upon the excessive prices established by the syndicates. The following are the quantities exported in January and February, compared with those for the corresponding period of last year: Pig iron, 26,619 (35,621) tons; scrap, 4049 (9616) tons; half wrought iron—blooms, ingots, and puddle bars—5161 (7096) tons; finished iron—bars, angles, and plates—35,799 (45,865) tons; wire, 33,990 (43,289) tons; rails, 13,181 (29,091) tons; other railway iron, 4947 (4744) tons; manufactured goods other than machines, 31,859 (26,179) tons; total, 155,605 (201,502) tons, a decrease of 22·77 per cent. The total for the month of February amounts to 77,183 tons, against 78,422 tons in January. Angles and plates show a considerable increase, but bars have declined from 34,848 tons last year to 18,833 in 1888. There is an increase in nearly every class of manufactured goods. The larger exports of wire nails, 6956 tons against 6098 tons, is doubtless due to buying in anticipation of the higher prices to obtain which the syndicate was formed.

LILLE, 10th April, 1888.

Textile Manufactures.—The Easter holidays, and the uncertain aspect of political affairs, have, as I predicted, occasioned a sensible retardation of business. The weather has changed for the better; but the sense of impending danger outweighs favourable influences of this sort. Events are constantly happening to remind traders of the instability of the situation, and with such a condition of affairs speculation cannot exist. Consumers limit their purchases to the bare needs of the moment, and business drags languidly along. The prospect is, therefore, gloomy and discouraging, notwithstanding the fact that all other conditions are favourable to a revival. Though the last week was characterised by dulness generaly, some improvement is noticeable in the woollen trade of the Roubaix district. A good numbers of buyers have visited the locality, and have bought largely. This revival is looked upon as the beginning of the spring trade. The goods most in demand are serges and corded fabrics. Fashion seems to be setting in the direction of mohair striped goods. The Lyons newspapers give glowing accounts of an invention which is said to have caused some stir among manufacturers of that locality. At one of the large weaving establishments a process is, it is said, in successful operation for the manufacture of metallic cloth—that is, cloth woven with wire thread. As trimmings this kind of goods is very effective.

Flax and Yarn Markets.—Last week was a quiet period for flax. Few transactions took place in home grown produce, and Russian was almost wholly neglected. Tows were bought in considerable quantities for export. The situation has not sensibly changed for linen yarns. Like all others, this market has felt the influence of the holiday season, and the political events of the last two weeks. Hemp shows some improvement.

The Iron Market.—The distinctive features of the iron market in this district are firmness and buoyancy of prices. The demand is not brisk; but manufacturers are determined to widen the margin for profits, and accordingly we hear of steadily advancing rates, from which no concession is made under any pretext. This attitude of the forge masters is much more conducive to life and activity in the market for finished goods than that of doubt and timidity taken up by the Paris merchants. The Syndical Chamber of Founders continues to obtain fresh adherents. It seems now certain that the project for syndicating the whole founding industry of the Nord will be carried into effect. The moment is opportune, for prices are but barely remunerative, and work is plentiful.

The Boulogne Fishing Industry.—The fishing industry of Boulogne, by far the most important in France, has been rapidly declining of late. The Government has resolved to establish at that port an "aquicultural station," with a view to check the evil. Under the management of Dr. H. E. Sauvage, this station will become a centre of technical instruction for fishermen.

MADRID, 9th April, 1888.

Shipbuilding.—No official announcement has been made as to the prices at which tenders have been made for the three cruisers of 7000 tons; but from what has transpired through the parties interested, it appears that the prices range from £480,000 to £620,000. Only three out of the nine tenders are supposed to comply with all the requirements laid down. As I have already said, it is most likely that the contract will be given to Señor Martinez de las Rivas, who is associated with Sir Charles Palmer. Their design is very good and complete, and they can establish the yard very quickly. The design of the Gironde Company is for a vessel 20 metres longer than Sir Charles Palmer's, and with the same displacement. By this means they expect to get the required speed with less powerful engines, but our naval authorities object to the length as being inconvenient. Tenders for three torpedo boats of 500 tons have been opened and publicly read. In this case the boats are to be built from designs made for Government by Señor Fallerie, a Spanish naval architect. The tenders varied from £90,000 by a new company at Corunna, to £120,000 by a Cadiz house. The lowest tender will probably be accepted if the company offers the necessary guarantee.

Electric Lighting.—The electric light is being introduced into Albacete, the capital of the province of the same name, for public lighting. Rules have been officially published for carrying out the order to introduce the electric light into all the theatres of this city within six months. The illuminated fountains at the Barcelona Exhibition are to be lighted by the Anglo-American Brush Corporation of London.

NEW YORK, 31st March, 1888.

The Coal Market.—The anthracite coal trade is dull, and prices have weakened somewhat; but the larger companies are maintaining circular rates. Dealers expect that the opening of the spring trade will improve the outlook, but it is difficult for an outsider to see anything favourable in the situation; up to the present time only about two-thirds of the mines have been at work, and the demand has never exceeded the production. Nearly all the mines, however, will be working soon, and the output will be as large as last year unless some restriction is placed upon production.

The Iron and Steel Markets.—There is a better feeling in the pig iron market than for some time past. Good brands find a ready sale, and the lower grade stocks having been largely absorbed by pipe makers, prices are steady, although makers of finished iron want lower prices; but there is little chance of any material reduction at present. The output has been largely reduced, and as there are now no large stocks on hand the demand will probably keep pace with the supply, and enable makers to maintain their prices. On the 1st March there were 98 anthracite and 128 bituminous and coke furnaces in blast, with an output of 95,000 tons, against 287 furnaces last year, with an output of 123,000 tons. For January and February the production was 200,000 tons less this year than last, or a decrease at the rate of 1,200,000 tons for the year. There is nothing encouraging in the outlook for manufactured iron. A moderate number of new orders have been given out for bars, but at prices that can leave no profit to the sellers. A great many of the mills are on short time, and those which run full have seldom more than a couple of weeks' work ahead. While 1·9 cent to 1·95 cent per lb. are the nominal quotations, the great bulk of the business is at 1·85 cent to 1·9 cent, and even less, for best refined bars. There is a little better inquiry for plates, and a fair business has been done, but with no improvement in price; and at the existing rates for foreign material, there are no prospects of an advance in domestic prices at present. The Pittsburgh Tube Works have closed down indefinitely, because of the dulness of the trade and low prices. The Atlantic Iron and Nail Works at Sharon, and the Greenville Rolling Mill at Greenville, Pa., have also closed, throwing over eight hundred men out of employment. It is now over three months since the Edgar Thompson Steel Works and the blast furnaces of Carnegie Brothers & Co. closed down because of difficulties with their men. Four of their seven furnaces are banked, and three are blown out. Negotiations are being made for the men to resume work. There is a fair demand for steel rails, and sales in small lots are numerous. Prices are steadily maintained, with most of the sales at $32 per ton at the mill, although desirable orders can be placed at $31·50 to $31·75. The demand for Bessemer steel in other shapes is exceptionally large, so that the mills find themselves pretty well employed.

The Metal Markets.—Consumers are buying but little copper now, and all transactions are light. The reports of the Calumet and Hecla mine are still favourable, and as the temperature is falling, it is believed that the fire is out. The exports for the year have been moderate, amounting to about £24,000,000. Prices are a little better for future delivery, quotations being 16·10 cents for May, and 16 cents for June. The tin market has declined, prices having fallen from 35·70 cents to 30·80 cents per lb. for May, and 30·25 cents for June. The business in tin plates has slightly increased, but the unsettled condition of the tariff keeps the market uncertain. There has been a moderate speculative demand for lead, over 1000 tons having been dealt in. Consumers are backward in buying, and the market closed at 5·15 cents per lb. for April. Spelter is weak and dull; spot for common domestic is quoted at 5 cents to 5·10 cents per lb.

Incandescent Lamp.—The Westinghouse Electric Company have just completed an incandescent lamp which will last 2500 to 3000 hours, as against 800 to 1000 hours in the ordinary Edison lamp.

PHILADELPHIA, 31st March, 1888.

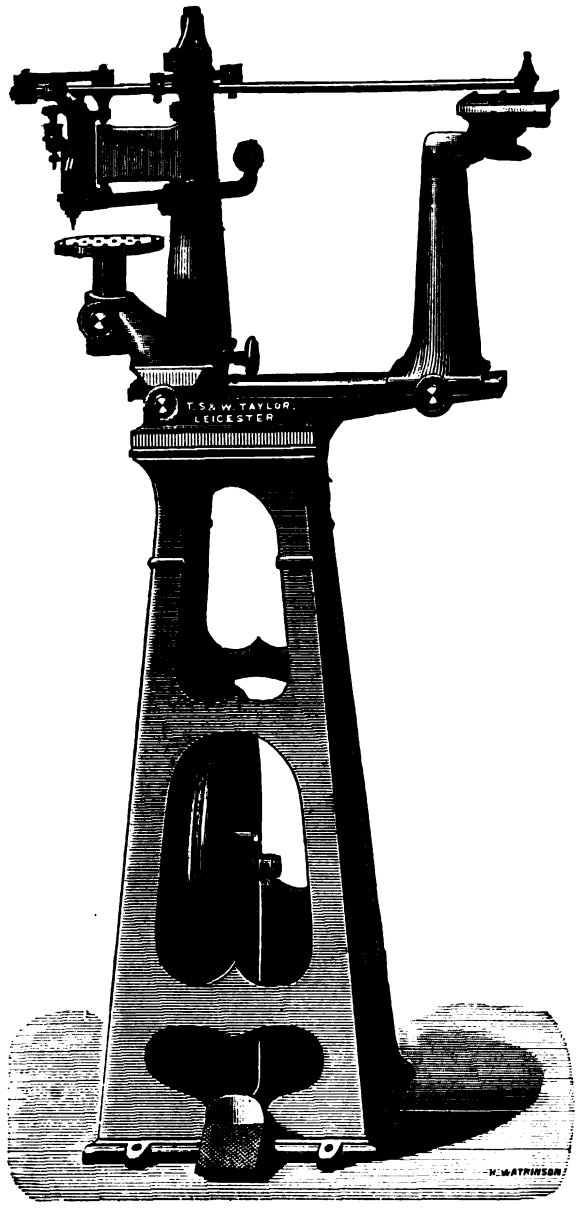
Sugar.—During the latter part of 1887 a sugar trust was formed among refiners, and all the refineries passed into the possession of the trust about the beginning of the year, the original owners receiving in return a certain amount of trust stock. There are four large refineries which have remained independent, and to a certain extent prevent the trust from completing their plans. Both the public and the producers of raw sugar feel the effects of this syndicate, the following being a fair example of how it is worked. On January 29th there arrived at New York a cargo of raw Manilla sugar amounting to 2100 tons. The cargo was sold in the usual way, at 4¼ cents per lb., to the only bidder. During the first week of the same month an almost identical cargo was sold at 4⅝ cents. During the same time the price of refined sugar had increased from below 6 cents to over 7½ cents per lb. This single transaction will net the trust nearly £16,000 over what the profits would have been if competition were free. There has been some talk of starting another independent refinery in this city, but the matter seems to have been dropped. Mr. Claus Spreckles has been in Philadelphia this last week, and talks of starting a refinery somewhere in the East; but as it would take a year and a half or two years to get it into operation, the prospect of lower prices in sugar by his efforts is rather slight, and it is probable that, if the trust will not disturb him in his own province west of the Mississippi, where he has practically a monopoly of the sugar trade, his visit East will have no good result.

Miners' Insurance.—The system of insurance in use among the Lehigh Coal and Navigation Company's mines in its practical working has been one of the most successful systems tried in this country. Each inside worker pays 1 per cent. of his earnings per month, and each outside worker ½ per cent.; but in no case are they allowed to pay over $1 per month. The company pays into the treasury of the relief association 1 cent per ton of coal mined. Allowances are paid to each workman who is prevented from working by accident, amounting to one-half the pay of the class to which he belongs; but the payment is stopped after six months. The death allowance amounts to $30 and half wages for one year. Owing to the prosperous condition of the treasury, the management has decided that hereafter half wages will be paid to a miner's family eighteen months after his death.

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TAYLOR'S ENGRAVING MACHINE.

We illustrate herewith a neat little tool by means of which engraving work can be done quickly and at the same time with almost mathematical precision. The graver is a drill or chisel revolving at high speed, and carried over the surface to be engraved by the short arm of an ordinary pantograph, the long arm of which is provided with a stylus or "tracer," and guided by hand over the enlarged pattern of the letters, figures, or other devices to be copied. Owing to the reduction of movement much greater accuracy can be obtained than by hand work, and the cut is so sharp and clean that it is possible to engrave, without any previous lining out, metal surfaces after they have been lacquered. This is an advantage insuring a good finish, for where the work is first engraved and then lacquered, the lacquer is liable



to accumulate round the edges of the letters as the brush passes over them. The arms of the pantograph allow a reduction of one-third to one-sixteenth to be attained, and any error of the hand in guiding the tracer on the end of the longer arm is therefore reduced in the same proportion. The machine consists of a vertical stand, with treadle and fly wheel, from which passes a gut to an overhead shaft, whilst a second gut passes down from this shaft over guide pulleys to the vertical spindle carrying the graver. The latter may be pointed or provided with a broad edge, according to the kind of work required; but in all cases a horizontal cross section near the cutting edge is semi-circular in shape, the flat of the semi-circle passing through the axis of the spindle, and one of the edges is slightly more prominent than the other. The machine is provided with a V bed and two slide rests, one to take the pattern and the other the work. Where letters and figures have to be engraved the pattern letters are arranged after the manner of printers' type, and slipped into the grooves shown in our illustration at the top of the pattern table. The slide rest for the work is arranged to take horizontal, vertical, or inclined surface plates, to which the object to be engraved is secured. For mathematical dividing the work is secured to a circular dividing plate provided with worm gearing and vernier.

An important feature of this machine is the feed gear, to insure constant depth of cut. This is fixed to the left of the cutter spindle, and consists of two screw motions, the one to advance the cutter to the surface of the work, and the other, which is limited by an adjustable stop, to give the requisite depth of cut. The half round cutters are ground on the machine itself by means of an emery wheel which is fixed on the cutter spindle, whilst the cutter is set at the requisite angle horizontally in bearings placed on the circular plate and slowly revolved through less than a half turn, whilst the emery wheel is advanced against the point of the cutter. By limiting the rotation of the cutter to less than 180°, one of the cutting edges is left slightly more prominent. The machine can be used not only to cut letters and designs, but also for circular mathematical dividing, forming routing, recessing, &c. It is the invention of Mr. W. Taylor, of Leicester, and can be seen at work at the show rooms of the Britannia Company, 100, Houndsditch, London.

AN IMPROVED AIR PROPELLER.

The air propeller shown in our illustrations has just been introduced by the Union Engineering Company, of Manchester, successors to the late firm of Messrs. C. Schiele & Co., and makers of the Schiele fan. It is, therefore, not a matter of surprise that this firm, in constructing their new propeller, should have concluded to adopt certain curves for the blades which had already proved successful in other forms. The revolving blades A are contained in a short tube so arranged as to be readily

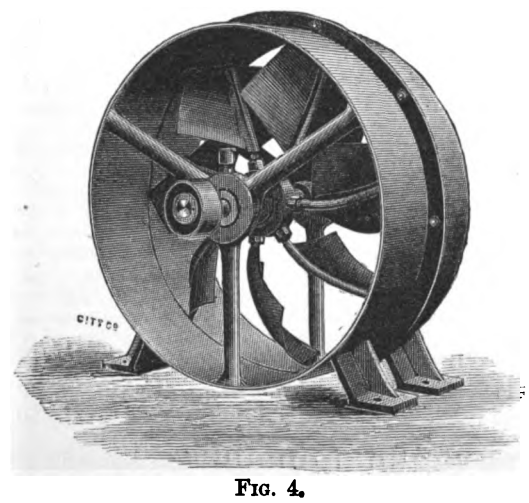


Fig. 4.

fixed in a wall or window as desired. The blades are carried on arms B, which are screwed into the boss, and, as will be seen, fastened securely by means of a lock nut. Contrary to the usual practice, the blades do not come right up to the centre, but are arranged to produce their operative effect nearer the inner circumference of the tube. Reference to Figs. 1, 2, 3, and 4 will give an accurate idea of the shape and curves of each blade, both the longitudinal and transverse sections being given. The propeller is driven with the concave side of the blades forward, the effect being that the air is drawn from the sides of the tube towards the centre, and there ejected. In this way the friction of the moving air is

AN IMPROVED AIR PROPELLER.

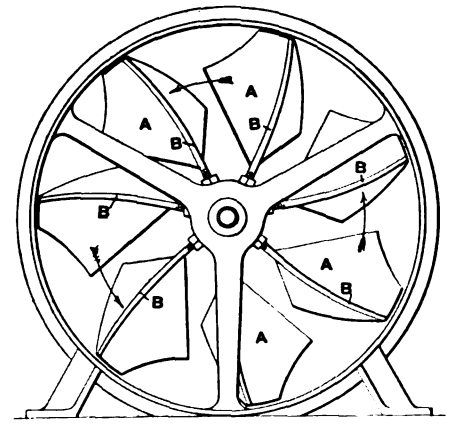


Fig. 1.

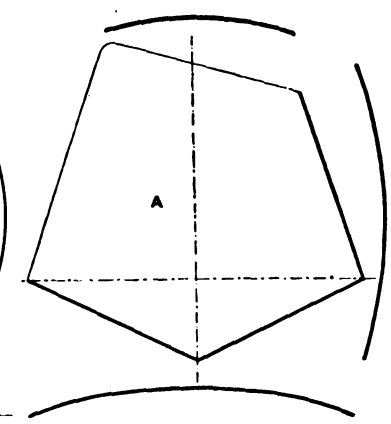


Fig. 2.

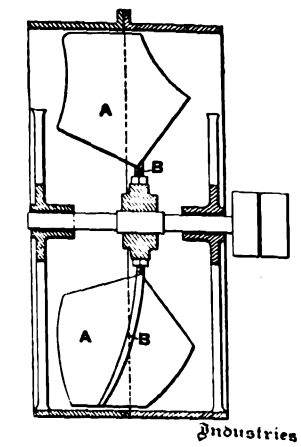


Fig. 3.

lessened, and the resistance from that cause diminished in proportion. The makers have made a series of experimental trials with a 36in. propeller, and state that, at a speed of six hundred revolutions per minute, 15,400 cub. ft. of air per minute was exhausted, and a partial vacuum set up, which registered 1½in. on the water gauge. The latter result is a valuable one, and is somewhat unusual so far as propellers are concerned. It overcomes the difficulty which is experienced whenever a strong wind is blowing against the face of some propellers, as no harmful effect is produced in this case. The whole of the bearings of the propeller are well arranged, and the machine is made in a thoroughly strong and satisfactory manner.

THE FORTH BRIDGE.

The twentieth quarterly report of inspection by Major General Hutchinson, R.E., and Major Marindin, C.M.G., R.E., of the works in progress for the construction of the bridge over the River Forth, states that the works have steadily advanced during the past quarter, and that the engineers state that, at the present rate of progress, which they anticipate no difficulty in maintaining, the bridge will be completed towards the end of next year.

Temporary Works.

Appliances connected with the erection of the cantilevers and internal viaduct continue to form the principal additions to plant. Among these are four double derrick cranes with detached winches. These are movable along the internal viaduct, and will be available for the erection of the latter, as well as of the bottom members and of other portions of the structure within reach.

Permanent Works.

South Queensferry.—*Main Piers.*—The riveting of the diagonal struts is now practically complete. The standards for the wind fence, and about one-third of the flooring plates, are fixed. On the southern portion of the cantilevers the bottom members of the first bay are completely built, and are riveted for 105ft. A large portion of the junctions with the bottom members of the first ties and second struts is erected and partially riveted. The vertical webs of the booms of the top members and the bracing between them are erected for 120ft., and the temporary columns for their support are nearly complete. The whole of the first ties are built. The girders of the internal viaduct are connected to their support at the first vertical ties, and are extended 50ft. beyond the latter. On the northern portion the bottom members of the first bay are completely built, and are riveted for 120ft.; with the exception of the lengths connecting them with the first ties and second struts, the junctions at their extremities are completely erected and the greater portion is riveted. The first bay of wind bracing between the bottom members, and three-quarters of the second bay, are in place. The vertical webs of the booms of the top members and the bracing between them are built out for a distance of 120ft., and the temporary columns for their support are in place. The whole of the first ties are built. The girders of the internal viaduct are extended to the same distance as on the southern portion. The riveted work at South Queensferry now amounts to about 5770 tons, an addition of about 890 tons during the quarter.

Cantilever and Viaduct Piers.—The masonry of the cantilever pier now stands at a level of 165·5ft. above O.D., and the centres of the arches of the masonry viaduct are in course of erection.

Inchgarvie.—*Main Piers.*—The junctions at the top of the vertical columns are complete, and also the top members. The riveting of the portion of the diagonal struts between their crossings and the top junctions has been commenced, and lengths of about 20ft. on each side are finished. On the southern portion of the cantilevers the bottom members are built out for about 156ft., and the first bay of wind bracing between them is riveted. The vertical webs of the booms and the bracing of the top members are built out for 40ft.; the first ties are built down for 45ft. The erecting platforms have been raised to their full height. The first struts are built to the level of 191ft. above O.D. The first vertical ties, with the bracing between them, and the support to the internal viaduct, are erected. Almost identical progress has been made on the

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northern portions of the cantilevers as on the southern. The total amount of riveted steel work at Inchgarvie is 6977 tons, showing an addition of 1160 tons during the quarter.

North Queensferry.—*Main Piers.*—The riveting of the diagonal struts is now complete. On the southern portion of the cantilevers the bottom members of the first bay are completely built, and are riveted for 150ft.; with the exception of the lengths connecting them with the first ties and second struts, the junctions at their extremities are completely erected. The vertical webs of the booms, and the bracing of the top members, are built out for 125ft., and the temporary column for their support is in place. The first ties have been erected. The first struts are built to the level of 228ft. above O.D., and are riveted for 170ft.; the second bay of bracing between them is erected as far as the intersection. The girders of the internal viaduct have been connected to the support at the first vertical ties, and extended about 50ft. beyond the latter. On the northern portion the amount of work completed is almost identical with that on the southern portion. The total quantity of riveted steel work at North Queensferry is about 6382 tons, an increase of 975 tons during the quarter.

Cantilever and Viaduct Piers.—The masonry of the cantilever pier now stands at an average height of 172·5ft. above O.D.

General Remarks.

Masonry and Concrete.—Up to the present date 585,000 cub. ft. of granite have been delivered, and 569,320 cub. ft. have been set; and about 111,950 cub. yards of rubble masonry and concrete work have been built.

Steel Work.—*First Bays.*—With the exception of two bays of bracing between No. 1 struts, the whole of the steel for the bays has been drilled and fitted.

Second Bays.—All the main members, the supports at the centre of the bays, the internal viaduct, the bracing between the bottom members, about half the junctions, and the trestles at the end of the bays, have been drilled. The fitting of the bottom junctions, of the bracing between the bottom members, of the supports at the centres of the bays, and of the internal viaduct, is well advanced. The fitting of the top junctions has been commenced.

Third Bays.—With the exception of the struts for the Inchgarvie cantilevers, the whole of the main members, as well as a large portion of the bottom junctions and of the bracing between the bottom members, have been drilled. The fitting of the bottom members has been commenced.

Fourth Bays.—The whole of the bottom members and of the main ties, and about one-half of the struts and top members have been drilled.

Fifth Bays.—The main ties are drilled.

In all 48,300 tons of steel, an addition of 1560 tons since the date of the last report, have been delivered.

The weather in December was below the average, that of January fairly good, and in February it was similar to that of past years. The greatest wind pressures recorded were: 9lb. per square foot on the large gauge on 17th December; 16lb. per square foot on the small gauge on 5th January; 27lb. per square foot on the small revolving gauge on January 5th; 28lb. per square foot on the small gauge on North Queensferry platform on 5th January. The average number of men employed per diem during the quarter has been 3090, and the number employed on the 27th February was 2940.

The inspectors state that they see no falling off in the quality of the work or in the nature of the skilful appliances by which it is being carried on, and that it is also satisfactory to note that during the past quarter the serious accidents have been far less numerous than heretofore.

THE STEAM YACHT "WANDERER."

The yacht "Wanderer," which has been purchased by Prince Torlonia, of Rome, left this country for Italy in the beginning of this week. The "Wanderer" was built about ten years ago for her late owner—Mr. Charles Lambert, of Valparaiso and London—by the late firm Steel & Co., of Greenock. The "Wanderer" is a composite vessel of 730 tons, and is primarily a sailing ship. She is brigantine rigged, has a poop deck and topgallant forecastle, is fitted with an auxiliary feathering screw, carries a telescopic funnel, and in general appearance is more like an American war cruiser than a pleasure yacht. When the vessel was built, engines and boilers on Perkins' high pressure system were supplied; but after a very exhaustive series of trials, extending over more than a year, it was decided to abandon the high pressure plant. The extreme delicacy required in the management of the boilers, and the practical difficulties involved in the use of such high pressures in the engines, were disadvantages which more than balanced any gain in economy of space and fuel. The engines were therefore removed, and replaced by compound engines supplied with steam of 80lb. per sq. in. pressure, by two return tube boilers; the speed attained being 11 knots. The "Wanderer," which name has been translated into "Vagus," has been undergoing thorough refit at Cowes during the past few weeks. The cabins and saloons have been upholstered in the most luxurious manner; and the ship has been fitted with an unusually complete installation of electric light, consisting of boiler, direct driven dynamo, complete auxiliary condensing plant, accumulators—capacity 660 ampère hours—115 lamps throughout the ship, a gangway lamp of 200 c.p., and a search light. The contractors for the electric lighting plant were Messrs. Muir, Mavor, and Coulson, of Glasgow.

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, 13th April, 7-30 p.m. Students' meeting. Paper to be read on "Joy's Valve Gear Applied to Locomotives," by Mr. H. H. Carrick, Stud.Inst.C.E.

Physical Society.—Saturday, 14th April, 3 p.m. Papers to be read on "The Measurements of the e.m.f. of Dynamos," by Professor W. E. Ayrton, F.R.S., and Professor J. Perry, F.R.S.; "The Variation of the Co-Efficients of Inductions," by Mr. W. E. Sumpner, B.Sc.; "Some Experiments on Soap Bubbles," by Mr. C. V. Boys; and "Electromotive Forces by Contact," by Mr. C. D. Burton, B.Sc.

NEXT WEEK.

Society of Arts.—Monday, 16th April, 8 p.m. Cantor lecture on "Milk Supply, and Butter and Cheese Making," by Mr. Richard Bannister.—Tuesday, 17th April, 8 p.m. Foreign and Colonial Section. Paper to be read on "A Hundred Years' Progress in New South Wales," by Mr. W. F. Buchanan.—Wednesday, 18th April, 8 p.m. Ordinary meeting. Paper to be read on "Telescopes for Stellar Photographs," by Sir Howard Grubb, F.R.S.

Cleveland Institution of Engineers.—Monday, 16th April, 7-30 p.m. Discussion on the "Architects' Registration Bill," now before Parliament. Paper to be read on "The Stockton and Middlesbrough Corporations' Water Works," by Mr. D. D. Wilson, Middlesbrough.

Institution of Civil Engineers.—Tuesday, 17th April, 8 p.m. Ordinary meeting. Paper to be further discussed, "Compressed Oil Gas and its Applications," by Mr. Arthur Ayres, M.Inst.C.E. Paper to be read (time permitting) on "The Distribution of Hydraulic Power in London," by Mr. E. B. Ellington, M.Inst.C.E.

Royal Statistical Society.—Tuesday, 17th April, 7-45 p.m. Paper to be read on "Progressive Taxation: Some Examples from Switzerland," by Mr. R. H. J. Palgrave, F.R.S.

Meteorological Society.—Wednesday, 18th April, 7 p.m. Papers to be read on "Jordan's New Pattern Photographic Sunshine Recorder," by Mr. J. B. Jordan; "On the Meteorology of South-Eastern China in 1886," by Mr. W. Doberck, Ph.D., F.R.Met.Soc.; on "Lightning in Snowstorms," by Professor A. S. Herschel, M.A., F.R.S.; and on "Insolation," by Mr. R. T. Smith, M.Inst.C.E., F.R.Met.Soc.

Royal Institution of Great Britain.—Thursday, 19th April, 3 p.m. Lecture on "The Chemical Arts," by Professor Dewar.

Chemical Society.—Thursday, 19th April, 8 p.m. Ballot. Paper to be read on "Influence of Temperature on the Composition and Solubility of Hydrated Calcium Sulphate and of Calcium Hydroxide," by Messrs. W. A. Shenstone and J. T. Cundall.

PRICES CURRENT, 12th April.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		32/1	Cash
Scotch Warrants, m/n		39 1½	"
Hematite Warrants, m/n		42 1½	"
Stocks in Stores. Scotch	970,004—Inc. for week,	2207	Tons
Middlesbro'	316,672—Dec. "	5123	"
Hematite	210,959—Inc. "	101	"

Exclusive of stocks in makers' yards.
Market continues steady.

	No. 1.		No. 3.		
Coltness	47 6	.....	42 6	f.o.b.	Glasgow.
Gartsherrie	44 6	.....	41/6	"	"
Dalmellington	39 9	.....	38 3	"	Ardrossan
Eglinton	38 9	.....	37/–	"	"
Glengarnock	43 9	.....	39 9	"	"
*Derbyshire	—	.....	35 6	f.o.t.	Works.
*Lincolnshire	—	.....	32 6	"	"
*Lancashire	—	.....	37/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 17 6	.....	5 7 6	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 2 6	.....	5 12 6	Manch'r.
" Angles	5 12 6	.....	6 2 6	"
Crown Sheets	6 5 0	.....	6 10 0	"
" Hoops	5 5 0	.....	6 5 0	"
"Siemens-Martin" Steel Boiler Plates			7 17 6	"
" Ship and Girder			7 12 6	"

METALS.

Spelter: Ordinary	£18	10	0	to	——		
Copper: British Cakes and Ingots	81	0	0	"	——		
" Chili Bars	80	5	0	"	80	15	0
" Manufactured (strong)	90	0	0	"	——		
Lead: Common Pig	15	0	0	"	——		
" English Sheet	16	0	0	"	——		
Tin: Straits	166	0	0	"	166	5	0
" Australian	167	0	0	"	167	5	0
" English Ingots	158	0	0	"	——		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—The estimated visible supply, England and France, at beginning of year stood at 42,251 tons, and on 1st April the figures given are 58,880 tons, showing an increase during the past three months of 16,129 tons. Notwithstanding this increase, Chili bars continue to be quoted £80 to £80. 10s. for spot parcels, and for three months about 10s. per ton less; but there is no great amount of business reported. Manufactured is still without life; there is no buying except for pressing requirements.

Tin.—Straits spot parcels still quoted at £166 to £166. 10s. per ton; but forward deliveries range from £123 to £140 per ton, according to date. The visible supply on the 1st inst. was estimated at 12,513 tons more than on 1st April last year.

Lead is easier. Spanish quoted £14 to £14. 5s. per ton.

Spelter quiet and rather drooping.

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

		Per ton extra
Delivery at Leith or Granton		2/-
Do.	at Broomielaw, Glasgow	2/6
Do.	at London (over ship's side in Thames)	6/-
Do.	at Liverpool (alongside export vessel)	9/6
Do.	at do. (traders' dock)	7/6
Do.	at Hull (on quay)	5/-

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	10	0
" Ceylon	"	24	5	0
Cottonseed	"	20	15	0
Cod	"	19	0	0
Lard	"	40	0	0
Linseed	"	18	12	6
Palm, Lagos	"	21	0	0
Rapeseed: English	"	23	10	0
Seal: Pale	"	23	10	0
" Brown	"	17	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	10	0
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6¼
" Spirit	"	0	0	8

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	6¾	—	0	1	7
" Oxalic	"	0	0	3½	—	0	0	4
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6½	—	0	1	6¼
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	17	6	—	12	0	0
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	7	6	—	7	10	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	31	0	0	—	31	10	0
Benzole (90%)	gal.	0	3	4	—	0	3	6
" (50 90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	0	0	5¾
" Prussiate (Yellow)	"	0	0	7	—	0	0	7¼
" Sulphate (Basis 90%)	ton	8	15	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
" Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—	.....		
" " (" 60%)	"	5	15	0	—	.....		
" " (Cream, 60%)	"	5	13	9	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	7	6	—	6	10	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

Great Northern Telegraph Company.—Traffic returns: Receipts in March, 1888, £22,000; 1st January to 31st March, 1888, £63,800. Corresponding months, 1887, £61,200; 1886, £58,680.

Finsbury Technical College.—A conference on technical instruction for tin, iron, and zinc plate workers, copper smiths, and others (the sixth of the series), will be held at the Finsbury Technical College, Leonard-street, City Road, E.C., on Wednesday, the 18th inst., at 7-30 p.m. The discussion will be opened by Mr. C. T. Millis, M.Inst.M.E., superintendent of the trade classes of the college. The chair will be taken by Hodgson Pratt, Esq.

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HOME INDUSTRIES.

MANCHESTER, 12th April, 1888.

The Cotton Trade.—The past fortnight has witnessed a very small trade in yarns. There are offers in the market, but they are too low in price for acceptance. The general tendency is decidedly towards lower prices, and there is a little more inclination on the part of sellers to give way. At present the majority of spinners are at work on contracts which have some time to run, and in consequence the pressure to sell only comes from those who are not in such a fortunate position. The influence of the silver question on this market is forcibly illustrated by the fact that the fall in the price of exchange which took place last month was immediately succeeded by lower offers for yarn and cloth. The recent stocktakings show better results in most cases, and dividends are again being regularly paid. In the cloth market there has been comparative stagnation, with a decided tendency towards lower rates. Here again the fall in exchange has had its effect, for although there are orders in the market they cannot be placed except at much lower prices than most makers are prepared to accept.

The Silver Question.—During the past week an important conference of the Bimetallic League has been held in Manchester. Several papers were read propounding theories as to the evil consequences alleged to flow from the present monetary system.

Wages Disputes.—A strike of iron moulders has taken place in Manchester owing to a demand made by the workmen for an advance of 2s. per week. At present the employers do not propose as a body to grant the advance, although in one or two cases that course has already been taken. The men appear to have acted quite independently of the Central Association, and the strike does not affect machine making establishments. The spinners in the Oldham district have asked their employers for an advance of wages of 5 per cent., on the ground that the state of trade is now so much better that the reduction which was made in 1885 ought to be restored. A conference of both parties is to be held, at which the matter will be discussed with a view of arriving at a settlement.

New Engineering Ventures.—As has been previously briefly announced in these columns, the works erected by the late Mr. Evan Leigh, for the manufacture of cotton machinery, have, after many vicissitudes, passed into the hands of Mr. S. Brooks, of the Union Iron Works, Manchester. These works are intended to be used for the construction of carding and roving machinery exclusively, and will be carried on separately from the works at West Gorton. The carding engine to be made by Mr. Brooks is that which has been patented by Mr. F. Wilkinson, and has many points of novelty. The works are capable of employing six or seven hundred hands. Messrs. Blakey, Emmott, & Co., Limited, the well known electrical engineers of Halifax, have opened premises in King-street, Manchester, for the sale of a number of special engineering tools, many of which are admirably adapted for electrical work. The machines are mostly special, and many of them have from time to time been described in these columns.

New Ice Making Machine.—During the present week there has been exhibited here a new patent domestic ice making machine, which is of very neat and compact design, and embodies some important improvements. The machine is known as the "Zero" ice making machine, and is the joint invention of Messrs. Connacher & Williams. Its principal features consist of a double acting vacuum pump, an acid resisting enamelled iron absorbing vessel for containing sulphuric acid, and an automatic feed arrangement for admitting in small quantities the water to be frozen. The vacuum pump suction valves are worked in a positive manner, and the whole of the working parts of the pump are immersed in a bath of oil, so that the pump is self lubricating, and its friction is reduced to a minimum. As we hope to give a detailed description of the invention shortly, we need only add that the inventors claim that the machine will work effectively in any climate without the need of skilled attendance, and that in the smallest machine they make for domestic use 7lb. of ice can be produced at a cost of 1d.

LONDON, 12th April, 1888.

The Money Market.—The demand for money is by no means strong, and the market is well stocked with funds, so that rates are exceedingly easy, day-to-day loans being on offer at 1 per cent., while advances for longer periods are proportionally cheap. The stock markets are, generally speaking, quiet. There is little speculation, what there is of it being upon a modest scale in every respect. General Boulanger has supplied the disturbing element, without which the foreign department would hardly be recognisable; but on the whole foreign securities have shown themselves wonderfully firm. Turkish and Egyptian stocks have come in for a great deal of favour, which is partly due to the fact that they have without doubt been undervalued in the past. Egyptian Preferences are recommended as a good investment, and though Turkish credit is not likely to become established all at once in popular estimation, there is no doubt that it is fast improving. The growing favour bestowed on foreign investments which, a short time ago, would have been looked at askance, is further indicated by the remarkable rush for the new loans of Mexico and Uruguay. There is little business doing in home railways, which are strong, especially the Northern lines. American railways have not yet made any move towards improvement. There has been a revival of speculative activity in copper shares, and the diamond shares are still disturbed, though in neither is there the great rush of a few weeks back.

Companies.—Mr. Goschen's Budget proposal to tax the capital of new limited liability companies on their formation is causing a tremendous rush to be registered before this becomes law. Since our last report, the following new companies have been registered: Hollins Mill Company, Limited, with a capital of £76,000, to purchase a cotton mill; Smith & Wright, Limited, with a capital of £50,000, to manufacture buttons and ornaments; the Great Harwood Albert Mill Company, Limited, with a capital of £15,000; Armstrong Patent Glass Blowing Machines Syndicate, Limited, with a capital of £50,000; Tunbridge Wells Electric Light Company, Limited, with a capital of £30,000; Kensington and Knightsbridge Electric Lighting Company, Limited, with a capital of £250,000, to take over the business of the Kensington Court Electric Lighting Company, Limited, whose installation was described and illustrated in *Industries*, Vol. II., page 173, and Vol. IV., page 220; the Anglo-Pacific Steel Company, Limited, with a capital of £100,000, to purchase the businesses of an agricultural capital of £63,000; Edward Humphries, Limited, with a and general engineer and brick maker carried on at Pershore, Worcestershire, by the late Edward Humphries; the Vale Mill, Limited, with a capital of £3,000, to carry on the business of cotton manufacturers; Salvo Laundry Supply Company, Limited, with a capital of £100,000; the Cellular Clothing Company, Limited, with a capital of £25,000, to manufacture Kershaw's cellular cloth; Magee, Marshall, and Co., Limited, with a capital of £250,000, to carry on business at Bolton as brewers, &c.; Roberts, Buckley, and Co., Limited, with a capital of £10,000, to purchase the business carried on at the Queen-street Iron Works, Stalybridge; the Tyddynmawr and North Wales Exploration Gold Mining Company, Limited, with a capital of £30,000; the Victory Gold Mining Company, Limited (Venezuela), with a capital of £200,000; the Hawaiian Tramway Company, Limited, with a capital of £130,000; the W. R. Goodbody Sewing Machine Company, Limited, with a capital of £10,000; the Kempson Stopper Bottling and Brewery Company, Limited, with a capital of £100,000; the Anglo-Chilian Nitrate and Railway Company, Limited, with a capital of £500,000; New Zealand Beaches, Limited, with a capital of £50,000, to acquire grants of sea beach in New Zealand, and to explore the same for the discovery of gold or other metals by dredging or other means; Gold Fields of French Guayana, Limited, with a capital of £100,000; Pacific Mining Company, Limited (U.S.A.), with a capital of £675,000; Sparre Patents Company, Limited, with a capital of £400,000, to acquire patents relating to a machine for preparing cards used in Jacquard looms, a machine relating to such cards, a new system of making cartridges, a new system of making writing paper, and a new system of moulds affording protection against imitation of bank notes and securities; and the Indian Tramways Construction Company, Limited, with a capital of £80,000.

Textiles.—At the opening of the second series of the Colonial wool sales last week there was a good attendance of buyers, both the home and foreign trades being represented. The total available quantity is 340,000 bales, and 9495 bales are catalogued for this sale. Prices on the whole have been the same as were obtained during the latter part of the first series of sales. Stocks of Baltic hemp are at present low, but fresh arrivals are expected. The price for spot parcels remains firm. A fair business has been done in Manilla hemp for arrival, but prices have varied. Nothing is doing in Sisal hemp.

Shipping.—With the exception of American and homeward Indian freights, rates are firm. Business is dull in the Baltic and Mediterranean, but the rates are higher than last year.

Coal.—The total imports of coal into the port and district of London during March amounted to 419,784 tons by sea, and 712,553 tons by railway and canal, as compared with 390,819 tons and 669,297 tons respectively in the same month of last year. The total exports amounted to 300,820 tons, as compared with 265,133 tons in March last. The total increase in trade within the London district for the first quarter of this year is 159,689 tons.

The Navy.—H.M.S. "Victoria," built by Sir W. G. Armstrong & Co., arrived at Sheerness on Monday from Newcastle-on-Tyne, where she was delivered to the Medway Steam Reserve authorities, to be completed for active service.—Admiralty and Lloyd's scholarships for private students in naval architecture and marine engineering, of the annual value of £50 each, tenable for three years, are thrown open to competition, there being a vacancy for one of each class of scholarship. Applications have to be made not later than the 23rd May by letter, addressed to the Secretary of the Admiralty, Whitehall, S.W.—A report has been published of the Directors of Army and Navy Contracts on the subject of the publication of the prices of accepted tenders, in which they say that there can be no hesitation in recommending the continuance of the present practice of treating tenders as strictly confidential.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 1st April amounted to £1,188,850 on 15,850¾ miles, as compared with £1,166,329 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 142 miles, or 0·9 per cent., and in the receipts of 1·9 per cent. A new railway will shortly be completed between Barking and Pitsea, on the London, Tilbury, & Southend Railway, which will shorten the distance between London and Southend by about 20 per cent. It has been about two years under construction.

The Carroll Feed Water Purifier.—When describing this apparatus in our issue of the 30th of March, we omitted to mention that Messrs. Charles Appleby & Co., of London, are manufacturing these appliances on behalf of the limited company which has been formed to acquire the patent rights for Great Britain, &c. We understand that the company are in a position to grant licenses for the use of this invention, and applications should be addressed to the Secretary of the Carroll Boiler Water Purifier, Limited, 89, Cannon-street, London, E.C.

GLASGOW, 12th April, 1888.

Shipping.—It is reported that grain can be brought from New York to Glasgow for ½d. per bushel, and that it is being brought free as ballast to Liverpool. The outlook in the grain trade is far from promising.—It is reported that a quantity of German steel plates has been imported by a shipbuilding firm on the Clyde.—The s.s. "Anchoria," of the Anchor Line, has just made a very fast passage across the Atlantic. She left Sandy Hook at 10-30 on the morning of the 31st ult., and passed Tory Island at noon on the 9th inst., having made the passage in eight days twenty-one hours.—The failure of a large firm of marine insurance brokers has been the subject of much Exchange talk. A statement of affairs has been submitted, from which it would appear that on a favourable realisation of assets, a considerable surplus would accrue. From the statement made at the meeting of creditors, it seems that losses to the amount of upwards of £100,000 fell upon the firm last year. Glasgow underwriters are known to have suffered heavily during the past few years.

Shipbuilding.—Messrs. Scott & Co., of Greenock, have booked a contract for a screw steamer of 800 tons, with triple expansion engines of 650 h.p. The steamer is to be employed in the South American coasting trade. Messrs. W. Swan & Co., Maryhill, are about to build a small screw steamer for the West Indies. Messrs. Fisher & Co., Paisley, will supply the triple expansion engines.

Glasgow Corporation Stock.—One effect of the conversion scheme of the Chancellor of the Exchequer has naturally been to increase the demand for local loan stock, which offers a fair interest and first class security. This has been manifested in the result of the second issue of £115,000 of Glasgow Corporation 3¼ per cent. redeemable stock. Applications amounting to upwards of £540,000 were placed in the hands of the committee. The average price at which allotments were made was £101. 5s. to £101. 10s., or a premium of from 25s. to 30s. per cent.

Tenders Wanted.—Contracts are about to be placed for the following: Two steam dredgers and seven barges for the North Sea Canal; and a steel bridge to be erected over the Clyde.

International Exhibition.—The sections of the Exhibition are now being rapidly filled with exhibits, the last day for receiving exhibits, according to the original prospectus, being Saturday, the 14th inst. The Exhibition will be opened by the Prince of Wales on the 8th May. On the 21st April there will be a Press view, to which invitations will be issued to a great number of journalists from all parts of the kingdom. The fountains, the switchback, and other out-of-door attractions are in an advanced state of preparation. The electric light installation is approaching completion, and the boilers, flues, &c., are being pushed forward with all possible speed.

(From our own Correspondents.)

SHEFFIELD, 11th April, 1888.

The Heavy Industries.—Comparatively few complaints are now heard from manufacturers about the dulness of trade. There is no doubt that the improvement is sound, and is likely to last for some months to come. At the furnaces the output is increasing, and a good business is being done in the iron trade. Bars are quoted at £5. 5s., and plates at £6. 5s. per ton. A much better price is also being obtained for best sections of steel rails; and quotations for all descriptions of railway material are firmer. At the works of Messrs. T. Turton & Sons there is great activity on railway springs; Messrs. Steel, Tozer, and Messrs. Cammell & Co. continue busy on Bessemer rails for Continental and Colonial use; and other local firms engaged on railway work are well employed. Girders for bridges and roofing are also in extensive demand; and Messrs. Vickers & Sons have good orders on hand for shipbuilding material. One of Sheffield's best customers for railway material is India, to which a vast quantity of rolling stock is now being sent, and manufacturers are hoping that with the conquest of Burmah, and the demonstration in Thibet, there may be a considerable development ere long of railway enterprise on the borders of our Indian possessions. There is somewhat of a lull in armour plate making, and in the production of war material generally. Nearly all kinds of heavy machinery are in demand, and high pressure boilers are now selling readily. The engineers and machinists have been internally busy during the Easter time; many local works have been overhauling their plant, and proceeding with extensions and renewals. The agricultural implement trade, the stove grate, the edge tool, and the cutlery branches are all

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yielding a satisfactory amount of work, and it is long since Sheffield hardware manufacturers and merchants were busier than now.

COAL.—At the South Yorkshire pits the demand for house and manufacturing coal shows slight diminution. The impression here is that the Midland Railway Company will yet succeed in taking over the Hull and Barnsley Railway at the terms offered, though the directors of the latter have declined the offer, preferring to have the opinion of the shareholders on the point. The project has aroused great interest not only among shareholders and coal owners, but among local manufacturers, for it is borne in mind that if the Midland obtain possession of this line, they will have, with the proposed link from Dore to Chinley, and on to Manchester, a through communication from sea to sea.

NORTH STAFFORDSHIRE, 11TH APRIL, 1888.

THE POTTERY TRADE.—Orders are rather more numerous, and on the average prices somewhat improved. Several large orders have recently been taken in this district from American buyers, and altogether there prevails a more satisfactory tone in the trade. The demand for manufacturing fuel is on the increase, at prices ruling from 7s. to 8s. at the pit, according to quality.

NORTH STAFFORDSHIRE COAL AND IRON MASTERS' ASSOCIATION.—The quarterly meeting of this Association was held at Stoke, on Monday last, Mr. Robert Heath, jun., in the chair. There was a fair attendance of members. The Bills now before Parliament for amending the Employers' Liability Act, 1880, were carefully discussed. Members felt with regard to trade that the future was uncertain, but no appreciable improvement was anticipated until the autumn. Sales were generally deferred until the quarterly meeting at Birmingham, to-morrow (Thursday). Since the January meeting two new blast furnaces have been blown in, one by the Chatterley Iron Company, and one by Earl Granville. There are now twenty-one in blast out of the thirty-nine in existence.

ENGINEERING.—Trade is very slack at the local foundries, and engineers complain bitterly of the prices which prevail. Ordinary castings can be obtained at little over £3 per ton, a price which leaves no margin for profit. Foundry pig iron is selling at about 38s. 6d. for No. 3, and 40s. for No. 1, into truck at works.

COAL MINES REGULATION ACT.—The special rules for the district, framed in accordance with the new Act, will shortly be obtainable from Mr. Knight, secretary to the Coal and Iron Masters' Association. As managers carry the provisions of the Act into force they find a considerable addition to the cost of production, which, in the aggregate, is estimated at 5 per cent.

BIRMINGHAM, 11TH APRIL, 1888.

THE IRON TRADE.—In this trade things continue in much the same condition as in the last report, but there is on the whole a rather better feeling prevailing. The downward tendency seems at length to have ceased, and now that the Easter holidays are over, and stocks have to a certain extent been diminished, the markets are ruling a little firmer. Marked bars remain at £7, and unmarked at £5 to £5. 10s. There is a fair demand for constructive iron work, chiefly owing to activity in railway matters in India and the Colonies. In the galvanising trade business might be brisker; the makers are standing out for rather higher prices than buyers care to give, and this is causing slackness of work in some of the mills. Galvanised sheets of 24 gauge are from £11 upwards. Advices from Australia report a rather slow market for this class of goods. There is a fair inquiry for pig iron. Staffordshire hot blast brings 50s. to 52s. 6d.; medium, 40s.; and cinder, 30s. The steel trade continues active.

THE HARDWARE TRADE.—The home trade is suffering from the untoward character of the weather, but export business is looking up as is natural at this season. Agricultural implements are in good request for the various agricultural countries and Colonies. Makers of metal fittings and requisites for ships are well employed. Jewellers, and especially silver smiths and electro-platers, are fairly well off for orders, but nickel makers are far from satisfied. Concerning the formation of a syndicate in the latter trade nothing further has transpired, although a few weeks ago it was considered certain that something of the kind would be attempted.

LEICESTER, 11TH APRIL, 1888.

WOOL SPINNING AND YARN TRADES.—No very decided movement has taken place in the wool market during the past fortnight. There is no greater amount of business being done, and prices are much as they were. Though growers are now more disposed to clear at a fractional decrease, yet country dealers are tolerably firm. The firmness of rates at the London wool sales has not, as was expected, very beneficially affected the local market. Spinners are only buying to supply their immediate wants. Orders are not numerous, nor for large amounts, whilst the prices which are quoted are barely remunerative. Yarn merchants are not doing much, and the uncertainty of prices militates greatly against the transaction of business.

HOSIERY TRADE.—General dissatisfaction prevails as to the present state of business. The trade is not up to the average, and the keen competition allows very narrow margins of profit. The trade is not prosperous either in the fancy or plain departments, and some of the houses have been heavily handicapped by several failures.

BOOT AND SHOE TRADE.—This year so far has been one in which trade has been much below the average. The usual heavy demand experienced before Easter has not been felt this year, and all orders were easily filled. Buyers are extremely reluctant to operate, and then only at prices which are cut down as low as possible. Orders coming in are only for unsatisfactory amounts, and it is not easy to keep the hands fully employed. There is but little doing in the leather market, and prices are ruling very low.

BARROW-IN-FURNESS, 11TH APRIL, 1888.

WOOD PULP WORKS.—The initial steps which have been taken at Barrow in the boring operations for water supply, preparatory to laying down large works for the manufacture on a large scale of wood pulp for paper making, have so far been very successful. A bore hole has been sunk about 200 yards through red sandstone, with the result that a considerable supply of water has already been secured. A much larger hole will now be sunk, and it is confidently expected that as the question of an adequate supply of water has been definitely solved, no difficulty will be experienced in proceeding with the undertaking.

NEW BOILER WORKS.—Messrs. Westray & Copeland, engineers and iron founders, of Barrow, who have lately developed a marine engineering trade, are now engaged in building a new boiler works of considerable size, and it is expected, as their establishment is in close proximity to the docks and the graving docks, they will be able to furnish themselves with plenty of work in this new branch of their business.

IRON AND STEEL TRADES.—There is a steady tone in the hematite pig iron trade, and orders are offering briskly, prices being steady for Bessemer in mixed numbers at 43s. 6d. to 44s. per ton net f.o.b., and 42s. 6d. to 43s. for forge and foundry qualities. There is a growing demand on foreign and Colonial account, but not much outlook from America. There is briskness in the steel trade in every department. The output of rails is maintained at its maximum, and orders are freely offering. Prices, however, do not move upwards, and are now quoted at £3. 10s. 6d. to £4 per ton. Shipbuilding material is steady at £6. 19s. for plates, and £6. 9s. for angles. A good trade is doing in billets at £3. 17s. 6d., and a quiet trade in nail slabs at £3. 16s. Blooms are in better inquiry at £3. 16s. per ton. Wire rods, however, have declined, and are at £5. 7s. 6d. for No. 5 standard. Iron ore is quiet; but the deliveries are fully maintained on old contracts, prices ranging from 8s. 6d. to 11s. 6d per ton net at mines. Spiegeleisen, which is largely consumed in the district, is quoted at £3. 15s. per ton net f.o.b. for 20 per cent. quality.

MIDDLESBROUGH, 11TH APRIL, 1888.

PIG IRON.—There is a growing conviction that, considering the state of business generally, and the large continued decrease in iron stocks, prices cannot remain long as they are. They have indeed begun to move, and No. 3 is quoted at from 31s. 9d. to 32s. for prompt delivery, and 32s. to 32s. 6d. for forward for No. 3 G.M.B. In warrants Connal's No. 3 is quoted at 31s. 10d. per ton cash, and Connal's hematite at 42s. 6d. to 43s. Makers' brands (East Coast) are 43s. to 43s. 6d. The shipments of pig iron still continue very favourable, having amounted to 23,836 tons up to the 9th of the current month, as compared with 18,516 tons to the 9th of April, 1887. The shipments for the first quarter of the year ending March 31st amounted to 207,555 tons, as compared with 172,388 tons during the first quarter of 1887. The increase is both in foreign and coastwise shipments, but chiefly in the foreign. The usual quarterly meeting of the North of England iron trade was held yesterday upon 'Change.

MANUFACTURED IRON AND STEEL.—There is no change in these trades, and all the works promptly resumed after the holidays. In the steel trade heavy rails are readily taken at £3. 15s. The shipments of manufactured iron and steel for the first quarter of the year showed a marked improvement over that of the corresponding quarter last year, being 126,989, against 104,467 tons. A curious claim by the East Indian Government has cropped up in the course of their shipments, viz., that stores going out to the East Indian Government railways should be free from all dock and harbour dues, so far as docks and harbours which had incorporated the Harbours, Docks, and Piers Clauses Act of 1847. The argument is that railway materials are Government stores virtually when they are wanted for the East Indian railways, which belong to the Government. Such a claim if pressed will tell heavily upon such bodies as the Tees Commission and the Clyde Trust. Both these bodies are resisting it.

COAL AND COKE.—Both these industries are active, and prices are well maintained. During the first quarter of the year the export of coal coastwise has rather fallen off as compared with last year, but the export of coke has improved. The export of coal abroad is much about the same, but that of coke has decidedly improved. There is an increase in the over-sea exports in the value of goods other than coal and coke of £98,908.

NEWCASTLE, 11TH APRIL, 1888.

H.M.S. "VICTORIA."—The armour clad "Victoria," which has been built by Messrs. Armstrong, Mitchell, & Co., proceeded to Chatham from Newcastle on the 8th inst. Her chief dimensions are: Length, 340ft.; beam, 70ft.; mean draught, 26ft. 9in.; displacement, 10,500 tons, and the power of her engines is 12,000 i.h.p. The armanent consists of two guns of 110 tons each, and of 16¼in. calibre, as well as one 11in. gun of 30 tons, and twelve 6in. 5-ton broadside guns, &c. The turret in which the 110-ton guns are to be placed is covered with bound steel armour 17in. thick. The guns will fire a projectile of 1800lb. weight, with a charge of gunpowder weighing 960lb. The vessel is lighted throughout by electricity; the same means will be used for firing the guns, while the loading of the latter will be effected by hydraulic mechanism. The propelling power consists of twin screws of 16ft. diam., each of which is driven by triple expansion engines, with 43in., 62in., and 96in. cylinders, and 51in. stroke. There is accommodation for a storage of 1200 tons of coal, which is sufficient to carry the vessel at its maximum speed of 16¾ knots through a distance of 1600 nautical miles. For protection against heavy projectiles a belt of armour 18in. thick extends 3ft. or 4ft. above and below the water line, 152ft. in length, on each side of the vessel; and ample magazine accommodation is obtained in the internal part of the ship, on account of her great beam, so that for the 110-ton guns she will be able to carry 160 rounds of projectile and powder.

ROPE WORKS.—In addition to the important local orders that are now in the hands of rope manufacturers, some good export contracts have been secured, and the very ample resources of the various factories are being fully utilised. The demand for the different descriptions of wire rope is not only maintained, but is increasing, and the heavier sizes of hemp rope are also in fair request.

GLASS WORKS.—In the pressed glass trade business is very brisk, the requirements of jam manufacturers and other users of pressed glass goods being at this season unusually urgent. The makers of paraffin lamp chimneys, however, are becoming slack, and the operatives are now generally on short time. In the stained glass branch, activity is still the feature; and manufacturers of polished plate glass are extremely busy.

LEATHER WORKS.—In the leather trade, the demand for ordinary qualities is somewhat limited; but inquiries for special descriptions are numerous. The foreign demand for india-rubber goods has rather improved, and Messrs. George Angus & Co. are preparing to make some heavy shipments next week.

WIRE WORKS.—Wire workers are much busier than they were at the opening of the year, the demand for those descriptions of wire goods which are used in the preparation of fire clay having been considerably stimulated of late. There is also a good demand for the wire cloth used in connection with paper manufacture, and the consumption of goods required for gardening and agricultural purposes is steadily increasing.

FIRE BRICKS, &C.—In the fire brick and sanitary pipe trade considerable animation now exists, and large quantities of both kinds of goods are being shipped, in fulfilment of foreign orders.

PAPER WORKS.—Paper manufacturers are decidedly busy, the local demand being of itself almost sufficient to keep the machinery in steady operation.

THE COAL TRADE.—The Northumberland coal trade, which has been exceedingly dull throughout the winter, is now, through the re-opening of the Baltic ports, likely to regain some of its former activity. Prices of steam coals are already beginning to show an upward tendency, and there is no doubt whatever that an increasing demand will very shortly cause increased employment at the pits. The shipments of coals and coke from Tyne Dock for the week ending April 7th, amounted to 83,864 tons, being an increase of 8421 tons over the shipments for the corresponding week in 1887.

LAUNCH.—On the 4th inst. there was launched from the yard of Mr. J. T. Eltringham, South Shields, a paddle steamer, built to the order of Messrs. J. P. Rennoldson and Co. (who supply the engines, &c.), for Messrs. Martin and Marquand, Cardiff. The vessel is 122ft. long by 20ft. wide, and 11ft. deep. She is named "The Earl of Dunraven," and is intended for the passenger trade in the Bristol Channel.

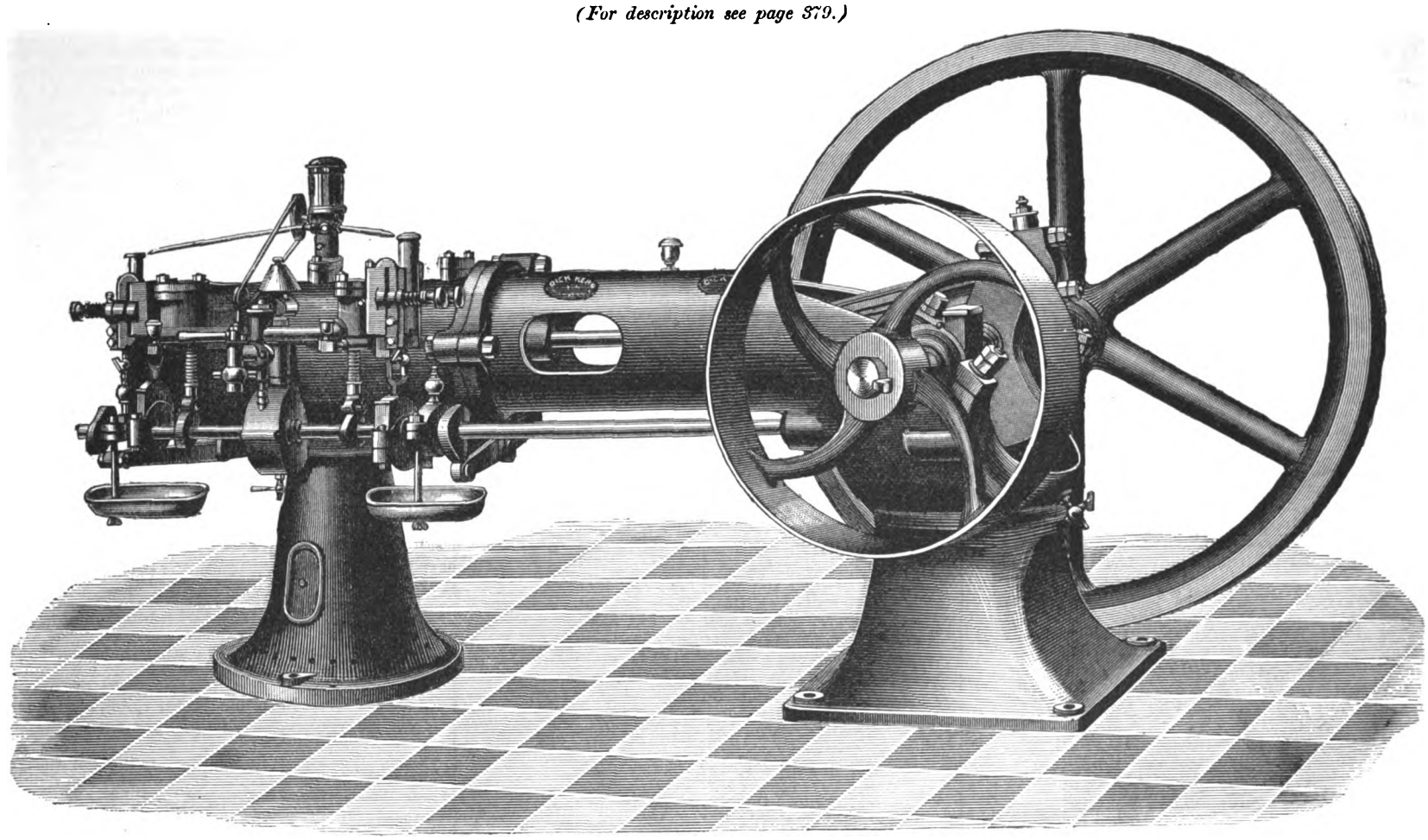
DUNDEE, 11TH APRIL, 1888.

FLAX AND JUTE TRADES.—The staple industries of the town and district have undergone little change during the last fortnight. Buyers show little disposition to extend their purchases beyond the supply of their immediate wants. Flax on the spot has sold to a moderate extent for assortment purposes. In view of the early opening of the Baltic ports spinners are not disposed to purchase largely. Few sales on contract have been reported. Exchange still shows an upward tendency, and prices here are consequently firmer. Flax yarns have been moderately dealt in at late prices, and where slight concessions are made by spinners, manufacturers operate more freely. There is still a want of life in the local linen trade; but in the Fife district manufacturers of fine goods are fairly well employed. The demand for sailcloth is quiet, and the prices are unchanged. Jute on the spot is in fair demand, at full rates. Jute yarns do not move off so freely, and although quotations are maintained, a slight concession might be made to effect sales. In jute fabrics hessians are in quiet demand, the orders being barely sufficient to take off the production, and quotations are weak in consequence. There is still a fairly active demand for bagging, but sacking and tarpaulin are in rather less request.

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THE "GRIFFIN" GAS ENGINE.

(For description see page 379.)



THE CARDON FLAX SCUTCHING MACHINE.

A short time ago we gave (see *Industries*, Vol. III., page 387) an illustrated description of the improved Cardon scutching machine, patented first in France, and brought to Belfast in the early part of last year. This machine, from the reports which had preceded it to this country, was expected to revolutionise the preparatory methods of separating the straw from the fibre, and by giving a greater yield out of the same weight of material, the cost of linen goods was to be reduced about 40 per cent. This opinion was not, as one might now suppose, merely a bait thrown out by the inventor to attract attention, nor even that of some persons with only a theoretical knowledge of the machine, but it was the true and conscientious opinion formed by practical men connected with flax manufactories, and also by the representatives of machine making firms in the United Kingdom. Prior to the introduction of the Cardon machine, no mechanical appliance or arrangement which had been introduced combined, with any degree of success, the two processes of crushing and scutching the flax straw. The objections which prevented all or any from being generally adopted when brought to actual test, were due to some one or more of the three following causes: (1) To their price being too great, which placed them beyond the reach of poor farmers, who are, as might be expected, unable to afford large sums for a machine which can only be used during a few months of each year; (2) to their productive capacities being too limited; and (3) to their action being too rough and injurious to the fibre. In flax scutching mills, both at home and abroad, the general system of crushing flax is to pass the stalks through one, two, or three pairs of iron fluted rollers in a loose condition. The crushed straw is then carried to the scutchers, who separate it into small bundles, and by holding these up against the blows of revolving wooden blades the core becomes broken into particles and knocked out, and the fibre freed from over 60 per cent. of unworkable matter. This process is necessarily slow, tedious, and not very satisfactory; but its great recommendation is that the first cost for fitting up a mill complete for the purpose is very small, and suits the limited means of the farmers, who can seldom afford to pay say £150 for each machine required, although even promised that this amount would be saved in wages after five years' work. Again, any machines which have been tested were only competent to manipulate about 600lb. or 800lb. of material per day.

Taking all these facts into consideration, M. Cardon realised that he could only hope to get his machine adopted by having it introduced into spinning factories, and the work carried out there instead of at the growing districts. He therefore invited inspection by manufacturers, and so satisfactory did the results appear to be, that information was at once dispatched to England on the subject. After several inquiries, representatives of several of our machine making firms were at once dispatched to Lille, where the machine was to be seen at work; and their report being satisfactory, a deputation of specialists from the North of Ireland followed suit, and after a careful inspection of its working, extending over several days, they returned home, and described it in terms of laudatory commendation, which even the inventor would have failed to surpass. Some further negotiations then took place between Messrs. Combe, Barbour, & Combe, machinists, Belfast, and the inventor, after which this firm were induced to purchase, at a considerable cost, the patent rights for the United Kingdom. No sooner was this agreement effected than several orders for the machines were placed in the makers' hands, and operations for making them were immediately commenced. When the first order was completed, and the machines fitted up, the straw was placed in holders, and—in the presence of a large number of specialists—introduced to the channel, through which it was conducted in satisfactory style between the crushers and beaters, after which it was delivered at the opposite end. On inspection, however, the fibre, although fairly well operated upon, was found to be rather inferior to what was expected. Among the orders placed for the machines was one by the Milfort Spinning and Weaving Company, Belfast, for two pairs, the price to be £400 each. This firm had them fitted up when completed in the best possible manner, so as to give every facility for doing good work: but when the first test was made, the result was found to be less encouraging than had been anticipated. The overlookers of this firm then decided to make an effort to improve the machines in their apparently defective points, and so perseveringly did they attach themselves to the work, that ultimately they felt justified in obtaining several patents for important improvements and additions. During the past year, the Cardon machines, although recognised to be partial failures, have been kept at work, in the hope of something being accomplished which would render them sufficiently profitable to return some part of the great outlay, but without avail, and they have now been stopped and are about to be discarded. Thus all the castles built in the air by those concerns enterprising enough to order the machines, have fallen to the ground. How our practical manufacturers could have been deceived to such an extent it is difficult to understand, as every test was conducted in a fair and apparently straightforward manner in France. From the great loss incurred, however, one good result has been obtained, viz., that it has now become fully recognised that the operations of crushing and scutching, whether conducted separately or in combination, must be left to the farmers.

Any machine which may be invented for this purpose must possess the following characteristics in order to insure success: (1) It must be cheap, the price not to exceed £60 for each machine; (2) if the "holder" system be adopted, a pair of scutchers must be capable of operating upon nearly 1000lb. of material per day; (3) each machine (or pair of machines, as the case may be) should only require the labour of not more than two attendants; (4) the working parts should be few and not liable to get out of order; (5) it is absolutely essential that both the crushing and scutching operations (by whatever means or methods they may be accomplished) should be combined in the same machine; (6) its principle should be such that while effectually separating the fibre from the wood, the former should on no account become broken or ruptured; and (7) the yield of fibre must not be less than 22 per cent.

The object is one well worthy of study and attention, and should be accomplished in one way or another in the near future. That such a machine would benefit the flax trade to a great extent, goes without saying; but it would also probably bring fame and wealth to the inventor. The obstacles in the way of success are no doubt difficult to surmount, chiefly on account of the great length of the flax fibre, which causes it to be so easily cut or broken, and to the fact that it adheres very firmly to the straw. The object, however, can, we believe, be accomplished, and our principal aim in making this reference to Cardon's machine is to give the question publicity, for we consider that flax machinery has not received a fraction of the attention which has been given by mechanical engineers to the machinery used in the manufacture of cotton. That the Cardon machine is an absolute failure is now beyond dispute; but its advent, although costing a few Irish spinners and machine makers probably £10,000, has been the means of directing a large share of public attention to the probability of a successful combination for mechanically separating the straw from the fibre.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 62 Ludgate Hill, E.C. (Watkins & Osmond.)
Manchester: 70, Market-street.
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Telegraphic address: "INDUS, MANCHESTER."
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Telephone number: 684, MANCHESTER.
„ „ 2785, LONDON.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 13TH APRIL, 1888.

NEW MARKETS FOR BRITISH MANUFACTURES.

THERE are two questions which are constantly being debated among men who are engaged in industry and commerce, but which, owing to their speculative character, are extremely difficult of solution. The first question is whether England is being beaten in the competition for the markets of the world by any other nation; the second is whether these markets are likely, in the future, to provide for any such development of our industry and trade as we have witnessed in the past. These questions embrace the sum and substance of the future of British trade, and are therefore at all times seasonable; but they have been invested within the last two or three weeks with a certain amount of additional prominence by reason of the publication of several official documents, viz.: (1) The "statistical abstract of the principal and other foreign countries," issued by the Board of Trade; (2) the "report on the external commerce of the United States during the year 1887," issued by the Treasury Department at Washington; and (3) the "report on the foreign trade of the United Kingdom," prepared by Mr. Giffen, of the Board of Trade. With these and other official data at command, we may be able to throw some light upon the present circumstances and future prospects of British trade.

Probably the first fact that will strike the inquirer into the general course of the commerce of the world, during the last few years, is the comparative stagnation that has been equally a characteristic of all industrial countries, so far as their foreign trade is concerned. It is not easy to illustrate this satisfactorily by any sets of figures applying to the same years, or to the same commodities, because each country is liable to be affected by circumstances peculiar to itself, and by special circumstances in special years; but the broad general fact may be sufficiently exemplified by comparing the export returns of the principal countries over an interval of ten years, taking the two terminal years 1877 and 1886 for comparison, and 1880 as a year of comparatively good trade. The results compare thus:—

Value of Total Exports from Different Countries in Different Years (1=1000).

	1877. £	1880. £	1886. £
United Kingdom	252,316	286,414	268,667
Germany	138,120	218,070	219,230
France	174,832	184,492	169,836
Italy	40,896	47,248	42,775
Austria-Hungary	88,068	84,787	82,396
Russia	52,794	49,867	48,848
Belgium	80,471	89,006	100,485
Spain	20,554	25,489	27,529
Holland	44,151	52,062	78,962
United States	125,515	174,091	141,568

It is evident from these figures that the depression within the last few years has been general. There has not in all cases been an absolute decline; but there has been a cessation of progress which tells much the same tale. Some writers have endeavoured to draw a distinction between machine using and hand labour countries, and have endeavoured to establish the proposition that only the former have been depressed. It is a difficult matter to institute a fair comparison between countries where the resources of civilisation are all but unknown, and countries in which the highest triumphs of civilisation have been achieved. For the present purpose, however, such a comparison is not required. We cannot say with precision what is the economic condition of the kingdom of Abyssinia, for example, because there are no available records to throw light upon the subject. What does concern us to know is that the decline of business, or the very serious depression of prices, which we have so keenly felt in Great Britain for some years previous to 1887, has been quite general among the countries that have dealings with the rest of mankind. It has not, therefore, been our fate to suffer alone, and, so far, this is satisfactory, showing that relatively to their competitors British manufacturers and traders have retained their hold over the chief outside markets, besides our own Colonies. But there are important markets in which Germany, or France, or both, by virtue of their geographical position and trade connections, have made serious encroachments upon our former supremacy. In Russia, Norway, Sweden, Denmark, Holland, and Switzerland, Germany has a considerably larger share of the import trade than our own country. The following figures show the proportions of the trade of those countries which the two rivals had in each of the years 1877 and 1886:—

(1 = 1000.)

	Imports received from United Kingdom. 1877. £	1886. £	Imports received from Germany. 1877. £	1886. £
Russia	16,156	10,800	26,313	13,516
Norway	2,775	1,915	2,907	2,113
Sweden	4,850	4,700	3,742	5,600
Denmark	2,675	3,009	4,720	5,200
Holland	17,150	21,853	16,200	26,200
Switzerland	—	1,824	—	10,447
Totals	43,606	44,101	53,882	63,076

Germany shows in this table to advantage. She has improved her relative superiority, and at the later year was about nineteen millions better than the United Kingdom. But even Germany has not had it all to her liking in markets that nature appears to have intended to make peculiarly her own, and the falling off in her trade with Russia is specially suggestive. The broad general conclusion that follows from the analyses of our foreign trade here set forth is that Germany has no special advantage over the United Kingdom that is sufficient to give her precedence or pre-eminence in the new markets which are every day being opened up in different parts of the world by the discoveries and pioneer labours of geographers and commercial agents, by conquest and annexation, by the development of trading facilities, and by the constantly increasing wants of mankind; and if we are free from fear from Germany, we certainly need be in no great concern about any other industrial rival at present. All other Continental countries, except France and Belgium, are at present barely able to meet their own needs, and as regards these two countries, it is to be observed that while France has dearer labour, higher railway rates, and more limited industrial resources than either Germany or Belgium, the Belgians are prohibited by their limited number, and the necessarily restricted extent of their industries, from pushing us very closely in any except a few special trades.

When we inquire into the character of the demand that is likely to come from new markets that are either at present in course of development, or likely before long to be developed, the first consideration forced upon us is the great diversity that exists between different countries in the consumption of

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manufactured commodities, and this diversity is so remarkable that it is quite impossible to argue from the experience of any one country what the demands of another are likely to be, even as regards the essentials of food and clothing, and much less so as regards commodities of which the consumption is necessarily varied according to the special conditions of each country. Take, for example, the items of cotton and wool among commodities that are so-called necessaries of life. The consumption of these is higher in the United States than in the United Kingdom, and higher in the United Kingdom than in Germany or France. Take, again, the consumption of iron, which in the United States is twice the *per capita* average of Great Britain, and in Great Britain is twice the *per capita* average of other European countries. The present annual production of pig iron is roughly 21 millions of tons, and of this quantity fully one-third is consumed in the United States, giving an average *per capita* consumption of 260lb. Assume the population of the world to be 1200 millions, and the quantity of iron consumed, if the general average were the same as the particular average of the United States, would be not 21 millions of tons, as at present, but 140 millions of tons, or nearly seven times as much. Iron may appear to be an isolated case, but there are many commodities of which it may be regarded as the proxy and representative, and the consumption of which must eventually increase in similar proportions. The question for the British manufacturer is what countries are most likely to bring about this increased consumption. The three great future fields for the enterprise and occupation of the commercial nations of the world are China, Japan, and Burmah in Asia; the Congo Free State and Abyssinia in Africa; and the various Republics of South and Central America on the Continent of that name. If measured by population alone, the most important market of the future should be China, which has a population variously estimated at 350 to 430 millions, or between one-third and one-fourth of the total population of the world. There is, however, at present less to hope from China than from some other and more progressive countries. It is true that in China a beginning has actually been made with railway construction; but it is only a beginning, and in spite of the approval of the authorities, and the encouragement of many outside friends and advisers, the people are slow to adopt improvements. Moreover, the Chinese intend to develop their industries independently of other nations; they will endeavour to establish engine factories, iron and steel works, and other requirements in their own country, to be carried on by Chinese workmen, to the advantage of Chinese capital and labour. As a national programme this is no doubt excellent; but the Chinese are unacquainted with Western arts and sciences, and if they are to do everything for themselves, their progress must necessarily be very slow. However this may be, China is not at present making great demands upon the commerce of Europe, having in 1886 and three previous years imported less than in the four years ending 1880. Nor can we say much more for Japan, which stands in quite a different rank as regards the characteristics of the people and their desire for advancement, seeing that the value of the imports into Japan were less in 1886 than in 1880. Burmah, on the other hand, is lying at our feet, and if we can only take steps to develop its vast resources we shall undoubtedly reap a rich reward. Recent reports state that Upper Burmah, and the Chinese provinces on its borders, contain a population of 112 millions of people, or, roughly, twice the population of the United States, which is at present hardly touched by our commerce. In United Burmah there is room for an additional population of 80 millions; but in order to create the development of population and commerce, railways are urgently required. It has been established by Messrs. Holt, Hallett, and Colquhoun, that a system of railways between South-Western China and the Burmese littoral could be constructed cheaply—about £5,000 per mile for the greater part of the distance,—and that it would be likely to pay. But they think that the Government should guarantee the line. This is just what the Government do not show any inclination to do; and meanwhile France is endeavouring, from her coign of vantage in Indo-China, to secure the trade of Southern China, Siam, and the Shan States, by connecting them with her ports by railways. Here is one of the gravest perils to which the commerce of Great Britain is at the present time exposed. Once let England secure the possession of the chief means of communication between Upper Burmah, and Indo-China, Siam, and all the adjoining States, and we should enter into the enjoyment of a practical monopoly in one of the most promising fields in the world for trade and commerce. The wealth of this territory has been described by its most recent explorers as "incalculable," but "it lies fallow at present for want of communications, both internal and with the outer world." Already we have in India 268,000,000 of fellow subjects. Add the population that would be brought within the reach of our commercial intercourse by the development of this territory, and we should have at least 112,000,000 more ready and eager to receive our merchandise. British India now takes exports of British produce to the value of about £33,000,000 a year. Since 1872 the export trade with British India has, on an average, increased by a million sterling per annum—that is, from 18,000,000 to 33,000,000. But India is poor by comparison with some of these adjoining States; and if the commerce of these States were developed we should not have to wait long for results. The first thing to be done is to open up railway communication. At the present time all merchandise has to be carried over the very primitive roads of the country, at a cost of from ten to twelve times as much as if carried by rail. This, of course, renders business on a large scale impossible. But railway enterprise does not appear sufficiently promising to attract private capital. What, then, is to be done? Is it not reasonable to ask the Government to give a guarantee of interest on the cost of construction? A 3 per cent. guarantee would secure all the capital required within twenty-four hours, and the risk would be infinitesimal. In China and Burmah we have not, as in Africa, to deal with a population of savages having few wants, but with races "for the most part energetic, sober, hardy, clothes wearing, tool using, trade loving, and industrious;" and in those countries, if anywhere, is a field for British industry and trade.

THE BELL TELEPHONE BEFORE THE AMERICAN COURTS.

One of the most important patent cases on record has been decided at Washington by the Supreme Court of the United States on the 19th of last month. The question on which the Court had to give an opinion was nothing less than the validity of Graham Bell's telephone patents, about which numerous litigations in inferior Courts had previously taken place. In some of these cases appeals were made, and the Supreme Court had to deal with five of these, viz.: Amos E. Dolbear, the Molecular Telephone Company, the Clay Commercial Telephone Company, the People's Telephone Company, the Overland Telephone Company, and a cross appeal in the case of the Molecular Telephone Company. The judgment of the Court was in all cases in favour of the American Bell Telephone Company, who own the Bell patents; but three justices dissented from the finding of the Court in the matter of the appeal of the People's Telephone Company, who own the Drawbaugh patents. The opinion which was written by the Chief Justice is a very lengthy document, containing many elaborate arguments, lengthy quotations from newspapers and other sources, and reads like a counsel's brief for Bell. Some portions of the opinion are of a decidedly sensational character, such, for instance, as the argument in which the Chief Justice dismisses as unfounded the allegation that Bell's patent agent altered Bell's application after it had been filed by interpolating a part of Elisha Gray's claims relating to his variable resistance method. This charge is of such a remarkable nature that it reads almost like a portion of the Arabian Nights; the actual wording in the counsel's brief is "that Mr. Bell's attorneys had an underground railroad in operation between their office and Examiner Wilber's room in the Patent Office, by which they were enabled to have unlawful and guilty knowledge of Gray's papers, as soon as they were filed in the Patent Office; and that an important invention and a claim therefor were bodily interpolated into Bell's specification between February 14th, 1876, and February 19th, 1876, by Pollok, in consequence of the guilty knowledge which the latter already had of the contents of Gray's caveat before the declaration of interference with Gray on February 19th."

The argument of the Chief Justice may be divided into two parts: the first dealing with matters of fact, viz., as to whether Reis, Van der Weyde, McDonough, and Varley had anticipated Bell, and the second with a matter of conjecture, viz., whether he had been anticipated by Drawbaugh. Only circumstantial evidence was forthcoming in the latter case, which presents some peculiar features. Daniel Drawbaugh claims that he invented the telephone years before Bell or anyone else made one, and that, being only a poor mechanic, he was unable to push his invention in the market. His experiments are stated to have extended from 1862 to 1878, and it is asserted that a number of persons saw the instruments in practical operation from 1870 up to 1874. The Chief Justice points out that all that any of the witnesses could say on the subject was that they had used instruments in Drawbaugh's shop, and heard sounds and sometimes words spoken to them, and that Drawbaugh told them the sound was carried on the wire by electricity; but no one could say how the instruments were originally constructed, or what the process was by which the sound was transmitted. Stress is also laid on the fact that Drawbaugh visited the Centennial Exhibition at Philadelphia in 1876, at which Bell's instrument was on view; but seemed to have lost all interest in the subject, spoke to no one as to what he had done, and made no special effort to find out whether what was exhibited resembled his own invention. The conclusion arrived at is that though Drawbaugh may have conceived the idea that speech could be transmitted to a distance by means of electricity, and may have experimented on the subject, he did not discover how to do it before Bell did. The evidence of the seventy witnesses called in connection with this portion of the case seems to have been very inconclusive, for the three dissenting justices are led by it to an exactly opposite opinion. They believe that "this obscure mechanic did do the thing, and that he is entitled to the merit of being the first inventor." With regard to anticipation by other inventors, there was no difference of opinion between the judges. They one and all declare that neither Reis nor Bourseul, nor any of the other early pioneers in telephony, can be considered to have really anticipated Bell. The judges considered that the question was not whether the apparatus devised by Reis can with our present knowledge be made to transmit speech, but whether Reis had in his time found out a way of using it successfully for that purpose, and they are of opinion that Bell's patent would be just as good if Bell had actually used the Reis apparatus in developing the process for which the patent was granted. The point of difference between the inventions of Reis and Bell is that the former aimed at using intermittent currents, whilst the latter used a current of an undulatory nature. Van der Weyde is said to have simply copied Reis, and not to have produced a speaking telephone until Bell had taught him how to do it; and as regards McDonough, the fact of the American Patent Office refusing him a patent proves that he was anticipated by Reis. Varley's patents referred to an electric telegraph, and are, therefore, not considered to be anticipations of Bell. In this way all the claimants for priority are dismissed, and the Bell patent holds the field.

THE BUDGET DEBATE.

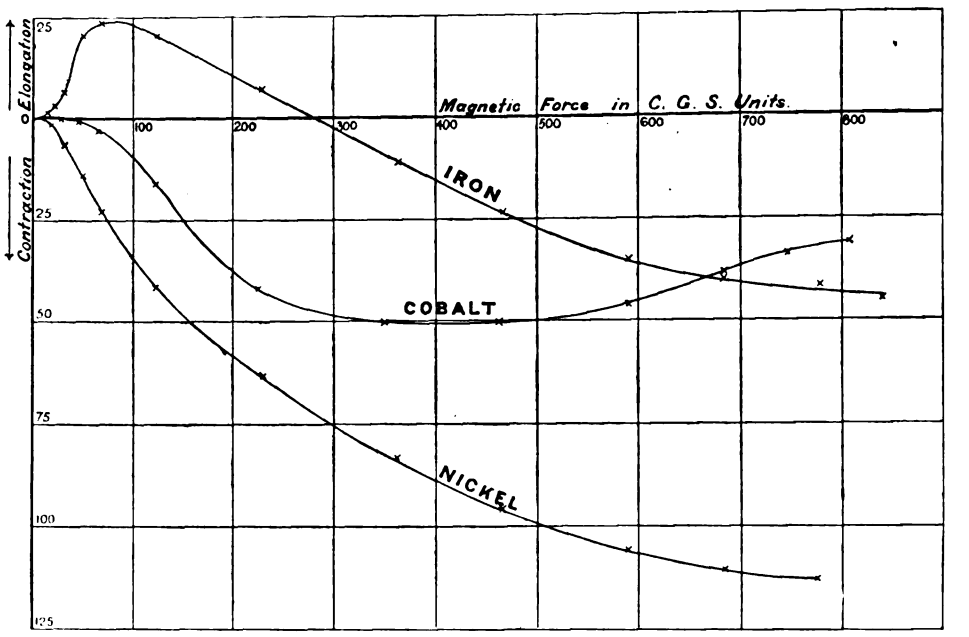
The Budget resolutions were passed on Monday evening "without amendment and without division." This was certainly due to the statement by the Chancellor of the Exchequer that the Government regarded their proposals as a whole, and would have all or none. The first Budget of Mr. Goschen exhibited several features questionable from the point of view of sound finance, and the second undoubtedly contains some provisions not quite consistent with sound principles of taxation. The relief of taxation by reducing the sum payable for the redemption of debt was the feature of the first, and the second might, perhaps, be characterised as a scheme for unloading the income tax and loading horses and carts. One of the cardinal principles of taxation is that "the tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible, over and above what it brings into the treasury." All experience goes to prove that the expense of collecting a number of small taxes is proportionally much greater than that of a single large tax. The cart tax will yield, according to Mr. Goschen's estimate, only £300,000, a sum which could have been raised by a fractional increase distributed over existing burdens without inventing a special tax to raise

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it. This proposal thus infringes the canon of taxation quoted. The cart tax, besides, clearly tends "to obstruct the industry of the people, and to discourage them from applying to certain branches of business." So far as Adam Smith's authority goes, therefore, he is distinctly against the tax. It is in effect a return on a paltry scale to the numerous and vexatious petty taxes that obstructed industry up till within the past half century, during which the tendency has been to consolidate taxation, and to strike off insignificant and expensive sources of revenue. The debate was largely deprived of interest, because it was felt that no criticism would have any effect upon the homogeneous proposals of Mr. Goschen. With his usual astuteness, he was doubtless aware of the weakness of his case if it were attacked in detail, and he realised that its strength lay in a policy of insisting upon the Budget and the whole Budget.

There was truth, though only partial truth, in the statement which several speakers made from the Opposition benches, that the landlords and the richer classes were unduly favoured in the Budget proposals. So far as the contribution to local rates is concerned, it is not quite correct to say that the landlords and the landlords alone will benefit. While it is hard to determine with precision the person upon whom any particular tax actually falls, it is fairly clear that the person who pays the bulk of local rates in rural districts is the tenant farmer, and not the landlord. On the average, the farms are let at a sum above strict economic rent, so that taxes are paid by the tenant not out of what would otherwise necessarily go to the landlord as rent, but what would otherwise, other things being equal, go to himself as profit. Individual cases may of course exist in which the conditions are different from those pre-supposed; but, speaking generally, the tax is paid now by the tenant, and a reduction would, for a time at any rate, benefit him. In urban districts, the conditions are practically the same—the saved rate will go, in the first instance, to the manufacturer, and not to the landlord. The smallness of a local rate may of course act as an advantage of situation, and thus enable a landlord to gain a part of the saving as rent; but this is a remote effect of which the Chancellor of the Exchequer is not bound to take cognisance, since reduction upon any tax might similarly be absorbed, and would thus be open to the same objection. One item in the Budget proposals received comparatively slight attention in the debate. This was the proposal to impose an *ad valorem* tax of £1 per £1,000 of nominal capital on the registration of limited liability companies. Mr. Goschen estimates from this source a revenue of £110,000, calculated upon an annual registration of companies having an aggregate of £110,000,000 of nominal capital. Such a tax has long been advocated by the authorities at Somerset House. It has been felt that limited liability companies receive from the Legislature a protection which the private trader does not receive. Limited companies are liable to their creditors in the last event only to a fixed amount, and not to the extent of the aggregate means of the partners, as in a private concern. For this privilege, it is felt, the limited companies ought to pay. The amount fixed by the Budget proposal is not an excessive one, and is calculable as a legitimate part of the establishment expenses of a limited concern. Mr. Goschen attacked share holding at another point, and on this head he met with some criticism in the course of the debate. His proposal involves the fixing of a stamp of the value of sixpence to each contract note above £100, and from this he estimates a return of £50,000. One of his critics suggested a stamp of one penny per £100 upon all transactions on the stock exchange. There is something to be said for this second proposal, since such a tax would be certain to hit speculators much more heavily than investors. As it is, the stamp duty of Mr. Goschen may not fall upon the client in many cases, but will fall upon the broker. In the case of small transactions, the broker may charge it; but in the case of large transactions, the broker will almost certainly pay it himself. Trifling as the amount is, it thus hits the wrong person; and since it does not apply to speculative transactions in minerals and produce, it does not hit quite fairly. Re-adjustment of the incidence of taxation is a supremely difficult task, partly because of the noise which each attacked interest makes, when it is strong enough to be heard, and mainly because of the impossibility under ordinary conditions of devising a system by which an equitable distribution of burdens may be made. Mr. Goschen's Budget, sound enough in parts, as, for example, in its insistence of payment for the service rendered to the limited liability companies by the State, is to a great extent retrogressive, since it multiplies taxes without correspondingly increasing the equitable distribution of the burden of taxation. The inroads made upon Mr. Goschen's original figures by the provisions of the Local Government Bill, and the handing over to the new County Councils of some taxes now carried to Imperial credit, were properly but slightly discussed in the debate. These belong rather to discussion of the Bill of which practically they form a part.

THE ELONGATION AND CONTRACTION OF METALS IN MAGNETIC FIELDS.



THE ELONGATION AND CONTRACTION OF METALS IN MAGNETIC FIELDS.

It has long been known that a bar of iron when magnetised by a surrounding solenoid alters its length, and with the weak magnetising forces which were originally employed in these experiments, the alteration was invariably an increase in length. One of the earliest experimenters, and probably the original discoverer of this behaviour of iron when magnetised, was Joule; but he invariably found that the length increases with the magnetising force. In his experiments, however, the magnetising force did not exceed 87 C.G.S. units, and an ingenious theory was propounded to show that elongation must take place when a bar of iron is magnetised. It was believed that the molecules as they rotate under the influence of the lines of force, and become more or less parallel, they naturally require more room in the direction of the length of the rod, and therefore cause the latter to extend with a corresponding decrease of diameter. This simple explanation was refuted by the experiments of Mr. Shelford Bidwell, which he made some years ago, and in a paper communicated by him to the Royal Society in 1885, he showed that the elongation does not remain unchanged at its maximum when the magnetising force exceeds that which is sufficient to produce so-called saturation; but, on the contrary, that with increasing magnetising forces beyond this limit the elongation becomes less until the rod, after returning to its original length, ultimately becomes actually shorter than it was in the unmagnetised condition. Mr. Shelford Bidwell has, however, recently contributed to the Royal Society, another paper on the same subject, and in this he points out that his original investigations might be open to the following objections: (1) The field due to the magnetising solenoid was not quite uniform; (2) the effect of the ends of the rods was uncertain, and might have played some material part in the production of the phenomena in question; (3) all the rods used in the experiments retained a certain amount of permanent magnetism. To meet these objections he has carried out a further series of experiments by using rings instead of rods of iron, and observing the changes of diameter. The rings were also demagnetised before every observation, and the battery employed was much stronger than that used in the first experiments, so as to produce very great magnetising forces. He found that in their general character the phenomena of elongation and contraction were the same with rings and with straight bars, thus proving that the effect of magnetisation was independent of the form of the iron, and as it was much easier to obtain intense fields with straight than with circular solenoids, the author made some further experiments with straight rods. These experiments embraced iron, cobalt, nickel, manganese steel, and bismuth, and the highest magnetising force reached was 840 C.G.S. units. We are able, by the courtesy of Mr. Shelford Bidwell, to publish herewith a diagram showing the behaviour of iron, cobalt, and nickel in magnetic fields of varying intensity. The strength of field is plotted on the horizontal, and the change of length in ten millionths of the original length of the rod is plotted on the vertical, the elongations being plotted above, and contractions below, the axis. The line of bismuth, which metal was tested in fields varying from 500 to 840 units, almost coincides with the axis, and manganese steel was also found to be almost unaffected, the elongation in a field of 850 units being only about one-fifty millionth of the length. That the change of length in the other metals which are sensibly affected by magnetisation cannot be due to the mechanical stress produced by magnetic attraction between the ends of the bar, is shown by the author in the case of iron where mechanical stress does not account for more than one-fifth part of the observed magnetic contraction. It should also be remembered that up to a magnetising force of 280 units, iron elongates, and, therefore, the mechanical stress in iron opposes magnetic extension.

THE LIABILITY OF MINE OWNERS.

In reviewing the incidence of mining legislation, we have, in previous issues, pointed out that some provisions for making employers pecuniarily liable for certain classes of accidents, is a necessary corollary of the working of the Mines Regulation Act, and the present system of inspection. The question of the extension of this liability is one of the most difficult problems of the day. On the one hand, there exists abundant proof that, through low prices, increased cost of production due to legislative enactments, and heavy railway and royalty charges, colliery proprietors already experience the greatest difficulty in obtaining any return for the enormous capital invested in mines; and, on the other hand, although it can be shown that the relative earning powers of labour are increasing, miners' delegates are demanding the amendment of the Act of 1880 in many important features. We think, however, that conclusive evidence of the want of change should be forthcoming before any further burden is imposed by the Legislature upon an industry, in the conduct of which the Mines' Regulation Bill, passed by Parliament last session, has been found in practice to increase the cost of getting minerals in many districts by as much as 5 per cent. Pending the production of such evidence, the Bill to amend the Employers' Liability Act, 1880, brought in by Messrs. Burt, Broadhurst, and other labour representatives, ought to be condemned. By its provisions the maximum compensation recoverable by a workman is raised to £500, the negligence of any person in the service of the employer is sufficient to establish a claim, and contracting out of the Act under any circumstances is practically declared illegal. With the more moderate Bill of Mr. Secretary Matthews before the House, it may be taken for granted that this somewhat drastic measure will not be sanctioned by Parliament. The Bill introduced by the Home Secretary is to stand as a complete measure on this subject, and provides for the repeal of the Act of 1880. As some fundamental alterations in the law appear to be required, this probably is the best course to pursue, as unnecessary complications in its application are thereby avoided. The main points of difference between the provisions of this Bill and the Act now in operation consist of an amplification of the grounds upon which, and a simplification of the conditions as to notice, &c., under which, a workman is entitled to recover compensation for accident; in affect-

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ing the usual common law form of defence, in defining more clearly the relative liability of employers and contractors or sub-contractors, and in legalising contraction out of the Act in accordance with the recommendation of the Select Committee of the House of Commons which sat in 1886—provided a benefit equivalent to the compensation recoverable under this Act is insured to the workmen out of a fund mutually subscribed to by employers and employed, but having regard to the "whole scope of the indemnity given and the proportion borne by the number of accidents in case of which the employer is liable to pay compensation under this Act, to the number of accidents which are the subject of insurance." The amount of compensation recoverable for an injury sustained by a workman shall not exceed the average earnings for the three previous years of a person in a similar grade of employment, or £150, as a maximum. The provisions of the measure are extended to injuries sustained by seamen in course of their employment on British ships. If passed into law the Act will come into operation on the 1st of January, 1889, and we recommend a more detailed consideration of its provisions to those particularly affected by the working of this measure, because, though conceived in a comparatively moderate spirit, it will certainly enhance the liability of employers, and make the not always desirable or beneficial machinery of litigation more accessible to workmen.

Letters to the Editor.

REGISTRATION OF ENGINEMEN.

To the Editor of "Industries."

Sir,—The official report No. 250, of which an abstract is given in your last week's issue, forms, I think, a good argument in support of Mr. Powis Bale's recent advocacy of the registration of enginemen. As the stupidity and ignorance of the engineman in question did not result in any serious accident, we can afford to smile over the report. It is obvious that a man who will adjust the load on the safety valve as he thinks fit, and test the saltness of the water by throwing a potato into it, is not a suitable person to be put in command of a boiler.

Yours, &c.,

Manchester, 9th April, 1888. Looker-on.

ON THE COST OF CENTRAL STATION LIGHTING.

To the Editor of "Industries."

Sir,—In a short letter, which you published on the 23rd March, I drew attention to some errors in the article by Mr. Crompton, which appeared in your issue of the 16th ult. The comparison drawn by him between the two rival systems, designated as the B.T. or battery transformer, and the A.T. or alternating transformer systems respectively, seems to show that of two installations, similar in regard to output and area supplied, based on the two methods of supply named, the prime cost is almost identically the same. If this were the case, and if the cost of maintenance of the two supply systems under consideration were also equal, I believe that the B.T. system might fairly claim to have a decided superiority over its rival, mainly from the fact that storage forms an important feature. That the first cost of the two systems is equal, and that the annual cost of maintenance is fairly comparable, I do not admit, and I will consequently endeavour to show what an ideal installation, such as taken by Mr. Crompton, would cost for construction and maintenance; leaving it to the advocates of the B.T. system to show that their method of supply is equally economical.

Before going into details it would, however, be well to make some further remarks regarding the feasibility and practical value of an undertaking carried out on the lines suggested by Mr. Crompton. No one will admit sooner than I, that a system in which storage is possible has an advantage over any other dependent entirely upon the producing machinery; but what I deny is that the problem of electric storage, suitable for the purposes of a general supply, and capable of being commercially maintained, has yet been solved, and that it is in a chemical contrivance that a solution of the difficulty is to be sought. Every system has its merits and advantages, and just as I would never contemplate employing transformers in a building where the lights are to be within a moderate distance of the producing plant, so would I consider inadvisable and out of place the use of storage batteries supplied direct from dynamos for electrical distribution on a large scale. Let me here enumerate my objections to the principle of the B.T. system for the purpose under consideration. (1) Secondary batteries have but a low efficiency, very low as compared with alternating transformers. (2) The cost of their maintenance is very great, quite out of comparison with that of transformers. (3) They require a great deal of attention; each cell has to be kept in order, and to be tested and examined, I may say daily, if it is to be kept in proper condition. (4) Every cell in a battery forms an important link in the series, and if anything goes wrong with one, it destroys the continuity of the whole series, and requires to be cut out and another put in its place. (5) The circuit of which the battery forms part is, after all, but a liquid circuit, possessing an infinity of joints all more or less imperfect, and liable to go wrong at any moment. (6) High insulation from earth on a circuit of which batteries form part is altogether out of the question, and leakage to earth on a line carrying a high potential is dangerous, and thus the limit of potential is soon reached at which it is practicable to work batteries. (7) In order to keep cells in working order, and each and every cell up to a proper standard condition, more charging must be given to some than to others, and this increases considerably the amount of attention required. (8) Cells designed for a given rate of discharge, if worked over this amount, are almost sure to be affected injuriously, and it is impossible to foretell exactly what the maximum discharge for a central supply station will be. The process of charging must of necessity be slow, as a large ampère current cannot be used if the source of supply be at a distance, and therefore the generating plant must be kept at work for a longer time than would be otherwise necessary. In fact, objections to the direct employment of batteries are numerous, and the difficulty lies in selecting those which are most forcible.

What now are the objections that may be fairly raised against the A.T. system? (1) The distribution of motive power is by this means not feasible at present; but that fault will, I believe, be remedied before long, as a means will be found for making an alternating current motor practicable and efficient. (2) The maximum output which may be required from the generating station at any moment must be provided for by the erection of the necessary producing plant in the first instance, and therefore the amount expended upon running machinery must be greater than would be the case in a storage system. (3) If an accident arises to the producing plant, as may easily happen whilst it is at work, part of the area supplied with electricity is left unprovided for and in darkness. (4) Arc lights worked by alternating currents are unsatisfactory. (5) Great difficulty exists in the maintenance of proper insulation when conductors carrying high potentials have to be placed underground. (6) Accidents may easily occur through the high potential of the primary breaking down the insulation in the transformers, finding its way to lamp circuit and to earth.

That other objections to the employment of the A.T. system exist in the minds of its opponents I have no doubt, but I believe the above list includes all which are important. Against these objections may be set advantages which will counterbalance, if not altogether do away with them. The second and third objections I have named are not so formidable as would appear at first sight, if the units of the producing plant at the supply works be kept small. In all undertakings of a similar nature in the United States it is the practice to employ a number of small dynamos and engines, each forming one integral unit of the supply works, and to throw them into circuit as and when the supply demands. I have before advocated that each unit dynamo forming part of the installation should not exceed 10 per cent. of the total station capacity, as by this means, should an accident happen to one of the units of supply, no serious inconvenience would be felt until another could be thrown into circuit to take its place; and further, no more units of supply plant would be at work at any moment than the output might demand; thus always working the machinery, both electrical and mechanical, at its greatest efficiency.

Although in a town lighting supply there is a portion of the twenty-four hours in which the demand is very considerably above the average, it must not be forgotten that, even with gas works and all their storage plant, during such periods of great demand the supply is *not* up to the requirements, and that the pressure in the mains falls in consequence. This is perceptible in the jets, and may be easily noticed. I remember that Mr. Edison, when advocating the three-wire system, called attention to the habit of the average householder, who instinctively turns his gas taps either more or less on if he finds the pressure in the pipes too great or too little, and trusted to this same habit to compensate for excess of load on either circuit in the three-wire system by making the householder unconsciously regulate the supply when he began to "meddle" with the switches. It is quite possible to imagine a similar scheme of compensation when distributing by alternating currents and transformers; and after all, if the demand is greater than the output, the worst that can happen is that the lights are dimmer than they should be, and such an excessive demand is only for a very limited time.

In estimating for the ideal installation taken by Mr. Crompton, I will assume the conditions laid down by him in his estimates, and will treat only of the A.T. system, taking it for granted that the cost of a similar undertaking carried out by the B.T. method is accurately arrived at by him. For the sake of clearness, I will state the conditions upon which my estimate and the proposed undertaking is based.

1. The central station is to be 1760 yards from the exterior of the district to be lighted.
2. Within this district there will be fixed 15,000 lamps.
3. Of these 15,000 lamps the maximum number that will be in use at any given moment is 10,000.
4. Each glow lamp requires 100 volts and ·6 ampère or 60 watts delivered to its terminals.
5. The length of the distributing main will be such as to comprise 9000 yards of house frontage and 3000 yards of street crossings.
6. Both supply and distributing mains are to be laid underground.
7. The transformer stations may be placed in any convenient positions within the area of supply, and consequently the supply mains may be laid together with those for distributing the current within the area in the same conduit.

I estimate that a building to hold the necessary plant, consisting of boilers, engines, dynamos, &c., if erected at a cost of say sixpence per cubic foot, would, together with smoke stack, engine foundations, boiler settings, and all such items, cost about £6,500. In order to get 600 kilo.-watts delivered in the lamps, about 1200 brake horse power would be required, to which may be added 25 per cent. for loss in engines and transmission, &c.; this would give 1500 i.h.p., and to this amount I will add the same reserve power of 20 per cent., or a total effective power erected of 1800 i.h.p. This is a larger amount than either of the two former writers have allowed in their estimates; but I have based my estimate on the assumption derived from practice, that 500 watts can be delivered to the lamps for each brake horse power of the engines, and I would not be inclined to estimate for a lower amount. I fail to see how Mr. Crompton could have estimated that the buildings for the B.T. and A.T. systems would cost £8,000 and £11,000 respectively. He has perhaps allowed for the purchase of land, but I do not think that in an ideal estimate of this nature the question of the cost of the site should be included; but if included, it would be greatly infavour of the A.T. system. I also do not admit that a building to hold the A.T. plant would cost three-eighths more than a similar building for the B.T. machinery; if anything, the latter should cost more, as space would have to be acquired for the batteries within the area lighted, and certainly a very much larger room would be necessary to contain the cells than would be requisite for a transformer of equal power. This is evident. The generating plant I would propose to erect would consist of twelve engines and twelve dynamos, each indicating 150 h.p., also four exciters, two of which would be ample to serve the ten engines and dynamos required to produce the 600 kilo.-watts. Each alternating dynamo would have its own engine, and be driven by a strap, or coupled direct to the engine, but no counter shafting could be allowed. The dynamos would all be connected to a main switch board, so that each or all the machines, if necessary, can be thrown in parallel into the supply mains as the outside demand requires. No more dynamos would be at work at any moment than the supply necessitated, so that each *unit* of the plant would work at its greatest efficiency.

The supply mains would be laid underground from the engine house to the area of supply, and I have considered that they would also have to be laid for half the length of what Mr. Crompton calls "useful frontage" within the area, say 600 yards. This would give a total distance of say 2400 yards, or, there and back, 4800 yards. The cost of such a cable to carry 300 ampères at 2000 volts I estimate at about £4,300. I have only allowed for 600 yards inside the area, because, although the supply mains would be laid almost throughout the district to be lighted, the size within the area will necessarily become less and less as the current required to supply each transformer is taken off, so that the furthest transformer will be fed by a current of perhaps less than one-thirtieth part of that amount required to be conveyed by the supply mains up to the area of supply. The amount I have therefore allowed, of *half* the length of mains at *full* size, is ample. As regards transformers and distributing mains within the 1200 yards of useful frontage, I would propose to fit one hundred transformers, of an average output of 6 kilo.-watts each. These would then be placed at about 12 yards apart, and consequently the current they would each have to give out in the secondaries would only be 60 ampères. Two thousand four hundred yards of distributing mains to carry this current to 12 yards on either side of a transformer would only cost say £250, as the potential being not more than 100 volts, a lower class of insulation could be allowed. One hundred transformers of about 9 h.p. each would certainly not cost more than £2,700, and if we allow £2 per h.p. for fixing, switches, &c., a further £1,800 must be added.

For the necessary laying of the conductors, opening up streets, providing conduits, &c., I allow 10s. per yard, or say £1,500 for the 2960 yards of roadway opened; 1760 yards without, and 1200 yards within the area of supply. This is as far as we have to go, for service mains, house connections, and wiring do not form part of our estimate, which may therefore be summarised as follows:—

Buildings, foundations, &c.	£6,500
Boilers, fourteen to indicate 120 h.p. each	5,320
Engines, twelve to indicate 150 h.p. each	7,200
Dynamos and exciters	7,000
Supply mains, 4800 yards	4,300
Distributing mains, 2400 yards	250
Laying mains in conduit	1,500
Transformers, 900 e.h.p.	2,700
Fixing ditto	1,800
Station fittings, &c.	500
	£37,070

Say £37,000, or £3. 14s. per lamp.

Mr. Crompton allows nothing, I observe, for contingencies, and generally in an estimate 10 per cent. ought to be allowed on this account; but I have not done so, in order to make the comparison fair. This, then, may be taken as the probable cost of an undertaking based on alternating currents and transformers; and if such a work were to be carried out, we should have a plant capable of easily running the lights required, with 20 per cent. reserve power, always worked at the greatest efficiency; entailing no large loss from depreciation and wear and tear, with perfect control over the supply, as well as simplicity and economy combined. Can Mr. Crompton allege the same for wasteful batteries, always requiring attention and repairs; for sparking dynamos, expensive regulating gear, heavy mains entailing general and continual anxiety?

As regards annual cost of maintenance and working expenses, I do not believe the two will bear comparison, and I should be glad to compare notes with Mr. Crompton in this respect, if he would calculate the probable yearly expenditure upon a similar installation on the B.T. system.

Yours, &c.,

J. Kenneth D. Mackenzie.

Westminster, 9th April, 1888.

FORCED DRAUGHT.

To the Editor of "Industries."

Sir,—Referring to the article on this subject in your last week's issue, I was somewhat astonished to find that the question of forced draught for boiler furnaces has not been much further developed. Some years ago—I think more than twenty—Dr. Percy, in a lecture given before the Society of Arts, showed that, at a pressure above that of the atmosphere, the contact of the atoms of oxygen in the atmosphere with those of the carbon and hydrogen was so much closer than under a minus pressure caused by heated air ascending in a chimney, and that more of the oxygen became effective and less passed up the chimney in a free state. Not only that, but more of the carbon was completely burnt, forming CO^2, instead of simply CO. That being the case, less atmospheric air is required for the complete combustion of the coal; and, therefore, less useless nitrogen passes through the fire to become heated, and in that way carrying a large portion of the total heat away into the atmosphere. So much for the economy of the thing. The practice has been carried out for a number of years by Sir Henry Edwards at his mills at Sowerby Bridge, and I never

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heard of any had effects produced upon the plates in the fire boxes of the boilers. Certainly, your last week's issue, or at least the portion of it referring to this matter, looks to me like some old periodical of twenty years ago.

Yours, &c.,

Bolton, 7th April, 1888. ALPHA.

AMENDMENT OF THE PATENT LAW.

To the Editor of "Industries."

SIR,—I have read with much interest your notice of the amendments in the patent law which the Institute of Patent Agents seek to promote. There are so many erroneous ideas afloat as to the nature of a patent agent's business and of his duties, that I beg leave to say a few words about the necessity for limiting practice in this profession to those who are able to show that they are qualified for it. At the present time any person may act as a patent agent, take fees, and profess to give that assistance which the inventor seeks. That is to say, anyone, however incompetent and however ignorant, may pretend that he can and will draw up a specification which will "hold water" in the Courts.

I know that a good many well intentioned people imagine that the inventor himself should be best qualified to do this. It is, however, undeniable that, to make a clear, comprehensive description of anything requires a talent which is quite beyond the gifts of many an ingenious constructor. To grasp, and in a few crisp words to set down what is the precise point of novelty in an invention, requires a highly trained analytical capacity, which also is rare amongst inventors, who are too prone to mistake the advantages presented by their improvements for the means by which they are obtained, the latter being capable of protection, whereas the former are not, when considered independently of the means. Add to this that, in order to make a satisfactory specification, precedents as established by the Courts should be kept in view, and it will be obvious that a patent agent who is to be a real help to his client must be as highly trained in his profession as lawyers, physicians, and others are in theirs. This is all the more necessary as the inventor wants help, not only in obtaining a patent in England, but in other countries also, and each country has laws of its own which have to be studied. That many who now practice are in every way unsuited for the work they undertake none know better than the qualified patent agents who are brought into contact with the work of the "black sheep" when, as a rule, the mischief is beyond repair.

Lest some of your readers imagine that the possibility of amendment granted by the Patent Acts is sufficient to save the inventor from harm, I may point out that an amendment may not enlarge a scanty claim, but only reduce an excessive one, and that, if the invention prove valuable and successful, the amendment is opposed almost as a matter of course by some one who is interested in the matter, and who generally is allowed to go scot-free for past infringements. Briefly, if a specification is badly drawn, an injury which is beyond repair is inflicted upon the patentee, and therefore means are required to prevent such damage being worked by unqualified men. The authorisation to practise should, I think, come from the Patent Office as represented by the Comptroller, and in case of refusal an appeal should be allowed to the law officers. I mention an appeal not because I have any fear that the Comptroller would intentionally withhold his certificate from anyone who has a fair claim to it, but because I think that those to whom he would most properly refuse it should not have even the semblance of just complaint left to them. It is but natural that the license should be revocable for misconduct, for incompetency, and for breach of trust. I do not think that a single patent agent of any standing would feel aggrieved by such a system, and I am sure that inventors would benefit considerably if a roll were established. It might be well to have a small annual fee for the license, but this should not be so heavy as to deter poor men from practice.

Yours, &c.,

London, 4th April, 1888. BERNARD DUKES.

THE DEFENCE OF OUR MERCANTILE PORTS.

To the Editor of "Industries."

SIR,—I think your article of the 30th ult. is a useful one as tending to direct the mind of the public in the right direction. I believe that in the report of Mr. Stanhope's Committee, a clerical error has perpetuated a grave mistake. It is said there, that the attack to be expected on our mercantile ports will be made by "armoured" cruisers; I understand that the term should be "armed," not "armoured," cruisers. Naval experts would not have been likely to use the other term, and I believe the guns it is intended to mount for the defence of the ports will not, as a rule, be armour piercing. It is not easy for a naval man conversant with the facts of naval history, remote and proximate, to share in the great alarms now in circulation with reference to the safety of the commercial ports, if reasonable steps are taken in the direction you mention towards keeping the navy paramount. If, after the navy is certainly made paramount at sea, our citizens feel alarm for particular parts of our coast and can spare the money, there is no reason why they should not make assurance doubly sure. But the danger we are in at present arises from our growing conception that fortresses and submarine mines are a substitute for the command of the sea, and for naval defence. There is no ground for such a belief, either in history or in reason. We must never forget that in any serious naval war our naval operations will be hampered with the weight of our commerce, whereas the first thing any possible opponent we could have would do, would be to lighten himself by getting rid of the whole of his sea-borne commerce. In our first war with Holland, the Dutch tried to carry on the war and their commerce together. In the second and third they began by forbidding their merchant ships to leave their harbours. Germany, in our own time, did the same thing in her war with France. She closed the whole of her ports, and telegraphed all over the world for her merchant ships to remain in their neutral harbours till the war was over. France, on the other hand, was able to assert her command of the sea, which was very nearly a complete protection to her commerce everywhere, and by consequence an absolute protection to her coasts and ports. But France, though in this absolute state of power at sea, with an ironclad squadron off the German ports in the North Sea, and another off the German ports in the Baltic, deliberately considered, and deliberately rejected, all proposals for sudden extemporised attacks on German ports which were at all thrust inland. A decision was come to to bombard a small coast town—Colberg—which could as easily be got at from the sea as Sunderland or Hartlepool; but this, owing to circumstances, did not come off, though it was the sole attack considered feasible. At the same time it was clearly decided that Kiel, Hamburg, or any port could, and would, were the war prolonged, be made the object of deliberate organised attack with proper appliances and plenty of time. These decisions were in accordance with the whole course of naval history. Mere sudden passing attacks—*coups de main*—were never uncommon, but were confined to places exposed to the open sea—those most easily got at. Serious conquering attacks, from the time of the Dutch raids up the Medway and the Thames, to Farragut's wonderful capture of Mobile, were directed up inlets and estuaries, but only when the command of the sea was complete behind the attacking force. I do not know that any of those who believe in the danger to the commercial ports, which we are now spending heavily to repel, are thinking of the conditions under which Farragut attacked Mobile, or Bouet-Willaumez declined to attack Kiel. They do not postulate the loss of the command of the sea by England, they only postulate an attack hasty in conception, carried out in a hurry, and more or less in fear of the arrival of an equal or superior English naval force before the work is done. But I think their hypothesis must throw over every lesson of history, experience, or reasonable probability. I know of no train of reasoning, no array of facts, or of reasonable suppositions, which will permit me to agree with them. But, on the other hand, if they postulate the loss of the command of the sea to England, navally armed as she is at present or is likely to be for some time—unless she wakes up—then, though I am neither alarmist nor pessimist, I cannot say they are unreasonable. The first steps in asserting the command of the sea—whenever we have had it—has always been to mask our enemy's main fleets in their own ports, and either to prevent them coming out, or to fight them and render them too far neutral should they come out. This can only be done by placing at least an equal force to what they have inside of armour clads in the immediate vicinity of each of the enemy's ports. Taking France, there is a reasonable belief that she would now muster fifteen ironclads at Toulon, five at Brest, and nine at Cherbourg. It is not usual to say this, because two of the ships at Brest and four of the ships at Cherbourg are coast defence vessels. But they are all powerful armour clads, quite competent to fight an armour clad in their own waters, though not prepared to go far to sea. If we sent three armour clads off Brest, it would be unreasonable to suppose that they would not be beaten by the three armour clads and the two coast defence armour clads there, which could come out and fight them. If we sent only five armour clads off Cherbourg, we could hardly hope that they would not be forced to retire before the five and the four which would there come out to fight them. No one has ventured to credit us with more than thirty ironclads, and it is evident that under such conditions we should be at the bare end of our armour clad resources. But it is worse than that, for the French forces inside the harbours would remain intact and ready—for months if necessary. It would be impossible with only nine armour clads to keep nine armour clads at sea off Cherbourg, or with five to keep five at sea off Brest. Coal and foul bottoms—the latter as great a trouble as it was two hundred years ago—would necessitate constant relays, and we have them not. I suppose that to keep five ships off Brest, the very least reserve necessary would be two, and to keep nine ships of Cherbourg, a reserve of three would be necessary. There are no such reserves.

I saw it stated in an influential paper the other day that it did not matter about armour clads as long as we could protect our commerce. A curious error to fall into if one imagines how commerce is to be protected when nine enemy's armour clads are placed between the Isle of Wight and Cape La Hague. In these waters there is a British ship wanting to come either way every ten minutes or so, and one does not quite see how they are to gratify their desires under the circumstances. It is about two hundred years since an enemy's fleet has occupied that advantageous position; but when it did, it took excellent care of our commerce according to its lights. This is one side of the picture, the other is this: that this same superior squadron, in the Channel now, must confine itself to the commercial business because of that squadron of ours which has retired before it. It was precisely the case of the great French fleet two hundred years ago, and it would be so now. It would be a superior fleet only while it held a superior position in the vicinity of Cherbourg. If it went away after a commercial port—even if it took the whole of the ships, which it could not, as four of them could not quit their base—yet could they not dare to set about an attack on a commercial port for fear of the inferior squadron catching them at a disadvantage in the middle of the business.

We are always told now, in preparing to spend a million or two on some kind of defence which is not naval, that we are to begin by assuming that we have no Channel Fleet. Though it is, or ought to be, rather a startling assumption, our forefathers at the beginning of this century, when war had taught them the lessons we are so complacently forgetting, would have but said: "What then? There is our reserve in the Downs," and they would and did decline to spend money in the face of that fact. So now with us, we cannot, perhaps, have a reserve fleet after we have masked the French in Toulon, Brest, and Cherbourg, if we spend the money which would have gone on that reserved fleet in forms of defence which are not naval. But it seems impossible to doubt, if we add up all the millions that have gone, that are going, and that are to go, in defending each port in England separately, that for a great deal less money we could have our old reserve fleet in the Downs, in war, connected with every port by electric telegraph and—merely by its attitude—preventing hostile squadrons, which could only get to sea by the failure of our masking squadrons, even dreaming of such a thing as an attack upon them. So, if I am asked to consider the mysterious disappearance of what people, not understanding fully, are pleased to call the Channel Squadron, I answer at once, give me my Downs Reserve, and I should decline to answer any more questions till I had got it. For it is plain to be seen that this Downs Reserve would not only protect the commercial ports, but would keep the command of the sea, and make the first step towards commerce protection, which no fixed defences can make.

Yours, &c.,

London, 7th April, 1888. P. H. COLOMB.

REPORT ON THE "GRIFFIN" PATENT GAS ENGINE.

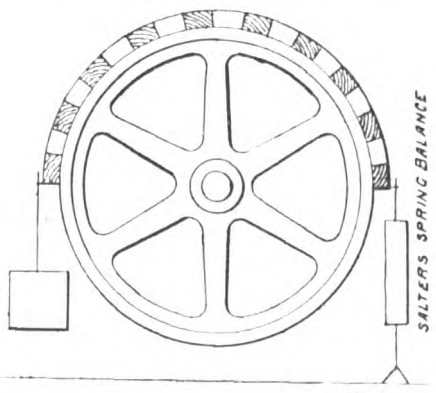
THE following report on the "Griffin" patent double acting horizontal gas engine, by Professor Jamieson, professor of engineering at the Glasgow and West of Scotland Technical College, will no doubt be read with interest. An illustration of this engine is given on page 374.

[COPY OF REPORT.]

To Messrs. DICK, KERR, & Co.,
101, LEADENHALL STREET, LONDON, E.C.

GENTLEMEN,—I have now the pleasure of reporting to you on the results of my examination and tests of your 8 h.p. nominal "Griffin" patent gas engine, as made at your Britannia Engineering Works, Kilmarnock. My tests extended over four hours on November 25th, four hours on November 26th, 1887, and over one hour on January 27th, 1888.

The engine, in its general style and behaviour, more closely resembles that of an ordinary double acting steam engine than any other gas engine with which I am acquainted, for both ends of the cylinder are closed in, and an impulse is given to the piston every one and a half revolutions, *i.e.*, combustion takes place at each end of the cylinder alternately every three revolutions of the crank shaft, when the engine is working under normal conditions. This feature naturally causes the *speed of the gas engine to be more constant than single acting gas engines, and therefore better adapted for driving dynamos* or other machinery where constant speed is required. The governing and ignition of the combustible mixture (gas and air) are effected in a manner similar to most gas engines—the former by entirely cutting off the gas supply, and the latter by plain slides. The charging and exhaust valves are of the lifting type. They are actuated by a simple and neat arrangement of cams on a side shaft, which is driven by worm gear from the crank shaft. The engine has been specially well designed with the view of transmitting the working stresses to the foundation, and thus avoiding as far as possible any annoyance from vibrations and racking. Great care has been taken to make all the working parts strong and simple, while the workmanship and finish throughout seem to me all that could be desired. Throughout the whole of my electrical test the *engine* WORKED VERY STEADILY; *in fact I have never before tested a gas engine which maintained such uniformity of speed* at full power, *no pulsation or blinking being observable in the incandescent lamps.* The mechanical efficiency or ratio of brake horse power to indicated horse power, as shown by the following results, is equal to 78·7 per cent., thus proving that but a comparatively small proportion of the whole power developed is absorbed in working the engine itself. The engine is very powerful for the so-called "nominal" horse power (a term still common among gas engine makers); in fact, it develops very nearly double the nominal horse power on the "brake." The absolute and the practical efficiencies or ratios of indicated horse power and of brake horse power to gas consumption in terms of heat units (as demonstrated in the appendix), are respectively equal to 19·2 per cent. and 15·1 per cent.; *which results are better than I have obtained from any other gas engine.*



Industries.

The following tests were mainly directed to two objects, viz.: (1) To obtain simultaneously the indicated and the brake horse power; (2) to obtain simultaneously the indicated and the electrical horse power. The following instruments were used by me in obtaining data for my results, viz.; (1) A Richards' indicator of Elliot Brothers' make, with spring yielding $\frac{1}{64}$in. per lb. of pressure per square inch, was used for taking the pressure diagrams from each end of cylinder at intervals of about five minutes during the various tests for the indicated horse power. (2) A revolution counter of Schaffer & Budenberg's make was fixed direct to the slide valve shaft, whereby the exact number of revolutions were obtained. (3) A Young's tachometer of Elliot Brothers' make was connected to the crank shaft, and another to the dynamo spindle, as a check on the mean revolutions per minute, and to indicate variations of speed. (4) A gas meter (Alder & Mackay's), 80-light, sealed and certified correct by an Edinburgh gas company's official, was used to measure the gas supply for developing the power. A separate small meter was used for the pilot and ignition lights. (5) Two thermometers (Fah. scale) were employed to indicate the rise in temperature of water passed through the cylinder jacket, one being placed on the supply tank, and the other where the water left the cylinder jacket. (6) A water supply tank,

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REPORT ON THE "GRIFFIN" PATENT GAS ENGINE.

TABLE I.

Volume of gas.	Hydrogen, H	Carbonic oxide, CO	Marsh gas, CH_4	Ethylene, C_2H_4	Tetrylene, C_4H_8	Carbonic acid and oxygen.	Nitrogen.	Total. cub. ft.
Cubic feet in one cubic foot of gas.....	·441 ...	·041 ...	·434 ...	·037 ...	·018 ...	·005 ...	·024 ...	1·0
Heat evolved per cubic foot in B.T.U.....	343·82 ...	342·03 ...	1066·7 ...	1677·6 ...	3063·6 ...	0 ...	0 ...	B.T.U.
Heat evolved by given amount of each...	151·6 ...	14·02 ...	462·9 ...	62·07 ...	55·14 ...	0 ...	0 ...	745·73

TABLE II.

MOVEMENT OF PISTON IN PERCENTAGE OF STROKE.

	0	5	15	25	35	45	55	65	75	85
v	0	44·5	133·5	222·6	311·5	400·6	489·5	578·5	667·5	756·5
V	404·0	448·5	537·5	626·5	715·5	804·5	893·5	982·5	1071·5	1160·2
Log V	2·606	—	2·73	2·8	2·855	2·906	2·95	2·99	3·03	3·06
P	—	—	159·7	124·7	107·7	87·7	77·7	68·5	60·7	53·7
Log P	—	—	2·203	2·1	2·03	1·94	1·89	1·84	1·78	1·73
p	57·7	—	39·7	31·7	25·7	22·7	19·7	18·5	16·7	—
Log p	1·76	—	1·60	1·50	1·41	1·36	1·29	1·27	1·22	—

fixed a short distance from and a few feet above the cylinder of the engine, with a regulating cock close to the same, was used to give any desired flow of water through the cylinder jacket. The quantity of water passed through the cylinder jacket was reckoned by careful measurements of the fall of water in the tank every five minutes. (7) The brake used was of the form shown on the preceding page, and one was placed on each fly wheel. It consists merely of a strap and blocks, with the dead weight on the one side, and a spring balance attached to the floor on the other. The load on each wheel, as well as the several dimentions, were as nearly as possible the same. The mean reading of the spring balance, plus part of the weight of the spring balance, was deducted from the dead weight, to arrive at the *net brake load* on each wheel.

Brake Tests.

Duration of test in minutes	60
Total revolutions in sixty minutes	11,016
Mean revolutions per minute (n)	183·6
Mean effective radius of brake load, in feet (r)	2·78
Mean net load or brake, in lbs. (p)	140
Brake horse power from above $\left(\frac{2\pi r n p}{33{,}000}\right)$	13·6
Number of indicator cards taken	12
Mean effective pressure from twelve cards, in lbs.	64
Indicated horse power from above	17·28
Gas used by engine in sixty minutes, in cubic feet.	333
Gas consumption per brake horse power	24·48
" " *indicated horse power*	19·27
Percentage efficiency of engine $\frac{\text{brake h.p.}}{\text{indicated h.p.}} \times 100$	78·7

The following instruments and appliances, in addition to those previously mentioned, were used, viz.:—(1) Dynamo: One of the fly wheels was connected direct by belt to a Rankin-Kennedy single magnet horseshoe compound wound dynamo of about 8000 watt power, which was kept running steadily at about eight hundred revolutions per minute. (2) Lamps: In parallel circuit with the dynamo were placed eight large incandescent lamps, capable of giving five hundred candles each, with twelve ampères at 80 volts, and one sixteen candle lamp. (3) Voltmeter: The difference of potential between the terminals was measured by a Cardew voltmeter. (4) Current Meter: The total current passing through all the lamps was measured by a Siemens electro-dynamometer. The voltmeter and ampère meter had been tested before leaving the Woodside Electric Works, and simultaneous readings were taken on each every five minutes.

Tests when Driving Dynamo.

Duration of two tests combined, in minutes...	45
Revolutions of engine fly wheel, per minute...	187·7
Mean pressure in cylinder, in lbs. per sq. inch.	63·2
Indicated horse power (from above data)	17·4
E.M.F. at lamp terminals, in volts	79
Current through all the lamps, in ampères ...	92
Electrical horse power spent on all the lamps.	9·74
Ratio of electrical to i.h.p., per cent.	55·8
" " brake h.p., per cent.	71
Gas used in cubic feet, per hour (without including pilots)	333
Gas used in cubic feet, per minute $\left(\frac{333}{60}\right)$	5·55
Heat equivalent of the 5·55 cub. ft. of gas used per minute in foot-pounds ($5{\cdot}55\times691\times773$) =	2,964,500
Water passed through cylinder jacket, in lbs. per hour	1,272·4
Mean rise in temperature of the above water in degrees Fah.	55°
Heat carried away by water per minute in B.T.U. $\left(\frac{1272\times55}{60}\right)$ =	1,166
Heat equivalent in foot-pounds ($1166{\cdot}4\times773$) =	901,600
Percentage of total heat carried away by jacket water $\left(\frac{901{,}600}{2{,}964{,}500}\right)\times100$ =	30·4

It remains, therefore, only to estimate the heat passing away in the exhaust and scavenger strokes and by radiation, which is done here "by difference," so that we have of the total heat due to the combustion of the gas:—

	Per cent.
I. *Converted into indicated horse power*	19·2
II. *Carried away by the cooling water*	30·4
III. *Discharged in exhaust and scavenger strokes, and by radiation, &c.*	50·4
	100·0

APPENDIX I.

Determination of the heat evolved per cubic foot of gas used during the tests.

A sample of the gas was analysed by Mr. C. J. Wilson, F.I.C., F.C.S., and gave the following results:—

Carbonic acid and oxygen gas	·5
Carbonic oxide, CO	4·1
Olefines, C_2H_4 and C_4H_8	5·5
Marsh gas, CH_4	43·4
Hydrogen, H	44·1
Nitrogen (by difference)	2·4
	100·0

The percentage of C_2H_4 and C_4H_8 should have been given separately, because the heat value of C_2H_4 is only about half that of C_4H_8 for a given volume. Assuming, however, that two-thirds of the olefines is C_2H_4, and one-third is C_4H_8 (which is probably not far from correct), we get the results shown in Table I.

Table I. shows the amount of heat evolved by the complete combustion of 1 cub. ft. of the gas measured at 14·7lb. pressure, and 32°F., but the pressure was 14·8lb. per square inch, and the temperature 67°F., hence the heat evolved per cubic foot of the gas used will be

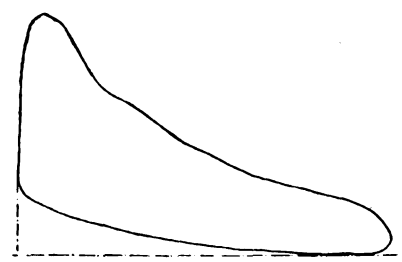
$$= 745{\cdot}7 \times \frac{14{\cdot}7}{14{\cdot}8}\left(\frac{460+32}{460+67}\right) = 691 \text{ B.T.U.}$$

Taking one B.T.U. as equivalent to 773 foot-pounds, the heat evolved by the complete combustion of 1 cub. ft. of the gas is equivalent to 691 B.T.U. × 773 = 534,500 foot-pounds.

Heat evolved by complete combustion of 1 cub. ft. gas		534,500
Gas used in cubic feet per brake horse power per hour	=	24·48
Do. equivalent in foot-pounds ($534{,}500\times24{\cdot}48$)	=	13,085,000
1 h.p. in foot-pounds per hour ($33{,}000\times60$)	=	1,980,000
Practical efficiency of engine $\left(\frac{1{,}980{,}000}{13{,}085{,}000}\right)\times100$	=	15·1 per cent.
Gas used in cubic feet per indicated horse power per hour	=	19·27
Do. equivalent in foot-pounds ($534{,}500\times19{\cdot}27$)	=	10,300,000
Absolute efficiency of engine $\left(\frac{1{,}980{,}000}{11{,}108{,}172}\right)\times100$ =		19·21

APPENDIX II.

Determination of equations for compression and expansion curves from the indicator diagram attached (which is a sample of a large number taken from both ends of the cylinder).



Let V=volume in cubic inches occupied by the gas at any part of stroke.

Let v=volume in cubic inches through which piston has swept from end of stroke.

$\therefore$ V=v+404 (where 404 cub. in. is the volume of clearance space at back end of cylinder).

Total volume swept by piston=890 cub. in.

P=absolute pressure on expansion curve.

p=absolute pressure on compression curve.

[See Table II.]

The equation to the curves will be $PV^m=k$ (a constant), and $pV^n=k^1$ (another constant).

Hence we have log P+m log V=log k; and log p+n log V=log k^1.

$\therefore$ If log P and log V are taken as co-ordinates of points and plotted on squared paper, these points ought to lie in a straight line. From a square paper diagram it is evident they lie very nearly in a straight line. Taking the straight line which lies most evenly among them we have:—

Log V=3·07 where log P=1·73
and log V=2·73 where log P=2·2

$\therefore$ $1{\cdot}73+3{\cdot}07m=\log k$
$2{\cdot}2+2{\cdot}73m=\log k$
$\therefore$ $m=1{\cdot}382$, and $k=926{,}000$

Hence the equation of expansion becomes $PV^{1\cdot382}=926{,}000$.

In the same way the equation for the compression curve is found to be $pV^{1\cdot4}=263{,}000$.

For an isothermal curve the formula is PV=k, and for an adiabatic curve the formula is $PV^{1\cdot375}=k$.

From the above, the expansion curve is evidently but very slightly steeper than an adiabatic curve, thus observing that the rate at which heat is generated during expansion, is nearly the same as the rate at which it is carried away by the water in the jacket.

The compression curve is also seen to be rather steeper than an adiabatic curve, thus showing that the mixture gains heat from the piston and the end of the cylinder, which more than compensates for the loss to the water jacket during compression

(Signed) ANDREW JAMIESON,
Prof. of Engineering.

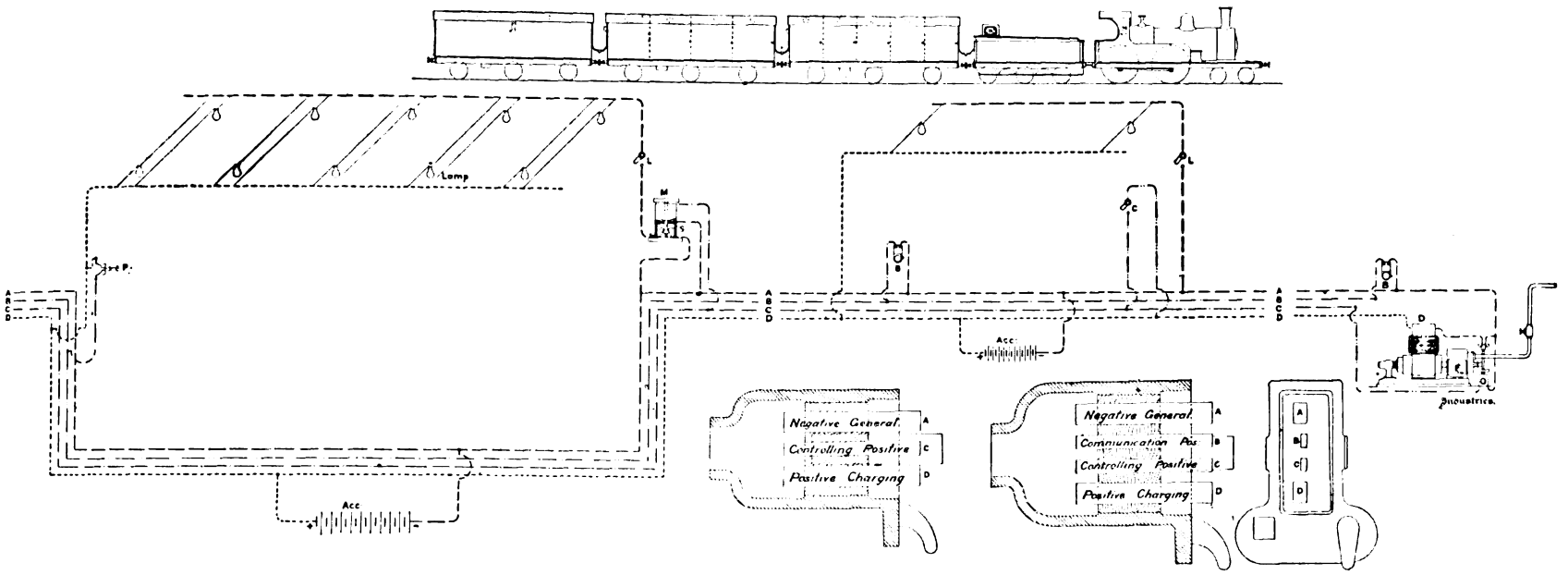
Glasgow and West of Scotland
Technical College,
Glasgow, 16th February, 1888.

THE TIMMIS SYSTEM OF TRAIN LIGHTING BY ELECTRICITY.

ALTHOUGH on the first glance the problem of lighting railway carriages by incandescent lamps seems a simple one, careful consideration shows that it is coupled with many difficulties, which arise chiefly from the necessity of so arranging the lights that they should be independent of each other, no matter how the train is made up. Various methods have from time to time been brought forward, and among those which were most successful, or, to speak more correctly, the failure of which was the least conspicuous, we may mention the following: (1) The direct system of lighting by means of a dynamo driven by a separate engine, and supplying current to mains which run the whole length of the train, and to which the lamps are connected. A very early example of this system, and perhaps the first example in England, was the installation tried by Mr. Massey several years ago on a London suburban train. In this case the dynamo and engine were placed in the front guard's van, and the lighting was under the control of the guard. Another example is the experiment made by the Great Eastern Railway, some four years ago, when several locomotives were fitted with steam dynamos (Crompton machines and Tower engines), and a cable, with special couplings, was laid throughout the train, from the locomotive to the last carriage, branches being taken off to the glow lamps, which were all coupled in parallel. The great objection to either system is that all the carriages in the train must be provided with electric fittings, for if a carriage not so fitted be inserted, all the carriages behind it would be cut off from the supply of current. Another objection is, that if the train has to be split up at a junction, and one portion be coupled to a train not provided with the same electric light apparatus, this portion will not be lighted at all, since the usual oil lamps have been replaced by incandescent lamps. The system appears therefore only applicable to short suburban trains, the make-up of which is never altered. The system is also objectionable because of imposing upon the engine driver or guard the additional duty of attending to the steam dynamo. This duty becomes particularly irksome on lines containing many tunnels, because, in the daytime, the dynamo must be started and stopped each time the train passes a tunnel. (2) The combined dynamo and battery system of electric train lighting, which is in use on a number of trains of the Brighton Company, and which has also found considerable favour on the Continent. The arrangements vary according to local circumstances; but the essential features are a dynamo and a set of accumulators, the dynamo being placed in the guard's van, and driven by belt gear from one of the axles. Automatic appliances are necessary to keep the electromotive force of the dynamo within such limits as will insure the batteries not being damaged by an excessive charging current on the one hand, and will, on the other hand, prevent a back discharge from the battery through the dynamo. For the latter purpose an arrangement must be provided which interrupts the charging circuit when the speed of the train, and therefore that of the dynamo, has fallen below a certain limit. All these automatic appliances are objectionable, because of their liability to get out of order The dynamo and gearing take up a large amount of space in the guard's van, which is of great value in main line trains; and the belt gearing, which is necessarily more or less exposed to dust on the road, entails a heavy outlay for maintenance. The depreciation of the dynamo and engine is also great, because guards' vans are often left standing in a siding, and the machinery is therefore liable to be neglected. Another objection is, that whilst the

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THE TIMMIS SYSTEM OF TRAIN LIGHTING BY ELECTRICITY.



batteries cannot be charged when the train is standing, the gear must always be worked when the train is in motion, whether the light be required or not. (3) The system of sub-divided batteries with or without dynamo carried on the train. The essential feature of this system lies in the employment of small storage batteries, one being fitted to each carriage. It is evident that by this means the lighting of each carriage is rendered perfectly independent of the other carriages, and also independent of the way in which the train is made up; but as hitherto carried out, the control of the lights in each carriage during the day when the train is going through tunnels, could not be effected from one place in the train by the guard, as in the previous systems. The lamps must therefore either be under the control of the passengers, or an attendant must be provided for every carriage. This system has since the beginning of the year been in use on the Alsatian State Railways, where the battery of each carriage consists of thirty-six cells carried in a tray, for facility of handling at the charging station. The batteries, which are of 40 ampère hours capacity, are fitted in the place of the gas reservoirs underneath the carriages, and are charged at certain stations which already possess electric lighting plant. Each carriage is fitted with five 10 c.p. lamps, requiring together about 3 ampères of current, so that the batteries have sufficient storage to light the train for thirteen hours before being re-charged.

A similar system of electric train lighting has been introduced into this country by Mr. J. A. Timmis, of 2, Great George-street, Westminster; but it is a great improvement upon the system in use on the Alsatian lines, and has been worked out quite independently. Mr. Timmis employs sub-divided storage batteries, ten of the Union Company's cells being placed under each of the carriages composing the train; but the lighting and extinguishing of the lamps is performed by the guard and not left to the passengers, thus removing the objection we have above alluded to. There are, however, other advantages connected with this system which we shall presently describe. Experiments with the Timmis system were begun on the Midland Railway in October last, and an electrically lighted train is now regularly running between Derby and Manchester. The light is supplied to a saloon carriage, a composite first and second class carriage, and the guard's van. Each battery, as already stated, consists of ten of the Union Company's storage cells, and weighs about 4cwt. These batteries are charged by a dynamo at the station at Derby, and supply current to 5 c.p. Swan lamps, of which two are placed in each compartment of the ordinary carriages, and four in the saloon. In this system, Mr. Timmis does not only provide for the electric lighting of every carriage independently of the others, but he also utilises the electric apparatus as a means of inter-communication between passengers, guard, and driver, and to a certain extent as an automatic alarm which will give notice in case the train parts. It is not necessary that the storage cells should be charged at the station, and Mr. Timmis has elaborated an arrangement by which the train is rendered perfectly independent of a fixed charging station, each locomotive being provided with a steam dynamo, which is used for charging all the batteries in the train from mains running from the locomotive to the last carriage. In elaborating his plans, he laid down the following conditions as essential to meet the requirements of railway engineers in lighting trains electrically: (1) Every vehicle must carry its own lighting power, because it may be put into a siding, or be slipped or break loose from the train; (2) the guard of the train must have the power to light or put out all the lamps in the train without quitting his van; (3) if a portion of the train is slipped or breaks loose, the lamps in that portion, as well as in the front part of the train, if lit, must remain lighted, and if they are not lit they must automatically light up so as to give the passengers warning that an accident has happened. This last condition is important, because it may happen that a train parts after leaving a tunnel, and while ascending an incline, when the rear vehicles will run back into the tunnel. If such an accident happens in the day time, the lamps in the whole of the train will automatically light up, and thus give notice that the train has parted. By the courtesy of Mr. Timmis we are enabled to put before our readers a diagram showing the manner in which these various functions are performed by the electrical apparatus.

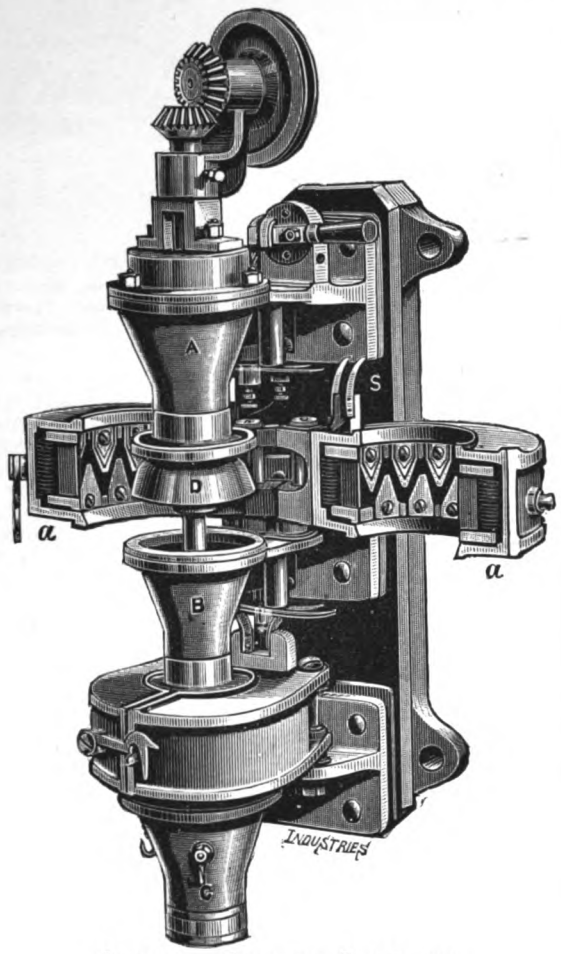
The steam dynamo is placed on the tender, as shown in the sketch of a portion of a railway train on the top of the diagram, and a four conductor cable with suitable couplings is led from the dynamo to the guard's van, and from there to the successive vehicles. Each vehicle is provided with a small local battery, marked Acc: in our illustration, weighing from 180lb. to 250lb., according to the size of the vehicle and the number of lamps in it. There is also in each carriage a local lighting circuit with the lamps in parallel, a magnetic switch M, and a communication pull P. The guard's van contains in addition a call bell B and a controlling switch C, the function of which will be presently described. Another call bell is placed on the locomotive. The dynamo D is driven direct by a high speed engine E, and the current from it is controlled by a magnetic switch O. In our illustration the four conductors of the main cable are shown by the lines A B C D. Circuit A leads from the negative terminal of the dynamo through the switch O to the end of the train, and branches are connected in each vehicle to the batteries, call bells, and negative local lighting circuit, the latter branches passing through the magnets M S. In the guard's van this magnet is omitted and the connection is direct. The circuit D is similarly connected with the positive terminal of the dynamo, the positive pole of the local batteries, and with the positive branch of the local lighting circuit. The two middle circuits B and C serve respectively for the pull communication and call bell, and for the magnetic switches M S. Each vehicle has a local lighting switch L, which is opened when the carriage is not in use in order that the current may not be wasted; but this switch is always closed when the carriage is in service, whether the light be required or not. The control of the current when the carriage is in service is not effected by the switch L, but by the magnetic switch M S. When the magnet M is energised, its core is pulled down and the switch S is thereby opened. All the magnets are controlled by the switch C in the guard's van. As long as this switch remains closed, a very small current flows through the magnets M and keeps all the switches S open, so that none of the lamps are lighted; but if the guard wishes to light up the train he opens the controlling switch C, the magnet M in each vehicle becomes demagnetised, a spring pushes the core up, and brings a contact piece into electrical connection with the springs of the switch S, thereby establishing a local circuit between the battery and lamps, and the latter light up. It will thus be seen that the lighting up is due to the breaking and not to the establishing of a current, and therefore, if the train should part, the current through the magnets M will be similarly broken, and the lamps will light up, giving the passengers notice that some of the carriages have broken loose. The bell circuit B is put into electrical communication with the general negative upon pulling out the plug P, when the springs which were previously separated by this insulating plug come in contact, and a current flows from the circuit D through the communication plug to the bell circuit B, thence through the bell and back to the accumulators or dynamo by the negative general circuit A. The connection of the four conductor cable between adjacent vehicles is effected by special coupling pieces, which we show in detail, and the arrangement of which explains itself. When no call bell is required, only three circuits and smaller couplings, with three contacts, are employed. The contact pieces are so arranged that it is impossible to couple the cables in any other way but that which is correct. It will be seen from the brief description we have here given of this system, that it complies with the requirements laid down by the inventor for a perfect system of train lighting without introducing any special complications. Mr. Timmis estimates that it will be possible to obtain an electrical horse power hour with an expenditure of from 40lb. to 45lb. of steam per hour, and in this case the extra amount of coal consumed by the locomotive for supplying current to a train fitted with 122 lamps would only be $\frac{1}{2}$lb. per mile. This estimate is based on the assumption that the light is required for a quarter of the time the train is in use.

THE HOLROYD SMITH MAGNETIC SEPARATOR.

The number of magnetic separators now in the market is considerable, but any apparatus of this kind hitherto constructed was intended for the treatment of a material in which the magnetic particles were of a size large enough for picking out by hand if required. Separators have become a necessity in many industries. As an example we might mention those which came into use shortly after the introduction of sheaf binders. As will be remembered, in the earliest combined reapers and binders the sheaves were bound with wire, and it often happened that when this wire was cut previous to the sheaf being introduced into the thrashing machine, a small piece of the wire, or perhaps the whole of it, passed through the drum, with the result that the finished grain as it was delivered from the machine contained occasionally short pieces of wire, and before the grain could be put on the mill these pieces of iron had to be taken out. This was done by magnetic separators of various designs; but since the abandonment of wire, and the introduction of string binders, magnetic separators are no longer required for treating grain. They are, however, largely in use for other purposes, notably for treating shop sweepings for the recovery of brass, copper, and gun metal. The particles of iron in this case, as in the previous example, are of fairly large size, and can therefore be acted upon

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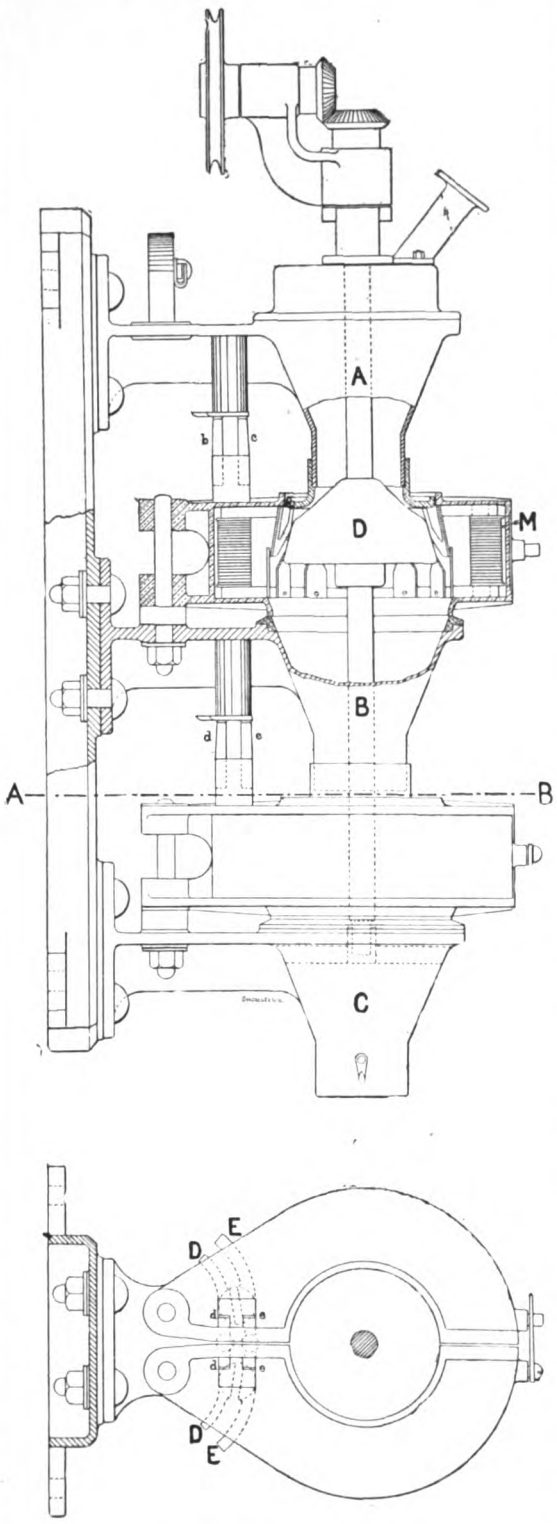
by a magnet at a considerable distance. The attraction of a magnet upon a particle of iron is a differential force. As the particle of iron comes into the field of the magnet, that end of it which is nearest assumes the opposite polarity to that of the magnet pole, and is attracted, whilst the opposite end, which assumes the same polarity, is repelled. The force with which the particle is drawn through the surrounding mass of non-magnetic material is equal to the difference between these attractive and repelling forces, and this difference will be the greater the greater the dimensions of the particle, not only because of the greater bulk of iron coming under the action of the magnet, but also on account of there being a more sensible difference in the distance of the induced poles from the inducing pole. It is thus a comparatively easy matter to separate magnetic particles from a loose mass of non-magnetic material if the particles are of fairly large size, such as chippings and turnings, or pieces of wire; but if the magnetic particles are in the form of powder, fine filings, &c., the problem becomes extremely difficult. It has, however, been solved in the magnetic



General View of Separator.

separator which we herewith illustrate. The machine was designed by Mr. Holroyd Smith, of Halifax, for use in the potteries. The material required for the manufacture of pottery, be this ordinary earthenware or porcelain, contains, besides china clay, also other substances, of which powdered flint is one. Flint is so hard that it has to be calcined before it can be crushed and reduced to the impalpably fine powder necessary for the potter's work, and the machine which used to be employed for the reduction, the "slipper mill," was found to be so slow in its action that potters have lately resorted to various more modern disintegrators or other pulverising machines. This change, although accelerating the work, has brought with it the serious evil that considerable quantities of metal are ground off the working parts of the machine at the same time that the flint becomes pulverised, and these small particles of metal become so thoroughly mixed with the flint as to make it almost unsuitable for the better class ware, because the iron produces stains and streaks in the china. It therefore became necessary to treat the powdered flint after it had passed through the pulveriser in some apparatus which would remove even the finest particles of iron. The question was taken in hand by Mr. Thomas Malkin, the proprietor of the Legal Mills, Burslem, who determined to put down a pulverising plant; but before doing so he had some flint pulverised by the maker of the plant, and he submitted the samples of the material so obtained to various makers of magnetic separators, to see whether their machines would efficiently treat this stuff. Existing separators, although they were able to extract nuts, washers, nails, turnings, &c., out of coarse grained non-magnetic material, were utterly unfit to deal with the very small particles of iron when intimately mixed with impalpable flint powder. Mr. Malkin then consulted Mr. Holroyd Smith, who undertook to design a machine specially for this purpose, and which we illustrate herewith.

The leading idea of the design is to bring the material into the closest possible proximity to the magnet poles, and for this purpose it is thrown against a series of poles by means of a revolving bell D, mounted upon a vertical spindle, which receives motion by a pair of bevel wheels and rope pulley on the top of the machine. As will be seen from our illustration, the machine is intended to be



Elevation and Plan.

fixed to a wall, and is provided with a spout and hopper A, into which the material is poured. The revolving bell is surrounded by two sets of electromagnets M, arranged in semi-circular casings *a*, which are hinged at the back, so that they can be opened for inspection. The poles are a series of triangular iron blades, the top row consisting of several plates, so as to present as many edges as possible. As the material passes by these poles the iron particles are retained, and cluster round the edges, whilst the flint powder falls into the second hopper B, and passes over a second bell and by a second set of electromagnets in the lower casing, where any particles of iron which might have escaped the first set of magnets are retained. The purified powder is finally discharged through the spout C into sacks. The magnets are energised from secondary batteries, or from a separate little dynamo, or from the lamp circuit, if the factory should possess an electric lighting plant. Ingenious self acting switches are employed, by means of which the exciting current is interrupted when the magnet casings are opened. These automatic switches consist of springs *b* and *c* for the upper magnets, and *d* and *e* for the lower magnets, which meet contact pieces D and E when the casings are closed, but which leave them when the casings are opened. By this means the current is interrupted automatically each time the casings are opened, and as thereby the magnets lose their carrying power, the iron dust which previously adhered to the poles falls off or can be brushed off. The percentage quantity of iron contained in the material is very small, and a considerable quantity of material can therefore pass through the machine before it is necessary to open and brush out the casings. The rate of feed can be adjusted in accordance with the nature of the material to be treated, by raising or lowering the bell D; and the best speed for the vertical spindle is about three hundred revolutions per minute. When we saw the machine at work there was a marked difference in the appearance of the material fed in at the top and passing out at the bottom, whilst the particles of iron brushed out from the magnets formed a very fine powder. So far as can be judged from a casual inspection, the machine appeared to do its work thoroughly well, and we are informed by the inventor that one of these machines has lately been supplied to a pottery in East Liverpool, Ohio, where it was submitted to the following test: A small sack of pure powdered flint was mixed with half an ounce of powdered iron, and the mixture was passed through the machine, when in the first passage 75 per cent. of the iron was recovered. The machine we illustrate is intended to deal with from 15cwt. to 50cwt. of flint powder per hour, according to the quantity of iron contained and the degree of purity required.

ELEMENTS AND META-ELEMENTS.

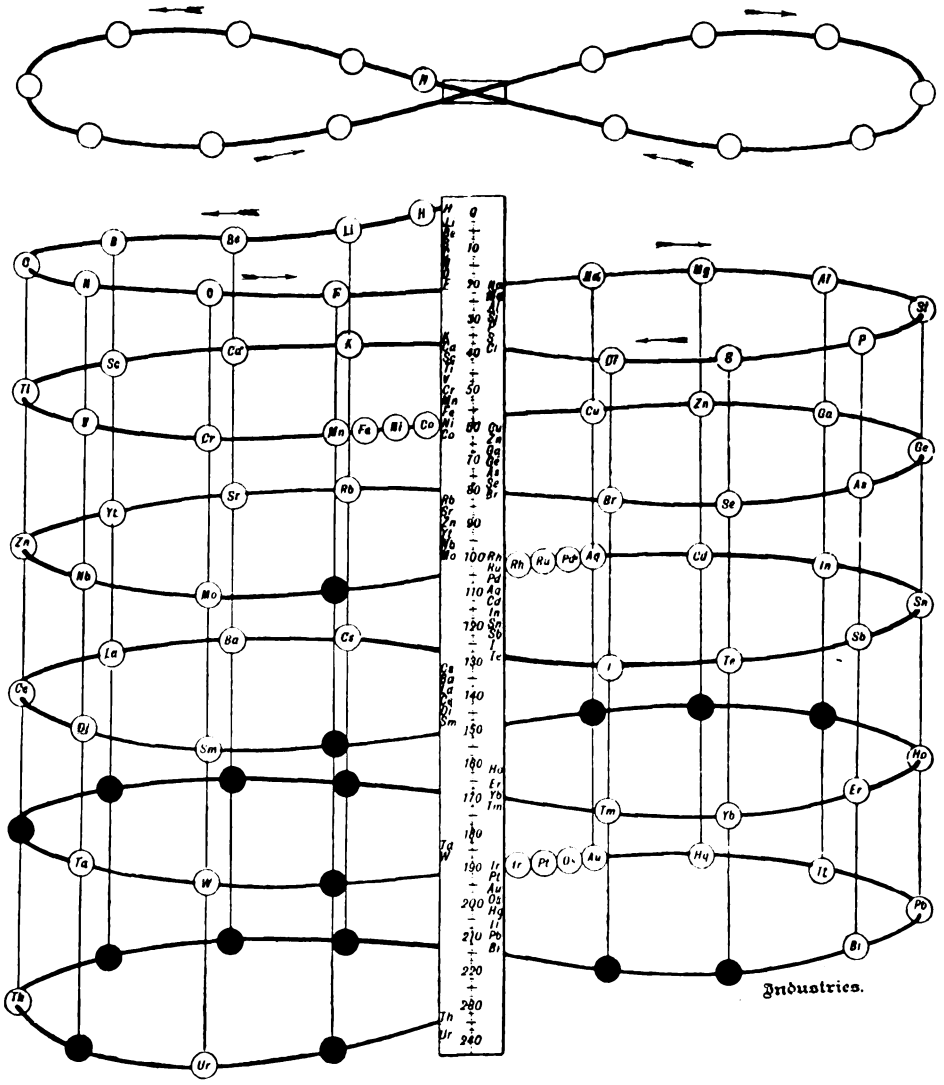
In reviewing the progress in the science of chemistry during the past year, at the anniversary meeting of the Chemical Society, the President (Professor W. Crookes, F.R.S.) called the attention of the Fellows present to the recent important work of Drs. Krüss and Nilson on the so-called rare earths, and the investigations of Grünwald on the spectra of the elements, whose work foreshadows the conclusion that hydrogen, oxygen, carbon, and magnesium are not simple, but compound substances. Mr. J. A. R. Newlands, who first pointed out the periodic nature of the elements, has at last received public recognition of the importance of his work by the Royal Society. The President was of opinion that we are now on the dawn of some epoch making, far reaching discovery concerning the nature of matter and the relations which exist among the elements. In previous communications at the British Association, and elsewhere, Professor Crookes has unfolded the views which he entertains concerning the nature of the elements, and has shown how his own work on the rarer elements supports the conclusions to which he has come. It is difficult when dealing with these substances to draw a line of distinction for an element; and he asked the question: "Are we going to open the portals and admit as an element every applicant, or make the examination a stiff one, so as to exclude all but sixty or seventy?" Among the known elements it is easy to distinguish and separate them when their basicity is different, or when their bascity is the same and when there is a marked difference in the colour of the salts, as in the case of nickel and cobalt; but when we meet with elements with the same degree of basicity unaccompanied by a marked difference in physical properties, it was extremely difficult to distinguish them, and in some cases, as in those which he himself had worked at, a difference in phosphorescent spectra alone was all that could be found to distinguish between them. The difficulty of accurately defining an element, in the present uncertain state, fades away if for an element we read an elementary group, and if we consider that there may be several different kinds of matter, all possessing nearly the same atomic weight, and have very similar degrees of basicity. Such a complex group of elements we have hitherto considered an element; but he has shown that in some cases, by a series of laborious separations by fractional precipitation of the bases from their salts by means of ammonia, it is possible to sort elementary yttrium into different kinds. The action which takes place is of a selective character, the elements present differ very slightly in their basicity, and the more basic are those which are first precipitated on rendering the solution alkaline. By repeated precipi-

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tations the basic constituents are sorted from the less basic, and after "many hundred times we educate the atoms, drawing out properties previously masked."

The evolution theory of the origin of these elementary groups from the vibratory protyle may be compared with the formation of small crowds of people in a crowded street in which each person has his own rate of movement and direction. A finely divided powder falling through water separates into different groups, owing to the slight differences of specific gravity, and each of such groups is comparable to an elementary group. A similar kind of sorting goes on when rarefied gases are subjected to an electrical rhythmic action. In space in the same way the elements and cosmic masses have probably been formed from the protyle of primary motion. This primary matter was at a high potential, and in running down, a secondary motion was produced, causing aggregations and polymerisation of the primary matter into elementary groups. These elementary groups would likewise form molecular and molar groups of greater complexity and less potential, the ultimate final size being determined by the loss of potential which the primary protyle has undergone. The element chlorine may be viewed as a grouping of atoms round one centre, of which the mean density is 35·5; but some of the atoms may have a higher and some a lower atomic weight than this, some having a weight which is only a little below that which would be attracted towards the nucleus whose mean weight is 80, and which we call bromine. The elements having similar properties and weights intermediate between bromine and iodine will be similarly drawn towards the centres 80 and 127. Didymium has recently been split up into two component elements, praseo- and neo-dymium, and it is probable that all the elementary groups might be similarly resolved into their components if we could find the right way of attacking each individual problem. In the accompanying zig-zag diagram, the formation of the elements in a periodic manner, from the primary protyle, gradually losing its potential, is shown. The representation in space of three dimensions instead of the pendulum figure which the author has been in the habit of using in his previous discourses, better illustrates the variation in properties and the periodic nature of the elements. In the first cycle from hydrogen (1) to chlorine (35·5) space and electricity remain the same during this period; but the temperature has fallen, causing the cycle not to return to its original starting point. If the temperature had not changed, or the potential had not been lowered, the first cycle would have been repeated, instead of a second period of elements of lower temperature values but of similar properties to the first cycle from potassium (K=39) to bromine (Br=80) being produced. The groups of similar properties will thus be situated on vertical lines, forming, as it were, pillars to the walls of the winding staircase. In the centre is a scale showing the gradual increase in atomic weight for the different periods. There is not necessarily any waste of energy in the universe, if the particles of secondary motion have their energy transformed into energy of primary motion at the confines of space. In conclusion, Professor Crookes expressed the hope that others would study the problem, and that the truth which, he had no doubt, underlay these speculations might soon be found.

ELEMENTS AND META-ELEMENTS.



Notes.

RAMIE FIBRE.

General L. Sewell, of New Orleans, in a report containing some practical information on the culture of the ramie plant, attributes the difficulty of obtaining a good supply of the fibre to the error of attempting to decorticate the plant when in an unripe state. He also states that none of the machines he knows of have the power to fibrise the ramie stalk when at its maturity. Consul de Fonblanque, of New Orleans, reports, however, that a Scheifner decorticator has since been imported from France and works well; but, unfortunately, a sufficient quantity of ramie to make a thorough test of the machine could not be obtained. As matters stand, farmers will not plant the crop, because they think that the machinery for utilising it is not perfected; on the other hand, the machinery cannot be perfected until there is enough of the raw material to test it with.

A NEW SUGAR CANE.

The *Times* states that for about one hundred years most of the sugar in the West India Islands has been obtained from the Otaheite cane, originally brought from the Pacific Islands by Captain Bligh in His Majesty's ships in 1796. Latterly strenuous efforts have been made to introduce new canes, in the hope that they would prove richer in yield of sugar. In one instance it is stated that a cane introduced by the present Assistant-Director of Kew Gardens, when in charge of the Botanical Gardens at Jamaica, has supplanted the Otaheite cane, and proved most productive. A planter at St. Kitts says the new cane, which he has called the Jamaican, is a "marvellous cane." He adds that "it stands dry weather well, and is entirely superseding the Otaheite cane."

ANNEALING STEEL BOILERS.

Our American contemporary the *Marine Journal* publishes the following account of a process for annealing steel boilers. It states that "a discovery of great importance to steamship and steamboat owners has recently been made by George V. Sloate, superintendent engineer of the Old Dominion Steamship Line, New York. It is a well known fact that steel plates forming the furnaces and connections of marine boilers after a few years' use become crystallised, and crust to such an extent that in many cases they have to be renewed at great expense. By using Sloate's process of annealing about once every three years, the metal is fully restored to its normal condition, viz., full strength, ductility, and proper reduction of area when tested. This treatment will insure the furnaces and connections lasting as long as the boiler. Boilers with the advantage of surface condensers should, with proper management and care, give twenty years of actual service, with moderate cost for repairs. The furnaces of the steamships 'Roanoke' and 'Guyandotte,' after five years' service, commenced to crack over the bridge walls to such an extent that the company had to renew two of them on each ship. Upon examination, it was found that the steel in the old furnaces had become crystallised, and was as brittle as cast iron; in fact, it resembled the latter more than the original steel. By heating it to a mild red heat, and afterwards allowing it to cool off gradually, the apparently worn out metal was restored to its original condition and tensile strength. Thus it was that Mr. Sloate conceived the idea of heating and annealing it. The work of accomplishing this object is very simple. The boiler is emptied of water, all manhole and handhole plates are put on, and the boiler is hermetically sealed. Before closing the furnace doors, a bridge wall is built up within 3in. of the furnace all round. After this a form is made of boiler iron, 2ft. less in diameter than the furnace, and about 3ft. long. The space between is then filled with chemical or tinder dried wood, after which the ash pans are closed, and the fires lighted. When a red heat is reached, the dampers are closed, and all air excluded from furnaces. The fire burns slowly for from twenty-five to thirty hours, and after all the wood is consumed the furnace is allowed to cool off gradually. Upon opening the furnaces the steel is found to have become annealed and restored to its normal condition without any injury to the boiler or loss of time to the ship. The boilers of the steamships 'Seneca' and 'Guyandotte' have undergone this treatment, thereby saving the owners the expense of repairing the furnaces."

THE MAXIM GUN.

The Maxim Gun Company has just issued a portion of the official report of the Austrian War Office of the trial of this new weapon. The report is extremely favourable. The preliminary trials of last July established the superiority of the Maxim system over all others, both as regards rapidity of fire and ease of manipulation, and thereupon the Austrian Government ordered exhaustive experiments to be made, which included tests for range and accuracy at distances from 200m. to 1575m., and tests for strength and durability. The results showed that the accuracy of the Maxim is superior either to the two-barrel Gardiner or the five-barrel Nordenfelt. For testing durability, series of 334 rounds, fired consecutively, were almost exclusively used, and an average speed of ten rounds per second was obtained, not only with the greatest elevation and greatest depression, but also when traversing the gun laterally through the greatest angle that the mounting would allow. In all 13,504 rounds were fired, and the report states that on the whole the gun behaved extremely well, the loading and firing mechanism operated faultlessly, and if certain reserve parts are supplied, and the buffer spring made stronger, the durability of the weapon would be guaranteed under all circumstances. After 6356 rounds had been fired, the weapon was tried for accuracy, at a target 2m. by 3·6m., at 600m. range, and an excellent diagram obtained. The 11mm. rifle cartridge (model of 1877) was used, and trials of the barrel with English "Henry" rifling did not show any advantage over that of the Werndl barrel. The report is signed by Colonel H. Huffzky.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

31st March, 1888.

4838. Richardson, H. F. ..... Beater bars used in threshing machines (*Woolnough*).
4841. Wilson, J..... Improvements in walls, buildings, silos, bins, warehouses, forts, batteries, theatres, safes, strong rooms, ships, barges, and other vessels, bulkheads, partitions, shields, tanks, vats, vehicles, refrigerating safes, houses, and fire proof screens.
4846. Rogers, S. A..... Tramway cars.
4850. Jucker, J..... Power looms.
4851. Kilbourn, J. K..... Compression pumps for gaseous fluids.
4855. Jones, W. P..... Cartridge ramming, crimping, and closing press.
4858. Smith, J..... Brakes for tram engines.
4859. Yewdall, W. H. ..... Writing machines.
4860. Abraham, J. F..... Recording the flow of water and the pressure of steam in pipes.
4861. Taylor & Warburton. Manufacture of figured fabrics.
4862. Holt, T..... Reeling machines.
4863. Sinnatt & Humphreys. Manufacture of stoppers for bottles.
4865. Barlow, C. A. ..... Moving boats from one canal on to another.
4867. Hughes, F. J..... Automatic car coupler.
4875. Wilson & Tafe..... Raising and lowering submarine telegraph cables.
4877. Prince, J. ..... Metallic dies for brick and tile making.
4883. Murgatroyd, E. ..... Wheels of carts.
4884. Thomson, W..... Wheel axles of tram cars.
4886. Forder & Forder ..... Hansom cabs.
4887. Figge, A..... Cleaning vegetable fibre.
4888. Turrettini, F..... Endless saws for cutting stone.
4889. Holmes, R. J. P. G..... Machine comprising a combination of tools.
4893. Read, H. V. R..... Sugar cane mills.
4894. Dobroff, S., & others... Manufacture of woven fabrics.
4896. Campion, W..... Seaming machine.
4897. Campion, W..... Turning-off machine.
4902. Lake, H. H..... Railway ties (*Sea*).
4904. Howard, J., & others... Straw trussing and sheafing machines.
4907. Sander & Hoffmann... Manufacture of checkered yarns.
4910. Chatwood, S., & others. Safes, strong rooms, and locks.

3rd April, 1888.

4917. Roberts, H., & others... Removing the scale from steam boilers, &c.
4918. Clyne & Mitchell..... Apparatus for polishing stone.
4919. Clegg & Moorhouse ... Self acting mules.
4920. Melling, J. W..... Valve gear.
4922. Gallon, W..... Breaking and beating engine rolls and elbow plates.
4923. Beck, I. ..... Punching machines.
4924. Ruck, H..... Pressing and tying up straw, hay, and flax into bundles.
4925. Smith & Smith ..... Jacquard machines.
4926. Seyfert & Donner..... Knitting machines for making plush.
4928. Bardsley & Johnson... Brakes and winding and drawing apparatus.
4932. Gilchrist, G..... Thrust blocks for screw propeller shafts.
4933. Lee & Croll..... Shuttle picking for looms by means of compressed air.
4934. Reaney & Blakemore.. Colliery cages.
4938. Priest, E..... Feeding slivers of wool to carding machines.
4939. Eaton & Birch..... Machinery for rubbing types.
4944. Wilson, A..... Combined gas engines and gas producers.
4951. Lindenthal, G..... Refining iron.
4956-7. Moseley, J..... Apparatus for making cards for carding fibrous materials.
4961. Boult, A. J. ..... Steam boilers (*Rushton*).
4963. Beardsley, G., & others Apparatus for carrying the bobbins of traverse warps.
4965. Caulfeild, F. St. G..... Maintaining submerged mines at a given distance from the surface of the water at all states of the tide.
4968. Papleux, J. ..... Apparatus for ungumming rhea.
4970. Stitzel & Weinedel ... Semaphore signalling apparatus.
4973. Dowling, J. P..... Presses for hay, straw, and wool.
4975. Warner, A. M..... Manufacture of iron.
4976. Noble, A. ..... Breech loading guns.
4978. Lake, H. H..... ..... Machines for pulverising ores (*Gates*).
4980. Sohn, A. H. ..... Dams.
4981. Jarvis, S. E..... Steam engines.
4984. Edwards, E..... Presses (*Gayon*).
4986. Appleby & Abrahams.. Machinery for stamping mineral ores.

4th April, 1888.

4993. Bland, J. ..... Washing, wringing, and mangling machines.
5000. Swanson, W. M..... Floating docks.
5004. Mitchell, W. ..... Propelling ships.
5007. Jucker, J..... Testing top rollers of spinning machines.
5009. Cartwright & Cartwright..... Self indicating weighing machines.
5012. McDougall, I. S..... Heating feed water.
5016. Thompson, W. P..... Rolling tubes and columns from hollow ingots and piles (*Kellogg*).
5018. Robertson, J. ..... Manufacture of metal tubes.
5021. Cheevers, J..... Apparatus for measuring granular materials.
5023. Collingbourne & Roe. Ball bearings.
5027. Lawrence, R. S. ..... Shells containing high explosives.
5033. Wilson & Pirrie..... Ships.
5034. Nordenfelt, T..... Machine guns.
5035. Schmidt, C. A. G..... Washing, dyeing, and bleaching textile materials.
5038. Haddan, R. ..... Dyeing skeins of textile material (*Decock*).
5040. Merryweather and Jakeman..... Fire engines.

5th April, 1888.

5048. Fletcher, J. M. ..... Engines.
5050. Unwin, F. ..... Tension pulleys.
5051. J. T. Hailwood ..... Lubricators.
5052. Rose & McLellan ... .. Looms for weaving fire hose.
5053. White & Wallbank ... Combustion of gases in steam generator furnaces.
5054. Burt, P. ..... Wringing machines.
5057. McDougall, I. S. ..... Steam generators.
5058. McDougall, I. S. ..... Securing tubes in tube plates and flanges.
5060. Lynde, F. C..... Spindles and flyers used in twisting and winding machines.
5062. Radcliffe, F. ..... Revolving furnaces for roasting cement.
5065. Rose, G. ..... Force pumps for use with spray, vapour, and other oil lamps.
5070. Jenkinson, T. ..... Roller bars and rag engine bottom plates.
5076. Birkett, I. R. E. ..... Hoists for warehouses.
5081. Winter, J. ..... Forge cranes.
5083. Walker, J. A. ..... Generating steam by liquid fuel.
5084. Twynam, T. ..... Manufacture of ingot iron and steel.
5085. Pellas, E..... Balanced lug sail.
5088. Walker, T. J. ..... Heating fluids.
5089. Campbell & Campbell Masts of ships.
5094. Hasted, G. ..... Thrashing machines.
5095. Bentall, E. H..... Lawn mowers.

ELECTRICITY.

31st March, 1888.

4844. Thompson, W. P. ..... Incandescent electric lamps (*Garczynski*).
4909. Fell, J. C..... Telephonic apparatus (*Otzen*).

3rd April, 1888.

4929. Gillett & Haseltine.. Magneto-electric generators.
4940. Parker, T. ..... Alternating current dynamo-electric machines.
4945. Proctor, C. F..... Coupling alternate current electric machines.
4964. Boult, A. J..... Regulating electric currents (*Doubrava*).

4th April, 1888.

5029. Morsby & Davies ..... Generation of electricity by tidal or river power.

5th April, 1888.

5069. Randall, C. A. ..... Mechanical and electromagnetic motor.
5082. Sellon & Jackson ..... Electricity meters.
5098. Kricboom, P. L. ..... Electrical signalling in connection with telephone circuits.

CHEMISTRY.

31st March, 1888.

4842. Jarvis, G. A. ..... Manufacture of sodium or potassium.
4843. Staveley, W. W..... Carbonates, sulphites, bisulphites, or hyposulphites of the alkalis, and phenol.

3rd April, 1888.

4959. Lewis, J. J. ..... Extraction of ammonia from tar water.

4th April, 1888.

5031. Selwyn, J. H. ..... Extraction of metals and production of nitric acid.

5th April, 1888.

5086. Donald, W. J. A..... Manufacture of chromates.

MISCELLANEOUS.

31st March, 1888.

4847. Rogers, S. A. ..... Apparatus for winding "Waterbury" watches.
4848. Prestwich, W. H. ..... Draught regulator for stoves.
4849. Howard, J. ..... Check tills.
4853. Taylor, W. .... Fire extinguishing apparatus.
4854. Powell & Dickinson ... Skinners' knives.
4856. Donovan, E. W. ..... Self regulating valve.
4866. Sanders, A. ..... Lamp fittings.
4868. Wilson, T. ..... Water taps.
4870. Brown & Mackenzie ... Door springs.
4871. Stuart & Young ..... Regulating the surface flow of liquids from tanks.
4881. Robertson, W..... Velocipedes.
4885. Dinsmore, J. H. R. ..... Manufacture of gas.
4890. Alexander, A. E. ..... Roasting coffee by superheated steam (*Cardozo*).
4892. Hazeldine, J. T..... Glass houses.
4895. Slazenger & Matthews Manufacture of boots.
4899. Schmidt, M. von..... Treatment of fatty substances for candles.
4903. Lake, H. H. ..... Barrels (*Cooke & Alvord*).
4906. Schroeter, W. ..... Bicycles.
4911. Hitchcock, R. ..... Fences.

3rd April, 1888.

4915. Avis, W. H. ..... Twisting and laying twines and cordage.
4916. Southall, R. H. ..... Paring the soles of boots.
4931. Turnbull, J..... Boiling esparto grass.
4941. Rice, W. H. ..... Rowlocks.
4947. Bailey, T. ..... Fire proof partition.
4949. Dick, R. ..... Manufacture of boots.
4953. Westphal, C. ..... Production of water gas.
4954. Hart, A. ..... Decanting the contents of oil cans.
4966. Petrie, G. ..... Taps.
4967. Wallis, H. E. A..... Liquid basins for gas governors.
4971. Kertsch, C. ..... Apparatus for preventing waste of water.
4977. Dutton, S. T. ..... Regulating the charge supplied to the oil cisterns of railway signal, carriage, ship, and other lamps.
4982. Duggan, J. ..... Lamps.
4983. Dehany, G. E. ..... Extinguishers for lamps.
4989. Beck, W. H. ..... Devices for winding clocks (*Diette and Hour*).

4th April, 1888.

4995. Lindsay, R. ..... Briquettes.
4997. Bunting, S. ..... Stoppering of bottles.
4999. Musselwhite, W. ..... Safety tap for effervescing liquids.
5001. Fahie, A. ..... Apparatus for counting boards, planks, rails, &c. (*Nielsen*).
5003. Weston, T. R. ..... Safety lamp.
5006. Ballardie, D. ..... Lamps.
5008. Phillips, J. H..... Vehicle with advertising attachments.
5010. Oliver & Hethering-ton..... Production of moulded wood articles.
5013. Tate, J. W. ..... Lamps.
5017. Paton, J. M. C. ..... Manufacturing gas for heating and illuminating purposes from molasses (*Van Dyk & Wilkinson*).
5020. Downie, T. ..... Metallic packings.
5022. Hutchins, H. E. ..... Rack pulleys.
5026. Reeve, J. T. ..... Receptacles for powdered matters.
5028. Eades, W. S..... Manufacture of boots.
5030. Newton, P. A. ..... Cock for conduit pipes (*Christopherson*).
5032. McNish, J..... Glazing paper and textile fabrics

5th April, 1888.

5044. Blagden & Slaytor ... Automatic measuring taps.
5045. Ross, J. H. ..... Lamp clock.
5047. Allen, J. J. ..... Gumming, pasting, & damping apparatus.
5059. Beesley, J. ..... Velocipedes.
5061. Müller, H. ..... Safety fuse.
5063. Kilsby, W. ..... Lamps.
5067. Carpenter, J. ..... Pendulum clock.
5068. Tautz, F. G., & others... Manufacture of hats, caps, and gloves.
5071. Bullen, J. ..... Apparatus for emptying carboys.
5072. Knowles, E. ..... Valves employed in sprinkler installations.
5079. Birkett, J. ..... Paving blocks for street crossings and gutters.
5080. Knowlton, M. D..... Manufacturing boxes of paper, straw, board, and wood. (Received 5th April, 1888 Ante-dated 14th February, 1888, under International Convention).
5090. Heimsoeth, B. ..... Locks.
5091. Chambers, G. J. ..... Earthenware bottles.
5092. Cunliffe. W. ..... Lamps.
5097. Vavasseur, J. ..... Cartridges for ordnance.
5100. Stark, J. ..... Velocipedes.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

7th April, 1888.

17010. Lake, H. H..... Button hole sewing machines (*Wheeler*).
4754. Gorgeon, N. J..... Apparatus for crushing and grinding.
4786. Riley, G. ..... Circular knitting machines.
4912. Gandy, M..... Textile belts for driving machinery.
5674. Newall & Blyth ..... Steam engines and pumps.
5730. Metcalfe & Davies ... Injectors.
5837. Edwards, E..... Self acting spinning machines (*Schneider*).
6045. Fox, S. ..... Manufacture of tubular parts of steam boilers.
6235. Watts, J. W..... Circular latch needle knitting machines.

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6351. Cranston, W. McI..... Binding mechanism of harvesting machines (*The Walter A. Wood Mowing and Reaping Machine Co.*)
6397. Edwards, E..... Apparatus for measuring water.
6455. Leuty, J. E..... Compressing ensilage stacks, hay, trusses, and bales.
6585. Walsh, E. Y..... Loom pickers.
6701. Thwaite, B. H., & others Portland cement.
6925. Obach, T. ..... Endless wire ways.
6973. Hall & Parry..... Machines for making casks.
7134. Gürtler, W..... Structures formed of asphalt and metal frame work.
7348. Stayner & Roberts ... Manufacture of coke forks.
7367. Parkes, G. W. ..... Automatic time keeping apparatus.
7460. Williamson, T., & others Turning over ingots on feed rollers.
7558. Whitaker, A. ..... Gearing for extension rails of railway turntables.
7828. Lloyd, G. H., & others.. Welding boiler flues.
7840. Pegden, J. B. ..... Steam steering gear.
7916. Dewar & Mair..... Washing machines.
7917. Hahlo, C., & others ... Pattern mechanism for looms.
7925. Wallwork & Sturgeon Gas engines.
7938. Hipkins, T. ..... Steam boilers.
7946. Oliver, W. S. ..... Sewing machine.
7947. Boothby, A. C..... Movable stern dock for screw steamers.
7948. Boothby, A. C..... Cleaning the bottoms of iron or steel vessels.
7964. Anderson & Pollock... Sewing machines for button holes.
7997. Ashenhurst, T. R. ..... An improved figured cloth.
8017. Sommerfeld & Hensel Sewing machines.
8052. Noble & Murray ..... Disappearing gun carriages.
8053. McEvoy, C. A. ..... Firing mechanism fuses for the ignition of cartridges in guns.
8060. Smith, F. H..... Preventing accidents in shafts, hoists, or elevators.
8160. Wood, J. ..... Paper making machines.
8276. Dowie, A. L..... Treating iron and castings.
8492. Quénéhen & Vansteenkiste..... Apparatus for grinding.
8550. Shapton, W..... Cranes for working grab buckets.
8628. Newton, H. E..... Sewing machines for button holes (*National Machine Co.*).
8860. Gauhe, O. W. ..... Detachable elevator chain.
9123. Tschörner & Wein..... Looms for the manufacture of damask.
9910. Leigh, H. H..... Table for guillotine machines (*Simoulin*).
10659. Thompson, W. P..... Converters (*Robert*).
10896. Colclough, W. A. ..... Mounting the bodies of vehicles.
11515. Lindsay & Allan ..... Shaping the teeth of bevel wheels.
11806. Bland, W..... Machines for taking copies of written or printed matter.
12013. Allison, H. J. ..... Apparatus for copying writings and designs (*Sanders.*)
14617. Clark, J. ..... Metallic belts for conveying coal.
16080. Moore & Palmer ..... Manufacture of hosiery.
17677. Griffiths, W. J..... Holding and guiding twist drills during grinding.
690. Aniello, J. A. ..... Lifeboat.
2154. Martin, M., & others... Apparatus for dressing hides and skins.
2540. Allison, H. J. ..... Chaff cutters (*Stout & Underwood*).
2571. Boult, A. J. ..... Car couplings (*Brown*).
3270. Winder, R. ..... Type composing machines.
3337. Windrath & Hausmann Reed for looms.
3347. Matthews, S. ..... Water gauges for steam boilers.
3474. Edwards, E..... Automatic starting and braking apparatus for cars (*Feenel*).

ELECTRICITY.

7th April, 1888.

6104. Foster & Anderson ... Electrical measuring instruments
6219. Swinburne, J..... Induction apparatus.
7184. Mackie, W. ..... Electric arc lamps.
7950. Smith & Jackson..... Telephones.
7982. Fitzgerald, C. L. W.... Telephonic instruments.
8159. Smith, W. ..... Telegraphic communication to lighthouses.
2179. Wheeler, M. ..... Incandescent electric lamps.
2246. Lake, H. H. ..... Dynamo-electric machines (*Fickemeyer*).
2250. Linville, J. H. ..... Printing telegraphs.
2308. Coerper, C. ..... Dynamo-electric machines.

CHEMISTRY.

7th April, 1888.

5124. Wells, G. I. J..... Evaporating liquors containing salts (*Pick*).
7812. Liebmann & Studer ... A new mono-sulpho acid of alpha-naphthol.
7998. Kennedy & Green ..... Apparatus for washing ores.
9363. Jacquemin, G. E..... Manufacture of wine from barley.
3393. Milligan, T. P. ..... Production of gelatine, glue, and size.

MISCELLANEOUS.

7th April, 1888.

4773. Boult, A. J..... Door checks and closers (*Elliott*).
4862. Darling, J. ..... Needle threader.
4876. Boult, A. J..... Files (*Custer, Napier, & Napier*).
5262. Simmons & Simmons ... Lithographic and letterpress rollers.
5792. Sparrow & Osgerby.... Automatically regulating the supply of gas.
6936. Heffter, P. J. E..... Clarifying and saturating sugar solutions by tannic acid.
7018. Fletcher & Clare..... Apparatus for automatically controlling the supply of gas to atmospheric gas burners.
7517. Tyzack, T..... Saws.
7907. Barthel, A. E..... Fluid reservoir.
7980. Klic, K..... Treatment of paper for drawing purposes.
8002. Granger & Alvey ..... Signalling between passengers and guards on railway trains.
8011. Nicholas, A..... Call bells.
8031. Gould, R. ..... Composition for distempering.
8198. McMullen, W. J..... Dust bins.
8334. Nicholls, J..... "Silver cleaning" paste.
8835. Fry, L. A. ..... Decorating clay ware.
9259. MacMahon, C. ..... Fire escape.
10034. Smith, R. ..... Chimney pots.
11032. Reid, J..... Pantograph drawing instrument.
14169. Hicks, J. J. ..... Hydrometers & saccharometers.
15107. Horn, W. W. ..... Argand burner (*Dodd*).
15889. Grimbleby, T. N. ..... Roofing tile.
16366. Baker, F. R..... Oil lamps.
691. Martinson, O..... Measuring & drawing off liquids.
838A. Sayer, R. C. ..... Filters. (This Application having been originally included in No. 838, dated 19th January, 1888, takes, under Patents Rule 23, that date.)
2356. Butler & Stanton..... Velocipedes.
3019. Goode, C. P..... Portable compressed forage.
3156. Lawrence, H. ..... Chimney cowl.
3255. Wheatley, W. T. ..... Cement for securing the handles of cutlery.
3412. Birkbeck, H..... Wind vanes (*Mattison*).
3468. Boynton & Johnson ... Bobbins for spinning machines.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 31st December, 1887, inclusive).

Year 1883.

5859. Brookes, A. G..... Augurs (*Swan*).
5865. Warburton, E. C., & ano. Dynamo-electric machines.
5866. Lake, W. R. ..... Printing presses (*Nowell*).
5868. Weldon, W. ..... Manufacture of chlorine.
5871. Hartley, J. W. ..... Locomotives.
5873. Henderson, N. McF. ... Obtaining oil and gas.
5874. Brandon, R. H. ..... Electrical conductors (*Campbell*).
5876. Brandon, R. H. ..... Compressing rods, &c. (*Billings*).
5880. Greenwood, A., & ano. Sewing machines.
5883. Keywood, F..... Knitting machinery.
5884. Wood, E. M..... Greenhouses.
5885. Brookes, A. G..... Signalling by electricity (*Downs*).
5886. Glaser, F. C. ..... Treating zinc ores (*Erben & ano.*)
5887. Haddan, H. J. ..... Expansion wrenches (*Lytle*).
5888. Paddock, W..... Rotary engines, &c.
5892. Greenwood, A. ..... Sewing machines.
5893. Imray, J. ..... Distilling, &c., liquids (*Egells*).
5894. Imray, J. ..... Vessels exposed to corrosive action (*Egells*).
5900. Lake, W. R. ..... Steam engines (*Porter*).
5901. Hill, O. W. F. ..... Imparting motion to parts of mechanism.
5902. Scott, D..... Production of patterns.
5903. McCulloch, J., & ano... Obtaining oil.
5904. Stott, D. ..... Production of patterns, &c.
5906. Wylie, R. P..... Raising sunken vessels, &c.
5907. Stevenson, G. ..... Steam boilers, &c.
5921. Beesley, W. T..... Cutting sheets of metals.
5923. Sombart, C. M. ..... Gas engines.
5928. Welch, E. J. C., & ano.. Gas engines.
5929. Campbell, J. ..... Ships' logs.
5933. Heath, W. E. ..... Storing up structures.
5935. Lake, W. R. ..... Repeating fire arms (*Larsen and another*).
5938. Morewood, E..... Coating metal plates, &c.
5939. Danchell, F. H. ..... Electromotor engines.
5942. Newton, G. E..... Lawn mowing.
5943. Howaldt, H. ..... Slide valve for steam engines.
5950. Gill, J. W. ..... Generation of steam, &c.
5952. Dempster, J..... Furnaces.
5954. Green, W..... Treatment of mineral oils.
5956. Wastfield, E. G..... Gas engines.
5962. Haddan, H. J. ..... White lead (*Schmoll*).
5963. Sombart, C. M. ..... Refrigerators (*Moebius*).
5964. Sinclair, D., & another Telegraphic, &c., apparatus.
5970. McIntyre, P. ..... Compression of crops.
5974. Warner, C. B..... Manufacture of artificial bone, &c. (*Mestaniz*).
5975. Warner, C. B..... Treatment of leather scraps (*Mestaniz*).
5980. Brougham, F. J. ..... Railway rolling stock (*Gesellschaft für Verwerthung von Erfindungen im Eisenbahnwesen*)
5981. Featherstonhaugh, J. C. W..... Printers' quoins.
5982–3–4. Williams, J. S. ... Generation, &c., of electricity.
5986. Haller, E..... Electromotors.
5987. Goldberg, L., & another Incandescent electric lamps, &c.
5990. Büsche, F. E. A. ..... Manufacture of lace, &c.

Year 1882.

6236. Lake, W. R. ..... Screws (*Faugier*).

Year 1881.

5682. White, J., & another ... Velocipedes.
5708. Nock, J..... Anchors.
5726. Speight, R., & another.. Winding machines.

Year 1880.

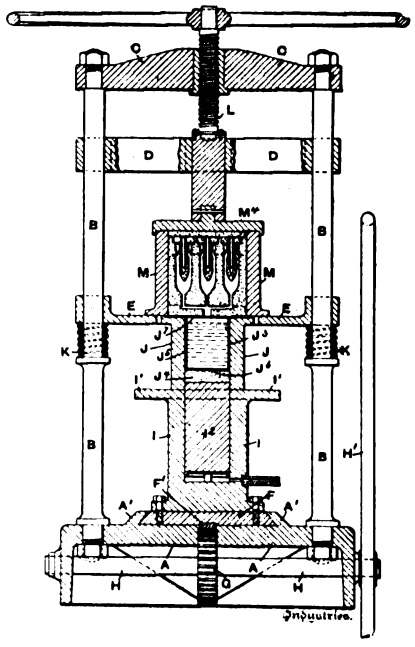
5457. Mills, B. J. B. ..... Blow pipe revolving furnace (*Duryee*).
5471. Hutchinson, R..... Gas motor engines.
5491. Foster, J..... Web printing machines.
5508. Fox, W., & another..... Preparing fibrous substances.
5516. Guattari, A. ..... Producing designs on wood, &c.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, *70, Market-street, Manchester.*

ENGINEERING.

Casting Metals under Pressure.—*J. J. C. Smith, Passaic, New Jersey, U.S.A.*—Several improvements are here introduced into the construction of an apparatus described in patent No. 1443 of 1869 granted to B. J. B. Mills. The general arrangement is shown in cross section in the accompanying diagram. The supports B carry the cross bar C, and form guides for the plates D and E. The hydraulic cylinder I is bolted to the sliding table F, which is movable sideways by means of the rack F^1, pinion G, and hand wheel H^1. The plunger I^2 projects above the top of the cylinder I, and it is surmounted by a layer of clay J^4. The cylinder J is made in two halves, which are hinged to I on



one side, and bolted together on the other. An asbestos lining J^5 prevents the heat of the molten metal in J from escaping through the walls, and a washer J^7 serves a similar purpose. The cylinder M is fastened to the plate E in the same manner as I, and is also made in two movable halves. The moulds are contained inside the cylinder M; those in the drawing are intended for the casting of elongated projectiles. In operating the machine the screw L is raised together with the table E and the mould receptacle M. This movement enables the slide F to be moved out of its central position, carrying the cylinders I and J along with it. After the molten metal has been deposited in J, the table F is replaced in its normal position. The screw L is then depressed, so as to form a tight connection between the receptacle J and the flask M. The valve admits the water underneath the plunger I^2 after the moulds are in position, and the metal is forced up into the moulds. After the casting is completed the top M^4 is unscrewed, and the flask M is separated into its two parts to facilitate the removal of the castings. Nine claims are made for the construction of the flask M and the cylinder J, for the interior lining employed, and for the disposition of the vessel J.—No. 9322. June 30th, 1887. 8*d.*

Drying Cotton.—*J. D. Sutcliffe, Manchester, and B. T. O'Brien, Liverpool.*—The object of the present invention is to obviate the damaging of the fibre when exposed on the floors of the drying chambers. A series of perforated platforms are arranged one above another, and the material which is placed on them is agitated continually by hand or by power. Steam or hot air pipes are laid round the chamber in which the platforms are erected, and the heated air is caused to circulate through the perforations by means of a Blackman air propeller. When the air has become saturated with the moisture which it has absorbed from the fibre, it is sent through a colder chamber, where the water is liberated and condensed. The same air may thus be used over again several times, and a reduction is effected in the cost of primarily drying, cleansing, and heating the air. Two claims are made for the perforated platforms, and for the manner of circulating the air.—No. 6208. April 28th, 1887. 8*d.*

Sand Moulds.—*O. Jones, London. (S. P. M. Tasker, Philadelphia.)*—This invention relates to an improved method of compressing the sand in the flask containing the patterns. A mass of shot, pebbles, or grains of sand which do not adhere, and are capable of relative motion, is placed upon a flexible presser or diaphragm, and is arranged in combination with an assemblage of rammers which are capable of independent movement, so that when the pressure is applied the surface of the mass next to the flask will conform more or less to the patterns. The yielding pressure is thus more evenly and uniformly distributed through the sand surrounding the various

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parts of the patterns. Several different methods of carrying out this idea are described in the specification. Six claims are made for this method of compressing the sand through the medium of shot or pebbles, as described.—No. 6750. May 7th, 1887. 8*d*.

Feed Apparatus for Boilers.—*A. Mayhew, London.*—Fig. 1 represents a vertical section of the apparatus, and Fig. 2 illustrates an application of the invention to a steam boiler. The apparatus consists of three cylinders A B C, arranged tandem; the upper two are made in one piece, and form a combined steam and hydraulic cylinder. The main piston A^1 and the loose fitting plunger B^1 extend into the central hydraulic cylinder B; the lowest cylinder C contains a regulating device, consisting of the piston C^1 with a spiral spring S fixed to its

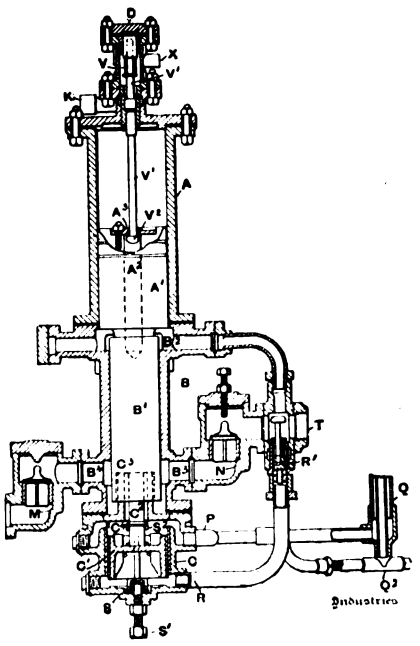


Fig. 1.

lower side. The weight of A^1 B^1 is made in excess of the pressure against which the apparatus is to act, and the spring S carries the weight of the piston C^1 and of the plungers A^1 B^1. The admission and exhaust of steam takes place through the slide valve V, which is actuated automatically by the main piston and plunger through the spindle V^1. This spindle is furnished with a stop V^2, which works within the main piston in a hole A^2. The valve casing D is connected by a pipe K to the steam space of the boiler, and the exhaust passage X leads to the feed supply. The pipes B^2 and B^3 communicate with the delivery pipe T and the water space of the boiler, and B^4 leads to the feed supply; the suction and delivery valves are shown at M N. The action of the apparatus as applied to the steam boiler is as follows: When all the valves are opened the piston A^1 B^1 descends by gravity and forces the liquid into the delivery pipe T, and the valve R^1 is automatically closed; when the down

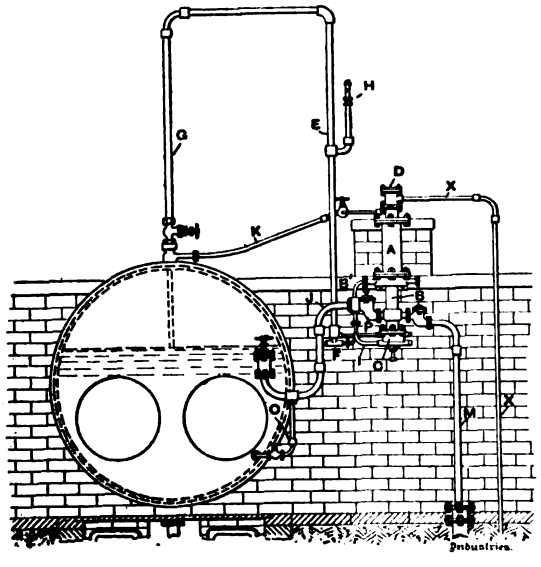


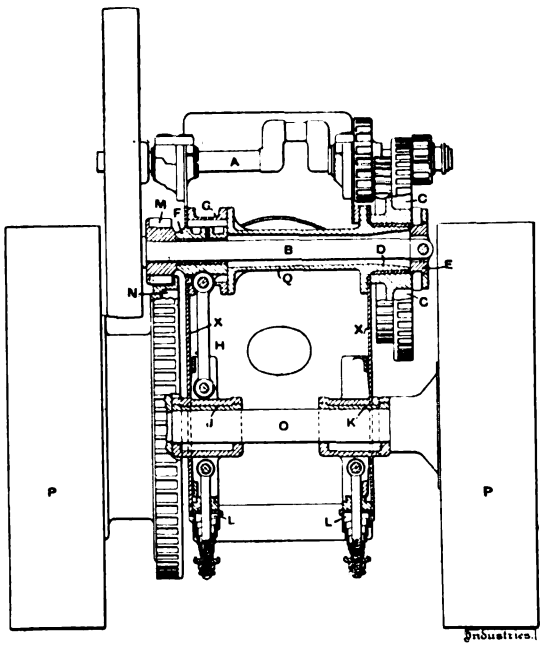
Fig. 2.

stroke is nearly completed, the stop V^2 comes against the plate A^3, draws down the slide valve V, and admits steam to the piston valve. The boiler liquid pressure acting upon the top part of B^1 and the lower side of A^1, forces them up and draws the feed supply through M B^4 into the cylinder B. When the piston has nearly reached the top of its up stroke, the plate A^3 comes against V^1, and raises the slide valve; steam thus enters through K and to the space above the main piston; the piston A^1 B^1 descends and forces the feed supply through T into the boiler. If the liquid in the boiler be at its normal working level the foot of the pipe Q^2 is sealed, and a column of water stands in it; the spiral spring S is now extended, and the rod C^2 passes up into the hydraulic cylinder B, and catching against the plunger, prevents the completion of the down stroke; the apparatus is thus brought to rest. As evaporation continues and the water level falls below the end of Q^2, the column of water falls into the boiler; the steam enters the pipe Q P, and forces down the regulator piston C^1 against the action of the spring S; the operation of the apparatus is then continued as before. Four claims are made.—No. 3729. March 11th, 1887. 8*d*.

Close Annealing Iron and Steel.—*J. E. East, Bilston, Staffordshire.*—The apparatus here described is intended as a substitute for the iron covers, dishes, and other appliances usually employed in close annealing iron and steel sheets. A dish is constructed as a movable platform which will form part of the bottom of the annealing furnace when it is in position. It consists of a cast iron plate, strengthened with ribs on the under side, and is carried on wheels which run on rails. The upper surface of the plate is protected with fire brick, and the cover which is placed over the metallic objects is composed of the same material. Cold air is allowed to circulate underneath the metal plate, in order to preserve it from the injurious attacks of the heat of the furnace. The advantages of this apparatus are that it is easily removable, is cheaper at first cost, and lasts longer than the apparatus hitherto employed. The inventor makes eight claims.—No. 6569. May 4th, 1887. 8*d*.

Hydraulic Lifts.—*B. Turner, London.*—In order to insure the safety of the cages of hydraulic lifts, the inventor suspends the cage by a single rope and connects them by a safety catch which grips the guides. Also two ropes are arranged so as to bear under ordinary circumstances only a slight straining load. These safety ropes are made of the same strength as the main suspending rope, so that if the latter rope should break and the safety catches fail to act, the cage will be suspended by strong ropes which have not been weakened by wear. To prevent the chafing of the three ropes, they are each run over separate pulleys; the ropes, when placed in this way, will not wear out so quickly. Three claims are made for the extra ropes which are not usually in strain, and for the method of arranging them upon the pulleys.—No. 16832. December 7th, 1887. 8*d*.

Traction Engines.—*F. J. Burrell, Thetford, Norfolk.*—The annexed diagram represents a transverse section of a traction engine embodying the present improvements. The crank shaft A transmits motion to the counter shaft B by means of pinions



gearing with the spur wheel C. This spur wheel revolves on the fixed tube D, and is connected to the counter shaft B by a universal joint. The other end of B is carried in a bearing F, which is free to move up and down in the box G. The link H connects F to the axle box J, which is free to slide up and down in the guides S secured to the horn plates X. A pinion M is fixed to the counter shaft, and gears with the wheel N, thus communicating motion to the road wheels P. The wheels M and N are prevented from altering the distance between their centres by the link H, and there is sufficient clearance at the sides of the teeth to allow for the sideway motion of the engine on its springs. An extension Q to the tube D is carried across the engine, and is bolted to the box G, thus forming a solid bearing for the spur wheel C, and a stay between the horn plates X. The inventor makes two claims: (1) For engine mounted on springs and having the counter shaft over the main axle; (2) for coupling one of the main axle bearings to the counter shaft, and connecting the opposite end of the counter shaft by a flexible coupling to a spur wheel mounted loosely on the fixed tube for the purpose described.—No. 5747. April 20th, 1887. 8*d*.

Valve Gear.—*W. Payton, Richmond, Surrey.*—The slide valve is operated by a mechanism attached to the cross head and connecting rod of the steam engine, and the usual eccentrics are dispensed with. A lever is pivoted at one end to some fixed part of the engine, and its other end is connected by means of a pin jointed rod to the cross head. The lever is vibrated on either side of a line at right angles to the line of motion of the cross head. A slotted link is fitted to a saddle piece, which is pivoted to the lever at such a distance from the fulcrum that each vibration of the lever moves the link through a distance equal to the travel of the slide valve between the two positions known as "lead." The saddle piece is pivoted to the lever in such a way as will permit the link to vibrate upon its pivots, which are placed near the centre of the slot. The end of the lever which is pin jointed to the rod connecting it with the cross head is provided with a bell crank lever moving on the pin of the said joint. One of the arms of the bell crank lever is connected by a pin jointed rod to an arm attached to the connecting rod of the engine, and the other arm is connected by a pin jointed rod to the above mentioned saddle piece in such a way that the motion of the connecting rod imparts motion to the saddle piece and slotted link. The slot in the link is of a curved shape, and a curved block slides in it. This block is connected to the slide valve by a rod whose length is equal to the radius of the curved slot. When the block is so placed in the slot that the centre of its pin joint is concentric with the pivots of the vibrating link, the motion of the cross head will cause the slide valve to travel from lead to lead only; but on shifting the block to any other position the slide valve will travel through a greater distance; and the engine can be reversed by moving the block from one side of its central position to the other. Two claims are made.—No. 6516. May 4th, 1887. 8*d*.

Pumping Engines.—*J. D. Wardale, Gateshead.*—The engine described in this invention is adapted to pumping matter which is not perfectly fluid, without the valves becoming clogged up. In the annexed diagrams, Fig. 1 represents a vertical section through the steam and water cylinders; and Fig. 2 is a cross

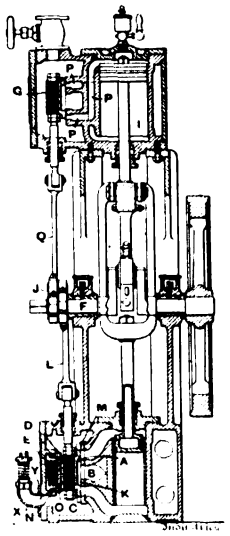


Fig. 1.

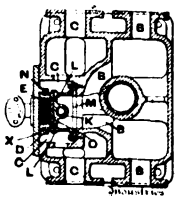


Fig. 2.

section of the water cylinder and valve. The slide valve A is employed to open the suction and delivery passage to and from the pumping cylinder; the inner part K opens to the suction passages at B, and the outer part of A opens to the delivery passages at C. The pressure of the delivery acts upon the back of A, and keeps it against the port faces at M; and any pressure in excess of that which is desirable is taken off the valve by a non-reciprocating box D pressed against the back of the valve by the delivery pressure. The inside of this box is in communication with the suction through the holes L; instead of this, a hole Y may be made for any leakage water to drain out, and in such case the atmospheric pressure would be inside the box. The spring E keeps the box D and valve A against their faces. The box may be of any shape, and is mounted so as to be capable of being pressed forward by the spring. In Fig. 1 it is shown mounted on the part of the casting N, and provided with loose packing rings X. The valve A is worked from the crank shaft F by cams, which also work the valve G. By crossing the ports P of the steam cylinder, so that they open to the valve chest at the ends opsosite to those at which they communicate with the steam cylinder I, one eccentric J can be employed to give motion to the valves of both the steam cylinder and the pump, by the rods Q and L^1. By the application of a slotted link over the eccentric, the travel of the valves may be regulated separately. Four claims are made—for the slide valve A which opens to the suction and delivery on its two sides, for the crossed ports of the steam cylinder, and for the slotted link, all for the purpose described.—No. 5584. April 16th, 1887. 8*d*.

Spinning Machinery.—*H. Stevenson, J. Webb, & S. Hallam, Manchester.*—These improvements relate to former patents granted to the same inventors, viz., Nos. 13440 of 1885, 4995 of 1886, and 3484 of 1887. In the apparatus described in these former patents, a hollow revolving spindle was employed, with a spinning device placed centrally above the tube, and with a wire hook placed centrally at the bottom of the tube. The present improvements consist in placing a flier below the hollow revolving tube and secured to it. The yarn is taken down the hollow tube, doubled over the leg of the flier, and led to a traveller. The effect of the flier is to assist materially in driving the traveller, thus tending to diminish and equalise the strain on the yarn as it is wound upon the bobbin. Three claims are made for the application of the flier on the bottom of the revolving spindle, in conjunction with the traveller, as described.—No. 6904. May 11th, 1887. 8*d*.

Yarn Taping Machines.—*J. Sugden & H. Colburn, Keighley, Yorkshire.*—The object of this invention is to deliver the threads from the beaming rollers to the loom warp beam at a uniform tension. A series of beaming rollers, having a gudgeon at each end, are mounted in a frame, and the gudgeons project into vertical slots; the roll of thread on each beam rests on a revolving driving drum, which causes the beam to rotate by frictional contact. The loom warp beam is driven in the usual manner, and the driving drums are caused to revolve by a shaft and gearing connected to the winding head of the machine. The gearing is so arranged that the circumference of the roll of warp on the loom warp beam travels slightly faster than that of the roll on the beaming rollers. Three claims are made.—No. 6526. May 4th, 1887. 8*d*.

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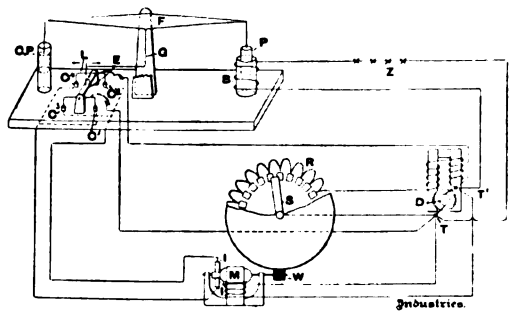
ELECTRICITY.

DYNAMOS.—*A. J. Gravier, Paris.*—In order to increase the efficiency and economy of a dynamo, the armature is placed within a field whose magnets are either not opposed to each other, or if opposed in position, are, by reason of their unsymmetrical form, caused to act and re-act in a new manner. This arrangement is applicable to various constructions of dynamos. In applying it to the Gramme machine, the extension of one pole is made to the right, reaching nearly round to the opposite pole, and the extension of the other pole is made to the left in a similar manner. Also the armature is made to carry an amount of wire equal to that of the field magnets, in order to increase the e.m.f. Nearly the whole of the armature wire is used to the profit of the induction; it follows that the neutral field is reduced almost to a point. The same results are obtained in machines of the Siemens type by coiling the upper right hand bar and the lower left hand bar of the field. Three claims are made.—No. 5709. April 19th, 1887. 8*d.*

TANNING BY ELECTRICITY.—*E. Worms & J. Balé, Paris.*—The current of electricity sent through the contents of the tanning vessels has been found to accelerate the process of tanning. The vessel used in the apparatus here described consists of a rotating drum, upon the circumference of which are fixed two metallic rings electrically connected with circular conductors in the interior of the drum. By means of two spring rubbers connected to the two poles of a battery, and bearing against the external rings of the drum, an electric current is caused to pass through the contents of the drum during its rotation. Two claims are made for the construction of the drums with the rings for the purpose described.—No. 9515. July 5th, 1887. 8*d.*

DISTRIBUTION OF ELECTRICITY.—*W. Maxwell, London.*—This invention relates to a system of generating and distributing electricity in which continuous currents are employed. The continuous current is transmitted from the dynamos to the distributing centres, where a set of transformers change the current and its electromotive force. In conjunction with the transformers, secondary batteries are used to store either the primary or the secondary currents. When there are a number of distributing centres connected to one generating station, they may be connected together, so that no inconvenience shall be entailed by a temporary breakdown. The inventor makes two claims for the combination of reproducing transformers with storage batteries, as described.—No. 5562. April 16th, 1887. 6*d.*

ELECTRICAL CONTROLLING APPARATUS.—*A. Siemens, London, and E. F. H. H. Lauckert, Charlton, Kent.*—The electric lamps being in the main circuit of the dyamo and the field magnets in a shunt circuit, the current is regulated by introducing a resistance into the latter circuit varying with the number of lamps in use. The main current is led through the coil of a regulating solenoid which has a movable equipoised core. The core moves in obedience to the attraction of the solenoid, and consequently makes one or other of two sets of contacts, according to its direction of motion; a small electromotor is brought into circuit by this means, and a greater or less number of resistances are introduced into the shunt circuit of the field magnets; the current in the main circuit is thus kept constant. The accompanying drawing illustrates diagrammatically an arrangement suited to supply a number of arc lamps Z. The main dynamo is at D; to the terminals T T¹ is attached a shunt circuit, which includes the field magnet coils of a small electromotor M. The worm W gears with a wheel which carries an arm S moving over



contacts for a number of resistances R. The regulating solenoid B has a core P linked to one end of the beam F, and a counterpoise C P is fixed to the other end. The arm G projects down from F, and is linked to a vertical arm L of a rocking shaft E, from which four wires project into the mercury cups $C^1C^2C^3C^4$. The current from T passes through the lamps and the coil of the solenoid B and back to T^1. When the current increases, the core P is drawn down and cants the beam F and shaft E, thus causing the wires to be immersed in the cups C^3C^4. A current from T is thus passed through C^3 to I, and from I^1 through C^4 and T^1, causing the worm W to revolve and drive the wheel in one direction, so that its arm S introduces an increased number of resistances R into the field magnet circuit until the current is brought back to its usual strength. When, on the other hand, the current from the dynamo decreases, the core P is raised and the shaft E is canted so as to immerse the wires in C^1C^2. A current from T then passes through C^1 to I^1, and from I through C^2 to T^1, causing the worm W to revolve in the opposite direction, and the arm S to move so as to lessen the number of resistances R in the field magnet circuit. Four claims are made.—No. 5637. April 18th, 1887. 8*d.*

GALVANOMETERS.—*P. Jolin, Bristol.*—The inventor attaches the magnet of a Thomson's syphon recorder directly to a rigid horizontal or vertical plate, which also carries the central core. This core is preferably formed of a compound magnet, in order to strengthen the field. The lower suspension is carried by a spring attached to the same plate, and the suspension is lengthened when in the vertical form by drilling a hole through the neutral part of the magnet, and allowing the suspension to pass through it to the spring; the electric connection is in that case made from this plate through the spring and lower suspension to the coil. In order to allow an adjustment for the coil the top suspension is attached to another plate, or to a tube with a suitable metal head capable of a rotary motion in a horizontal plane. The head is provided with another adjustment to raise or lower the coil; the top plate forms the other connection through the metal head and top suspension of the coil. The two plates, or the plate and tube, are attached to a piece of hard wood, which is provided with binding screws. The connection is made with mercury cups of a peculiar kind. The cup is of large size, and is well amalgamated in the interior up to ½in. of the top; an inverted cone piece fits tightly into the top of the cup; the cone is small at the bottom, and tapers inside and out in order to be of uniform thickness, and has a large opening at the top like a funnel. The inside of the cone is lacquered and the outside is amalgamated. By this arrangement, when the instrument is tipped over, the mercury follows the amalgamated part into the top of the cup instead of falling out. The inventor makes twelve claims.—No. 4369. March 23rd, 1887. 8*d.*

DYNAMOS.—*W. H. Ravenshaw, Halifax, W. T. Goolden, & A. P. Trotter, London.*—In winding a drum armature the inventors cover the whole of the periphery with the wires wound thereon, and hold the wires in place by passing between the coils a series of projecting pieces attached to the ends of the armature. The whole of the periphery is thus used for the purpose of winding. In the accompanying drawings Fig. 1 is a sectional elevation of part of the commutator end of the armature, and Fig. 2 is a plan of the opposite end. The core C is formed of iron discs J; outside the discs is placed a disc of vulcanised fibre D, which is

FIG. 1.

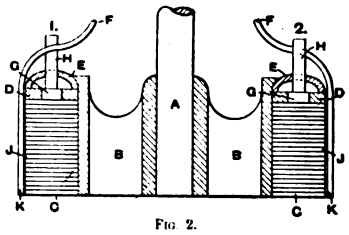
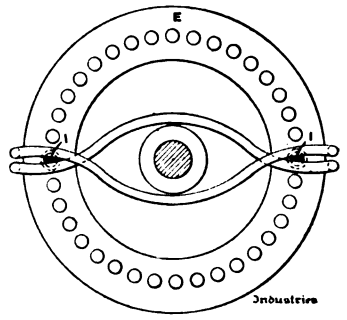


FIG. 2.



pierced to receive the heads G of the fibre pins or projecting pieces H. These pins are formed with flattened shanks, as shown in Fig. 2. An outer ring of cast iron E is secured to the armature, in order to retain these pieces in their places. The ring is pierced with holes, through which the shanks I of the fibre pins project. The wires K, after traversing the periphery of the armature in any desired manner of winding, have their ends F brought past the pins 1 2 to the commutator. In Fig. 2 a typical method of passing the wires round the pulley end is shown, the pins I in this case serving to retain the two adjacent wires in place. It is equally permissible to employ two or more sets of pins, as the particular method of winding may necessitate. The inventors claim the method of constructing the armature with end pins for the purpose of retaining the wires in their places.—No. 5303. April 12th, 1887. 8*d.*

CHEMISTRY.

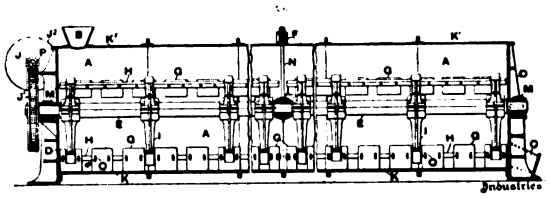
CHLORATES OF THE ALKALIES.—*H. Gall & Viscount Amaury de Montlaur, Paris.*—The process described in this invention relates to the manufacture of the chlorates of the alkalies from the corresponding chlorides. The solution of the respective chloride is submitted to the action of an electric current in a trough which is provided with a porous partition. The trough may be of earthenware, and is divided into ten parts by a diaphragm, which may be composed of porous earthenware. To avoid the reducing action of the hydrogen which is separated at the negative pole, the liquid in the negative compartment is caused to circulate by exterior tubes towards the positive compartment, so that the base formed may combine with the chloric acid. Platinum and iron are employed for the positive and negative electrodes respectively. For separating the chlorate advantage is taken of their difference in solubilities in water. One claim is made.—No. 4686. March 29th, 1887. 6*d.*

TREATMENT OF PHOSPHATES.—*W. L. Wise, London. (E. Solvay, Brussels.)*—In order to prepare phosphates for use in agriculture, the inventor mixes the phosphate with silica or alumina in such quantities that the silica and alumina will be sufficient to take up all the bases, either free or united to the phosphoric acid. The mixture is heated along with fuel which is adapted to the particular phosphate in use. To the products thus obtained is added common salt or chloride of potassium, and the whole is calcined in the presence of air or steam. Chlorine or hydrochloric acid is set free, and the residuum contains a soluble phosphate of soda or potash. This phosphate, on being treated by lime, gives precipitated dibasic phosphate and a solution of caustic soda or potash. The apparatus employed in carrying out this process consists of a reverberating furnace, or of a revolving furnace used in the Leblanc process. One claim is made for the process for liberating the phosphoric acid from the phosphate of lime, as described.—No. 6632. May 5th, 1887. 6*d.*

CAUSTIC SODA AND POTASH.—*A. Delhaye, Brussels.*—This process is based on the preparation of phosphate of soda either by decomposing sea salt with phosphoric acid, or by precipitating a concentrated solution of acid phosphate of calcium by sulphate of soda. The phosphated mineral is mixed with a sufficient quantity of hydrochloric acid to dissolve the whole of the phosphoric acid. The reaction having taken place, some sulphuric acid is added, and sulphate of lime is precipitated. Common salt is then added, and the acid phosphate of sodium is produced. If sulphate of soda is employed the mineral is mixed with a certain quantity of sulphuric acid; the mass is stirred until the reaction ceases, and sulphate of soda is then added. Sulphate of lime and acid phosphate of soda are thus produced. The acid phosphate so obtained is employed in the manufacture of soda, after the addition of a proportion of carbonate of soda. Four claims are made for these two processes.—No. 4371. March 23rd, 1887. 6*d.*

SACCHARINE.—*A. G. Salamon, London.*—The object of this invention is to prepare a soluble powder of saccharine without the usual quantity of alkali. The amounts made use of in this preparation are: Saccharine 25lb., bicarbonate of soda 10lb. 3oz., and a suitable proportion of water. The mixture is evaporated, and the resulting product weighs 28lb. 3oz. The powder thus obtained contains 90 per cent. of saccharine, and is soluble in 20 per cent. of its weight in cold water. The inventor makes one claim for this process.—No. 13839. October 12th, 1887. 6*d.*

MANUFACTURE OF CAUSTIC ASH.—*T. T. Mathieson & J. Hawliczek, Liverpool.*—According to the present invention, caustic ash is manufactured from a mixture of monocarbonate and bicarbonate of soda by the injection of a spray of strong caustic liquor while the soda is being continually agitated. One form of apparatus designed for carrying out this process is illustrated in longitudinal section in the diagram. The lower half K of the vessel A is made of cast iron, and the upper half K^1 of wrought iron or steel. The upper half is of light construction and serves chiefly as a covering, while the bottom part is placed above a furnace, and also bears the greater proportion of internal wear, owing to the action of the agitated material. B represents the hopper which allows the introduction of the carbonates, and C the shoot through which the ultimate product makes its exit. The ends D are made in halves, and carry the bearings M for the main shaft E; the suspended bearing L is placed midway between the ends, and is held in position by the rods N. The blades or scrapers G are secured to bars H, which are of rectangular cross section, and are carried by the arms I mounted on the shaft E. The ends of these arms are provided with caps, which are bolted to the arms, gripping the bars H between themselves and the main portion of the arm. J represents a worm, and J^1 a worm wheel mounted on the end of E; this gear serves to drive the shaft and scrapers. The caustic liquor is supplied in the form of a spray through special perforations in the side of the case. It is so arranged that the bicarbonate shall have been converted by the scrapers into monocarbonate



before the sprays reach it, on account of the fact that the liquor affects the monocarbonate more readily. The interior of the chamber may be kept free from scale by providing every alternate blade with an auxiliary scraper. The case is preferably 30ft. long, and the shaft performs three or four revolutions per minute, and the material will be propelled from one end to the other in three-quarters of an hour. Five claims are made for the process, and for this and another form of apparatus.—No. 5757. April 20th, 1887. 11*d.*

MISCELLANEOUS.

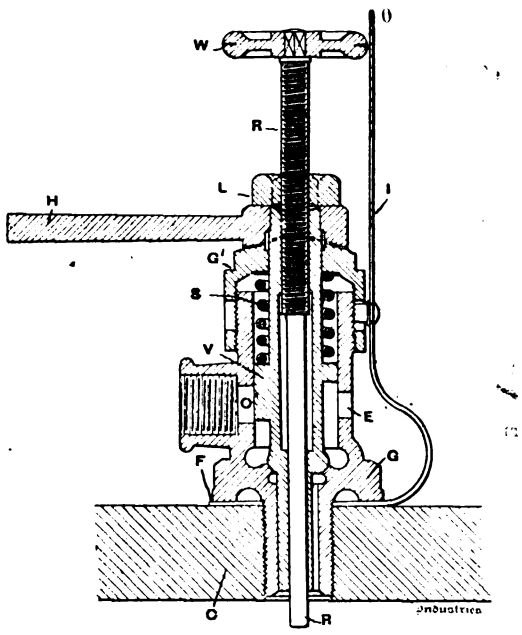
TREADLE MECHANISM.—*P. L. Gerisher & F. W. M. Schröder, Leipzig.*—In the improved mechanism there is a crank, one of whose arms moves in a slot radially arranged in the fly wheel, while the shorter arm is connected by a rod with the treadle. The shorter arm of the crank is turned by foot pressure, and the motion is transmitted to the longer arm, which moves the fly wheel. The crank shaft is so arranged with regard to the main shaft that the longer crank arm acts eccentrically on the fly wheel. The longer arm is so arranged that the lever length with which the fly wheel is moved is the greatest when the poise of the fly wheel acts with its gravity against the revolution of the fly wheel; and its lever length is smallest when the poise has arrived at its opposite position, in which case it contributes to the revolution of the wheel. Therefore the lever length with which the fly wheel is moved is increased with each revolution in the same proportion in which the action of the poise against the revolution of the fly wheel increases, and is decreased again in the same proportion in which the action of the poise for the revolution of the wheel increases. In this way, it is claimed that the utilisation of force of each revolution is more uniformly distributed, and a more uniform motion of the fly wheel is obtained. One claim is made.—No. 6512. May 3rd, 1887. 8*d.*

MANUFACTURE OF PAPER PULP.—*A. Wilkinson, Chiswick, Middlesex.*—One hundredweight of vegetable fibre is submerged in a tank containing 250 gallons of hot water, to which is added about 5lb. of chloride of lime and 3lb. of sulphuric or hydrochloric acid. After this solution has stood for twelve hours, the gummy matter contained in the fibre will be loosened. On the completion of this process, the fibre is removed to an ordinary close boiler, and there boiled to any suitable pressure depending on the nature of the fibre under treatment. The fibres are afterwards boiled in a vessel containing spent chlorine liquid. For this purpose 250 gallons of chlorine liquid is placed in a close boiler, with about 80lb. of crystalline soda and 14lb. of hydrochloric or sulphuric acid. This mass is allowed to remain at a temperature of 75°F until the solution is complete. The

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fibre is then boiled in this liquid to any suitable pressure for six or eight hours; the liquid is afterwards drawn off and placed in tanks for the next batch of fibre to be treated. The fibre is washed in hot water and boiled in another similar solution of chlorine liquid. The next operation to which the fibre is submitted is the washing in 500 gallons of water in which is contained 28lb. of acid. After this treatment the fibre is ready for bleaching. For this purpose 1cwt. of the fibre, 7lb. of sulphide of barium, and 7lb. of acid are mixed in a tank and allowed to remain for six hours, after which time the fibre is transferred to a solution of 4lb. of bisulphide of lime or magnesia and 1lb. of sodium hypochlorite in 500 gallons of cold water. In weighing the pulp before it is run on to the rollers of the paper machine, a pulp of rice, animal size, and baryta is mixed with the fibre, and a little starch and borax may be added to produce a glaze upon the surface of the paper while passing between the rollers. One claim is made.—No. 3937. March 15th, 1887. 6*d*.

Safety Apparatus for Steam Cylinders.—*J. S. Warburton and H. J. Sanderson, London.*—In order to reduce the clearance in the cylinder to a minimum without entailing any danger, the inventors place relief valves at both ends of the cylinder. A spindle projects from the valve into the cylinder, and as long as the piston pursues its right path it does not come in contact with it; but directly the spindle is pressed the valve is operated as afterwards described. The figure represents a longitudinal section of the apparatus. The valve box G is furnished at its lower end with a screw thread for fixing it to the cylinder. The orifice E allows the steam to escape when the alarm is given, and the orifice O is brought into operation when the apparatus is used as a drain cock or relief valve. The valve V is held to its seat by the spring S, whose reverse end presses against the inside of the gland G¹. The rod R passes through the centre of the relief valve, and is surmounted by an index wheel W. The



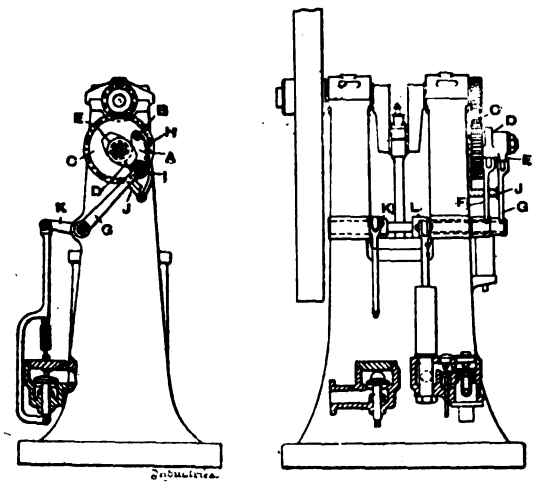
check nut L locks the rod R after having adjustment, and prevents the emission of steam beyond the end of the relief valve. The index plate I carries a scale on which can be read the distance between the end of the rod R and the cylinder cover. The handle H is provided with an inclined boss, which rests upon the gland G¹. This gland is also provided with a corresponding scroll, so that when the handle is turned the valve will be raised from its seat to allow a free passage for the steam, either to the drain orifice O or to the alarm orifice E, according to the direction in which the handle is turned. When the handle is in the central position the relief valve V remains upon its seat, and all communication is stopped until the valve is raised by pressure at the end of the rod R. The rod R may be raised either by the piston or by the too great pressure of the steam. Five claims are made for the combination of valve V, rod R, and handle H, as described.—No. 5585. April 16th, 1887. 8*d*.

Elevating Band Chains.—*J. Qualter & E. Hall, Barnsley.*—The usual picking bands and elevating band chains have hitherto been made from expensive forgings or malleable castings. The present inventors use a section of L shaped iron, rolled expressly for the purpose, and cut into lengths to form links. These links are riveted together at suitable centres, so as to pass over flat sided drums. A semi-circular piece is taken out of each end of the links; at the upper side of each link a steel plate is secured, which is riveted to the flange of the link. The inventors do not limit themselves to this particular form, but claim the construction of the improved band made from specially rolled iron or steel for the purpose described.—No. 6374. May 2nd, 1887. 6*d*.

Decorating Tin Plates.—*F. H. Rees, London.*—In the ordinary transfer system of decorating and printing on tin plates, the impression is often spoilt by the removal of the paper. In order to obviate this and other disadvantages, the inventor takes a piece of mill board and renders it water proof by rubbing it over with hydrocarbon oil. A covering of varnished cloth or oil baize is attached to the board; the surface of this material is made perfectly level and smooth, and is rubbed over with hydrocarbon oil and turpentine. The required design is made in the usual manner upon the stone, wood, or metal plate. An inked impression of the design is made on the prepared board, and from thence transferred to the tin plate. In practice the two sides of the board are used alternately, so as to save time and expense. One claim is made for the process of transferring the printed design by means of the prepared board.—No. 14321. October 21st, 1887. 4*d*.

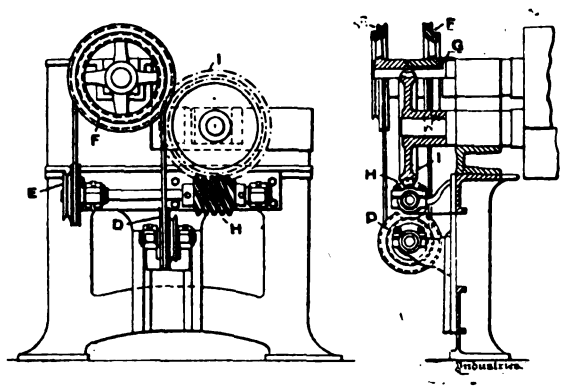
GERMAN PATENT ABSTRACTS.

Gas Engines.—*C. Pieper, Berlin.*—This invention relates to the valve gear and regulation of gas engines. The igniting apparatus and the exhaust valve are actuated by the catches D and E and the levers F, G, K, and L. The catches D and E are



revolved by a cog wheel C, which is fitted with a weight A. If the speed of the engine exceeds a given limit, the weight A is moved towards the circumference of C, actuating the lever I in such a manner that the catch J engages with the lever G, thereby influencing the exhaust valve and retarding the speed of the machine.—No. 42600. August 31st, 1887.

Rolling Mills.—*P. Tafel, Augsburg.*—The motion of the roller actuated by the power is transmitted to the other roller by means of a rope and a worm H and worm wheel I. The endless rope is conducted over a pulley C keyed to the roller



shaft, then over an adjustable pulley D to a loose pulley F on the same shaft as C. From F it goes round a pulley E keyed on to the shaft of the worm H, and then back over C. In order to alter the relative speed of the two rollers, the pulleys are cone pulleys, and the tension of the rope is adjusted by moving the pulley D up or down.—No. 42354. March 31st, 1887.

UNITED STATES PATENT ABSTRACTS.

Steam Engine.—*J. D. Bowne, Jamesburg, New Jersey.*—The cylinder oscillates in horizontal bearings, and is supported on two trunnions fixed to the middle of its length. One of the trunnions is bored out so as to form the sides of the steam chest. The steam pipe passes through a circular stuffing box, and the steam arrives on the face of a stationary side valve. The oscillating motion of the cylinder over the face of this valve brings the two steam ports and the exhaust port into register with openings in the valve at the right time. The inventor makes three claims for this method of supplying the cylinder with steam.—No. 379630, dated 20th March, 1888.

Propelling Water in Pipes.—*T. H. Bolmer, New York.*—The apparatus here designed for the purpose of setting up a current of liquid consists of a chamber which forms an enlargement of the pipe. The water enters the chamber through a valve which opens in the direction of the flow, and another valve at the point where the water leaves the vessel opens in the same direction. Two gas chambers containing air and hydrogen respectively are connected by means of pipes to the upper part of the large vessel, and their contents fill it partially with the explosive mixture. When sufficient water has entered the chamber an explosion is caused which drives the water through the valve in the exit pipe. The repetition of this process generates a constant flow of the water. Two claims are made.—No. 379674, dated 20th March, 1888.

Corn Planting Attachment for Ploughs.—*F. L. Aten, Round Rock, Texas.*—This attachment may be combined with a plough of any construction, and is supported by a downwardly projecting bracket secured to the inner side of the rear end of the beam. A box or flanged way is fixed upon the side of the bracket, and a standard slides in it. A seed box is carried at the upper end of the standard, and is provided with a longitudinal groove in its upper side, and with slots in the end walls registering with the groove. An arm projects laterally from the lower end of the standard, and carries a wheel; a system of levers transmits the rotary motion of the wheel to the rear end of the seed slide, and so causes the grain to be deposited in the ground at intervals. Two claims are made.—No. 379554, dated 20th March, 1887.

Filtering Plug.—*W. H. Macdonald, Washington.*—This invention is intended to be inserted in ordinary house water taps. The plug is of the usual shape, but is made hollow for the reception of some coarse filtering material such as charcoal. The openings in the side for the passage of the water are covered with fine wire gauze in order to confine the charcoal. A handle at the top screws on a short thread on the upper end of the plug, so that the plug can be turned round in one direction; when turned in the contrary direction the handle screws off, and exposes a hole in the plug through which the filtering material is inserted. In order to prevent the screw jambing, two notches are made in the handle, which fit in corresponding notches below the screw thread on the plug. Four claims are made.—No. 379801, dated 20th March, 1888.

Steel Springs.—*E. W. Gillon, Brooklyn.*—In forming steel springs from Bessemer steel wire, the wire is first hard drawn, and then bent into the requisite shape. The hot metal is immersed in an oil bath, and afterwards in a bath of molten metal. The spring thus formed is finally cooled by being plunged into a common tempering bath. Two claims are made for this process, as described.—No. 379573, dated 20th March, 1888.

Valve Gear.—*L. H. Nash, Brooklyn.*—This invention is a device for making the piston act as its own inlet and exhaust valve. The piston A works in the cylinder C, and the connecting rod D¹ imparts rotary motion to the shaft C¹. A port F¹ is formed in the side of the piston, and leads to its lower end. The two

Fig. 1.

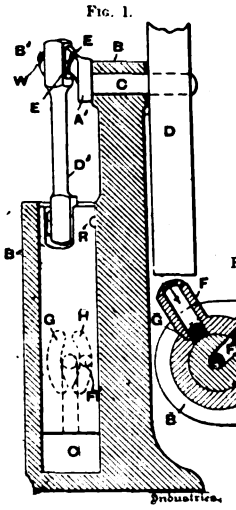
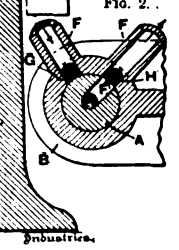
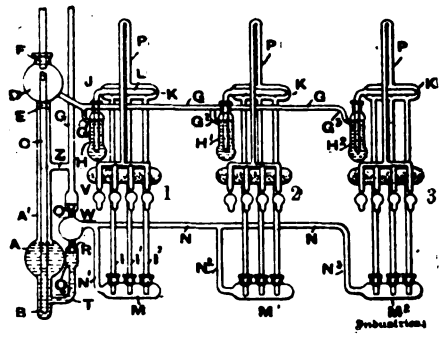


Fig. 2.



ports G H in the side of the cylinder act as the steam and exhaust ports respectively. The crank pin is inclined to the axis of the shaft C¹, and the bearing parts E at each end of the connecting rod have cylindrical interior and exterior bearings arranged at right angles to each other. The piston A thus receives an oscillating motion round its cylindrical axis, and acts as its own slide valve. Five claims are made.—No. 378847, dated 28th February, 1888.

Air Pump.—*H. J. Doerr, Newark, New Jersey.*—The arrangement of this mercury air pump will be understood by reference to the diagram. The mercury reservoir is shown at A; the



tube A¹ is closed at its upper extremity; and the suction pipe C extends between the upper reservoir D and the lower reservoir A. The tube Y is connected with the tube A¹ through the tubes T and Z; and two valves W and R regulate the entry of the air and mercury into the bulb O. The bulb O is in communication with two series of chambers M M¹ through the pipes N N¹, and the bulb D is connected with the vessels K K¹ by means of the tubes G J. The fall tubes are shown at I, and the exhaust tubes at P. Two claims are made for this air extractor.—No. 378666, dated 28th February, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

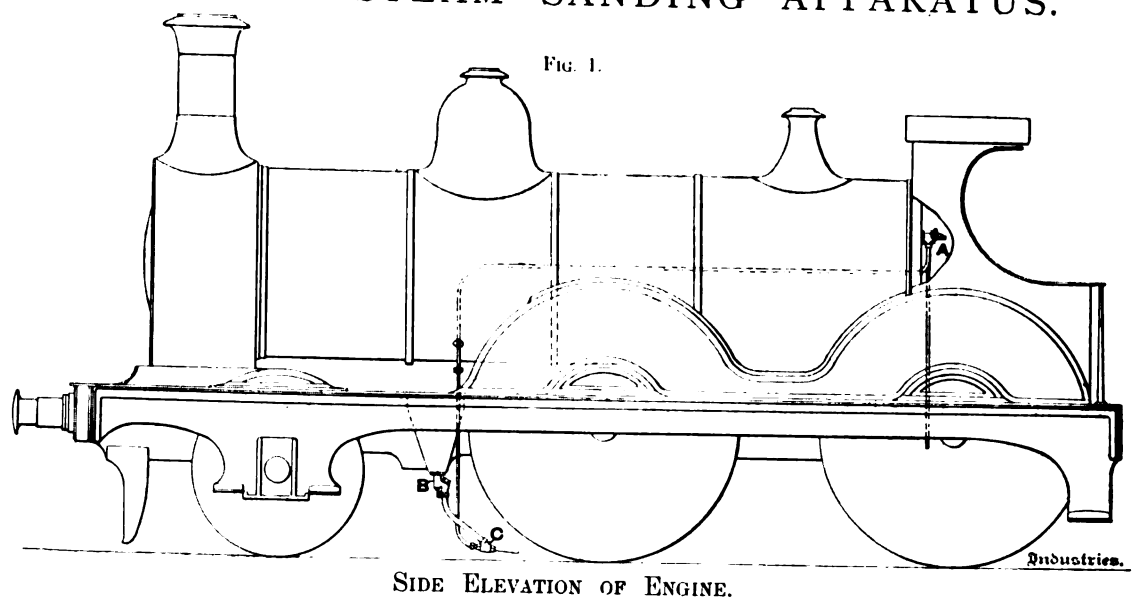
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IMPROVED STEAM SANDING APPARATUS.

ARRANGEMENTS to prevent locomotive wheels from slipping have hitherto not received that attention which their practical importance deserved. This fact is the more surprising, when we consider how greatly the economic working of the locomotive is affected by the slipping of the driving wheels. The apparatus we illustrate herewith has been devised to meet this want, and is manufactured by Messrs. Gresham & Craven, engineers, Salford. As will be seen, it is extremely simple in construction, and a great improvement upon the old fashioned system of sand box and pipe. Referring to our illustrations, Fig. 1 shows a side elevation of a locomotive fitted with the complete apparatus, and Figs. 2, 3, and 4, vertical sections of the details. It will be seen from Fig. 1 that the arrangement consists essentially of three parts: The steam valve A for supplying and regulating the steam to the ejector, a sand trap B which can be fitted on existing sand boxes, and the small ejector C, which lifts the sand, and impels it under the wheel at the line of tread. In this apparatus it has been found desirable that the steam should be perfectly dry, and an ingenious method of accomplishing this end may be seen in the steam valve section (Fig. 2); the condensed steam which accumulates being allowed to escape through ports in the plug, and conducted away by a drip pipe. The method of working this system is as follows: The driver, by means of the valve A, admits steam to the ejector, as shown by the horizontal arrow in Fig. 4. As indicated by the arrows, the air is thereby drawn in through the hole in the cap of the sand trap. It then strikes on the sand, which is scoured on the surface, and carried down until it comes in contact with the steam jet. It then mixes with the steam, and is driven under the wheel. The makers claim the following advantages for this system: The use of coupling rods may be dispensed with, as a single engine fitted with this apparatus has as much adhesion as a coupled engine without it; great saving of sand, as the apparatus is able to deliver in large or small quantities; absolute certainty of delivering at the position required, irrespective of wind; simultaneous delivery to both wheels, thus minimising the liability to injure or strain the driving axles; and no rods or levers are required for working the gear. No additional train resistance is caused, as no superfluous sand is left on the rail, and by the prevention of slipping some economy in fuel is effected. We understand that the apparatus is being used on nearly every important railway in the kingdom, including the Midland, Great Northern, and the Manchester, Sheffield, and Lincolnshire lines, and has given complete satisfaction.

IMPROVED STEAM SANDING APPARATUS.

FIG. 1.



SIDE ELEVATION OF ENGINE.

FIG. 2

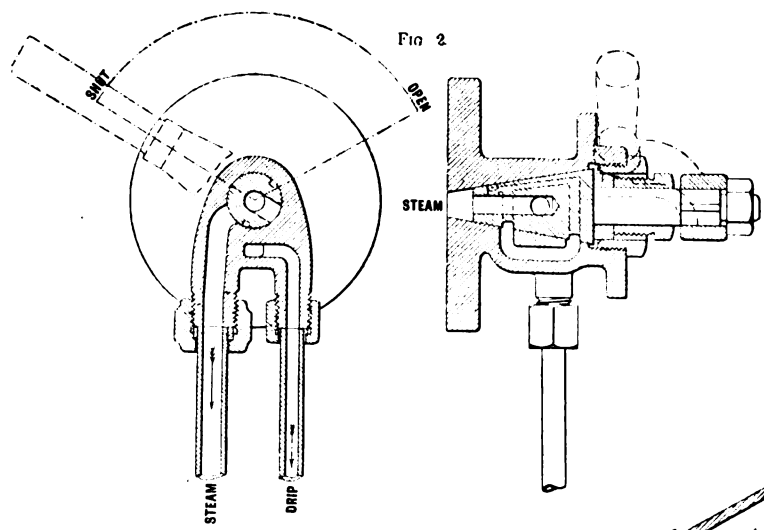


FIG. 3

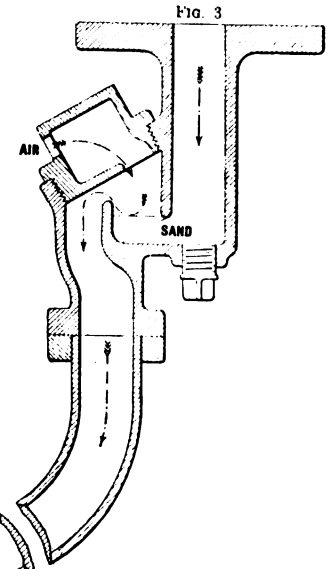
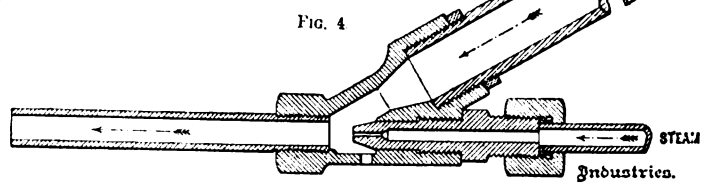


FIG. 4



DETAILS OF SANDING APPARATUS.

INSTITUTION OF NAVAL ARCHITECTS.

(Concluded from page 366.)

THE next paper read was by Mr. W. C. Wallace, on

THE MATERIAL BEST SUITED FOR PROPELLER BLADES.

In this paper the author presented data regarding the strength, durability, and cost of propeller blades made from various materials. These materials were the following: Cast iron, steel, gun metal, manganese bronze, phosphor bronze, delta metal, and aluminium bronze.

Until recent years cast iron was the material most generally in use for propeller blades, and is still in favour with some engineers. Its most serious defect is its liability to fracture, and the increase in thickness of the blade necessitated thereby. It is not to be recommended where trustworthiness is a desideratum, but has the advantage of being cheap, of preserving the true form of the screw in casting, and of having a smooth surface. Cast iron propeller blades require to be renewed every five or six years. The cost of finished blades may be taken as from £20 to £24 per ton.

The introduction of mild steel as a material for propeller blades has been a great improvement, rendering them absolutely trustworthy as regards strength, but bringing about the evil of corrosion. The blades become so pitted and broken in a few years that they have to be renewed, and with steel it is not possible, as with cast iron, to burn on new tips. The life of steel blades varies from three to six years. Many attempts have been made to protect steel blades from becoming pitted by a covering of some other metal. Mr. Johnstone applied tin to the back of the blades near the tip, and other inventors have applied brass plates to cover that portion of the back of the blades which is most subject to corrosion. It is, however, extremely difficult to prevent water from getting behind the coating, and thus setting up galvanic action. The present price for finished steel blades is from £35 to £40 per ton.

Gun metal has been used almost as early as cast iron, but the use was restricted to the Royal Navy and to small private vessels. It has great resistance to corrosion, the life of the blades being in most cases longer than that of the ship; but owing to the galvanic action between the blades on the hull, serious pitting would take place in the stern frames and plating if the latter were not protected by placing strips of zinc round the inside of the propeller aperture. The zinc is consumed, but the hull is preserved. The quantity of zinc required for a propeller of 20ft. diam. is about 3cwt., and must be renewed every twelve or fifteen months at a cost of about £10. In point of strength gun metal is only slightly ahead of cast iron, but it is not so brittle. The present price for finished blades is about £130 per ton.

Manganese bronze, like gun metal, is free from corrosion, but is difficult to cast, and sets up galvanic action, requiring the application of zinc, as already explained. Its price is about £5 higher than that of gun metal.

Phosphor bronze has an ultimate tensile strength of 15·8 tons, and in this respect is not much superior to either gun metal or manganese bronze; but its elongation is 17½ per cent., showing its great ductility. No large propellers have, so far as the author is aware, been made of this metal; but in steam launches and torpedo boats it has been used. The price of finished blades is £170 per ton.

Delta metal, which is an alloy of copper, zinc, and iron, and which has a breaking strength of from 15 to 23 tons, with an elongation of from 10 to 20 per cent., has to a limited extent been used for the propellers of sea-going ships; but the author was unable to speak either of its trustworthiness or of its lasting qualities. The price for finished blades was given as £115 a ton, or five times that of cast iron, and three times that of steel.

Aluminium bronze has up to the present been little used for propellers of any size; but if aluminium brass is all that the advocates of this material claim for it, the author considers it likely that it will be largely used for propellers. The following table gives some data as to the strength and elongation of some aluminium alloys manufactured by the Cowles Company:—

Bronze composition.	Elongation per cent.	Tensile strength. Tons per sq. in.
Copper and 8% aluminium and silicon.....	23·7	26·1
" 10 " "	3·2	30·4
" 8½ " "	26·0	27·2
Brass composition.		
Copper, 3½ aluminium and 33½ zinc	1·6	31·3
" " "	2·5	36·8

An 8½ per cent. aluminium bronze is recommended by one of the officials of the United States Navy for twin screws, but the high price of £235 per ton for finished blades renders its adoption in the merchant navy almost impossible. The following table contains a summary of the strength and elongation of the various materials above enumerated:—

	Ultimate tensile strength. Tons per sq. in.	Elongation. Per cent.	Weight to break bar 1in. by 1in., 12in. between supports. Cwt.
Cast iron	10	—	18
Steel	31	10	55
Gun metal	14	9	23
Manganese bronze.....	15	—	28
Manganese bronze (by Bronze and Brass Co.)	—	—	45
Phosphor bronze (by Phosphor Bronze Co.).....	16	17	24
Delta metal.....	19	15	—
Aluminium brass	34	2	—

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Practical experience has led to steel blades being made 25 per cent. thinner at the root than cast iron, whilst for manganese bronze and aluminium brass an allowance of 30 per cent. may be assumed. Delta metal may be allowed 25 per cent. reduction, and gun metal and phosphor bronze each a reduction of 10 per cent. Making these allowances, the relative cost of blades compared with cast iron is as follows:—

	Cost per ton.	Equivalent cost of blades for every ton of cast iron blades.
	£	£
Cast iron	24	24
Steel	38	33
Gun metal	130	144
Manganese bronze	135	123
Phosphor bronze	170	153
Delta metal	115	110
Aluminium bronze	145	139

The relative first cost is, however, not the only item of expenditure which must be considered. Shipowners must remember that the renewal of blades and the difference in power consumed are also important matters. Assuming cast iron blades to last six years and steel blades four years, then for a vessel of 5000 tons, having four propeller blades of joint weight 12 tons, if of cast iron, an expenditure of £288 every six years, and if of steel an expenditure of £396 every four years, would have to be incurred. The saving in the cost of cast iron would allow of three out of the four blades being replaced every four years, after failure due to accidents of such a nature as would leave steel intact. Comparing steel with the other metals in the table, the author pointed out that with steel the coal bill would be larger and the renewals more frequent. The power required with a propeller of manganese bronze is 4 per cent. lower than that with a steel propeller of the same shape and doing the same work, and in the case of a 5000-ton ship, consuming 50 tons of coal a day, the saving would be £2 daily, representing an annual charge against steel blades of £300, taking one hundred and fifty as the number of days at sea. In four years the amount becomes £1,200, which, added to the £396 given above as the price of steel blades, makes £1,596 as the disbursement in connection with steel blades for four years; whereas with gun metal blades the total cost of the propeller would be £1,728, and this expenditure would be equivalent to that of a steel propeller if the gun metal propeller had to be renewed every 4⅓ years.

The discussion was opened by Admiral Colomb, who asked for information as to the cause of corrosion of steel blades. It seemed to him remarkable that the corrosion should take place at the back of the blades, and that the grooving should be radial instead of circumferential.

Mr. Hall, although speaking as a steel manufacturer, could not deny that as regards corrosion, steel is far worse than cast iron. The speaker advanced a very extraordinary theory as to the cause of corrosion. Some four years ago, he had to examine an old steel boiler, in which the rivets were of wrought iron, and he found that the material surrounding the rivets had deteriorated. This he explained by a transfer of carbon from the steel plate to the wrought iron rivet, which, as he termed it, sucked away the carbon out of the boiler shell. Similarly he thought that a wrought iron stern post may suck the carbon out of the steel propeller blade, and as a remedy he proposed to make the stern post also of steel. In his opinion corrosion is aided by the vacuum behind the blade causing the water to surge. On the whole he considered the use of mild steel for propellers a mistake, and anticipated a great future for some suitable steel alloy.

Mr. Martell, referring to Admiral Colomb's question, remarked that the inventor of some antidote to corrosion would certainly secure a big fortune. At present the only plausible theory in explanation of corrosion is, that the front of the blade meets with a solid body of water, but that air penetrates to the back of the blade, and so produces scouring. The speaker agreed with Mr. Hall's condemnation of mild steel, and remarked that the most tenacious and therefore the softest iron becomes more pitted than hard iron. He was surprised to see that "mitis" metal had been completely omitted from the list given in Mr. Wallace's paper, and he believed that there is a great future for this material in connection with propellers.

Mr. Manuel said he had devoted considerable attention to the question as to the best material for propeller blades since the year 1880, the immediate reason for discarding cast iron being the frequent cases of breakage when the blades strike an obstacle, and the blunting of the edges, which increases the resistance. He had had some steel blades made by Messrs. Vickers, of Sheffield, which were found to possess the very desirable quality of not breaking when striking an obstacle, but of simply bending. On the other hand, the corrosion at the forward part was much greater than with cast iron. To remedy this evil he applied brass sheathing let in flush with the surface, and this lasted in some cases for six or seven years, but in others only for two or three years. He had recently improved the brass sheathing by shaping it like a ploughshare, so as to keep a fair cutting edge. As regards manganese bronze, he had long hesitated to adopt it, owing to the many cases of breakage of the blades in the Atlantic, which sometimes were simply due to the racing of the engine. In discussing the matter with Mr. Parsons, the maker of manganese bronze, he learned that these failures occurred to propellers which were made by other manufacturers, but that his own had never broken, and the speaker therefore fitted one of his company's steamers with a manganese bronze propeller, and on the next voyage to Australia the average speed of 12·35 knots was made instead of 12·11 knots as on previous voyages. To further test the relative value of manganese bronze, he had recently fitted two sister ships, the "Britannia" and the "Victoria," one with steel and the other with manganese bronze blades. On the measured miles the results were as follow:—

	Revolutions of engine.	Steam pressure.	Speed.	Slip, per cent.
"Victoria," with manganese bronze blades	63	146	16·52	8
"Britannia," with steel blades	64·64	146	16·47	10

The speaker thought that the superiority of manganese bronze was not so much due to the smaller thickness of the blades as to the sharper cutting edge.

Mr. Fothergill, referring to the possibility of a ductile blade bending instead of breaking, considered that this is not altogether an advantage, as especially in four-bladed screws the speed of the vessel may be seriously retarded, and power may be wasted, by one of the blades being bent; whereas, if the blade were entirely lost through breakage, the efficiency would be almost the same, whilst the speed would be only slightly diminished.

The last paper read was by Mr. J. H. Heck, on

The Influence of Size and Speed on Collisions at Sea.

The author drew attention to the vague character of the existing regulations as regards reduction of speed in foggy weather, and the omission of the element of size, which is of some importance. It is quite possible for a small vessel, when going at full speed, to be more under control than a large steamer going at half speed. By theoretical investigations, which the author gave in an appendix, he arrived at the following results:—

(1) Two steamers of different maximum speeds, but of equal size and displacement, when going at full speed, can be stopped in the same distance by the reversing of the engines. Showing in vessels of equal dimensions and form, but of different maximum speeds, that in foggy weather the faster vessel can go at a greater speed, and still be under the same control as the slow vessel.

(2) If two vesssels of different maximum speeds, but of equal size and displacement, are going at equal speeds, the fast vessel would be under greater control, and could be stopped in a lesser distance, by the reversing of the engines.

(3) A vessel when in the light condition is under much greater control than when loaded, and can be stopped in a shorter distance by the reversing of the engines. In thick or foggy weather, therefore, a loaded vessel should go at a less speed than when simply making a voyage in ballast.

(4) Of two steamers of the same form and speed, but one having twice the dimensions of the other, the smaller vessel is more under control, and can be stopped in half the distance; in other words, the larger vessel would go through twice the distance after the engines were reversed before she would come to rest. From this it follows that if the condition of the weather renders a reduction of speed prudent, then the reduction of speed should be greatest in the case of larger vessels.

(5) Of two vessels of the same size and form, but having different maximum speeds, while both can be stopped in the same distance by the reversing of the engines, the faster vessel will come to rest in less time than the slow one. The loss, of course, of a few seconds by a captain or mate being undecided what to do would be of more consequence in the case of a fast than a slow vessel.

(6) Of two vessels of similar form and speed, but of different dimensions, the smaller vessel will come to rest in less time than the larger; more promptness is, therefore, necessary in the case of the larger vessel.

(7) Steamers travelling between ordinary speeds will go an enormous distance before coming to rest if the engines are simply stopped but not reversed, this distance being at least from twenty to thirty lengths, according to the speed and size of the vessels, showing how much less under control a sailing vessel is when compared with a steamer.

In conclusion the author advocated that experiments on retardation and steering qualities of vessels should be made during the course of the ordinary speed trial trips, to enable seamen to get more reliable and accurate information in regard to the vessels under their charge.

COMPRESSED OIL GAS AND ITS APPLICATIONS.

At the ordinary meeting of the Institution of Civil Engineers, held on the 10th inst., a paper was read on the above subject by Mr. Arthur Ayres, M.Inst.C.E. In considering this system of illumination, its applicability to buoys, isolated beacons, lighthouses, and railway carriages, &c., the author treated it under the primary heads of mode of manufacture, illuminating properties, cost, storage, and transit, and in doing so he referred to the early history of oil gas, and the patents taken out from time to time in connection with the system. In 1825 Faraday contributed a paper to the Royal Society "On New Compounds of Carbon and Hydrogen, and on certain other Products obtained during the Decomposition of Oil by Heat." That communication, however, dealt with the chemistry of oil gas. It was mentioned in that paper that 1000 cub. ft. of good gas yielded nearly one gallon of hydrocarbon. The gas from which the hydrocarbon was obtained was manufactured by the Portable Gas Company, and was compressed to 30 atmospheres. It was drawn from a gasholder and passed over water into a large and strong receiver, and from it into portable vessels, the principal condensation taking place in the receiver. The oil gas manufactured by the Portable Gas Company was not distilled from shale oil or petroleum, but from other oils and fatty substances, mineral or vegetable. Between the years 1792 and 1883, numerous ingenious patents were taken out for manufacturing and compressing oil gas for lighting and heating purposes. Oil or hydrocarbon gas was the product of heavy petroleum, or shale oil once distilled. It had a specific gravity of about ·840, and flashed at about 220°F. In detailing the process of the manufacture of oil gas, the author described the works erected at the South Foreland by Pintsch's Patent Lighting Company, Limited. The illuminating intensity of oil gas might be taken at from forty to fifty candles when burned in a London standard Argand burner, with a consumption of 5 cub. ft. per hour, under a pressure of 0·5in. of water. The price varied from about 5s. 6d. to 16s. per 1000 cub. ft., being directly influenced by the quantity of gas produced, the management of the retorts, and the price of oil, fuel, and wages. Until the adoption of oil gas for their illumination, buoys and isolated beacons were only useful for the purposes of navigation by day; but they were now equally so by night (in clear weather), enabling vessels to navigate with safety intricate channels, which hitherto could not have been attempted except at considerable risk. Gas buoys (see *Industries*, Vol. I., page 560), as at present used by the Honourable Corporation of Trinity House, were constructed of best mild steel; they were spherical, 9ft. in diameter, and surmounted by a light wrought iron superstructure, carrying a lantern enclosing the illuminating apparatus. The total weight of one of these buoys complete was about 80cwt., the weight of the buoy being 78¾cwt., and that of the illuminating apparatus 1¼cwt. The buoys were usually charged to a pressure of 5 or 6 atmospheres, or from 75lb. to 90lb. pressure per square inch. The gas was contained in the spherical portion of the buoy, the capacity of which was about 382 cub. ft., and was consumed at the rate of 0·75 cub. ft. per hour, burning night and day continuously. When fully charged to 5 atmospheres, and burning at the above rate of consumption, the light would be maintained for 106 nights and days. The intensity of the light was from 17 to 20 candles through the lens. The estimated cost of a first class gas buoy, including the lantern and illuminating apparatus, also royalty, was about £420. In a new form of gas buoy, constructed wholly of mild steel, it was intended to carry the gas in the lower portion of the buoy. The capacity for storage of gas would be 383 cub. ft., which, at a pressure of 5 atmospheres, would sustain the light (consuming 0·75 cub. ft. per hour) for 106 nights and days. The advantages of this form of buoy were improved stability and its applicability to the recently adopted uniform system of buoyage. The estimated weight of this buoy was about 6 tons, without moorings. In 1885 the Canadian Government adopted a combination of the bell and gas buoy for service in the Gulf of St. Lawrence; the bell, weighing 3cwt., giving the usual warning by day and night, supplemented by the light. The gas was stored in a welded cylinder (independent of the buoy proper) having a capacity of 339 cub. ft. The cylinder, when charged to 6 atmospheres, was capable of maintaining the light for 113 nights and days. The weight of the buoy complete was 9½ tons. In 1881, a beacon, lighted automatically by compressed oil gas on Pintsch's system, was adopted by the Clyde Trust Commissioners, who had recently erected another on the Gantock Rock, off Dunoon, on the Argyleshire coast, and who were extending this system of illumination at Cardross and Dumbuck lighthouses, Donald's Quay, Rashilee, and Dalmuir light towers. In December, 1885, two iron lighthouses, similar in construction, were erected by the Trinity House, one at Stoneness, opposite Greenhithe, and the other at Broadness, on the Thames Estuary. At Stoneness Lindberg's system had been adopted, the burner for producing the light being that of Lyth, of Stockholm. The light burned day and night at full power, showing a white light with short occultation at periods of about five seconds. A description of this system was given. The first cost of Stoneness Lighthouse had been £630, and the cost of its annual maintenance was £88. Broadness Light was produced by the combustion of compressed oil gas. The intensity of the flashes at Stoneness was about 60 candles, and at Broadness about 500 candles. The first cost of Broadness Lighthouse had been £1,026, and the cost of its annual maintenance was £128. Both Broadness and Stoneness Lighthouses were under the charge of a boatman, who visited them at least twice a week, when he adjusted and cleaned the apparatus. These systems being comparatively new, no reliable comparison had yet been made as to their relative efficiency. An important installation of an oil gas apparatus for lighting and fog signalling had recently been made by the Commissioners of Northern Lighthouses at Ailsa Craig, on the Frith of Clyde (Min. Proc. Inst.C.E., Vol. LXXXIX., page 297), the first cost of which had been £24,000, while the cost of its annual maintenance was £725. There were now 214 buoys, lightships, beacons, and other lights in use in various countries on Pintsch's system.

The author next dealt with the application of compressed oil gas to the lighting of railway carriages, which he stated was one of growing importance. It was probably first tried in the year 1871 with satisfactory results, in Germany, on the Lower

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Silesian Railway, and in England in 1878 on the St. John's Wood trains of the Metropolitan Railway, with equally satisfactory results. The Great Eastern Railway Company was the next to adopt it, the Metropolitan Railway Company definitively adopted it for the whole of its rolling stock a few weeks later, and other companies quickly followed suit. The systems chosen were those of Messrs. Pintsch and Messrs. Pope & Sons, which differed but little from each other. Some trials were also made of Messrs. Bower's system on the Great Northern Railway. The gas holders were attached either to the roofs or to the under framing of the carriages, and were charged to a pressure of from 6 to 8 atmospheres. The gas was conveyed to the roof lamps by pipes from the gas holders, passing through a contrivance for regulating the pressure at the burners, one such regulator being attached to each carriage. There were now 23,499 carriages so illuminated on Pintsch's system, and 2791 on Pope's system. Taking the double journey between Euston and Aberdeen, the cost of compressed oil gas was 0·0404d. per lamp per hour, and for the ordinary oil system 0·385d. per lamp per hour, showing a greater cost of the ordinary oil system of 0·3446d. per lamp per hour, or eight and a half times more than oil gas.

AUTOMATIC DAMPER FOR BOILER FURNACES.

THE accompanying illustrations show in Fig. 1 a section and in Fig. 2 a side elevation of an automatic damper regulator, designed by Messrs. White & Carson, for controlling the consumption of fuel and the pressure of steam in boilers. The arrangement is in direct communication with the boiler or the main steam pipe, and as soon as the pressure of the steam exceeds a given limit the regulator is actuated, causing a corresponding depression of the damper. When the fires are sufficiently low, and the steam has assumed its normal pressure, the damper is raised, thereby adjusting the fires in such a manner as to maintain the required pressure in the boiler. The steam pipe E, shown in Figs. 1 and 2, is provided with a bend in which the condensed steam is retained. The steam thus condensed passes into the cylinder B and actuates the brass ram D. The motion of D is transmitted to the cone pulley A, thereby imparting a downward motion to the damper. In the column on the opposite side of the pulley is suspended a weight F, which is sufficiently heavy to raise the damper to its highest position as soon as the pressure on the ram D is relieved. The ram D is constructed in such a manner that all parts are in equilibrium so long as the normal steam pressure is maintained. If the pressure increases the ram D is actuated and the damper moved downwards, while the weight F is raised in the column. As F ascends it is gradually loaded by chains suspended from the cover of the column which collect in the space C on the top of F. These chains act as a brake, and check the too rapid ascent of F. After the fires have been sufficiently checked and the steam pressure begins to decrease, the weight F descends, and the chains again come into action, for the lower F sinks the lighter it gets in proportion to the decreased pressure on the ram. By means of this differential arrangement the damper may be moved up or down gradually, or stopped in any required position. The damper may be adjusted for slow combustion and low pressures by detaching part of the weight F, thereby economising fuel during the night or other times of partial working. This arrangement, which appears to be neatly designed, is being introduced by Messrs. J. M. Adam and Co., the Engineering Bureau, Glasgow.

AUTOMATIC DAMPER FOR BOILER FURNACES.

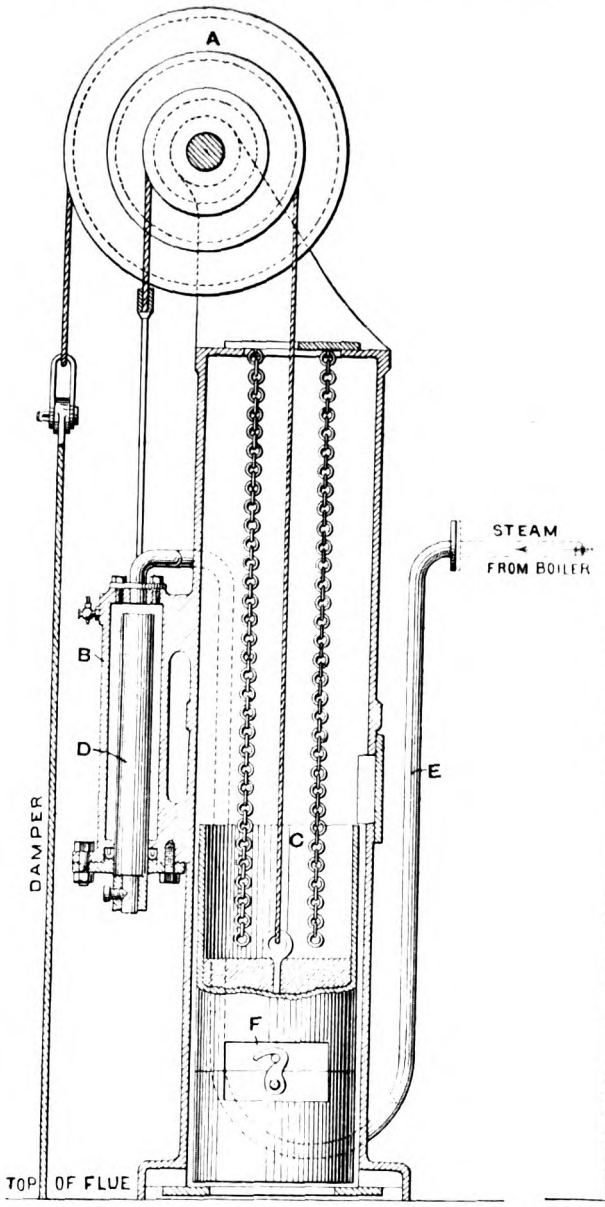


FIG. 1.

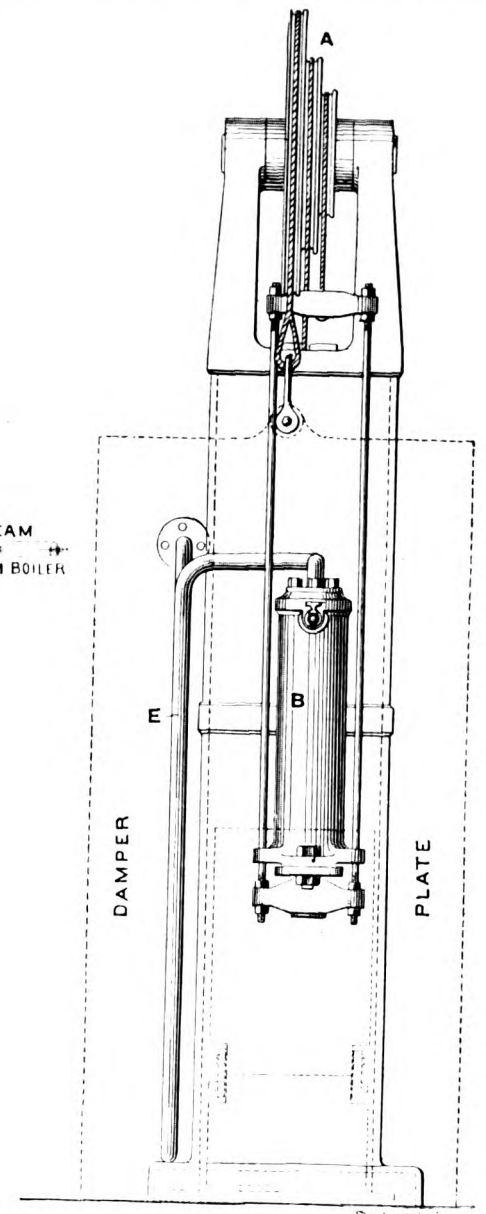


FIG. 2.

SOME RECENT OFFICIAL REPORTS ON BOILER EXPLOSIONS.

THE explosion of a small vertical boiler about 11-50 a.m. on the 13th December, 1887, belonging to Mr. S. Carnelly, Red House Farm, Kimberworth, near Rotherham, deserves the special attention of wharfingers, farmers, hay and straw dealers, and others who use small boilers intermittently, being an example of a danger not usually borne in mind, except in relation to circulating boilers for heating water, viz., the danger from frost. This boiler, which was a second hand one, having its age and maker's name unknown, was only 2ft. 5⅝in. in diameter, and contained a fire box 2ft. 1¼in. in diameter and 2ft. 10½in. high, connected to an uptake 6in. in diameter. The shell plates were $\frac{5}{16}$in. thick, and those of the fire box and uptake ⅜in. thick, all single riveted. It was provided with the usual mountings, the safety valve being loaded to about 90lb. per square inch. A farm labourer who was attending to the fire was severely scalded by the explosion, which was of a violent character, rending the shell into six pieces. There appears to be little doubt that fracture commenced at one of the vertical seams of the shell, where a crack through the rivet holes of the inside lap, 13½in. long, had existed some little time before, caused by freezing of the water in the narrow space between the fire box and shell. The boiler only worked once a week, and stood in a shed exposed to the cold air; and the water, which was allowed to remain in the boiler after the fires were drawn, had on several occasions been found frozen. This shows that great care should be taken by all those who have charge of boilers, not regularly in work and exposed to the atmosphere, to carefully empty them after ceasing work, so as to prevent the formation of ice. Care should also be taken to empty boilers during the cold season which may have been undergoing test by water pressure, as we have known several serious accidents not only to boilers, but to the cylinders of portable engines which have become filled with water during test. This explosion was the subject of preliminary inquiry No. 252. Preliminary report No. 253 deals with the explosion of a cylindrical multitubular boiler, externally fired, belonging to Messrs. Beare & Sons, tanners, Heigham-street, Norwich, which took place on the 5th December, 1887, about 7-30 a.m. The boiler was made by Messrs. Sabberton Brothers, Norwich, in 1881; it was 5ft. 3¼in. in diameter, and 11ft. 7½in. in length, made of ⅜in. plates, double riveted. The ends, which were flat, were $\frac{9}{16}$in. thick, stayed by three gusset stays at each end, and two longitudinal stays 1½in. in diameter, in addition to the support given by fifty-eight tubes 3¼in. in diameter, and it was provided with the usual mountings, the blow-off tap being at the bottom of the back end. No person was injured by the explosion. The boiler was inspected and insured by the National Boiler Insurance Company, Limited, St. Ann's Square, Manchester. The explosion was caused by overheating of the plate over the fire grate, due to the accumulation of deposit; the solid plate bulging down and opening out 14¾in. in the longitudinal direction. From an analysis made by the authorities at Somerset House, it appeared that the deposit formed by the feed water contained, among other matter, carbonate of lime, 24·62 per cent.; sulphate of magnesia, 7·67 per cent.; and carbon and organic matter, 53·66 per cent.; from which it was evident that the feed water was most unsuited for use in an externally fired boiler. By a frequent use of the blow-off tap the accumulation of deposit had previously been kept down; but owing to the absence of the regular attendant from illness, and the sinking of the foundation, so that the front of the boiler had become lower than the back, deposit in large quantities had been allowed to gather over the fire grate, with the result already detailed. Deposit of the nature described does not form into hard masses, and can easily be removed by a proper system of blowing off, particularly from the surface, as being of a light and floury character much of it will float in the form of scum, and is easily carried away by the escaping water. Or the objectionable qualities of the feed water might have been removed by the adoption of some method of water purification. A useful lesson may be drawn from this accident, and it would be well for those who through local circumstances are compelled to use such objectionable water, to well consider the type of boiler best suited for their special circumstances, as for example, in the present case, one of internally fired construction, as the worst that usually occurs in the event of bad water is simply deformation, or collapse of the furnace tube or tubes from overheating, caused by deposit; whereas, in an externally fired boiler, the result, as in the case under notice, is generally rupture and explosion. There is no doubt that in an exceptional case of bad feed water sufficient deposit might be formed, and accumulate on the furnace crown even of an internally fired boiler, to produce serious injury; but the form of the surface and the motion of the water from ebullition and circulation, do not favour retention so well as in the case of an externally fired boiler, where all the deposit must necessarily settle along the bottom, exposed to the fire or heated gases. Practice shows that an internally fired boiler will work satisfactorily, or at the worst with slight recurring leakage from the furnace seams, using water which would produce overheating, fracture, and possibly explosion of a boiler externally fired; and in laying down new plant, embodying steam power, no point requires

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HENDERSON'S PATENT MECHANICAL STOKER.

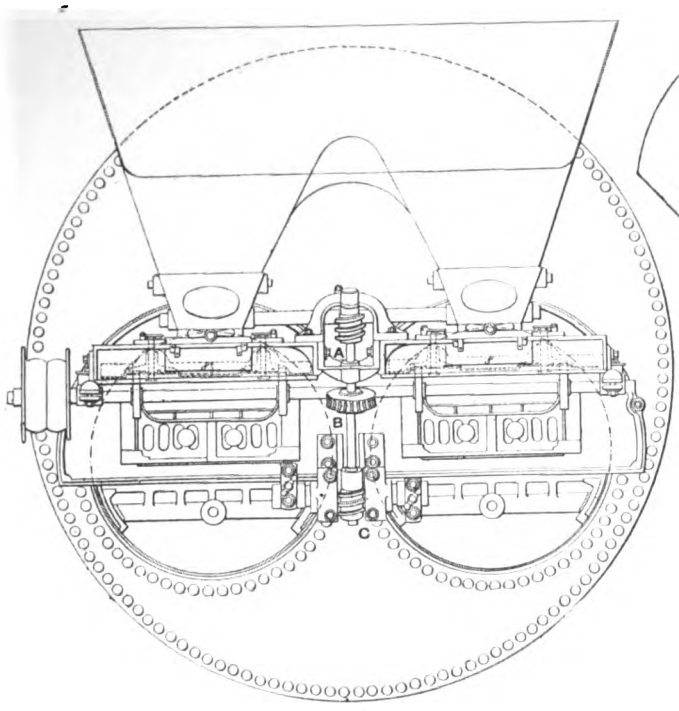


FIG. 1.

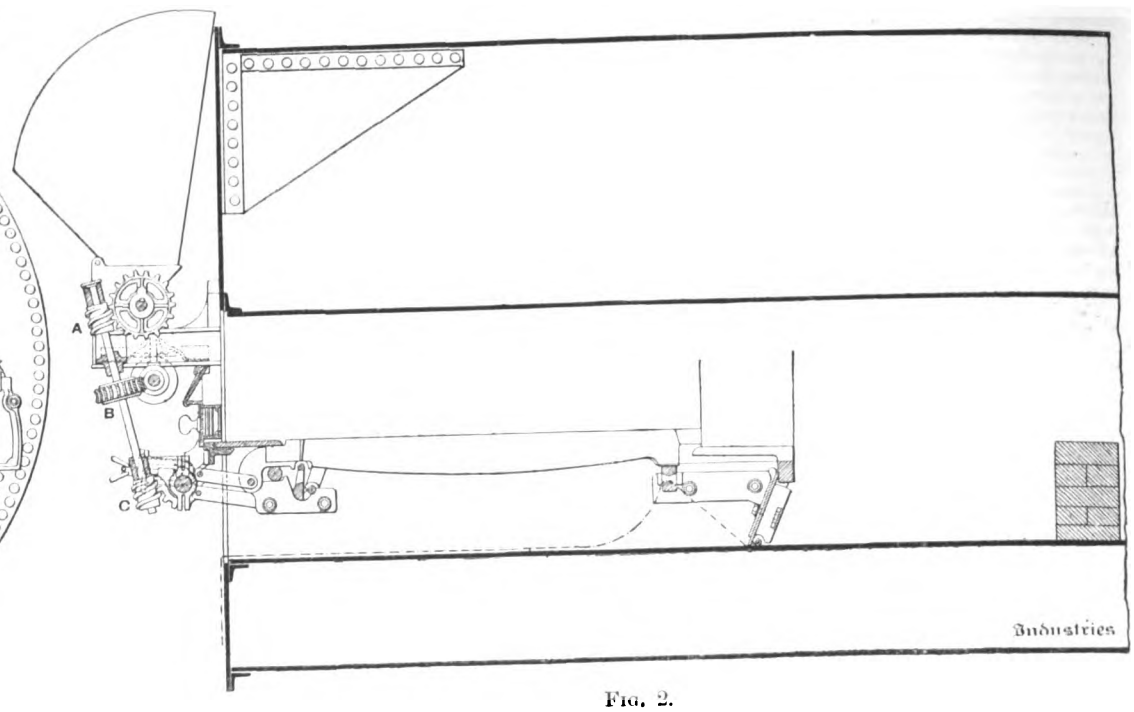


FIG. 2.

Results of Evaporative Tests made at Wingate Grange Colliery, Durham.

	Date.	Description of boiler.	Description of furnaces.	Quality of coal.	Duration of test.	Total coal burnt in lbs.	Coal burnt per sq. ft. of grate area per hour in lbs.	Total water evaporated in lbs.	Area of fire grate in sq. ft.	Ashes per cent.	Water evaporated in lbs. per lb. of coal burnt.	Gallons of water evaporated per hour.	Temperature of feed water in degrees F.	Cost of evaporating 10,000 gallons of water. £ s. d.	Remarks.
						HAND FIRING.									
1887.	Nov. 2 to 4	Lancashire	Ordinary	Small	48 hours	21,735	12·82	139,230	35·6	13·1	6·41	297·5	164	1 4 5	Damper full open.
	„ 9 „ 11	„	„	„	„	23,513	13·74	151,456	35·6	12·6	6·44	323·6	164	1 4 4	
	„ 16 „ 18	„	„	„	„	22,498	13·15	140,263	35·6	15·5	6·23	299·7	165	1 5 1	
						HENDERSON'S MECHANICAL STOKER.									
1888.	Jan. 25 to 27	Lancashire	Henderson	Small	48 hours	22,147	18·31	181,930	25·2	—	8·22	379	165	0 19 0	Damper one-third open.
	Feb. 1 „ 3	„	„	„	„	23,247	19·22	193,300	25·2	8·9	8·19	403	165	0 18 9	Damper half open.
	„ 21 „ 23	„	„	„	„	24,416	—	208,800	25·2	10·6	8·41	435	165	0 18 2	
						HAND FIRING.									
1887.	Nov. 23 to 25	Lancashire	Ordinary	Duff	48 hours	24,136	14·19	127,792	35·6	15·3	5·29	266	151	0 16 10	Damper full open.
	„ 29 to Dec. 1	„	„	„	„	21,280	12·38	130,134	35·6	16·7	6·12	279	151	0 14 7	
						HENDERSON'S MECHANICAL STOKER.									
1888.	Feb. 29 to Mar. 1	Lancashire	Henderson	Duff	48 hours	27,440	22·69	206,814	25·2	10·1	7·54	436	151	0 11 10	Damper one-third open.
	March 27 to 29	„	„	„	„	27,496	22·73	209,150	25·2	11·7	7·51	436	151	0 11 8	

more careful attention than the quality and nature of the available supply of feed water. This question is very often passed over, and, in some cases, entirely neglected, thereby involving increased coal bills, expensive repairs to boilers, loss of wages, and not infrequently serious accident.

HENDERSON'S MECHANICAL STOKER.

THE accompanying illustrations show in Fig. 1 the elevation, and in Fig. 2 the longitudinal section of a patent mechanical stoker and self cleaning furnace invented by Mr. Thomas Henderson, 40, Castle-street, Liverpool. The power is supplied to the apparatus by means of a belt, and fast and loose pulleys secured to a horizontal shaft, shown in Fig. 1. This shaft is provided with a worm gearing into the worm wheel B (Fig 1), which is attached to a vertical shaft carrying the worms A and C. The worm A engages with a worm wheel secured to a horizontal shaft by means of which the fuel crushers are actuated, which break the coal into pieces of suitable size. Below these crushers four fans are arranged, and a plate, which is adjustable by means of a screw, is interposed between the crushers and fans for regulating the supply of coal. The fans are revolved in opposite directions by friction pulleys attached to the main shaft, and distribute the broken up fuel in a suitable manner over the front of the grate. The worm C secured to the lower end of the vertical shaft engages with a worm wheel attached to a short horizontal shaft, to which the grate bars are connected by a simple rocking or cradle arrangement, shown in Fig. 2. By means of this rocking arrangement one half of the number of grate bars are moved up and down, thereby breaking up the clinker; while the rest of the grate bars receive a reciprocating motion, thereby conveying the clinker and other refuse to the back end of the furnace—depositing it over the end of the fire bars into the combustion chamber. The deposit when cold is removed from the combustion chamber through a damper door below the end of the fire bars. The fire bars of each furnace may be thrown out of gear by means of thumb screws fitted into the cranks. A clutch arrangement is also provided, by means of which the gear actuating the fire bars is disengaged from the feed apparatus in such a manner that the latter stands still while the former continues to work. The fire doors are arranged so as to allow hand firing to take the place of the automatic supply in case of the feeding apparatus getting out of order. The clutch mentioned above is then disengaged, and the feeding apparatus stopped and repaired, while the fire bars continue to break up and clean the fires, so that no interruption of the working of the boiler is experienced. The tests shown in the above table were carried out at the instance of Mr. W. Armstrong, and all the observations were made by Mr. W. J. Bird.

THE MANCHESTER ROYAL JUBILEE EXHIBITION.

TEXTILE MACHINERY *(continued from page 367).*—A loom exhibited by Mr. Wright Shaw, Bredbury, had an ingenious drop box motion, which had several points of interest, but which it is difficult to describe without illustrations. In this case, the whole of the lifting hooks are placed at the top of the loom, and it is therefore much more easy to get at them. There is an ingenious arrangement of discs by which the pattern chain may be stopped, and any even number of picks woven from one card—the length of the chain being thus economised. A double lift is obtained by means of cams, which can be thrown into action when desired, and long helical springs are used to help the changes, and enable them to be made without shock. The machine was well designed, and strongly constructed.

Messrs. Harling & Todd, Burnley, exhibited a loom fitted with the motion illustrated in Fig. 71. The boxes

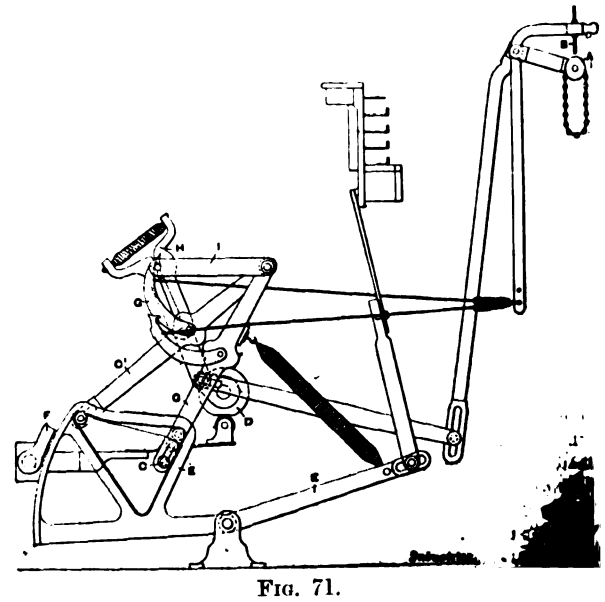


FIG. 71.

are sustained at the end of a vertical lever, which is jointed to the rocking lever E. E is formed with a quadrant at one end, the shape of which is utilised in lifting the boxes. The pattern chain A is fixed at the end of a lever, and is oscillated by the crank D. The hooks G are pivoted as shown, and are connected with

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the lower ends of levers, to which the needles B are attached. The hooks, needles, and their connecting levers correspond in number to the number of boxes. A catch plate I is continually reciprocated from the crank D by means of the lever H, which is formed with a forked arm held together by a strong spiral spring. Four levers C C^1 are pivoted from the plate I, each of them being of a different length, so as to engage with various parts of the quadrant on the end of E. A brake F is fixed to one end of the lever shown, which carries, by means of a strong flat spring, a bowl kept in contact with a revolving roller or cam with a flat formed on it. The action is as follows: If the needle B is pushed by the motion of A, its corresponding catch G is drawn and engaged with the catch plate I. In this way the movement is communicated to the lever C, to which G is attached, and the lower end of the lever is caused to pull the quadrant, and so cause the lever E to oscillate and raise or lower the box. When the box is being lifted, the cam surface, acting on the bowl in touch with it, releases F from its contact with the quadrant; but as soon as the change of box is made, F again acts as a brake, and holds the lever E steady. The motion is positive, and in case of an obstruction the forked lever H opens and allows the catch plate to be pulled downwards, thus obviating the risk of breakage.

Messrs. Butterworth & Dickinson, Burnley, showed Catlow's patent dobby, which is illustrated in Fig. 72, as applied to a strong calico loom. This dobby is a double lift one, thus obtaining a wide shed, and the use of two lattice barrels connected by gearing so that they both revolve in the same direction. The jack lever is attached to the vertical levers, the top and bottom catches being worked respectively by the two barrels, and connected with the ends of the levers. To each of these catches a light blade spring is attached, which insures them being sprung upon the top of the knife, and thereby obtaining a certain lift. A series of wooden jacks or levers are employed, so as to give a varying lift to the front and back healds, in this way keeping the yarn in even tension, and preventing slack sheds. The healds are drawn down by means of a series of levers adjoining one another, and worked by means of a rocking bar driven from the tappet shaft. When the shed is being formed, the jacks are pushed down until it is fully open, and the warp is thus drawn down with the same certainty as the upward movement is made.

Messrs. Willan & Mills, Blackburn, exhibited Jepson's dobby. The lattice barrel is driven by a ratchet feed, and the motion of the healds is obtained through levers and rods. A brass pulley is placed at the bottom of the loom framing, being formed with an indent, into which a projection made on a hanging lever falls. To the lever is attached a wire, which at its other end is connected with the pawl working the chain barrel. By placing a peg in the lattice at the proper point the pawl is raised, and the projection is thus lifted out of the indent in the pulley. The latter then begins to revolve, and the projection resting on the plain part of the pulley retains the catch in its lifted position. When the indent again comes under the projection, the latter again falls and holds the pulley. The same movement puts the pawl into the ratchet on the barrel spindle, and the rotation of the chain is re-commenced. By regulating the speed of the brass pulley with change wheels, any plain length can be woven, an arrangement which is in many cases very convenient.

Several examples of looms with the Bradford style of treading by means of side tappets were shown; but these are so well known that special reference to them is not necessary. Messrs. Platt Brothers & Co., Oldham, showed a velvet loom, in which Nuttal's patent oscillating tappets were used. By combining two chains, the necessary changes could be made without the use of the long chains which are ordinarily essential.

In this great exhibition of textile machinery we naturally looked for some examples of jacquard machines, and the most complete show of these was made by Messrs. Devoge & Co., Manchester. The principle of these machines is well known, and includes the use of a number of vertical rods hooked at their upper end, which are connected with the warp threads, and are lifted by a knife or "griff," having a constant vertically reciprocating movement. The hooks are pushed out of the way of the griff by means of needles, actuated by a pattern card passing over a barrel. The barrel has a horizontal or radial movement to and fro, and in some cases there are two barrels, one on each side, so that with the same number of hooks a double effect can be produced. By means of a cord from below, either cylinder can be thrown out of gear. There were several patterns exhibited by Messrs. Devoge, of all sizes, including a machine for double shedding, which is especially desirable where large shuttles are being used. The comber board slip shown by this firm is also a notable feature, inasmuch as the space between the holes is much increased, and the risk of wearing through is overcome. This has been a great source of mischief in the old type, and the remedy for it is of importance. The machine shown in motion worked smoothly at a speed of two hundred picks per minute.

THE MANCHESTER ROYAL JUBILEE EXHIBITION.

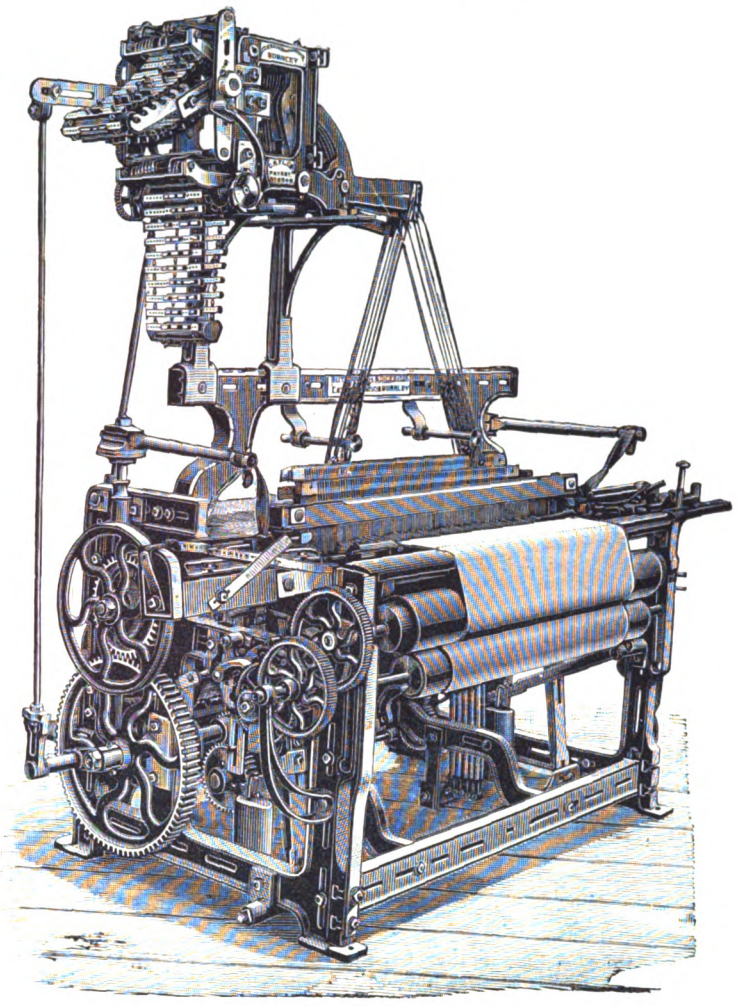


Fig. 72.

Messrs. J. H. Riley & Co., Bury, showed a beetling machine, which was fitted with forty fallers of beech, lifted by three-winged wooden tappets in the usual way. They also exhibited a four-bowl calender, which was large enough to deal with cloth 40in. wide. The bowls were four in number, two being made of pressed cotton, one cast iron, and one hollow bright chilled bowl. By means of a special gas heating device, to which an injector of peculiar coustruction was applied, the chilled bowl was heated effectually. The machine was very massive and well fitted. Special arrangements were provided for lifting the top bowl out of contact when desired, in order to give a special finish. It was geared with a helical wheel on the chilled bowl, driven by a pinion fixed on a short shaft 5in. diam. The driving was effected by Hunter's patent clutch, which can be easily handled, and enables a few inches of cloth only to be passed through the machine. A stretching machine was also exhibited by this firm, in which two pulleys, the axes of which can be arranged at an angle to each other, are employed. The revolution of the pulleys while the cloth is passing over them draws it tight sideways, and so restores the width lost in bleaching.

Mr. Birch also exhibited a patent squeezer, which consists of a disc mounted on a shaft, and having its periphery formed with a square groove, from the outer edge of which to the periphery the disc is bevelled, so as to gently guide the cloth into the groove. A second disc, wide enough to go easily into the groove, is forced up to the latter by means of a lever, a spring being fitted to insure against over-pressure. The cloth being passed into the groove in the form of a loose rope, is, when the pressure is applied, effectually squeezed.

(To be continued.)

ARMY AND NAVY CONTRACTS.

The question as to the advisability of publishing the prices quoted in tenders accepted by the War Office and Admiralty having been raised, these Government departments addressed 103 firms and 70 chambers of commerce on the subject. From the latter 48 replies have been received, of which 24 are on the side of publicity, 20 against it, and 4 neutral; the 20 chambers opposed to publicity, however, include the chief manufacturing districts in the kingdom, while the others are of a more general commercial character not so directly concerned in Government contracts. The replies received from the manufacturers themselves are almost entirely in favour of secrecy, some twenty different reasons being assigned. Taking the replies received at the Admiralty from 61 manufacturers, we find the reasons given for privacy are as follow: (1) That it is not in accordance with trade usages. (2) That manufacturers, for various reasons, such, for example, as a desire to keep their workmen employed, the magnitude of orders, security against bad debts, and prestige of holding Government contracts, constantly quote to the Government departments much lower rates than those quoted to private customers, who would learn the Government rates and demand them. To such an extent is this felt that many firms would cease to do business with the Government if the publication of prices were permitted, or be compelled to raise their prices. (3) That the publication of prices would enable cutting firms to put in a price just below what was last accepted, and one probably which is unremunerative, for reasons given before. They would recoup themselves, or try to do it, by inferiority of quality. (4) That contractors would find greater difficulty in buying the raw material, and in dealing with their workpeople. (5) That occasionally the department might be compelled to accept a tender which was not the lowest. It would have to justify its action to disappointed competitors, by stating what it thought about their character, and endless correspondence would arise. The effect would be that those persons who have to adjudicate upon tenders would be tempted to neglect every consideration excepting price. (6) That the practice of publishing prices in foreign countries throws the business into the hands of third or fourth rate houses and agents. The second point is that on which most stress is laid, and the third is one which even firms not engaged in Government work, but who have experienced the opposition of inferior manufacturers, who constantly quote prices which can hardly leave any margin of profit, will readily appreciate. In six replies received by the Admiralty in favour of publicity no reasons were assigned. The official view of the matter is, that though some of the arguments advanced affect the individual contractor rather than the State at large, yet that the Departments would ultimately suffer in most cases, and the general opinion of manufacturers clearly shows the advisability of continuing the present system of treating tenders as confidential.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 17th April, 1888.

The Iron Market.—Judged by the amount of business transacted, the iron market appears in a state of languor; but when we take account of the steadily advancing prices we must regard the situation as on the whole satisfactory. The firm attitude of the manufacturers of the North has had a strengthening effect upon the trade generally, and upon the markets here in particular. The merchants have recovered from their fright, and instead of selling below the syndicate quotations, have issued circulars announcing a further advance in bars and joists. Now that the prospect has grown clear again, we may expect renewed activity. The principal obstacle to the revival of business is the uncertainty of the political situation. The reality of the advance which has been made in prices is shown by two contracts tendered for last week. One was for pipes for the Telegraph Department, and the other for railway chairs for the State railways. The tenders showed an increase of 8s. a ton on former prices. In the Haute-Marne wire and wire nails are still in strong demand. In the Nord plates are actively sought after. In the Ardennes building iron and hardware are the classes of goods chiefly dealt in. There is also some life in the business in malleable castings.

The Metal Market.—The syndicate is still able to maintain the price of copper, in spite of increasing stocks and restricted consumption. Tin stocks, too, accumulate steadily, but prices do not give way in any serious degree. There has been large buying of lead on German account, which has imparted strength to the market for the moment. Consumers of spelter restrict their purchases to present needs in anticipation of lower prices. Like copper, zinc has become too dear for many uses to which it was formerly applied.

Proportions of Steam Boilers.—M. D. Stapfer, finding that no precise rules have ever been laid down in practical hand books on boiler construction, has collected a large number of designs of boilers in actual use, and working under favourable conditions, with a view to deduce such rules for future guidance. The water level, he says, of ordinary land boilers, and in boilers for torpedo boats, is usually fixed at two-thirds of the diameter, and in marine boilers and also in those of the locomotive type at three-fourths of the diameter; but the level or evaporating surface ought to be proportional to the steam pressure, being larger for higher steam pressures. This surface should be at least 1·50 square metres for a production of 100 kilo. of steam per hour when the boiler is to work under a pressure of 1 atmosphere, and may be reduced to 0·30 square metres at 5 atmospheres, and to 0·15 square metres at 10 atmospheres. Hence the reduction of the dimensions of marine boilers to be used with the new triple expansion engines. The capacity of the steam reservoir should be determined, not by the power of the boiler, but by the dimensions of the engine cylinders. A good proportion is one hundred times the capacity of the cylinders. The sectional area of the flues and tubes should be one-sixth of that of the grate surface when the draught is produced by a chimney from 8m. to 10m. in height, a draught corresponding to a consumption of 60 kilo. of coal per square metre of grate. This proportion is reduced to one-tenth in boilers working under forced draught. In non-tubular boilers, however, the proportion is to be increased to one-third or one-fourth.

BERLIN, 16th April, 1888.

The Iron Market.—The great activity in the iron market during the last few months is now giving way to a steady trade, without, however, any diminution in prices taking place. In Upper Silesia there were twenty-seven blast furnaces in operation at the end of the first quarter of the year. One of the furnaces at the Falvahütte has been shut down, and the reduction of output thus occasioned will in part be compensated by pressing the remaining furnaces harder. The new furnace for this works will not be ready until far on in the present quarter. One of the new furnaces at the Friedenshütte is to be put in blast very shortly, and an additional furnace for charcoal iron has been started at the Bruschiek works. Foundries continue to be well employed, and some rolling mills are working night shifts. Forge pig remains firm, at from 50s. to 54s., and the better qualities of foundry pig fetch from 56s. to 60s. The export trade is still languishing, and there is hardly any business done over the eastern frontier.

The Exhibition of Small Motors at Munich.—Applications for space for this Exhibition, which is to be held from the 1st of August to the 15th of October, have being received by the committee in great numbers, and it has been found necessary to enlarge the space originally reserved for the exhibits by the addition of side galleries. Nearly every important system of gas engine, domestic, steam, or hot air engine has been entered, and machine tool makers have also responded to the invitation in considerable numbers. The railway companies have made the concession of returning, carriage free, to the exhibitors any article which may remain unsold at the close of the Exhibition. The cost of the prizes will be borne by the Bavarian Government.

Telephony.—The question of right of way for underground telephone wires in the streets of Berlin has been debated between the Town Council and the postal authorities for some considerable time, the latter claiming the right to lay cables through any thoroughfare, and the former refusing it. The matter has at last been settled, and, under the new agreement, the Post Office will be able to put as many wires underground as they think fit. This will greatly relieve the overhead system, which had already threatened to become unmanageable, on account of the multiplication of circuits. The total number of telephone subscribers in Berlin is now about 10,000, and the tendency is still to increase.

Wood Paving.—In recent years the town authorities of Berlin and Hamburg have largely experimented with wood paving, in order to determine the best materials to be employed, and the most suitable methods of laying the blocks. The first trials made in Berlin were with American yellow pine and cypress wood, after which various portions of the town were experimentally laid with unimpregnated German and Swedish pine, with impregnated pine, and with impregnated German beech. These experiments have shown that unimpregnated pine is totally unsuitable for paving purposes, whilst impregnated pine offers greater resistance to the influence of the weather. Beech is preferable to pine as being harder, but there is some difficulty in the impregnation. American wood without any impregnation has up to the present been found most successful, and resists climatic influences because of its being hard, fatty, and resinous. The total quantity of wood pavement laid down in Berlin at the end of last year amounted to 50,000 square yards, but recently the tendency is to give asphalt the preference, and wood is not used for new streets.

Water Gas.—The use of water gas for heating and lighting purposes is steadily extending throughout Germany. This gas has been employed with satisfactory results in various iron and chemical works, also for lime kilns and glass works. At the works of Messrs. Schulz, Knaudt, and Co., in Essen, there are two generators in use, each of a capacity of 500 cubic metres per hour, and the gas is used for the welding of boiler flues and for lighting, a total of 900 lights being supplied. At the Witkowitz works there are three generators, each of 500 cubic metres capacity, and the gas is used in two Martin furnaces and for lighting. Messrs. J. Pintsch & Co., in their works at Fürstenwalde, use water gas for the welding of the steel reservoirs required for compound oil gas, and they also supply water gas for lighting the railway station. The station of Königszelt is also lighted by water gas, and in Frankfort-on-the-Main water gas is used for the smelting of gold and silver.

VIENNA, 16th April, 1888.

The Iron Market.—The improvement in the iron market which I reported in my last letter as having set in with the change of the weather, appears to be progressive, and the situation becomes better from day to day. The building trades are specially brisk, and large quantities of girders and other building iron are required. This is partly due to the destruction of buildings in Hungary during the recent floods, but there is also a movement of centralisation going on, large numbers of persons from the country flocking to the towns, and the additional accommodation required influences the iron market favourably. In sympathy with the rolled iron market, the crude iron market is also firm. Engineering works are fairly well employed, particularly with agricultural machinery and with orders for the sugar factories. The large engineering works of Messrs. Ganz & Co., of Buda-Pesth, with branch establishments in Leobersdorf, Austria, and in Ratibor, Prussia, are very busy with milling machinery, railway wheels and waggons, and electrical machinery. During the last financial year the total value of the goods turned out amounted to 5,400,000 florins (about £430,000), and the net profit was 440,000 florins (about £35,000). A dividend of 55 florins per share has been declared. A peculiar feature of the company is a pension fund for their employés, to which 93,000 florins (£7,500) have been transferred from the profits.

Metals.—Owing to heavy orders from sugar factories and other industrial establishments for machinery in which copper is required, the present demand for copper on the part of engineering works is very brisk, and considerable quantities of this metal are required. The stocks of old copper have hitherto been sufficiently large to prevent this demand from further increasing the prices of the copper syndicate; but these stocks are now almost exhausted, and consumers are forced to come into the market for new copper. They do not evince any eagerness for making large purchases, as the general opinion here is that the copper syndicate will not be able to hold out much longer, and consumers therefore prefer to delay giving their orders as much as possible. There is a great scarcity of the better quality of copper required for gun metal and brass work. A good trade is being done in so-called copper vessels for the Oriental market; but these are in reality an imitation, being made of zinc with a copper coating deposited electrolytically. There is an abundance of copper ores in the country, but unfortunately they are too poor to pay for smelting, and mine owners are now turning their attention to the electrolytic process, by which the exploitation of the poor ores is thought to be possible. Amongst these mine owners, I may mention Messrs. Tlach & Keil, of Troppau, who have adopted an electrolytic process. There is also a copper mine in Servia owned by Austrian capitalists where the poor ore is worked up electrolytically. Some rich lodes of silver have been found in the Hungarian Government mine at Vihnye. The old and hitherto disused silver mine of Klostergrab in Bohemia has been bought by a private company, and is to be re-opened. The ores are poor, but it is hoped that they can be profitably worked by an electrolytic process. The necessary machinery is to be ordered from Messrs. Siemens and Halske.

Textiles.—After a slight drop in prices which took place a fortnight ago the market has shown no signs of receding further, but weavers are still reluctant to place large orders at the present prices of yarns. The demand for cotton goods is fairly brisk, and English goods are specially in request. In cloth and woollen goods the market is very languid. Silks are in favour, as are also worsteds and trimmings. Although efforts have been made for years to emancipate Austrian textile industries from foreign imports, we still depend to a large extent upon England for our wants in textiles. I have collected the following figures regarding the import and export of textiles, and these will be found specially interesting, as they show that notwithstanding the increase in our import duties which took place after 1886, the quantities imported have not sensibly diminished. The diminution in cotton goods amounts to only 1·6 per cent., and in jute to 6·8 per cent. On the other hand, the importation of woollen goods has increased 6·9 per cent., and that of linen goods 23·8 per cent. The quantities are given in tons. As regards the export of textiles, there is a diminution of 3·3 per cent. in linen goods, and of 30·2 per cent. in woollen goods, whilst cottons have only very slightly increased.

	Textile goods imported during 1886.	1887.
Cotton yarn	5582	5493
Linen yarn	589	720
Jute yarn	1647	1534
Woollen yarn	2421	2588
	Textile goods exported during 1886.	**1887.**
Linen yarn	5297	5122
Woollen yarn	872	609
Cotton yarn	479	483

BRUSSELS, 17th April, 1888.

The Coal Market.—Business is brisk in smiths' coals, coke, and coke dust. The new tariffs of the Belgian Grand Central Railway in connection with the Rhenish and Westphalian railways for coke, briquettes, and metallurgical products, are about to come into force, and will enable the Germans to regain the ground they have lost during the past two years, unless the Belgian Government promptly takes action to counterbalance this movement. The market is firm at Liège, Charleroi, and Mons, prices being well maintained. In these districts colliery owners have decided not to make long contracts, except at an advance of 5d. per ton. Present quotations are: 12s. for screened coal, 8s. for unscreened, and 6s. 10d. to 7s. 2d. for coke dust.

The Iron Market.—The pig iron market is well maintained. The Malines works have an order for 1000 tons of iron piles, and the Monceau works have 500 tons of iron work in connection with the same. Cockerill has received a large order for rails. There is a good demand for finished iron, especially girders; but difficulties are still caused by the dearness and scarcity of the raw material. Mine owners in Luxemburg have been disturbed by the news that our blast furnaces are to obtain part of their ore from the Haute-Moselle. A representative of the group of blast furnaces, who has inquired into the subject in the neighbourhood of Nancy, reports that in two months ore can be sent to Belgium at the rate of 600,000 tons per year, and that this business could be later developed to supply 1,470,000 tons per year, or more than is obtained at present from Luxemburg by our blast furnaces. There is no doubt that the imports from the Moselle district will largely increase.

Glass Works.—The situation has improved slightly, the fall in the English market having ceased, and some important orders having been received from the country. There is still a good demand from the United States. Inquiries have been received from Japan and China, but buyers there are not able to pay the prices owing to the rates of exchange. The annual report of the Société Anonyme of Charleroi shows a profit for 1887 of £2,906, out of which a dividend of 2 per cent. will be paid.

Textiles.—There has been absolutely nothing done in Russian flax and hemp during the past week, and the price of other foreign hemps is falling. There is a demand for the better qualities of flax, but yarns are not inquired for.

Electric Lighting.—The Belgian Society of Electricians have offered a reward of £10 for the best elementary essay on applied electricity. Either members or non-members of the Society, irrespective of nationality, may compete for this prize, and the essay must be written in such a way that persons of ordinary education and ignorant of the science of electricity may understand it. Messrs. Mourlon Frères of this town are now pushing an American petroleum engine for domestic electric light installations, and several exhibits will be on view at the forthcoming Exhibition, where they will be employed for lighting some cafés and restaurants in the gardens. An interesting novelty, for Belgian visitors at least, will be high power incandescent lamps ranging from 200 to 1200 candles. In my letter of the 13th March I gave some particulars of the illuminated fountains which will be used at this Exhibition. Since then the work has

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been actively pushed forward, and some preliminary trials made with great success. Complaints are being made in connection with the electric lighting of the interior of the Exhibition, as it is now considered probable that the contracts will be reduced to one hundred lighting hours.

Electric Tram Cars.—The Société l'Electrique have entered a protest against M. Michelet's report attributing the deficit on last year's working to the electric traction. They say that if there is a loss, it is due to the bad management of the tramway company, which wasted a large amount of money on the charging station in the Rue Juste-Lips. In addition, the expense of working a station intended for at least forty cars has been debited to two cars only. They consequently consider that the report does not give a fair idea of the real cost of electric traction, which is as cheap as horse traction. In order to prove this the Société l'Electrique are willing to contract for electric traction, and if the tramway company refuse the offer their conduct could only be explained on the score of prejudice on their part against electricity in any shape or form.

DÜSSELDORF, 16th April, 1888.

The Coal Market.—The coal market is still distinguished by a degree of activity unusual at this season of the year. The demand for house coal is falling off; but a very animated business is being done in the industrial sorts, and prices are buoyant. Coke for metallurgical purposes cannot be produced fast enough to satisfy the demand. This larger consumption of fuel is the best possible evidence of reviving industry. Though the output from the German mines is considerably greater than in the early months of last year, foreign coal is being bought in larger quantities. From the Customs returns just issued it appears that in the first two months of the current year the imports were 618,479 (552,544) tons of "brown" coal (lignite); 327,250 (231,474) tons of "black" coal; 44,963 (36,704) tons of coke; and 4333 (3301) tons of artificial fuel, a total of 995,025 (824,023) tons, the quantities within brackets being those for the corresponding period of 1887. The increase in the coal imports is chiefly observable in the trade with England. The exports of German coal in the two months' period amounted to 1,450,361 (1,441,206) tons; 133,831 (116,827) tons of coke; and 23,318 (23,428) tons of artificial fuel, besides 2106 (1293) tons of lignite, a total quantity of 1,599,616 (1,582,754) tons. Thus we have an increase of 20·75 per cent. in the imports and 1·07 per cent. in the exports.

The Iron Market.—The iron market has not materially changed since my last report. The calm which has come upon it is likely to be of long duration, for consumers have bought far forward into the year, and prices, being dependent upon well organised syndicates, are too firmly established to give way for some months to come. At the last meeting of the Pig Iron Association, held at Cologne, measures were taken to insure, by means of heavy fines for infraction, observance of the regulation on the part of the merchants. There is a steady, but by no means animated, demand for pig iron, no class being actively sought after. Prices are as follow: Spiegel pig of 10 to 12 per cent. manganese, 59s.; forge, 51s. to 52s.; white steel pig is quoted the same as forge; basic steel pig, 45s. to 46s.; Bessemer pig, 54s. to 54s. 6d.; Luxemburg forge, 38s. 7d.; and foundry pig, No. 1, 57s. per ton. English pig is arriving in considerable quantities. The exports from Great Britain to Germany and Holland in the first quarter of the current year amounted to 62,513 tons, against 52,480 tons in 1887, and 40,974 tons in 1886. The average declared value per ton is 38s. 9d., against 40s. 5½d. and 35s. 11½d. in the two previous years respectively. The market for finished iron shows a little more animation, bars being more inquired after. There is a brisk demand for joists, and an average amount of business is being done in plates, both of the common and the boiler classes. For all other goods the market is very quiet. Founders are fairly busy. The lowest tender for 118 tons of cast iron pipes for the railway at Kassel last week was £600. The latest quotations for finished iron and steel are as follow: Merchant bars, £6. 5s. to £6. 7s. 6d.; angles, £6. 15s.; common plates, £7. 5s.; boiler plates, £8. 5s.; Siegen sheets, £7. 10s. to £7. 12s.; hoops, £6. 17s. 6d. to £7; common steel plates, about £6. 18s.; steel billets, £6. 15s.; drawn iron wire, £7; rolled (wire nail quality), £6. 1s.; drawn steel wire, £7; rolled, £6; wire nails, £8. 5s. per ton. These prices are for Germany. Considerable concessions are made to foreign buyers.

Shipbuilding and the Iron Industry.—The iron industry of this district is beginning to feel the influence of the growth which is taking place in our shipbuilding yards. A short time ago, the Hamburg-American Steamship Company gave an order for a large steamer to the Vulcan Works at Stettin. Now, the Bremen Lloyd, which hitherto has had all its ships built in English yards, has placed with the same works an order for a second fast steamer. These two vessels represent a cost of £400,000. The Vulcan Company has purchased the whole of the steel for these vessels, amounting to 7500 tons, from one of the works of this locality.

LILLE, 17th April, 1888.

Textile Manufactures.—There has been greater activity this week in the markets for textile goods. Linen fabrics have been in fairly brisk demand; prices have, however, not become sensibly stronger. In cotton goods there is also more life, though the market is far from buoyant. These changes may mean no more than an adjustment of affairs, the course of which has been recently disturbed, or they may indicate a genuine revival of business. Most persons incline to the latter view. The week has been marked by a spurt in the wool trade. Manufacturers have bought largely, and speculators have helped forward the movement with some effect, seeing that prices have been advanced 25 centimes per kilogramme; but as the manufacturers refused to follow the rise above 10 centimes, it must be concluded that this advance is not justified by the state of trade, and that accordingly a relapse will probably occur. The trade in woollen fabrics shows a little more life, and orders are coming to hand more plentifully.

Flax and Yarn Market.—The flax market is very dull. Only a few transactions, and those unimportant, have taken place within the last two weeks either in home grown or in Russian produce. Reports of similar inactivity have been received concerning the market at Ghent. Tows are also almost wholly neglected. The situation remains unchanged for linen yarns. Spinners have enough to do to meet the demands of consumers for the present, and refuse to accept the lower prices which weavers say are necessary for the expansion of business. Jute yarns are still much sought after. Cotton spinners also firmly maintain their prices, in spite of the resistance offered by buyers. The Association of German Wool Spinners has uttered a vigorous protest against the speculative dealings which distinguish the new wool market at Antwerp, on the ground that such dealings are injurious to trade, by the constant fluctuations in prices which they occasion.

The Iron Market.—Though the iron market is not animated there is a steady course of business, which has suffered no check from the fresh advance in prices announced last week. On the contrary, the determined attitude taken up by the manufacturers has stimulated the market, consumers being now convinced that the weakness reported from Paris is only a temporary circumstance of merely local interest. Bars and joists are being bought in considerable quantities, the former at £5. 12s., the latter at £5. 4s.; but the chief demand is for plates, which are soon likely to advance beyond their present price of £6. 8s. The Tobergues Steel Works, which import large quantities of Spanish ores, have obtained from the Northern Railway Company a reduction of carriage from 2·50fr. per ton from the port of Dunkirk to 1·85fr.

Prohibition of Foreign Materials.—The Prefect of the Nord has addressed a circular to the engineer-in-chief of that department, forbidding for the future the use of foreign materials in the Government works executed under his supervision. In taking this step, which is generally regarded with approval, M. Saisset-Schneider has followed the example of the Prefect of the adjoining department of the Pas de Calais.

MADRID, 16th April, 1888.

Phosphate Mines.—A Belgian company has acquired the phosphate mines of Jumilla, which are estimated to contain 5,000,000 tons of apatite, and they expect to do an extensive business at present prices. A very favourable report was made on the mines by M. Grandeau, who surveyed them on behalf of the purchasers. Several other phosphate mines are now in the market, but they have not got the same facilities for exporting at low cost as the Jumilla mines possess.

The Barcelona Exhibition.—Advices from Barcelona state that, although the Exhibition has been officially opened, it is still in such an incomplete condition that it will be hardly worth while visiting it before the middle of June. There is no doubt, however, it will prove successful later on, many important novelties being amongst the exhibits. The large hotel, to which I have previously referred, and which can accommodate one thousand visitors, is now completed. The total time occupied from the cutting of the first sod to the final completion was 125 days. The building occupies a site of 152m. by 35m., on ground reclaimed from the sea. This ground is very valuable, and it is intended to pull down the hotel as soon as the Exhibition is over, and to use the site for other purposes. The hotel is only three storeys high. The constructor's time book shows 48,000 working days of masons and assistants, 6500 working days of joiners, and 8000 working days of painters, plumbers, &c. About 6,000,000 bricks and 800 tons of iron have been used.

Railways.—It is stated that an English house is making proposals to the Government to obtain the concession of three lines of railway in the province of Cadiz, to be constructed on the one-metre gauge. At present agriculture in this province is in a backward state, but the construction of these railways is likely to be followed up by agricultural and industrial improvements.

NEW YORK, 7th April, 1888.

The Coal Market.—The situation is less satisfactory now than it was during the miners' strike. The demand is not good, and prices have decreased from 10c. to 50c. per ton below circular rates in New York. The future depends entirely on whether the companies can agree upon the output for the present year. It is known beyond doubt that the Pennsylvania Railroad Company will not enter into any agreement either as to production or price, but it is not believed that they will interfere with any arrangements the other companies may make. In the coke market orders are scarce, and as manufacturers are not anxious to make contracts at present rates, the outlook is decidedly bad.

The Iron and Steel Markets.—The past week has not shown much improvement in the iron trade, either as regards the amount of business or prices. Considering the dulness, prices are remarkably firm, this being probably in a measure due to the very light stocks in hand. Only small lots are taken, buyers expecting after a while to be able to place their orders on better terms. There has been a moderately large business in pig iron, but there is no disposition to do more than to cover immediate requirements. This demand is sufficient to maintain prices for standard brands, and while a few lots of other descriptions have been placed either as sample lots or at prices low enough to make the buyer feel safe, it has been found to be impossible to make headway at the quoted rates. The low prices ruling for finished iron compel consumers to economise in every way, and as Western cities are getting pig iron at a cost of from $1 to $2·50 per ton less than Eastern cities, it is impossible to successfully compete for Western trade. Many of our Eastern manufactories have branches in the West, and the lower cost of pig iron is gradually moving the greater part of the business intended for Western trade to Chicago, St. Louis, St. Paul, and other cities. The demand for manufactured iron is disappointing. Prices, too, are unsteady, and without anything to indicate improvement in the near future. The chief object of manufacturers is to cheapen cost to meet competition from outside sources, but this cannot be done at present. There is a fair consumption, but not nearly equal to what it was a year ago, hence the continuous seeking for business. Prices are about 2·1 cents per lb. for plate iron, 1·85 cents to 1·9 cents for best bars, and 2·15 cents to 2·2 cents for angles. The steel rail market is quiet. Prices are well sustained, and mills are quite busy either on rails or steel for other purposes. The wrought iron tyre business has been improving, and a fair amount of business is being done. On large orders competition is very close, and concessions are very easy to obtain.

The Metal Markets.—The copper market has been rather quiet, and shows signs of declining prices. Tin has been active and declining. For spot 34½ cents per lb. is bid, and 36 cents asked. May sales are down to 29·50 cents. The business in lead is almost entirely confined to speculators. About 1000 tons have been dealt in. April prices are 5·15 cents per lb. Consumers have been buying very little, but as the season opens there will probably be a heavier demand.

Electric Transmission of Energy.—Wherever electricity has been introduced, motors are rapidly taking the place of small steam plants. In St. Louis, Mo., at present 125 h.p. are used; in Boston, over 400 h.p. One company in New York distributes 200 h.p. among sixty customers, and arrangements are now nearly completed for a plant of 2000 h.p. on the east side, and a similar plant on the west. Motors are supplied from ⅛ to 25 h.p., and are used, among other purposes, for cash railways in stores, sewing machines, ventilating fans, elevators, in foundries, printing offices, by tailors, and for street cars. The cost of power varies considerably. In Pittsburgh a half horse power motor is rented with power for £2 per month, and a 10 h.p. motor for £16. In Buffalo, N.Y., the rental of a half horse power motor and power is £1. 4s. per month.

PHILADELPHIA, 7th April, 1888.

The Harbour of Philadelphia.—A report has been published on the improvement of the port, and the total removal of two islands, and the partial removal of a third island in the Delaware. The scheme is considered quite practicable by the Board of Engineers appointed to consider the matter. About 400,000 cubic yards of material would have to be removed, the cost being estimated at from £600,000 to £800,000.

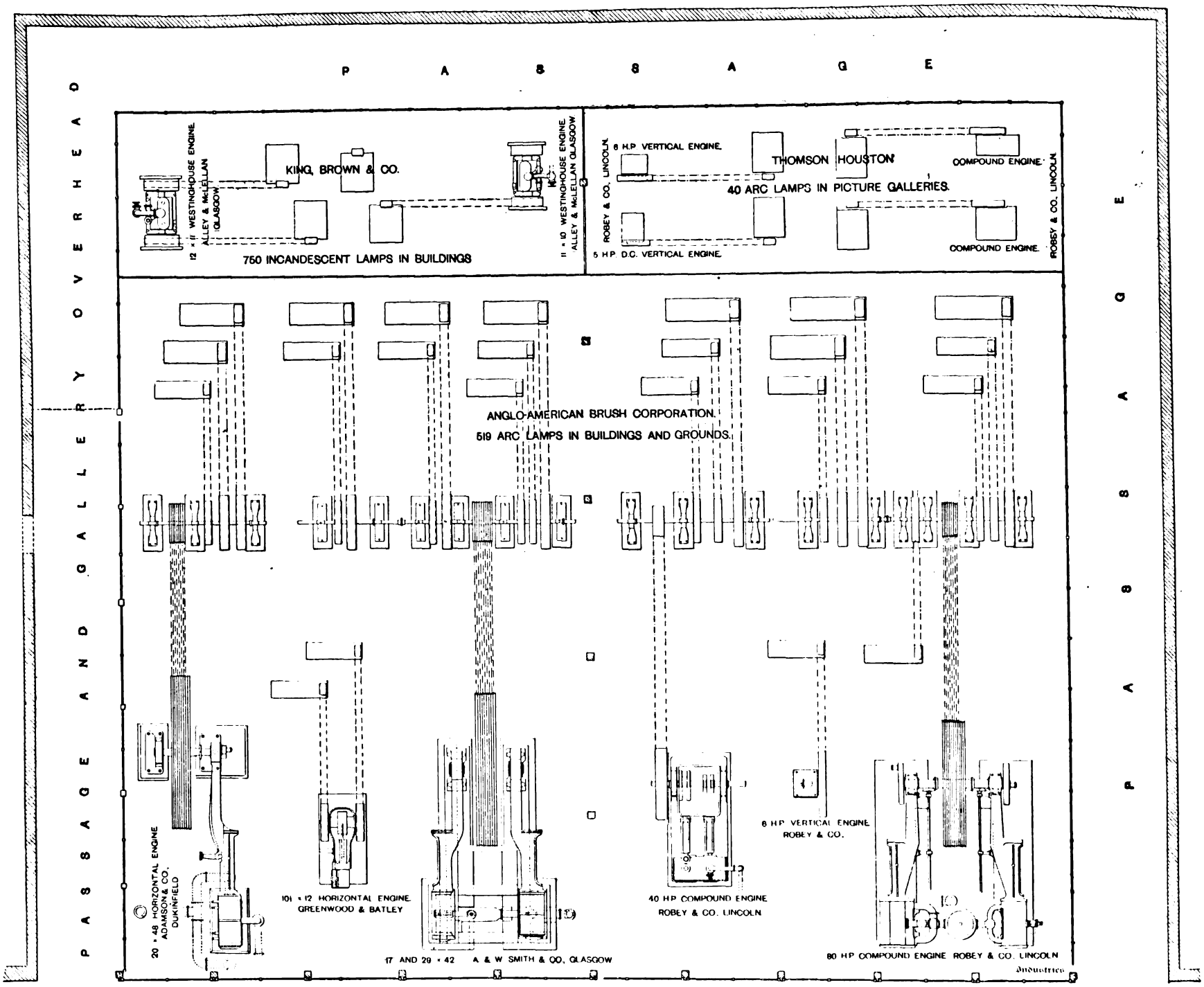
New Works.—A commencement has been made in replacing the wooden building of the Pennsylvania tube works by an iron building. The new building is to be built outside the old one, so as not to interfere with the working of the mill. It will be 260ft. wide by 363ft. long, and will cost about £20,000.

Open Hearth Steel Plant.—The Henderson Steel and Manufacturing Company, of Birmingham, Alabama, are putting down a 120-ton steel plant, which is of a somewhat novel design. The hearth is made of calcined dolomite, pulverised and mixed with 10 per cent. of fluorspar, charged loose into the furnace, where it is set by heat. The operation is divided into two parts, taking place in separate chambers, a purifying and a converting one. Into the first the molten iron is taken from the blast furnace and treated with ore to remove the silicon and half the carbon, which operation requires two and a half hours. To prepare the furnace for a second charge takes half an hour, allowing about seven heats for twenty-four hours. The metal is then transferred by an outside runner to the converting chamber, where two and a half hours longer are required to convert it into steel by removing the phosphorus and some more of the carbon. Half an hour is required to repair this chamber, using 80lb. of lime and fluorspar per ton of steel. Out of pig iron containing ·7 per cent. phosphorus, 1·0 per cent. silica, and 22 per cent. sulphur, steel has been made containing ·75 per cent. carbon, ·05 per cent. phosphorus, and ·099 per cent. of silica, and has been found excellent for tools and cutlery.

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GLASGOW INTERNATIONAL EXHIBITION, 1888.

General Plan of Electric Lighting Plant.



ELECTRIC LIGHTING AT THE GLASGOW INTERNATIONAL EXHIBITION, 1888.

The combined electric lighting installations at the Glasgow International Exhibition afford a very fine display. The total number of arc lamps in the building and grounds is 559, and the number of incandescent lamps is 750. These numbers are exclusive of the powerful arc lamps used in the manipulation of the fairy fountains, which are supplied, with the other plant for this attractive feature, by Messrs. W. & J. Galloway & Sons, Manchester. The Anglo-American Brush Electric Light Corporation supplies 519 arc lamps. Messrs. Thomson, Houston, & Co., Limited, supply forty arc lamps, and the installation of incandescent lamps is by Messrs. King, Brown, & Co., of Edinburgh. The above illustration represents the plan of the dynamo room, and the arrangement of engines and dynamos. The room affords ample space, engines and machines being alike shown to advantage. The Anglo-American Brush plant occupies the most prominent position, their share of the work being the lighting of the main portion of the buildings and all the grounds. Messrs. King, Brown, and Co.'s incandescent lamps are fitted in the refreshment and dining rooms and in some of the smaller courts, while Messrs. Thomson, Houston, & Co. have their forty arc lamps placed in the picture galleries. The Anglo-American Brush Co. supply the current for their 519 arc lamps from nine large and ten smaller dynamos. The large dynamos supply current to thirty-five arc lamps and the smaller to twenty-five arc lamps each. Power for this portion of the installation is obtained from engines made by four separate firms. The largest set is by Messrs. Robey & Co., Lincoln, who supply a pair of horizontal compound engines working up to 240 i.h.p., a single engine working up to 120 h.p., and a vertical engine of 6 n.h.p. Messrs. A. & W. Smith & Co., Eglinton Engine Works, Glasgow, supply a horizontal compound engine with 17in. and 29in. cylinders, and 42in. stroke. Messrs. D. Adamson & Co., Dukinfield, Manchester, supply a large horizontal engine having a cylinder 20in. diam. and 48in. stroke, and Messrs. Greenwood & Batley, Leeds, exhibit a horizontal engine with cylinder 10½in. diam. and 12in. stroke. The main shafting in the dynamo room is divided into sections, and the large engines actuate separate sections of the shafting by means of rope gearing. The pulleys on this shaft, as also to a large extent throughout the mechanical section of the Exhibition, are the patent "differential tight-grip" pulleys of Messrs. Weyman & Johnson, of Guildford.

The installation of Messrs. King, Brown, & Co. consists of two Westinghouse engines, one having a cylinder 12in. diam. and 11in. stroke, and the other a cylinder 11in. diam. and 10in. stroke. The engines are made by Messrs. Alley & McLellan, and actuate by direct drive four dynamos of Messrs. King, Brown, & Co's. own manufacture. Messrs. Thomson, Houston, & Co's. installation consists of four dynamos, the power for which is derived from Messrs. Robey & Co's neat little vertical engines of 5 and 6 n.h.p. and their horizontal engine having cylinders 5½in. and 9in. diam. and 6in. stroke. The arrangements for the electric lighting of the Exhibition have been devised by and carried out under the superintendence of Mr. W. A. Bryson, engineer to the Exhibition. We hope to illustrate in an early number the plan of wiring, and shall then also give further details of this plant.

ENGLISH FISHERIES.

In a recent issue we supplemented the review of a Bill introduced into Parliament with the object of reducing rates of carriage on common kinds of fish, by a short account of the present state of our fishing industry, and a protest against the existing conditions under which its full development is retarded. A few days ago the whole matter was brought before Parliament by Sir E. Birkbeck in the following motion: "That in the opinion of this House the Fishery Department of the Board of Trade, as now constituted, is not in accordance with the scheme by which the control of the fisheries was transferred to the Board of Trade; and in order to carry out that scheme, and to secure the proper management and

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development of the Fisheries of England and Wales, they should be placed under an authority comprising, in addition to the officials of the Board of Trade, persons with a practical knowledge of the sea and inland fisheries." He recommended the appointment of elective councils at all the principal fishing ports on the coast, with certain powers for the regulation of local fisheries, and to send representatives periodically to London to confer with a central board. As illustrative of the point to which in our previous article we directed attention, as to the heavy carriage rates now charged on fish, and the necessity for bringing English merchants and consumers into closer relations, Mr. Mundella stated that when he was staying on the Malaga Pass in Switzerland, he found English turbot, landed at Ostend, was selling cheaper there than at the West End of London. Sir M. Hicks-Beach, on behalf of the Government, while claiming that the Fishery Department of the Board of Trade was in much closer touch than formerly with the fishing industry, admitted that there was still great scope for improvement in respect to local regulations and by-laws, the collection of statistics and investigations by scientific experts. The motion was finally withdrawn, on the understanding that a Bill would shortly be introduced to meet the exigencies of the case, and embodying the incorporation of local councils. The importance of this industry, alike to the quarter of a million of men engaged in it, and the whole body of consumers, is sufficient justification for urging upon the Government the necessity for initiating the basis of a satisfactory *régime* under which the full resources of our fisheries may be cultivated, and for encouraging the better distribution of their product.

The *Times* St. Petersburg correspondent states that the death is announced of the celebrated "naphtha king," Ludwig Nobel, who has created such a gigantic petroleum industry at Baku. He was one of the three Swedish brothers whose enterprising and wonderfully successful careers in Russia are now known to all the world.

Steam Engines and Boilers.—The Steam Engines and Boilers Bill, intended to provide for the registration and certification of steam engine and boiler attendants, of which we gave an abstract in our issue of the 30th March, was rejected on the 17th inst., when brought in for second reading, by 147 to 96. It was pointed out that no proof whatever had been given that explosions would be prevented by the passing of such a measure. Sir M. Hicks-Beach observed that it would not deal with carelessness or negligence generally; and further, that it would interfere with small trades and agricultural operations.

University College, Bristol.—This College will re-open on the 25th inst. The work in the engineering department during the coming term will be largely of a special character. Professor Ryan will lecture on civil engineering, mining engineering, and electrical engineering. The last named course will comprise electric lighting, dynamo-electric machinery, and transmission of power. It is arranged for civil engineering students to attend Professor Lloyd Morgan's practical geology classes in the field, and Mr. Selman's outdoor exercises in surveying. Electrical engineering students and others will occupy themselves in the chemical, physical, and engineering laboratories of the college.

Death of Mr. Matthew Arnold.—England has lost one of her celebrated sons by the death of Mr. Matthew Arnold, which took place on Sunday, the 15th inst. Mr. Arnold came of a distinguished family, being the son of Dr. Arnold, the late head master of Rugby, and brother of Sir Edwin Arnold, the author of the "Light of Asia." He was a poet and essayist of eminent ability, and for ten years he occupied the Chair of Poetry at the University of Oxford. The most lasting result of his life's work, however, will be understood by the fact that, for nearly twenty years, he was the chief adviser of the Government on the subject of education. In 1851 he was appointed to be an Inspector of Schools; and it was not until 1886 that he retired from the chief inspectorship. In 1859-60, he was sent as a foreign commissioner to inquire into the state of popular education, and to obtain information respecting the various plans of education adopted by several Continental States. Mr. Arnold again visited the Continent in 1865, to procure for the Royal Commission on middle class education information about foreign schools.

Steam Boiler Explosions.—The usual fortnightly meeting of the Liverpool Engineering Society was held at the Royal Institution, Colquitt-street, on the 11th inst., Mr. Charles H. Darbishire, Assoc.M.Inst.C.E., president, in the chair, when a paper on "Steam Boiler Explosions" was read by Mr. John J. Webster, M.Inst.C.E., and discussed by the members. The paper commenced by stating that the average number of steam boiler explosions during the last twenty-five years was about fifty-six per annum, the average loss of life amounting to about seventy per annum, and although the number of explosions was very great, and the loss of life to be deplored, the actual percentage of explosions to boilers at work was very small, being at the rate of one explosion to every 2500 boilers at work. Owing to the good work done by the different boiler associations, and to the immense improvement in the design and construction of boilers, this percentage had now been reduced to less than one in 6000. The paper then described in detail the various causes of boiler explosions under the following heads: (1) Bad material; (2) defective design, including the mountings and fittings; (3) bad workmanship; (4) careless and improper working; (5) neglect of periodical inspection; (6) bad maintenance. The paper then described some interesting physical phenomena, which had given rise to a novel theory of boiler explosions, and after discussing the question of simultaneous boiler explosions, concluded with a brief review of the existing and proposed legislation on the subject. The paper was illustrated by numerous wall diagrams. As several members desired to take part in the debate the discussion was adjourned.

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, 20th April, 7-30 p.m. Students' meeting. Paper to be read on "The Speed Trials of the Latest Addition to 'The Admiral' Class of British War Vessels," by Mr. David S. Capper, M.A., Stud.Inst.C.E.

Royal United Service Institution.—Friday, 20th April, 3 p.m. Paper to be read on "The Game of Naval Blockade," by Lieutenant H. Chamberlain.

Balloon Society of Great Britain.—Friday, 20th April, 8 p.m. Lecture on "The Architects', Engineers', and Surveyors' Bill, 1888," by Hugh Roumieu Gough, F.R.I.B.A.

NEXT WEEK.

Society of Arts.—Monday, 23rd April, 8 p.m. Cantor lecture on "Milk Supply, and Butter and Cheese Making," by Mr. Richard Bannister.—Tuesday, 24th April, 8 p.m. Applied Art Section. Paper to be read on "Craftsman and Manufacturer," by Mr. Lewis Foreman Day.—Wednesday, 25th April, 8 p.m. Ordinary meeting. Paper to be read on "The Physical Culture of Women," by Miss Chreiman.

Royal Institute of British Architects.—Monday, 23rd April. Ordinary meeting. Paper and discussion. Issue of balloting paper for the new Council.

Institution of Civil Engineers.—Tuesday, 24th April, 8 p.m. Ordinary meeting. Paper to be read, with a view to discussion, on "The Distribution of Hydraulic Power in London," by Mr. E. B. Ellington, M.Inst.C.E.

Civil and Mechanical Engineers' Society.—Wednesday, 25th April, 7 p.m. Paper to be read on "Railways for Rural and Undeveloped Districts," by Mr. James B. Walton, M.Inst.C.E.

Liverpool Engineering Society.—Wednesday, 25th April, 8 p.m. Ordinary meeting. Adjourned discussion on Mr. Webster's paper on "Steam Boiler Explosions." Paper to be read on "Air Brakes," by Mr. C. F. Bamford.

Society of Telegraph Engineers and Electricians.—Thursday, 26th April, 8 p.m. Paper to be read on "The Risks of Fire Incidental to Electric Lighting," by Mr. W. H. Preece, F.R.S.

Royal Institution of Great Britain.—Thursday, 26th April, 3 p.m. Lecture on "The Chemical Arts," by Professor Dewar.—Friday, 27th April, 9 p.m. Lecture on "Electrical Influence Machines," by Mr. J. Wimshurst.

PRICES CURRENT, 19th April.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/7½	Cash
Scotch Warrants, m/n		38/9	"
Hematite Warrants, m/n		41/7	"
Stocks in Stores. Scotch	972,209—Inc. for week,	2205	Tons
Middlesbro'	312,553—Dec. "	4119	"
Hematite	210,321—Dec. "	638	"

Exclusive of stocks in makers' yards.

Market dull and lifeless.

	No. 1.		No. 3.		
Coltness	47/0	.....	42/6	f.o.b.	Glasgow.
Gartsherrie	44/6	.....	41/6	"	"
Dalmellington	39/9	.....	38/3	"	Ardrossan
Eglinton	38/9	.....	37/-	"	"
Glengarnock	43/9	.....	39/9	"	"
*Derbyshire	—	.....	35/6	f.o.t.	Works.
*Lincolnshire	—	.....	32/6	"	"
*Lancashire	—	.....	37/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 17 6	.....	5 7 6	f.o.t. wks
" Angles	4 15 0	.....	5 5 0	"
" Plates	5 0 0	.....	5 10 0	"
Staffordshire Bars	5 2 6	.....	5 12 6	Manch'r.
" Angles	5 12 6	.....	6 2 6	"
Crown Sheets	6 5 0	.....	6 10 0	"
" Hoops	5 5 0	.....	6 5 0	"
"Siemens-Martin" Steel Boiler Plates			7 17 6	"
" Ship and Girder			7 12 6	"

METALS.

Spelter: Ordinary	£18	0	0	to	18	5	0
Copper: British Cakes and Ingots	81	0	0	"			
" Chili Bars	80	2	6	"	80	7	6
" Manufactured (strong)	90	0	0	"			
Lead: Common Pig	15	0	0	"	15	5	0
" English Sheet	16	0	0	"	16	5	0
Tin: Straits	166	0	0	"	166	2	6
" Australian	167	0	0	"	167	2	6
" English Ingots	152	0	0	"	153	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Since our last, quotations for Chili spot parcels have been firm at £80 to £80. 7s. 6d. per ton; but forward deliveries have fallen during the past few days to £77. 7s. 6d. three months. The stocks of raw copper continue to increase very rapidly, and the production in America and elsewhere is being largely augmented, so that the quantity of raw copper to be dealt with in stock and for early delivery is becoming serious. The syndicate has included nearly all the large producers of copper in its speculative arrangement, and most of the English smelters and manufacturers are also under contract for their supplies under this colossal monopoly. The consumers, however, hold aloof the world over, and the copper trade is still stagnant, stocks increasing accordingly. The position is thus without precedent, and all sides are waiting, and speculating on the ultimate result. Manufactured unchanged, and with very little demand.

Tin.—A moderate business is still being done in sharp cash Straits at £166 to £166. 2s. 6d.; forward deliveries are, however, quoted down to £115 per ton, according to date, but not much doing thereat, as consumers do not appear to have confidence, and are only buying for their immediate requirements.

Lead.—Quotations for Spanish have been variable during the past week, from £13. 12s. 6d. to £14 per ton.

Spelter rather lower again.

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	53/6	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	10	0
" Ceylon	"	24	5	0
Cottonseed	"	21	0	0
Cod	"	19	0	0
Lard	"	40	0	0
Linseed	"	18	10	0
Palm, Lagos	"	21	10	0
Rapeseed: English	"	24	0	0
Seal: Pale	"	23	0	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	11	0
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6 1/16
" Spirit	"	0	0	8 1/4

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	6¾	—	0	1	7
" Oxalic	"	0	0	3½	—	0	0	4
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6⅛	—	0	1	6¼
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	12	5	0	—	12	10	0
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	12	6	—	7	15	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	31	0	0	—	31	10	0
Benzole (90%)	gal.	0	3	4	—	0	3	6
" (50/90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	0	0	5¾
" Prussiate (Yellow)	"	0	0	7	—	0	0	7¼
" Sulphate (Basis 90%)	ton	8	15	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—	.....		
" " " 60%)	"	5	15	0	—	.....		
" " (Cream, 60%)	"	5	13	9	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	7	6	—	6	10	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

IRISH EXHIBITION IN LONDON.

At the Irish Exhibition, which is to be opened early in June, at the Olympia, Kensington, and which is intended to place before the English public the leading industries of Ireland, the exhibits will be classified as follows: Agriculture, textiles and manufactures, shipbuilding and sea industries, machinery and engineering, mining and mineral products, brewing and distilling; paper, printing, bookbinding, &c.; scientific, chemical, and allied industries; education and science, furniture and decoration, women's and cottage industries, fine arts, historical and antiquarian exhibits.

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HOME INDUSTRIES.

MANCHESTER, 19th April, 1888.

The Engineering Trades.—Stationary engine builders are still fairly supplied with work, and in some cases are even fully occupied; but in many instances a good deal more business could be accepted if favourable terms were offered. Millwrights are well employed, and it appears probable that, for some time to come, this favourable condition of things will be maintained. Boiler makers continue to do a large business. Locomotive builders are finding a little more inquiry, and, on the whole, this branch of engineering is gradually recovering from the extreme depression of the past few months. The railway carriage and waggon builders are mostly well employed on contracts, and are not likely to be in any immediate want of work. Machine tool makers are booking orders much more freely than they were a short time ago, and inquiries are more numerous than they were. We understand that Messrs. Kendall & Gent, Victoria Works, Salford, have purchased the good-will, patterns, drawings, &c., in connection with the old established works recently occupied by Messrs. William Collier & Co., Salford. Wood working machinists are only indifferently employed, and the same remark applies to general iron founders. Makers of cotton machinery have sufficient orders on hand to employ them for long periods ahead. In spinning machinery there is an abundance of orders, particularly for carding engines and ring spinning machines. Several orders for carding engines on American account have been placed lately, and ring spinning machines are being largely sent to India. The figures recently given in a consular report from Tokio with relation to the advance of cotton spinning in Japan have attracted a good deal of attention. Looms and weaving machinery are still in good request, and although orders are not being given so freely as they were two years ago, there are still plenty to be found. In the miscellaneous class of engineering industries there are complaints made, both as to the scarcity of orders and the prices obtainable. The dispute between the engineers of the district and the moulders still continues, although there are one or two cases in which the desired advance has been granted. The dispute also exists in Oldham, and it is on the whole likely that an advance will be given, unless the present feeling of the majority of the outside employers alters. Our readers will remember that a few months since there was a long strike at Bolton for an advance of 2s. per week, which ended in the defeat of the men. The employers in that district have now decided to grant an advance, beginning on the first pay day in July, which will bring up the wages to the level of 1885. It is expressly stated that the advance is given in consequence of the receipt of more orders, although there is the usual complaint about prices not being remunerative.

Cotton Trade Wages.—Last week we referred to the fact that a demand had been made by the operatives in the Oldham district for advances in the rate of wages paid. In consequence of this a joint conference of representatives of the employers and employed was held, which has ended in a refusal on the part of the former to grant the advance. On their behalf it was contended that the working of eighty-seven spinning companies during 1885 resulted in an aggregate loss of £2,730, and that in 1886 the loss of ninety concerns was £61,000. The gain in 1887, which was a more profitable year, was only on share capital 2¾ per cent., and on loan and share capital combined less than 3½ per cent., the capital involved being £6,250,000. For an average of eleven years it was stated that the return was only 2½ per cent. on the share capital. The replies of the operatives to this statement show a curious notion of the position, as they contend they have nothing to do with losses, and that they should not suffer because capital is unremuneratively employed. It was suggested that a further conference should be held in January, 1889, and that in the meantime the matter should be in abeyance. At a subsequent meeting of the operatives resolutions were passed, which, if carried into effect, can only result in a strike.

A New Company.—The prospectus is issued of a company which has been formed to acquire the patent rights of machines invented by Count P. A. Sparre for the manufacture of cards used in the process of jacquard weaving, and also a special mode of making cartridges and other articles. The former part of the business is to be carried on in Manchester, under the superintendence of Mr. Jacob Lloyd, who has long been engaged in this work.

LONDON, 19th April, 1888.

The Money Market.—The value of loanable capital was considerably enhanced at the close of last week, both from a contraction of the supply and an increase of the demand. The Stock Exchange settlement of course absorbed a fair share, and a number of loans were repayable at the Bank. Borrowers are always desirous to transfer their obligations from the bank to the open market, and hence there was a distinct improvement in the price of money; but since then it has declined into pretty much the old groove, though rates are harder than they have been for some time. The Stock Markets were also much brisker at the end of the week. There was an altogether buoyant feeling, and prices gained all round. The Stock Exchange was in the humour for business and, curiously enough, this was evidenced by a distinct fall in the price of preference securities. The jobbers had not expected the fund holders to assent unanimously to Mr. Goschen's conversion proposals, and so they carefully bought up every preference security they could lay hands on, and put them up to prices which would produce just a trifle over the 2¾ per cent. at which the Chancellor of the Exchequer assessed the credit of the country. The fund holders having preferred to stick to Consols with a quarter per cent. taken off, jobbers have been left with great quantities of securities on their hands, which are unsaleable at the high prices put upon them. They have, therefore, been reluctantly compelled to allow the official prices to drop, so as to get rid of them at all. Thus this fall in fine securities was really a sign of a healthy business tone in the market. Unfortunately, Monday brought disquieting news from Paris, which gave a blow to the markets, and later on the hopeless appearance of the telegrams from Charlottenburg completed the discomfiture, everything falling, and business coming to absolute stagnation. But recovery sets in speedily, and as the market is really healthy, the lost ground should be more than recovered. The hurry to register new companies continues, as may be seen from the list in the next paragraph, and which is merely a selection of the more important projects.

Companies.—Since our last report the following new companies have been registered: The British Sodium and Aluminium Company, Limited, with a capital of £1,050,000, to acquire the inventions of Mr. Albert Berwick Cunningham for the manufacture of sodium and aluminium, the right to an exclusive supply of artificial cryolite, and to manufacture and sell sodium and potassium, or utilise the same for the purpose of reducing any metal from its compounds, and chiefly aluminium; E. Green & Son, Limited, with a capital of £130,000, to acquire the business of manufacturer of fuel economisers and steam generators, now carried on by Sir Edward Green, Wakefield; Mineral Oil Extraction Company, Limited (Rose's patent), with a capital of £200,000; The Butterley Company, Limited, with a capital of £600,000, for the acquisition of the undertaking of the Butterley Company, Alfreton, Derbyshire; Dowson, Taylor, & Co., Limited, with a capital of £100,000, to acquire the business of Messrs. Dowson & Taylor, fire engineers, Bolton, including the benefit of a trading agreement with Messrs. Mather & Platt, Salford; Grenoble St. Etienne Breweries Company, Limited, with a capital of £200,000; Chesters Brewery Company, Limited, with a capital of £300,000, to acquire the brewing business carried on at Ardwick, Manchester, under the style of Executors of the late Thomas Chesters; Edward Marston & Co., Limited, with a capital of £20,000, to purchase a patent for an improved willow peeler, and carry on the business of cane splitting, cutting and weaving, &c.; the Mid-Kent Water Company, Limited, with a capital of £18,000; Port Royal Docks and Harbour Board, Limited, with a capital of £500,000, to acquire and develop the port of Port Royal, South Carolina; Public and Private Works Company, Limited, with a capital of £200,000; British Borneo Guano Company, Limited, with a capital of £100,000; the General and Domestic Inventions Company, Limited, with a capital of £60,000; the West Clogan Gold Company, Limited (Wales), with a capital of £15,000; Transvaal Komati Gold Mining Company, Limited, with a capital of £50,000; Lower Weardale Minerals Company, Limited, with a capital of £50,000, to carry on mining operations, &c., in Durham; the Iron Crown Gold Mines, Limited (Hungary), with a capital of £230,000; Sicilian United Copper Mines, Limited, with a capital of £100,000; New Bultfontein Mining Company, Limited, with a capital of £935,000; California Water and Land Company, Limited, with a capital of £150,000; Cleator Glebe Mining Company, Limited, with a capital of £60,000, to acquire iron ore mines in Cumberland; Sorbridge Tin Mining Company, Limited (Devon), with a capital of £50,000; Descada, Cobalt, and Copper Mines of Spain, Limited, with a capital of £20,000; the Kuysna Concession Gold Mining Company, Limited (Cape Colony), with a capital of £100,000; Sheba Reef Gold Mining Company, Limited (South Africa), with a capital of £60,000; Atlas (Broken Hill) Silver Lead Mining Syndicate, Limited, with a capital of £300,000; the Tilt Cove Copper Company, Limited (Newfoundland), with a capital of £160,000; Original Pittsburg (Grass Valley) Gold Mines, Limited, with a capital of £100,000; the Oberlin Tin Mining Company, Limited (Queensland), with a capital of £200,000; and the Golden Fleece, Limited (Victoria), with a capital of £100,000.

Hemp.—There is but little doing in Baltic hemp, but business in Manilla hemp for arrival has been brisk.

Sugar.—Although buyers are cautious, the situation shows signs of improvement, and sellers have more confidence in the future, especially as the imports of raw and refined beetroot sugar have decreased, and an improved demand for home refined may therefore be anticipated. The Sugar Bounties Conference has been holding further meetings during the present week.

Electric Lighting in Kensington.—The Board of Trade has consented to receive a deputation from the Kensington Vestry to-day, several questions of importance having arisen with regard to the proposal of the parish authorities of Kensington to carry out electric lighting themselves. Mr. John Braye, of the Kensington Vestry, contends that the Vestry already possesses the right to become a trader, and amongst other undertakings to supply electricity to private consumers. As a matter of fact, under an existing Act, London vestries have the power to raise money for lighting purposes, and as the Act in question does not define the character of the lighting, a section of the Vestry is inclined to interpret the Act as being applicable to electric lighting, and this question among others is to be discussed between the deputation and the Board of Trade.

Electric Lighting Act (1882) Amendment Bill.—At a meeting of traders and others interested in the subject of electric lighting, which was held recently at the offices of the Anglo-American Brush Corporation, it was decided to petition in favour of Lord Thurlow's Bill, which is now before the House of Lords. The subscribers to the petition which is now being signed, express the opinion that the extension from twenty-one to forty-two years of the period stipulated by the Act of 1882, after the expiration of which local authorities may have the option of purchasing electric lighting undertakings within their district, will lessen the restrictions which have hitherto prevented the electric lighting industry from making great progress. They recommend, therefore, that the Electric Lighting Act of 1882 Amendment (No. 2) Bill, which has also been introduced in the House of Lords, and which would raise complex questions in connection with the powers of local authorities, should not be proceeded with if found to have a tendency to delay the first Bill, which ought to be passed as soon as possible.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 8th April amounted to £1,176,577 on 15,850¾ miles, as compared with £1,219,547 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 142 miles, or 0·9 per cent., and a decrease in the receipts of £42,970, or 3·5 per cent.

The Jubilee Shot.—This shot was fired at Shoeburyness last Monday. Particulars respecting the estimated trajectory were given in a note in our issue of 16th March.

Taylor's Engraving Machine.—In connection with the illustrated description which we gave of this machine in our last week's issue, we are asked to state that it is made by Messrs. T. S. & W. Taylor, engineers, Slate-street, Leicester. As stated in our description, the London agents for Messrs. Taylor & Co. are the Britannia Company, 100, Houndsditch.

Institution of Mechanical Engineers.—The ordinary general meeting of the Institution of Mechanical Engineers is arranged to be held on Thursday and Friday, the 3rd and 4th prox., at the Institution of Civil Engineers, 25, Great George-street, Westminster. The following papers will be read and discussed at the meeting as far as time will permit: (1) Third Report of the Research Committee on Friction Experiments on the Friction of a Collar Bearing; (2) Description of the Emery Testing Machine, by Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A.; (3) Supplementary Paper on the Use of Petroleum Refuse as Fuel in Locomotive Engines, by Mr. Thomas Urquhart, locomotive superintendent, Grazi and Tsaritsim Railway, South East Russia. The anniversary dinner will be held on Friday evening, the 4th prox., at the Criterion, Piccadilly. The Marquis of Hartington has accepted the invitation to be present at the dinner, and it is hoped that a large number of members will be able to be present on the occasion.

GLASGOW, 19th April, 1888.

Glasgow International Exhibition.—Though Saturday was nominally the last day for the reception of exhibits, it was found quite impossible to take delivery of the enormous number of cases which arrived at the last moment. The week, indeed, had well advanced before the last consignments could be taken from the railway stations and deposited in the halls of the Exhibition. It is now possible to estimate more fairly than a few days ago the probable appearance of the various sections. The large trophies of the Steel Company of Scotland and of Messrs. Colville remind the visitor immediately on entering the machinery section, that he is in one of the chief centres of the steel industry; while in general machinery there is variety enough to be instructive as well as interesting from a commercial point of view. Much has yet to be done to make the Exhibition presentable to the general public, but the labour of many thousand hands can in three weeks effect wonderful transformations, so that there is little likelihood of any material deficiency on the opening day, the 8th May.

Heating of Railway Carriages by Gas.—Experiments have been in progress of heating railway carriages by gas. The method adopted is the invention of Mr. Foulis, gas engineer to the Corporation of Glasgow. The feature of the invention is the placing of a small boiler above the lamp, which is fixed in the usual way in the roof of the compartment. The water in this boiler is made to circulate by means of an arrangement of valves through pipes, placed under the seats. The experiments have been carried out in carriages belonging to the Glasgow and South-Western Railway.

Iron Market.—In spite of a fair amount of shipments during the week, the pig iron market has shown little buoyancy. The tone has been firm, but has probably been prevented from assuming an upward tendency by the want of encouraging reports from America. Steel makers are busy with boiler plates, and with the completion of the contracts for ship plates booked some months ago.

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THE CLYDE TRUST.—A reunion of the employés of this Trust was held on the 6th inst. in the Waterloo Rooms, Glasgow, under the presidency of Mr. George W. Clark. After tea had been provided, a short address was delivered by the chairman, in which he pointed out that 130 years ago the Clyde Trust did not employ a dozen men, whereas now they had about 1000 men in their service. After this address, Mr. James Deas, jun., was presented by his fellow employés with several valuable articles in consequence of his leaving the service of the Clyde Trust to join the engineering staff of the Manchester Ship Canal.

(From our own Correspondents.)

LIVERPOOL, 18TH APRIL, 1888.

THE ISLE OF MAN TRAFFIC.—It is most probable that the competition for the traffic of the coming season will be between the old company and the Manx Line only; the "Lancashire Witch," the screw steamer belonging to one of the competing companies last year, being advertised for sale by auction. Two of the old company's largest boats are being lengthened and fitted with a promenade deck the whole length of the vessel; the old machinery has also been taken out and replaced with triple expansion engines and steel boilers. It is expected by the builders that the speed will be greatly increased, and that they will be able to compete satisfactorily with the steamers of the Manx Line. It is reported that the latter company are obtaining two additional steamers, and they expect to commence running early in May. There was a rumour that the competing companies had come to some arrangement whereby the regular fares would be maintained; this, however, has been dispelled by the advertisement of the old company, stating that on and after the 1st of May the return fares will be reduced to 5s. cabin and 2s. 6d. steerage.

THE EMIGRATION SEASON.—The emigration season has now fairly commenced, and, as Liverpool appears to be the favourite port for the departure of emigrants of all nations, long streams of men are daily to be seen wending their way to the landing stage. Last week was an exceptionally busy time, all the Atlantic liners sailing with their full complement of passengers; the total number of emigrants was greater last week than was ever known in any previous week.

SHEFFIELD, 18TH APRIL, 1888.

THE HEAVY INDUSTRIES.—The condition of the heavy industries continues to be satisfactory, though the exports of unwrought steel from the town, particularly to the United States, have not been so extensive as in the first quarter of last year. However, the bulk of heavy material now being sent out of Sheffield is probably greater than at any time in its history. In railway material the demand has grown very rapidly, and rails, tyres, and axles are being turned out in immense quantities both for home and foreign markets. The rail mills, not only in the town, but those which are worked at Rotherham, Penistone, and Workington, with Sheffield capital, are all doing an extensive trade. One of the best foreign customers is the Argentine Republic, but Japan is perhaps the country in which industrial and commercial enterprise is most active. In March, last year, the latter country imported railway material from England to the amount of £5,612; last month it spent no less than £58,303. In addition to railway material, Japan is taking from Sheffield a quantity of heavy machinery. The engineers and boiler makers are doing a profitable business, and firms engaged on big castings and shipbuilding material continue to be well employed. There is great activity at Messrs. T. Vickers & Sons, Messrs. W. Jessop & Sons, and the Hadfield Steel Foundry Company. The success of the projectiles manufactured by Messrs. T. Firth & Sons in the recent tests has caused great satisfaction. It is now proved that Sheffield compound armour plates and shells cannot be beaten by foreign makers. Ship armour, however, is not yet at its best, and one or two Sheffield firms are exercising their best powers to obtain still greater excellence. The balance of practical and scientific opinion is in favour of steel faced plates, and it is to the improvement of these that attention is turned.

LEEDS, 18TH APRIL, 1888.

IRON AND STEEL.—The manufactured iron trade is brisker, and in all classes of steel there is more doing. Billets are bought up with greater eagerness and beyond present wants, the feeling being that prices may go higher. The well known local firms, such as Kitson's, Tannett's, and Whitworth's, are exceedingly busy, the last mentioned on Government orders. Heavy machinery, colliery plant, roofing, bridge work, are all in better demand, and at the foundries work is plentiful. Leeds is profitably participating in railway development trade. It is sending out a vast quantity of railway material; and it is also much busier than it was on textile machinery and mill fittings. The textile industries continue steadily to improve, and necessitate extensions, new plant, and renewals. Messrs. Kitson have extensive orders on hand for locomotives, and are doing more in steam tram engines. Generally the heavy trades of Leeds are in a prosperous condition, and makers who are turning their attention to entirely new markets find that their trouble is not thrown away.

NORTH STAFFORDSHIRE, 18TH APRIL, 1888.

THE IRON TRADE.—Work has now been generally resumed throughout the district, and specifications are coming in freely. The results of the quarterly meetings were not encouraging to producers, either with regard to price or bulk of orders, and the outlook for the immediate future is an indifferent one. It will soon be possible to head this paragraph, "The iron and steel trades," as it is anticipated that within a few weeks the latter metal will be produced in this district, at the new works of the Shelton Iron and Steel Company. There is no alteration in the price of pig iron, forge quality being worth from 34s. to 36s. at works according to brand, and foundry iron fetching about 40s. for No. 1 and 1s. 6d. less for No. 3.

NORTH STAFFORDSHIRE MINING INSTITUTE.—An ordinary meeting of this Institute was held at Stoke on Monday last, the chair being taken by Mr. J. Lucas, vice-president. Mr. J. W. Swan read a paper on "Edison-Swan's (Electric) Miner's Safety Lamp." The lamp, several samples of which were exhibited on the table, consists of an incandescent lamp in connection with a portable generator of electricity, and gives more than double the light of an ordinary oil lamp. Its weight is rather over 5lb., but it can be hung up at the working face. After the original outlay the cost of maintenance, &c., amounts to only 5d. per week per lamp, in cases where several hundreds are in use. A protracted discussion proved the interest taken by members in the application of electricity to the lighting of mines, and Mr. Swan's lamp was looked upon as a very considerable development on all previous efforts in this direction. Pearson's patent safety lamp for detecting the presence of gas, and containing an automatic appliance to extinguish the flame in case of an inrush of explosive mixture, was also exhibited and explained.

SOUTH WALES, 18TH APRIL, 1888.

TIN PLATES.—It is a remarkable fact that notwithstanding the present high price of tin, which remains at £166, tin plates are at the same level as when the metal was at £102. It is not surprising, therefore, that a paragraph should be going the round of the Press cautioning users against plates in the coating of which lead has partially been employed. The poisonous nature of such a mixture is too well known to suppose that any maker having a reputation to lose would resort to the practice. The extent of the use of canned fruit in the United States is so great that it is there being urged that an inspector of tin plates should be appointed at once. In the meantime the extraordinary character of the phenomenon is intensified by the circumstance that stocks are 50,000 boxes less than the corresponding week last year. A further attempt to form a syndicate to raise prices has again failed for want of the necessary combined action on the part of makers.

PAVING.—A new pavement has just been completed in Caroline-street, Cardiff, by the French Asphalt Company, which will be watched with some interest. Upon a foundation of cement concrete, 6in. thick, a layer of compressed asphalt of French origin is well rammed with heated iron rammers. The asphalt is first ground to a fine powder and roasted. After the process of ramming, the asphalt becomes of the same consistency as the natural rock, and makes a road suitable for the heaviest traffic; the cost of maintenance and cleaning is very small, averaging 7d. or 8d. per yard per annum, as against about 2s. for macadam.

BARROW-IN-FURNESS, 18TH APRIL, 1888.

IRON AND STEEL.—The steady tone of the hematite pig iron trade still continues. There is a good market for all classes of pig iron; but Bessemer is more especially in brisk request, owing to the large consumption on the part of steel makers. There is not a large trade being done in the forge and foundry departments. Orders are offering more freely on general foreign account, and a better trade is being done with America than was expected a short time ago. Prices of pig iron are unchanged at about 44s. per ton net f.o.b. for parcels of Bessemer iron in mixed numbers, and 43s. for forge and foundry, No. 3 quality. Stocks are still very large, especially at some of the works; but at Barrow they are represented almost wholly by the parcels held by merchants or speculators. The make of iron is fairly maintained, although all the furnaces are not in blast. Thirteen out of fourteen furnaces in Barrow are in blast, and the fourteenth is undergoing repairs. Fully 90 per cent. of the pig iron made in Barrow is converted into steel at the local works. The steel trade is exceptionally busy in all departments, and there is much activity both in rails and in Siemens-Martin steel. Rails have been very largely ordered, and the mills are briskly employed night and day. Prices are steady, at from £3. 18s. 6d. to £4 for heavy sections. Light sections are quoted 5s. over these prices.

MIDDLESBROUGH, 18TH APRIL, 1888.

PIG IRON.—This market has been keeping very firm for some time past. No. 3 has been offered at 31s. 9d., although 31s. 10½d. to 32s. had ruled for some time past. It is believed that this temporary depression will give place to a further strengthening of the market as the season advances and the northern ports are opened out. The shipments continue to improve; the total for the current month up till Monday, the 16th April inclusive, amounting to 45,808 tons, against 34,035 tons to same date last month. Germany and Holland have more than doubled their take. There is a falling off in the shipments to Scotland; but that is not to be wondered at, considering the state of the Scotch market.

MANUFACTURED IRON AND STEEL.—The works are going steadily on old orders, but manufacturers are becoming anxious about the future. Buyers are holding off, in the expectation that prices will fall. In finished steel much the same sort of feeling exists. Heavy rails are taken lower than ever, £3. 12s. 6d. per ton having been accepted.

COAL AND COKE.—The coal industry maintains its activity. The land sale will soon be declining, but this will be replaced by exports to the northern ports as they become open. Coke is steady, and maintains its price.

SUNDERLAND, 18TH APRIL, 1888.

SHIPPING TRADE.—The last week's coal exports were scarcely up to the average, although, as compared with the previous week, there was a marked improvement. Altogether 78,408 tons were shipped, an increase of 23,443 tons on the seven days preceding; 57,779 tons went coastwise, and 20,629 to foreign ports. Other shipments comprised 1840 tons of patent fuel, 400 tons of coke, 24,000 dozen bottles, 105 tons of cement, 18 tons of fire bricks, whitening, and goods. The import trade was very brisk, especially in esparto grass, iron ore, timber, block ice, and silver sand. There were also eleven coasting cargoes of various merchandise received.

LIFE SAVING RAFT.—Mr. John A. Baharie, of this town, has invented a novel life saving raft, capable of supporting ten or twelve persons. It is composed of very light materials, and folds up into a small compass, so that it requires a minimum stowage space, and can always be kept at hand ready for immediate use. It is self opening, spreading to its full extent immediately it touches the water; it should prove of special value in excursion and other passenger steamers, where sufficient boat accommodation is really impracticable.

NEWCASTLE, 18TH APRIL, 1888.

CHEMICALS.—In some branches of chemical industry greater animation has been manifested during the past two weeks, and this circumstance tends to encourage the hope that a healthier tone will soon be imparted to the trade generally. The demand for bleaching powder and soda crystals has very sensibly increased, and the supply of high strength caustic soda is far from being sufficient to meet the requirements of the market. Messrs. Allhusen and Co. have now a large force of operatives engaged in the erection of new premises for the manufacture of the last named product, and before the close of the year they will be in a position to more than double their present output. The Jarrow Chemical Company have commenced preparations for the working of a new process referred to in a former report. The Heworth Alkali Works are now extremely busy, and another chemical factory in the vicinity of Felling has re-commenced operations after a somewhat lengthened stoppage. The extensive works of Messrs. H. L. Patterson & Co., and also the works of Messrs. Boult & Partners, are still inoperative. Chemical manures are in good demand, and the works devoted to their manufacture are kept busy.

CEMENT.—In the cement trade business is still very active, the demand for the article, both on home and foreign account, being well sustained. A small factory which was started a few months ago at New Benwell, is now turning out 120 tons per week, the greater part of which is being shipped to America.

COPPER.—At a recent meeting of the directors of the Tharsis Copper Company, it was decided to pay a dividend equal to 10 per cent. per annum to the shareholders. The stock of copper at the Hebburn works of the company is very large, and operations are consequently being carried out on a somewhat restricted scale.

LEAD.—There continues to be a good local demand for sheet lead, and so far as this department of the trade is concerned, business may be said to be brisk.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock, for the week ending April 14th, amounted to 94,115 tons, an increase of 19,768 tons over the shipments for the corresponding week of last year.

BELFAST, 18TH APRIL, 1888.

SHIPBUILDING.—Trade still continues good, and higher rates of wages have been asked, and in some cases granted. All the stocks are full, and there are a large number of vessels in the water approaching completion. The immense new steamer for the White Star Company is now in frame, and Messrs. Harland & Wolff are pushing the work forward as much as possible. An order for a new passenger steel screw steamer of about 1450 tons, for the British and Irish Steam Packet Company, has been placed in the hands of Messrs. Workman, Clark, & Co., Limited, Belfast. She will be employed in their regular line of trade between London and Dublin, and is expected to be ready before the end of the year.

LINEN TRADE.—The market for yarns has been rather dull for the past fortnight, but though the sales have been small, the late prices still hold firm; stocks of wefts are increasing in the higher numbers. Sales have been steady, with a slight advance in prices in some cases. Tows are dull at late prices. The demand for cloths continues good at firm prices. Brown goods are firm and in good demand, and the looms are busy with forward orders. Sellers of finished linens are asking higher rates, but without avail.

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PHOTOGRAPHY IN COMPRESSED AIR.

In the Air Chambers of the Caissons at the Forth Bridge.

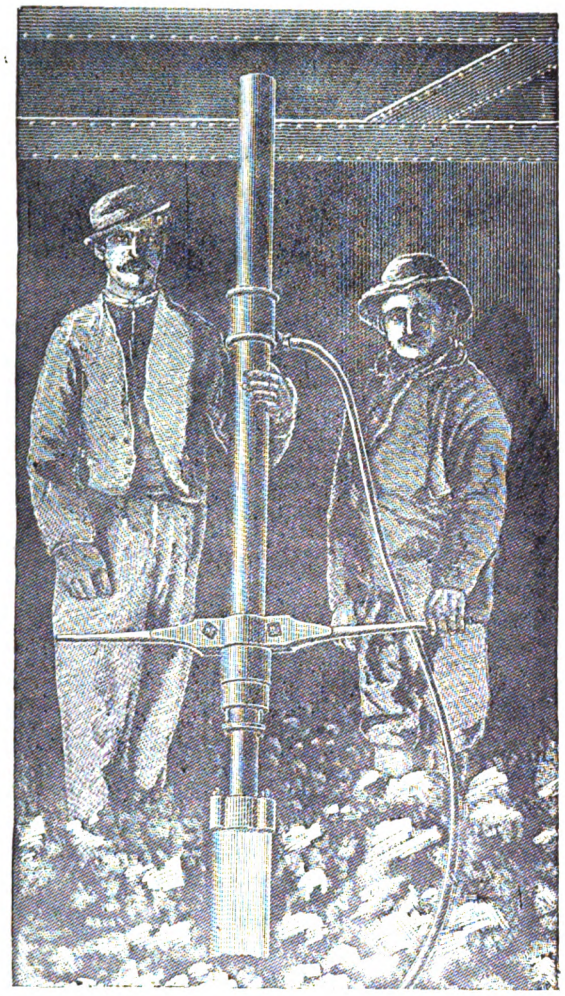


Fig. 1.



Fig. 2.

PHOTOGRAPHY IN COMPRESSED AIR.

By E. G. Carey, Assoc.M.Inst.C.E.

The founding of the main piers of the Forth Bridge afforded an opportunity—but rarely offered in this country—of testing the feasibility of obtaining photographs under air pressure considerably greater than that of the atmosphere. So far as the author is aware, no previous attempts had been made to employ photography under such conditions; the interest attached to the following experiments lies, consequently, in the novel surroundings attendant on their execution, and the difficulties encountered at every step, rather than in any degree of success attained. The views obtained, though serving as records of the work carried on in the air chambers, have no pretensions to photographic excellence, definition and sharpness of outline being impossible to attain in the peculiar atmosphere in which the plates were exposed. The caissons of the Forth Bridge have been already fully described in these pages (see *Industries*, Vol. III., page 148), and are therefore familiar to its readers. Hence it is unnecessary to again refer to them in detail. Suffice it to briefly state that they are constructed of iron, are 70ft. diam., and in exterior appearance closely resemble large gasometers. Built up on shore, they were launched on slipways, towed out to the site of the proposed pier, and filled with concrete till they rested on the bed of the Forth. Seven feet above the shoe, or lower edge of the caisson, is placed a floor forming the roof of the air chamber, which was in fact a large diving bell 70ft. diam. and 7ft. high, in which the work of excavation was carried on, the caisson sinking by its own weight into the hollow thus formed, until the final depth was reached. This air chamber was the scene of the experiments hereafter described. The greatest depth reached was between 80ft. and 90ft. below water level, and the pressure ranged up to 33lb. per square inch above that of the atmosphere. A trial was first made on shore at night, to obtain some data as to the requisite exposure. A group lighted by two arc lamps, each 1200 c.p., and carefully shaded, gave fair results with a rapid plate, the largest stop, and 10sec. exposure. This result formed the basis of the first attempt in the caisson. The roof and sides of the air chambers having been whitewashed, to aid in the diffusion of the light and render sharper the outline of dark figures against them, four rapid plates were exposed for 12sec., 20sec., 25sec., and 30sec. respectively, each with the largest stop in the lens; three arc lights, each of 1200 c.p., being employed to illuminate the group. The plates were found to be considerably under exposed, and no results of any value were obtained. It was now decided to considerably increase the length of exposure; accordingly, ten days later, a second series of exposures were made, of 5min., 10min., and 15min. duration, under the same conditions of lighting and in every way identical with the first experiments. The results on development proved again very disappointing, and failure had evidently to be traced to other causes than deficient exposure. In the third attempt it was accordingly arranged to test the effect of improved illumination, and negatives resulting from exposures of 7min. and 8min., with the largest stop, and five arc lights, or a total of 6000 c.p., carefully arranged so as to light the group most favourably, gave the first encouraging results, and fully demonstrated the importance of adequate illumination. In the fourth series of experiments, it was sought to gain enhanced results by the adoption of more rapid plates than those hitherto employed. Plates of XXXXX rapidity, manufactured by the Paget Prize Plate Company, of Ealing, were accordingly used with the same lighting power as in the third experiment. A further marked improvement ensued, exposure of 1½ and 2 minutes being given with the largest stop. Fig. 1, obtained at this juncture, has been selected as one of the most successful of the whole series. A fifth and final series of experiments were conducted during the founding of the last caisson, viz., that for Queensferry north-west pier. The author endeavoured, by increasing the lighting power, to produce a corresponding gain in definition and sharpness of outline in the groups. It has been already stated that five arc lights had been employed in the later experiments, each having 1200 c.p. The current, it may now be mentioned, was 12 ampères with carbons 10mm. in diameter, and an arc $\frac{1}{10}$in. in length. The attention of the author having been directed to the requirements of electric lighting for engraving purposes, where, in order to secure actinic rays of strength requisite for that class of work, a current of considerably higher strength is essential, he determined in continuing his experiments to employ arc lamps, having a current of at least 25 ampères with 13mm. carbons and an arc ¼in. to ⅜in. in length. Accordingly two Siemens arc lamps of 6000 c.p. each, a current of 30 ampères, an arc averaging ¼in., and Siemens B cored carbons 13mm. diam. (employed on account of the excellent white light they yield), were fixed in the caisson. The power available did not permit the employment of a larger number of lamps at the high current now adopted—a fact to be regretted, as doubtless greater diffusion of light from several sources would, as in former cases, have produced enhanced results. In former experiments the lamps had been suspended from the roof of the air chamber; for the final exposures it was, however, decided to place them on the boulder clay bottom, and to project the rays upwards by placing the positive pole below its fellow. It is doubtful, however, whether much advantage accrued from this arrangement. Fig. 2 has been selected from negatives obtained during the final experiments. The exposure was one minute, with the largest stop. Considerable discomfort to those present at these trials resulted from the high current employed; the symptoms in each case being identical, viz., intense irritation in the eyes, as if filled with sharp, gritty dust. It may be added that bathing the eyes with weak tea and milk—a standard remedy amongst electricians in such cases—alleviated the soreness, and in a few days all pain passed away. Shortly afterwards, the founding of the piers was brought to a successful termination, and with it the employment of compressed air at the Forth Bridge, terminating of necessity any further experiments in this branch of photography. The author was, however, assured by a photographic expert that the dense, hazy atmosphere of the air chambers insuperably debarred him from obtaining the highest results; and that, much as the specimens secured might leave to be desired, he could not in reason hope to improve much further on them. The haze, caused either by a sudden influx or a sudden expansion of air due to its escape, was a continued source of trouble throughout the experiments. No remedy could be found, save to run the air compressing machinery as slowly and regularly as possible, and then seize the moment of least fog for exposure. Some trouble was experienced at first by the formation of moisture on the lenses, due to the heat of the air chamber. The author was not unprepared for this, a similar difficulty having been experienced by Mr. W. D. Valentine, the eminent photographer of Dundee, when engaged in obtaining submarine photographs of the ruins of the old Tay Bridge, a difficulty which Mr. Valentine successfully overcame by rubbing a thin film of glycerine over the lens, and thus checking the formation of moisture. In the air chambers of the Forth Bridge, however, it was found that after a little time the lenses got warm, and the trouble then ceased. A glance at Fig. 2 demonstrates the advantages of light clothing when groups are taken under such conditions. Want of diffused light forms the great difficulty under such circumstances, and every device by which the few rays that are obtained can be diffused and aided should be utilised to the utmost. The lens used throughout these experiments was of the rapid rectilinear type made by Dallmeyer, and had 2½in. aperture and 18in. equivalent focal length. The size of plates was 12in. by 15in. The author is indebted to Mr. Valentine, who on two occasions accompanied him into the air chambers, for much valuable assistance and information; whilst it is due to the kind permission of Sir John Fowler and Mr. Baker, the engineers of the Forth Bridge, that the author has briefly sketched the chief points of interest, and the novel difficulties, in experiments as unique as interesting, carried out by their instructions.

MANUFACTURE OF COTTON IN JAPAN.

The total production of cotton per annum in Japan is officially estimated at 40,000,000lb., a quantity which is not sufficient to supply the requirements of the empire, so that the importation of cotton yarns and cotton goods is an important item in the foreign trade of the country. From a Foreign Office report, however, it appears probable that the imports of cotton manufactures will decrease, as the Japanese spinning industry has of late years received a great impetus. There are twenty-two old established mills at work, with an aggregate number of 76,000 spindles, and in addition to these, eight new factories have been started, with an aggregate of 117,000 spindles, being an increase in eighteen months of over 150 per cent. The *Japan Daily Mail* states that at this rate of progress it is evident that Japan, so far from continuing to afford a market for manufactured cotton goods, will herself ultimately become an exporter of them. It is pointed out that the situation of Japan is very favourable, as it is comparatively within easy reach of the great centres of cotton supply, is itself a cotton producing country, and has the command of cheap and skilful labour. Under such circumstances there is every reason to anticipate a steady and rapid growth of this branch of Japanese industry.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
,, ,, "INDUS, LONDON."
,, ,, "JOURNAL, GLASGOW."
Telephone number: 684, MANCHESTER.
,, ,, 2785, LONDON.

Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 20TH APRIL, 1888.

SCIENCE AND TRADE.

THERE are very few causes which do not suffer more from the injudiciousness of their friends than from the opposition of their enemies. The cause of scientific and technical education has certainly so suffered. Some of its extreme partisans look upon it as sufficient to cure all the ills from which society is suffering, and forget that unless beneath it all we have the strong fibre of healthy manhood, such education by itself only affords a quicker way of going to ruin. On the other hand, manufacturers are too apt to look upon it simply as a means for cheapening or bettering their products, and they only value it in so far as it does; and the sub-division of labour and the employment of machinery render technical instruction not so necessary for the hands he employs in his work as for the heads which direct it. Skilled engineers, chemists, or artistic designers are therefore what they insist is required, and they think technical education for the working classes altogether unnecessary. They argue that our workshops and manufactories are the best technical schools in the world, and that the chief want of the workmen is that they should be both sober and intelligent enough to carry out the instructions they receive from their managers. Again, we find some conservative enough to deny that we are inferior to any of the Continental nations in either science or practice, although they are willing to admit that from our past prosperity we have got into the way of taking things easily and allowing trade to push itself, whereas the Germans have been compelled, from their past conditions, to found technical schools and send their travellers all over the globe, and they are of opinion that what we require is rather a better commercial organisation for bringing our productions to the notice of our probable customers. In this, as in almost all other matters, there is some truth in each of these opinions, and if people would only learn to take a broad view of matters, they would soon see how the wants of the different classes of the community were to be met, and the demands of modern trade to be satisfied. We do require for the continued prosperity of our manufacturers men who have received the highest scientific training, as there can be no doubt that the inventions of the future which will revolutionise old industries or found new ones will only be possible to those who have undergone such a training. In proof of this, we have only to mention the discoveries of Bessemer and Siemens, which have revolutionised the iron and steel trade; of Wheatstone and Thomson, which have made telegraphy successful; of Young, which founded the paraffin oil trade; and of the German chemists, which have given them a monopoly of some of the chemical industries requiring high scientific skill. We further require a considerable number, although not so large as some people imagine, of men capable of acting as draughtsmen and foremen; but the great body of the working classes stand more in need of an education which will fit them to be good citizens, than one which is specially adapted to technical ends. Every opportunity should be given to those who really display original ability for improving their position; but the way from the workshop to the drawing office should not be too easy. Clerks have long been a drug on the market, on account of our present system of education, which inclines a man to starve on a pittance, if he can keep on his coat, rather than earn a good wage as an artisan. If such men would only combine some scientific training along with what they obtain in commerce, and if they paid more attention to modern languages, so that they might be able to meet the well trained graduates of Continental schools on something like equal terms, they would be more useful.

The foregoing considerations occurred to us after reading an article in a recent number of the *Contemporary Review*, by Sir Lyon Playfair, on "The Progress of Applied Science in its Effect upon Trade," in which he takes for his text a remark which he made some years ago, to the effect "that the world has not yet accommodated itself to the wonderful changes which science has produced in the modes of production and in the exchanges of commerce," and he contends that there are only two causes of the universal depression which at present prevails, viz.: (1) That the improvements in machinery, by new inventions, have produced great changes in the quickness and economy of distribution of commodities, and have profoundly altered the whole system of commerce; (2) that the improvements of machinery used in production have increased the supply of commodities beyond the demands of the world, and have too rapidly displaced the old forms of labour. He maintains that capital has suffered, during this long continued depression, more than labour. For some time past capital, when applied to staple commodities, is glad to be content with about 10 per cent. of the cost of conversion of raw material into a useful product, while labour gets 90 per cent. Of the 10 per cent. which goes to the capitalist only from 5 to 6 per cent. can be put to profit, the rest going to the wear and tear of the machinery. There is at present a want of harmony between capital and labour which tends to continue the depression. Sir Lyon Playfair remarks that sometimes working men, not content with the shorter hours of labour, put arbitrary limits to output and to the mode in which the workers shall be employed, and such restrictions, lessening the very narrow margin of profit that prevails, have stopped some works, and threaten to drive others from this country to foreign parts; and he contends that a better education of masters and men would show that the interests of capital and labour are not antagonistic, but identical.

Our space will not allow us to follow him in his purely economic speculations; but, having regard to Sir Lyon's position as an authority on scientific matters, we will briefly note a few of his remarks on the effects of science on trade. He mentions, in the first place, the changes produced by science in the economy of distribution, and the consequent and profound alterations which have followed in the commerce of the world. The opening of the Suez Canal in 1869 caused the old route round the Cape of Good Hope to be abandoned; and by the substitution of iron steamers for wooden ships, a tonnage estimated at two millions of tons was practically destroyed, and vast arrangements in commercial industry were displaced. In the old system of long voyages, large storehouses of goods had to be provided for the shipping interests, not only in foreign ports, but also in England, which became the centre of warehousing, banking, and exchange. All this was changed by the mighty power of electricity, which has not only revolutionised the method of effecting exchanges, but has also, through its various applications—the telegraph, telephone, and electric lighting—created new labour, and at the same time displaced a large amount of old labour. The Suez Canal and improved telegraphy made great demands

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for quick and economical distribution of material. Numerous steamers were built between 1870-73 for this purpose; but so rapid were the improvements that they were nearly all displaced two years afterwards, and sold at half their cost. Iron has been largely substituted by steel both on land and sea, Bessemer's invention at first destroyed wealth; but, phœnix-like, new wealth has arisen from its ashes. The improvements in the marine engine have produced great economy of fuel, and a great reduction in the cost of transit has been the result. The raw material can thus be distributed at low charges, and England has, in consequence, lost its great advantages in the possession of coal and iron—the first, the source of power; the second, the material of strength. The value of raw material in industry is the lowest factor of production, while the value of intellect in converting it into utility in the cheapest and best way is the highest and dominating factor in manufactures.

Sir Lyon Playfair then proceeds to dwell on what he considers the second cause of the depression which now exists, viz., that modern inventions have produced commodities faster than the world could absorb them at remunerative prices, and in doing so have displaced old forms of labour with too great rapidity for its absorption by replacement, and this he illustrates by examples from chemical manufacture, only one of which we have space to mention, viz., the root called madder. This was grown as extensive crops in various countries of the world—Turkey, Holland, Belgium, France, and Italy—and gave employment to a large number of cultivators. Commerce was startled some time since to learn that chemists had succeeded in making the colouring principle of madder out of coal tar, and in a short time a great change took place in agriculture, commerce, and dyeing. Madder is still used to some extent; but its importation has decreased from 28,750,000lb. in 1872, to about 2,000,000lb. in 1887. Sir Lyon then mentions some of the effects of invention on the cotton trade, and on agriculture; but as these are generally pretty well known we will not repeat them, but the effect of railways may be noted. Through them a vast amount of the labour of men and horses has been displaced, but is replaced in other forms by feeding the railways with material. If the locomotives on English railways were annihilated, it would require the labour of 75,000,000 men, or of 12,000,000 horses, to carry on the traffic, in an inferior way and at a much larger cost; for the cost of carting a ton weight by a man with a cart and horse is one shilling per mile, while the railway carries it for a penny or under. The last illustration Sir Lyon gives is from the iron industry, and shows the various economies which have been effected not only in the main, but also in many subsidiary products.

The conclusion Sir Lyon draws is that the equation of the older economists—the product equals labour plus capital—is not correct. The product is actually the result of three kinds of labour—capital or accumulated labour, labour of quality, and labour of quantity; or reducing this to a simpler expression, the present state of manufactures depends mainly upon the intellectual condition of the producers, and he quotes statistics to show how much more the Germans are doing than we are in the way of education. It ought to be noted that it is chiefly in the education of leaders of industry. It is not yet too late, however, for us to hold our own in the ever increasing competition of the industrial world. There is no occasion for panic. Let us develop our newly established University Colleges, and extend our evening science and general classes, keeping, however, the practical part of the training of the students in the workshops or manufactories; and above all, let us not make the passage from the workshop to the college too easy, except to those of proved ability and energy; and without introducing any new machinery or organisation we shall be able to do all that is required at a comparatively small cost to the community.

THE BIMETALLIC CONFERENCE.

It may well be doubted whether much that is new can be said on the subject of bimetallism. For at least ten years there has been an almost continuous flow of bimetallic rhetoric, in the press and on the platform; and it might safely be assumed that all the arguments have been advanced, and all the objections answered. Yet the Bimetallic League may think that it has work before it, not precisely in the way of scientific pioneering, for that is not its function, but rather in popularising conceptions which in the minds of monetary reformers have long been commonplaces. To put the issue clearly before those who are not specialists in the science of money, and to stimulate public interest in a question that may ere long press for settlement at the polling booths, are, it would seem, the present functions of the League. One of the modes of exercising these functions is the holding of conferences, at which papers dealing with various aspects of the subject may be read. Such a conference was held in Manchester a few days ago, and although the recent changes in the relative values of the precious metals are just now a subject of Parliamentary inquiry, there was nothing in the least inopportune in this meeting of bimetallists, for the "battle of the standards" cannot be said to be either lost or won. The Bimetallic Conference, like most others convened by a single party in a controversy, was pervaded by perfect harmony. There was no possibility of discord, since there were no dissentients there. It is well for propagandist leagues to turn aside from time to time from the strife of controversy, and to rejoice in harmonious possession of their shibboleth, whatever it may happen to be. Leaving aside the very obvious charge of one-sidedness which has been in certain quarters pressed against the Bimetallic Conference, it were well to examine calmly what justification there is for the bimetallic propaganda, and what it may be expected to effect. Perhaps the primary justification for the advocacy of bimetallism as a new monetary gospel, is the circumstance that even among professed economists monetary science had almost fallen into desuetude. Jevons, and a few others who were adherents of the orthodox economics—if the views of the English critical group of whom Jevons was a member can be called orthodox economics—wrote well and impartially upon monetary problems and the movements of wages and prices; but the rank and file met all suggestions of the need of currency reform with a simple *non possumus*. The result was that currency came to be looked upon as subject to certain immutable laws with which it was quite impossible to interfere, and the Act of Lord Liverpool, which established our present monetary system, was assumed to have all the force of a law of nature. To the bimetallists belongs at least the credit of having shaken up the dry bones of monetary controversy, and of having directed anew the minds of economists to the history and the theory of money, while the serious price fluctuations of the past few years have given them ample material upon which to draw for illustration of their position. One might even go a step further, and say that the bimetallists have been largely unconsciously aiding in the development of a study of economics from the point of view of dynamics, as opposed to the older static method; and this service will remain to their credit after their frequent extravagances and unrealisable hopes are forgotten. Besides this justification on scientific grounds, the bimetallic propaganda might be justified on the ground that it occupies vigorously a position in the general circle of critical attack upon current conditions. However one may disagree with the positive proposals of an opponent, it is almost invariably useful to learn what one can from his criticism. Thus the constructive schemes and millennium visions in which some bimetallists and others indulge their imaginations, may, perhaps, be quietly ignored; but when they point to dislocation of commerce produced by changes in monetary legislation and to fluctuations in the supply of the precious metals, as affording reasons for a re-examination of the whole subject of money as an international question, it is impossible seriously to deny the need of such an inquiry. When we ask, however, what bimetallism may be expected to effect, we find room for vast divergence of opinion. It is one thing to agree with, for example, Sir H. Meysey-Thompson's statement that there has been "plenty of trade but no profit," and quite another thing to expect that bimetallism would mean increased profit. It is one thing to admit that the depression of prices has been largely due to currency causes, quite another thing to expect that the establishment of bimetallism would result in a general advance of prices. If there is any truth in the bimetallic position, the result of its establishment would be a steadying of general wholesale prices, not a rebound from the low prices now current. Nor would it probably have any immediate or even remote effect upon profits. It might contribute slightly to steady them—that it would cause them to rise is a theory inconsistent with the fundamental proposition of bimetallism. The fact is that currency movements, whether legislative or productive, form only one set in a complex system of movements, and it is as unscientific to give them an exaggerated value as it is to ignore them. It is to be expected that those who urge a special point should use special pleading; it is for the impartial public—impartial in this case, it may be said without offence, chiefly from ignorance—to discount the exaggerations, and apply a rigid test to the statements of the bimetallists. Some of these statements do seriously require the application of such a test. The address of the chairman, for instance, contained in rather an exaggerated form, indication of the existence in his mind of the cruder errors of the Mercantile School, which, long relegated to the limbo of exploded theories, seems inclined now to re-visit us. He said, for example, that "silver using countries have no money metal with which to discharge the balance of debts to England, but must send commodities." This is clearly a survival of the "mercantile" exaggeration of the importance of the settlement of the balance of trade by the transference of money metals. It is too old a controversy to re-open; but apart from theoretic objections, the statement might be called in question as to matter of fact. India is understood to have large gold hoards, which it could, if it were so disposed, remit to Europe in settlement of the balance of trade. Exports from India have indeed been stimulated by the fall in the exchange, and not because India has no "money metal" wherewith to settle her balances.

It may be held as proved, since very ample evidence to the effect appears in Mr. Inglis-Palgrave's Memorandum in the Third Report of the Royal Commission on the Depression of Trade, that silver prices in India have not risen, so that there is no apparent hardship in the Indian people being compelled, in their attention to their economic interests, to send their commodities rather than their money to us. While this is the case as regards people in India, there can be no doubt that the uncertainty and constant variation of the exchange has caused great commercial distress in this country, and that not because of the mode of settling international balances, but because of the downward tendency of gold prices, of which the fall in the exchange was the manifestation. Among the papers read at the recent conference was one by Mr. Samuel Smith, M.P., which speculated upon the effects which would follow the re-monetisation of silver; one by Professor Nicholson, attempting to reconcile the bimetallic theory of money with that of Adam Smith; and one by Professor Foxwell, upon "certain misconceptions in regard to the 'fixed ratio.'" In his paper Professor Nicholson pointed out that what is wanted is an international standard by which the fluctuations of prices due to monetary causes alone might be minimised, and he endeavoured to show that it is hopeless to construct such a standard with a single metal, either silver or gold, and that, therefore, the only practicable standard is a joint one. In Professor Nicholson's opinion, one of the leading characteristics of a good money, viz., stability, would be realised by bimetallism. Professor Foxwell's paper on the fixed ratio approached the subject from a slightly different point of view. He described the fixing of a ratio between commodities as of common occurrence, and pointed out that the vague ratio arrived at by the silver market is too haphazard and inconvenient. These papers together formed an exceedingly good summary of the bimetallic position, and from the point of view of the monometallists, seemed to demand serious answer. There are, however, larger aspects of the question with which none of the papers read at the conference dealt, and which, perhaps, it would have been impossible to deal on such an occasion. Among these is the question of a multiple standard, to which at the best bimetallism is but a stepping stone. If it be the case that the countries of the Latin Union are waiting for the report of the English Commission now sitting, and that they look to England to act, should the slightest encouragement to do so be offered in the report, it may be that Mr. Goschen's next surprise will be a proposal for an International Monetary Conference to succeed those of 1878 and 1881. Though it is not likely that much that is novel would be disclosed at such a conference, it would at least help in preparing the way for an international monetary system in the future, by which the increasing movements of commerce might be rendered possible with decreasing friction. The question of State interference with industry is hardly a valid one in this case. We have on numerous occasions expressed our disapproval of the undue interference of the State in industrial matters, whether for party purposes or for objects more worthy of general support, but as between State control of the Mint and *laisser faire* in the making of money, civilised nations have long decided. The question is not really now an open one. The discussion is practically between a State regulated *single* standard and a State regulated *double* standard. Neither monometallists nor bimetallists thus adopt in its fulness the principle of *laisser faire*.

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EMPLOYERS' LIABILITY LEGISLATION.

We referred last week to this subject, but with special regard to the effect which the proposed legislative changes would have upon mine owners. The Government Bill now before the House is backed by the Home Secretary, the Attorney General, Mr. Ritchie, Mr. Forwood, and Mr. Stuart Wortley. The Bill shows that it is proposed to repeal the Act of 1880, but that the main principles of that Act are to be re-enacted, together with some additions which eight years' experience would seem to justify.

It will be remembered that previous to the Employers' Liability Act of 1880 an employer was not in general liable to a workman for an injury which was the result of (*a*) the employer's negligence in respect of certain defections in his machinery, or (*b*) the negligence of a fellow workman. The Act of 1880 made material changes in these respects; but where the injury was caused by the negligence of a fellow workman, the employer was only liable if the fellow workman was in a position of authority over the injured workman. The Act removed certain anomalies in the law, and was, we think, generally beneficial to both masters and men. Legislation of this kind does not often affect large minded employers, who make it their duty to see that their machinery and plant are of the best, and who look after the welfare of their workpeople. But it does affect a certain class of employers. For instance, an employer whose chief concern is his legal liability, would be led to take more care in the selection of a second hand boiler or hoist. There was nothing in the Act of 1880 to prevent employers and workpeople contracting to exclude the provisions of that Act, and it was said at the time that this would make the Act a dead letter; but experience has shown the prediction to be baseless. To a very large extent employers of labour now insure against their liabilities, and the extensive business done by several insurance companies dealing with this special risk show that the Act of 1880 has not been a dead letter. It has done good service, not the least being that it has paved the way for the present measure. As we mentioned last week, there is another Bill before the House, having for its object the amendment of the Act of 1880. This is backed by Messrs. Burt, Broadhurst, Joicey, Haldane, and Lockwood, and may be said to specially represent the interests of workpeople. It will be interesting to note where the two Bills differ. By Mr. Burt's Bill the employer would be liable for injuries arising "by reason of the negligence of *any* person in the service of the employer." The Government Bill limits the employer's liability to negligence on the part of workmen who have authority or supervision. Again, by Mr. Burt's Bill the amount of compensation is limited to £500, whereas by the Government Bill the limit is £150. Mr. Burt's Bill provides that any contract which excludes the provisions of the Act shall be void; but that in reckoning the compensation there must be deducted therefrom the amount paid by the employer or by an insurance company receiving a premium from the employer. The Government Bill avoids all contracts by which the benefits of the Act are surrendered except in one case. By Mr. Burt's Bill, where a person has a right of action against a sub-contractor, he shall have the same right of action against any superior contractor; but such superior contractor shall be entitled to be indemnified by the sub-contractor in respect of the negligence of whom or of whose servants the cause of action arises. Section 2 of the Government Bill deals with the question of sub-contracts.

Having given above the material points on which the two Bills differ, we may state that, on the whole, the Government Bill appears to be a reasonable measure, and would seem to deserve the support of both employers and workpeople. Legislation too often seems to be directed in favour of one class at the expense of another, though in time this brings an unhealthy reaction. This remark applies to a certain extent to Mr. Burt's Bill, which might give a serious check to the employment of capital. For instance, a company desires the construction of a certain work, and thinks it cheaper to have it done by contract. The contractor finds it convenient to have say the masonry work done by sub-contract. By Mr. Burt's Bill the company, who merely find the money, might be harassed by legal proceedings on the part of a workman of the sub-contractor. The liability for compensation should be on the person who is morally responsible for the injury; and this, we think, is clearly provided for in the Government Bill.

Particular care must be taken not to deter owners of capital from employing it to the general advantage of the community at large, as industrial enterprise obtains its success from the wise union of capital and labour. The greatest foresight should be used to see that legislation intended for the benefit of the workman does not ultimately have the reverse effect.

Telegraph Cable.—The Spanish Government is in treaty with a foreign company for the establishment of a telegraph cable between Spain and the Balearic Islands.

Letters to the Editor.

STEEL SLEEPERS.

To the Editor of "Industries."

Sir,—Referring to the abstract of the paper on "Steel Sleepers" read before the Civil and Mechanical Engineers' Society on the 18th January, 1888, by Mr. H. T. Munday, Assoc. Mem., which appeared in your issue of the 6th inst, I think it is a matter for regret that the author did not enter more freely into the subject, which is one of great importance to railway companies as well as to the iron trade and kindred industries of this country, which require all the assistance they can obtain to maintain their position and keep their works going. To quote the words of a late president of the Iron and Steel Institute, "The change from timber to metal sleepers would be in importance second only to that of iron to steel rails."

Mr. Munday in his paper does not give the comparative cost of the few types of sleepers alluded to, nor the length of time they have been in use, the cost of maintenance, &c. This information would have been interesting to myself, and doubtless to many of your readers, as the subject is one that demands full consideration, having regard to the increasing weight of engines, rolling stock, and loads carried at higher speeds and at more frequent intervals over the permanent ways, which have to bear the whole burthen of the traffic, while allowing but little time for the necessary inspection, adjustment, or renewal. It is obvious that any real improvement in the *matériel* of this department of railway work would be a boon to the shareholders. It would also tend to diminish the cares of the directors and chief officials of our railways, and conduce to the safety of the travelling public, as the judicious use of the block system of signalling and continuous brakes have done. I hope to be able to allude at length to this subject at an early date; but, in the meantime, this letter may lead to the ventilation of this important matter by some of the readers of *Industries*.

Yours, &c., L. L.

Manchester, 17th April, 1888.

ON THE COST OF CENTRAL STATION LIGHTING.

To the Editor of "Industries."

Sir,—In my letter to last week's *Industries* I notice that only 1200 yards of useful frontage have been estimated for instead of 12,000 as suggested by Mr. Crompton. This of course makes a very considerable difference in the total cost of the proposed scheme, and therefore I would make the paragraph on the last column commencing "The supply mains would be laid," &c., read as follows:—

The supply mains would be laid underground from the engine house to the exterior of the area of supply, and I have considered that at this point they would branch off into ten distributing mains along 12,000 yards of useful frontage within the area of the supply. The cost of the supply mains up to the area carrying 300 ampères at 2000 volts would be about £1,600. For the distributing mains, which might carry a maximum of 30 ampères at 2000 volts, about £1,300 might be allowed. This is on the supposition that there are no secondary distributing mains, but that the primary current is led throughout the whole district, viz. 12,000 yards. As regards transformers, I assume for the moment that one instrument is provided for every two houses, and therefore about five hundred will be necessary. For laying conductors, opening streets, &c., I believe 10s. per yard will be a fair amount, or £6,880 for the 13,760 yards opened altogether. My estimate would therefore read as follows:—

Buildings, &c.		£6,500
Boilers, &c.		5,320
Engines, &c.		7,200
Dynamos, &c.		7,000
Supply mains	for primary current	1,600
Distributing mains	for primary current	1,300
Laying mains		6,880
Transformers		2,700
Fixing transformers		1,800
Station fittings, &c.		500
Total		£40,800

Or about £4. 1s. 6d. per lamp.

I must, however, say that on no account would I advise an undertaking of this nature to be carried out on these lines. The problem given by Mr. Crompton is altogether too vague and indefinite to form a criterion as to the relative merits of the two systems.

Yours, &c.,
J. Kenneth D. Mackenzie.

Westminster, 17th April, 1888.

"FUEL AND WATER," BY SCHWACKHÖFER & BROWNE.

To the Editor of "Industries."

Sir,—I have recently perused this volume, and find that, notwithstanding the high encomiums which greeted its publication some four years ago, one section of the book is so entirely erroneous as to be practically meaningless, owing to the fact that the figures do not bear any relationship to the formulæ enunciated. One of your contemporaries, when reviewing the book, said: "We confidently recommend this work to students. The section on heat is one of the best and most lucid ever written." Another said: "The practical utility of the volume is beyond question;" a third that "The reader has every guarantee for the soundness of the work, which will be readily purchased by all users of steam and water;" and a fourth that it would be "A welcome addition to the engineer's library. Gathering within itself many facts and data of physical science, often difficult to find when required, it will serve as a useful book of memoranda to the scientific engineer." No doubt the foregoing eulogies apply to the general principles set forth in the volume, and it is therefore the more to be regretted that, in the comparatively elementary process of applying the general principles to actual examples, the figures have got so far astray. With your permission I will proceed to state the corrected figures in such a form as will be of use both to those of your readers who have and have not the volume in question. Chapter III. treats on heating apparatus, which is divided into three principal parts, viz.: (1) The furnace, with grate and ash pit; (2) the flues; (3) the chimney; and after a general dissertation on each of these heads the author proceeds to treat on the "useful effect of furnaces (with examples of calculations)." It is in these examples of calculations that the figures get astray.

Example I.

commences on page 115, and merely noting that we here find "1675" (kilos.) printed instead of "16,752 litres," we pass on to the data upon which the calculations for arriving at the "useful heat" are based. They are as follow:—

Chemical composition of coal:

		Per cent.
Carbon		69·77
Hydrogen		2·72
Nitrogen		0·46
H_2O (in chemical combination)	13·45	
H_2O (hygroscopic)	3·25	
		16·70
Ashes		10·35
		100·00

Composition of chimney gases, per cent. of volume:

CO	0·0
CO_2	12·2
Air	38·6
N	49·2
	100·0

Mean temperature of chimney gases	200°C.
„ „ air	25°C.
Moisture of air, per cent. by weight	0·8
Water evaporated per kilo. of coal burnt	9·097 kilo.
Temperature of feed water	58°C.
„ steam	155°C.
Water carried over in steam	1·3 per cent. by weight.
Weight of cinder per kilo. of coal burnt	0·113 kilo.
Analysis of cinder	0·0137 kilo. carbon. 0·0993 kilo. ash.

The first error which we have to note is in the "air theoretically needful for complete burning of 1 kilo. of coal," which is stated as = 9·17 kilo. On page 43 we find it stated that "the weight of air L required for one unit of fuel is given by the formula

$$L = \frac{11{\cdot}696C + 35{\cdot}088H}{100}$$

where C is the percentage of carbon, and H that of free hydrogen in the fuel." The weight of air theoretically needful for complete burning of 1 kilo. coal of above analysis should therefore be 9·11 kilo., and not 9·17, as stated.

We next find an error in the calorific value of the fuel. The formula for this, a modification of Dulong's, is given on page 45 as follows:—

$$p = \frac{8080C + 29633H - 637W}{100}$$

where p is the absolute heating power of the fuel, and C, H, and W are respectively the percentages of carbon, free hydrogen, and chemically combined or hygroscopic water. Applying this formula to the analysis of coal stated above, we find the absolute heating effect of the fuel to be 6337 calories, instead of 6600, as stated, and from this of course it follows that the theoretical figure of evaporation of water at 0°C. to steam at 100°C. is 9·95 kilo. of water per kilo. of coal, instead of 10·4 kilo., as stated.

The calculations determining the useful heat, and apportioning the heat lost, are as follow:—

I.—Heat Lost in Chimney Gases.

(*a*) Volume of each kind of gas in a weight unit, by analysis, which see above.

	Weight of a litre in grammes.		Parts by volume.		Parts by weight.
Carbonic acid	1·9666	×	12·2	=	23·993
Air	1·2936	×	38·6	=	49·933
Nitrogen	1·2566	×	49·2	=	61·825

(*b*) Weight of each kind of gas per kilo. of coal burnt. 1 kilo. of coal contains 0·6977 kilo. of carbon; of this there fall into the ash pit 0·0137 kilo., and are burnt 0·684 kilo. Three kilo. C give, when completely burnt, 11 kilo. CO_2; hence

$$\frac{0{\cdot}684 \times 11}{3} = 2{\cdot}508 \text{ kilo. } CO_2 \text{ per kilo. of coal.}$$

To 23·993 CO_2 correspond 49·933 air; hence

$$\frac{49{\cdot}933 \times 2{\cdot}508}{23{\cdot}993} = 5{\cdot}219 \text{ kilo. of air per kilo. of coal.}$$

To 23·993 CO_2 correspond 61·825N; hence

$$\frac{61{\cdot}825 \times 2{\cdot}508}{23{\cdot}993} = 6{\cdot}463 \text{ kilo. of N per kilo. of coal.}$$

The water in the chimney gases is made up as under:—

1. Water contained as such in the coal (0·167).
2. Water from combustion of available hydrogen (0·0272 × 9 = 0·2448).
3. Water in incoming air.

Here we come upon a confusion of terms, and an irregularity in the method of computation. It is stated that 77N correspond to 100 air, and upon this basis the quantity of air used in combustion is computed, and then 0·8 per cent. for watery vapour is added. Later on we find that the air computed on the basis of 77N : 100 air is described as atmospheric air. Now, "atmospheric air" means air in the condition of the then existing atmosphere, that is to say, including its 0·8 per cent. of moisture. The term atmospheric is therefore wrongly applied, as it is applied to air (N_4O) without the moisture. The calculation is

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however, also wrong, for taking air as N_4O, 77N—would correspond to 220 = 99, and not 100 air. The correct computation of the air used in combustion will be as follows:—

Atmospheric air	100·00
Less moisture	0·80
	99·20 N_4O

= 77·15 units of N plus 22·05 units of O. 77·15 weight units of N therefore correspond to 99·20 weight units of air; hence

$$\frac{6{\cdot}463\times99{\cdot}20}{77{\cdot}15}=8{\cdot}310 \text{ kilo. of air used in combustion;}$$

and vapour with above air

$$=\frac{6{\cdot}463\times0{\cdot}80}{77{\cdot}15}=0{\cdot}067 \text{ kilo.}$$

No note is taken by the authors at the foregoing stage of the ·0046N originally present in the coal, presumably because it would not make any practical difference in the results; it would, however, have been more regular to have shown this.

The weight of the excess air having been computed above as dry air, the 0·80 per cent. moisture must be added; hence, vapour along with excess air

$$=\frac{5{\cdot}219\times0{\cdot}80}{99{\cdot}20}=\cdot042 \text{ kilo.}$$

The total incoming air and vapour per kilo. of fuel burnt will therefore be

8·310 air used in combustion,
5·219 excess air.

Total, 13·529 kilo. instead of 13·613, as stated.

The total vapour brought in will be

0·067 along with air used in combustion,
0·042 along with excess air.

Total, 0·109 kilo. instead of 0·110, as stated.

The total vapour in chimney gases will be

0·4118 kilo. from the coal,
0·1090 kilo. with the air.

Total, 0·5208 kilo. H_2O instead of 0·5218, as stated.

(*c*) Calculation of heat capacity of chimney gases:—

	Kilogrammes.	Specific heat.	Heat capacity.
Carbonic acid	2·509	× 0·2160	= 0·542
Air	5·219	× 0·2375	= 1·239
Nitrogen	6·463	× 0·2438	= 1·576
Steam	0·521	× 0·4805	= 0·250
Total			3·607

(*d*) Calculation of heat capacity of entering air:—

	Kilogrammes.	Specific heat.	Heat capacity.
Air (N_4O)	13·529	× 0·2375	= 3·213
Steam	0·109	× 0·4805	= 0·052
Total			3·265

instead of 3·286, as stated.

(*e*) Calculation of heat lost in chimney gases:—

	Heat capacity.	Temp. (deg. C.)	Calories.
In chimney gases	3·607	× 200	= 721·4
Less brought in by air	3·265	× 25	= 81·6
Loss			639·8

II.—Heat Lost by Coal Falling in Ash Pit.

The residue per kilo. of coal consists of:—

0·0137 kilo. carbon.
0·0993 kilo. ash.

Kilo. C.	Heat value.	Calories.
0·0137	× 8080	= 110·7

III.—Heat Lost in Priming Water.

For each kilo. of coal burnt there were:—

8·9787 kilo. water actually evaporated.
1·3 per cent. or 0·1183 kilo. water carried over as liquid.

Total..... 9·0970

Kilo. of water.	Temp. of water in boiler.	Temp. of feed water.	Calories.
0·1183	× (155	− 58)	= 11·5

IV.—Heat Lost by Conduction of Radiation through Walls.

The total heat of evaporation by Regnault's formula

$$W t=606{\cdot}5+0{\cdot}305\,t$$

is stated as follows:—

$$8{\cdot}9787\times(606{\cdot}5+0{\cdot}305\times155-58)=5349{\cdot}5 \text{ calories.}$$

This, however, would be more intelligibly and correctly stated as follows:—

$$8{\cdot}9787\left\{606{\cdot}5+(0{\cdot}305\times155)-58\right\}=5349{\cdot}28 \text{ calories.}$$

The total losses are stated as:—

Heating effect of coal.		Heat utilised.		Calories.
6600	−	5349·5	=	1250·5
6337	−	5349·3	=	987·7

This, however, subject to the foregoing corrections, will now be:—

and hence the loss by conduction and radiation, which is given as:—

$$1250{\cdot}5-\overbrace{(639{\cdot}4+110{\cdot}7+11{\cdot}5)}^{\text{Special losses.}}=488{\cdot}9 \text{ calories}$$

will now be

$$987{\cdot}7-(639{\cdot}8+110{\cdot}7+11{\cdot}5)=225{\cdot}7 \text{ calories.}$$

The corrected resumé will then read:

From 100 kilo. of coal burnt

$\frac{5349{\cdot}3\times100}{6337}=84{\cdot}41$ kilo.	utilised instead of	81·05 as stated.
15·59 kilo.	lost „	18·95 as stated.
100·00		100·00

This loss is made up as follows:—

1. Escaped in chimney gases:
$\frac{639{\cdot}8\times100}{6337}=10{\cdot}10$ per cent. instead of 9·69 per cent.
2. Incomplete combustion; coal in ash pit:
$\frac{110{\cdot}7\times100}{6337}=1{\cdot}75$ per cent. instead of 1·68 per cent.
3. Priming water:
$\frac{11{\cdot}5\times100}{6337}=0{\cdot}18$ per cent. instead of 0·17 per cent.
4. Conduction and radiation:
$\frac{225{\cdot}7\times100}{6337}=3{\cdot}56$ per cent. instead of 7·41 per cent.

Total, 15·59 per cent. instead of 18·95 per cent.

Example II.

This is similar to Example I., but with a different analysis of fuel, and a more complicated analysis of chimney gases. The absolute heating effect is correctly given, but the "air theoretically needful for combustion" is stated as 6·74 kilo., instead of 6·70 kilo. There are several printer's errors, the most important being that of the omission of the water arising from combustion of H, from the statement of total water in chimney gases. It is worth while noting that there is a want of uniformity in the method of computing the quantities of air and moisture. In Example I. the quantity of dry air was computed, and a percentage of moisture *added*. We now find in Example II. that the quantity of dry air is computed in exactly the same way as in Example I., and a percentage *deducted* from it for moisture. The equation for calculation of heat lost by radiation is again irregularly stated, but there are no errors of sufficient moment to make any material difference in the results given in the *resumé*.

Example III.

This is an example of the results of four boilers at work in a group, with an economiser for heating the feed water. The data for the calculations are as follow:—

Composition of coal:

	Per cent.
Carbon	75·56
Hydrogen	2·45
Nitrogen	0·76
H_2O (in chemical combination)	10·39
H_2O (hygroscopic)	1·56
	11·95
Ash	9·28
	100·00

Mean composition of chimney gases:

	Boiler No. 1.	2.	3.	4.
CO	0·0	0·0	0·0	0·0
CO_2	4·8	6·2	5·3	4·6
Air	74·6	68·3	72·2	75·3
N	20·6	25·5	22·5	20·1
Mean temperature of chimney gases	353°	410°	372°	340°C.

Temperature of air	27°C.
Moisture in air, per cent. by weight	1·10
Water evaporated per kilo. of coal burnt	6·742 kilo.
Water carried away in steam, per cent. by weight	2·8
Mean temperature of feed water	118°C.

Composition of chimney gases, per cent. of volume:—

	Before economiser.	Beyond economiser.
CO	0·0	0·0
CO_2	4·8	4·1
Air	74·6	78·6
N	20·6	17·3
Temperature of chimney gases	340°C	202°C.

Temperature of feed water entering economiser	10°C.
Temperature of air entering economiser	30°C.
Moisture per cent. of weight	1·07
Weight of cinder per kilo. of coal burnt	0·113 kilo.
Analysis of cinder	0·024 carbon. 0·089 ash.

At the outset we find that the following values, which are to be calculated in the same way as described in Example I., are erroneously stated.

The absolute heating effect stated as 7100 calories should be 6755 calories.

The theoretical figure of evaporation stated as

$$\frac{7100}{637}=11{\cdot}15 \text{ kilo.}$$

should be

$$\frac{6755}{637}=10{\cdot}60 \text{ kilo.}$$

The air theoretically needful for complete combustion of 1 kilo. of fuel, stated as 9·76 kilo. should be 9·69 kilo.

The calculation of air actually used is again erroneously taken as 77N : 100 air, and 1·1 per cent. added for moisture. It is not worth while here again recapitulating the whole of the figures as in Example I., on account of this difference; but we will take them as they stand until we come to the calculation for loss of heat by conduction and radiation. Up to this point the losses which have been determined are as follow:—

	Calories.
I. Heat Lost in Chimney Gases	2968·4
II. Heat Lost by Coal Falling in Ash Pit	193·9
III. Heat Lost by Priming Water	6·1
Total	3168·4

We now come to

IV. Heat Lost by Conduction and Radiation.

The useful heat is stated in the old form, to which we took exception in Example I., as

$$6{\cdot}558\times(606{\cdot}5+0{\cdot}305\times151-118)=3505{\cdot}9 \text{ calories.}$$

The total loss, and loss by radiation and conduction, are then stated as follow:—

Heat value of coal.		Heat utilised.		Loss.
7100	−	3505·9	=	3594·1

Loss by radiation and conduction:

$$3594{\cdot}1-\overbrace{(2968{\cdot}4+193{\cdot}9+6{\cdot}1)}^{\text{Special losses.}}=425{\cdot}7 \text{ calories;}$$

these however, should be

$$6755-3505{\cdot}9=3249{\cdot}1 \text{ total loss,}$$

and $3249{\cdot}1-3168{\cdot}4=80{\cdot}7$ calories loss by radiation and conduction.

The corrected resumé will then read as follows:—

Of 100 kilo. of coal burnt

$\frac{3505{\cdot}9\times100}{6755}=51{\cdot}90$ kilo.	utilised instead of	49·38 as stated.
48·10 kilo.	lost „	50·62 „
100·00		100·00

This loss is made up as follows:—

1. Escaped in chimney gases:
$\frac{2968{\cdot}4\times100}{6755}=43{\cdot}95$ per cent. instead of 41·81 per cent.
2. Incomplete combustion.
$\frac{193{\cdot}9\times100}{6755}=2{\cdot}87$ per cent. instead of 2·73 per cent.
3. Priming water:
$\frac{6{\cdot}1\times100}{6755}=0{\cdot}09$ per cent. instead of 0·08 per cent.
4. Conduction and radiation:
$\frac{80{\cdot}7\times100}{6755}=1{\cdot}19$ per cent. instead of 6·00 per cent.

Total, 48·10 per cent. instead of 50·62 per cent.

The economiser results are as follow:—

The water was heated from 10°C. to 118°C., corresponding to $(118-10)\times6{\cdot}742=728$ calories per kilo. of coal. Owing to the original error in the calorific value of the fuel, the useful effect of the economiser per 100 kilo. of coal burnt is incorrectly stated. It should be

$$\frac{728\times100}{6755}=10{\cdot}77 \text{ kilo. instead of 10·25 kilo.,}$$

and the total useful effect of boiler and economiser combined is

therefore $51{\cdot}90+10{\cdot}77=62{\cdot}67$ per cent.
instead of $49{\cdot}38+10{\cdot}25=59{\cdot}63$ per cent. as stated.

Askam-in-Furness, 14th April, 1888.

Yours, &c.,
R. M. Wight.

SHIPBUILDING NOTES.

Mr. David MacBrayne, the owner of the well known West Highland coasting steamers, is about to make an important addition to his fleet. The "Fusilier," which was launched on Saturday, the 14th inst., by Messrs. J. MacArthur & Co., Paisley, is a handsome paddle steamer 200ft. by 21ft. 6in. by 8ft. 3in. The engines of the "Fusilier" will indicate upwards of 900 h.p., and will be made by Messrs. Hutson & Corbett, Glasgow.

Messrs. Scott & Co., Glasgow, launched on Monday, the 16th inst., the "Ruby," an iron screw steamer 175ft. by 26ft. 6in. by 13ft. The "Ruby" is built with a cellular bottom, and is entered in Lloyd's highest class. Messrs. W. King & Co., Glasgow, will supply the engines, which will be triple expansion, the cylinders being respectively 15in., 25in., and 40in. diam., by 30in. stroke. The "Ruby" has been built to the order of Mr. William Robertson, Great Clyde-street, Glasgow.

Messrs. Archibald Macmillan & Son, Dumbarton, launched on Saturday, the 14th inst., the "Volunteer," a composite screw steamer, built for the Government for mail and passenger service on the coast of Newfoundland. The dimensions of the "Volunteer" are 190ft. by 30ft. by 22½ft. The gross tonnage is 750 tons, and the engines, which will be of 800 i.h.p., will be constructed by Messrs. D. Rowan and Son, Glasgow.

THE VARIATION OF THE CO-EFFICIENT OF SELF INDUCTION.

At the last meeting of the Physical Society, Mr. W. E. Sumpner read a paper on the above subject, in which he pointed out that the co-efficient of self induction of a coil whose magnetic circuit is wholly or partially composed of iron is a variable quantity, and should be defined more exactly than has hitherto been done. It is the ratio of the induced electromotive force to the rate at which the current is changing, and since the induced electromotive force is equal to the rate at which the magnetism is changing, the ratio in question is the rate at which magnetism changes with the current. From this it follows that if a curve be drawn whose abscissæ represent the current, and whose ordinates represent the amount of magnetism, or the number of lines of force through the coil, the co-efficient for any particular current will be represented by the rate of slope of this curve. The shape of these curves is well known from the researches of Professor Ewing, Dr. Hopkinson, and others. The curve slopes generally very little at first, but becomes more and more steep as the current increases. When the iron becomes saturated the curve bends over again, and the slope becomes ultimately very small. When the current is diminished, the curve of magnetism, owing to magnetic hysteresis, does not return on itself, but becomes steeper and steeper

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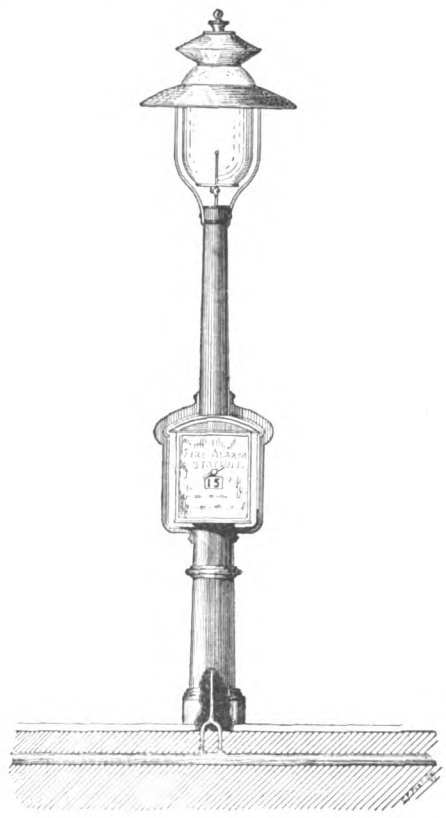
as the current is diminished. The co-efficient of self induction for increasing currents should therefore at first increase and afterwards decrease, while for decreasing currents it should be small at first, but steadily increase as the current is brought towards zero. Many experiments made on an electromagnet, on the field magnets of dynamos, and on a Kapp transformer, have completely confirmed these conclusions. Owing to magnetic hysteresis, the number of lines of force enclosed by the coil will depend not only on the current flowing at the moment, but also on those that have been flowing previously; and for the same reason the co-efficients will depend on the previous history of magnetisation, and may be obtained of almost any value by previously using suitable magnetising currents. The hysteresis in the case of the Kapp transformer was very marked. If the co-efficient is a variable, the time taken for a current to rise to a given fraction of its steady value will depend on the amount of this current. If the final current is large, it will rise to its full value much more rapidly than if the final current is small. If the electromotive force is only such as to maintain a small current, the current will increase most rapidly at first, and with less and less rapidity afterwards. If, however, the final current is large, it will increase rapidly at first, more slowly afterwards, then with great rapidity, and will attain its final value slowly. When the steady current is large enough to magnetise the iron far beyond suturation, this effect may be very marked, and has actually been observed experimentally by Professor Thompson. The general effect of the variation of the co-efficient of self induction is to introduce ripples into the curve obtained on the assumption that the co-efficient is a constant and equal to the mean of the different values. It is generally assumed in calculations connected with alternating currents that the electromotive force of the dynamo is a sine function of the time, and that the co-efficient of self induction is a constant. These assumptions are supposed to be sufficiently true for practical purposes, but the author considers this doubtful.

Experiments made on the Ferranti dynamo at the Central Institution have shown that the electromotive force curve is such that its ordinates differ from those of the most favourable sine curve by as much as 10 per cent. It is probable that with some dynamos the curve of electromotive force consists of the sum of two sine curves, one with a period corresponding with the current alternations, the other having a small amplitude and a period corresponding with the revolutions of the dynamo. This will occur if there is any want of symmetry in the machine. Whenever this occurs the effect of induction will be to magnify the sine wave of large period in comparison with the wave of short period, as Professor Perry has pointed out, and the consequence will be that the current curve will differ in a marked degree from a simple sine curve, since any want of symmetry in the dynamo will be much magnified, especially at high speeds. That alternating currents are not generally simple sine waves seems to be indicated by the well known pulsations to which electric lights fed by alternating currents are subject. These pulsations are too slow to be due to the ordinary current alternations, but might be in time with the revolutions of the dynamo.

Although it is well known that self induction always delays the rise and fall of currents, it does not appear to have been noticed that it may, under certain circumstances, hasten the discharge of a condenser. If the plates of a charged condenser be connected by a wire, the discharging current has both to rise and fall. The effect of self induction is to delay both. It always delays the fall of the current more than the rise, because while the current is rising the condenser is far more highly charged. If the self induction be not too great, the condenser will discharge quicker than when self induction is not present. It is always possible to halve the time the condenser takes to discharge by using a suitable amount of self induction. As a lightning discharge is essentially the same as the discharge of a condenser, it seems likely that a lightning conductor of iron will be better than one of copper, because the former has more self induction than the latter. Dr. Lodge has recently shown experimentally that the iron conductor is the better of the two, but the author does not consider his suggested explanation as necessarily the right one.

THE NEW YORK FIRE TELEGRAPHS.

There is perhaps no town in the world where fire telegraphy is developed to such an extent as in New York. As was shown by Herr Fischer von Treuenfeld, in the paper he recently read at the Society of Telegraph Engineers and Electricians, London and other English towns compare very unfavourably with many Continental towns in the matter of fire telegraphs; but even Continental towns are quite eclipsed by New York in this respect, whilst fire telegraphy is hardly less fully developed in Philadelphia, Washington, and other American towns. The New York fire telegraphs are all centralised, the wires from the street calls being carried to the central office of the fire department, which is in telegraphic communication with the local fire stations. The circuits start from the office switch board, and pass out to the call points and local stations underground. For these circuits Waring anti-induction lead covered cables are used. The annexed illustration shows the connection of a street call with the underground cable, and in most cases the call boxes are combined with the existing lamp



posts. Where the circuit passes from underground to overhead, the junction is made by a box containing lightning arresters, which is placed on a pole, and the cables pass inside the hollow pole to the boxes, from whence the aerial lines radiate. All alarms are received at the central station, and the particular call box from which the alarm is sent is indicated on an annunciator board. The information is then telegraphed to the neighbouring local fire stations, where by means of a current the doors of the engine house are automatically opened, the horses are loosened, and the men are called up, and slide down on vertical poles from their sleeping apartments to the engine, as it would take up too much time if the brigade were to walk downstairs in the usual way. The time which elapses between the giving of the alarm and the starting of the engines is often less than half a minute. The Waring cables were first introduced for fire telegraphy in 1884, and about 285 miles are now laid down in New York, Philadelphia, and Washington.

CENTRAL STATION LIGHTING.

(Transformers v. Accumulators.)

Under the above title Mr. R. E. Crompton read an interesting paper at the meeting of the Society of Telegraph Engineers and Electricians, held on 12th inst. This paper, as the author states in his preface, is the outcome of the discussion which took place on the papers by Messrs. Kapp and Mackenzie, read some weeks ago before the same society: and it may also be regarded as an amplification of an article by Mr. Crompton, which was published in our issue of the 16th of March, page 276. The object of the paper was to show the comparative cost in first outlay and maintenance of two central electric light stations, each for a total of 15,000 glow lamps fixed, of which 10,000 are lighted simultaneously during the hours of maximum supply; one of these stations laid out on the alternating current system, and the other on the battery system.

The author divided electric supply schemes into two classes. First, those confessedly carried out in a temporary manner, and for the purpose of popularising the electric light, and inspiring the confidence of the public in supply companies as a form of investment, and, secondly, those intended to be of as permanent a nature as the gas supply with which they come into competition. He relegated to the first class such systems of supply as are in use at Brighton, Eastbourne, and London (Grosvenor Gallery), and, in fact, all stations which distribute electricity by means of overhead wires, picking their customers here and there, but which cannot be considered fit for a general system when the time arrives that more than half the houses in the district take the light. As regards supply stations of a permanent character, the author thinks that load diagrams, such as are taken by gas companies, should form the basis of the design. He exhibited three such load diagrams, one being representative of an ordinary London residential district, and the two others of American electric lighting stations. On the basis of the London diagrams he finds that the average daily output in units throughout the year is about three and a half times the maximum load in kilo.-watts; in other words, that a station designed for a maximum supply of 10,000 16 c.p. lamps simultaneously alight could not reckon upon selling more than an average quantity of 2100 Board of Trade units per day. In this connection the author drew attention to our article of the 2nd December, 1887, where the average output of a similar station was estimated as 3600 Board of Trade units, which estimate he considered excessive. In order to sell 2100 units it would be necessary that the supply should reach at least 1000 houses, representing a useful frontage of 10,000 yards; but on the supposition that only two houses out of three would take the light, and adding the length of mains required for crossings, and those portions which do not front the houses, he estimates that at least 20,000 yards of double mains would have to be laid. He assumes the generating station to be 2000 yards distant from the centre of the district supplied, so that in all there must be provided 22,000 yards of double mains. As regards the cost, the author prepared Tables I. and II. (see next page), the first of which refers to cables protected by insulation, and the second to a class of underground mains lately introduced by the author in his Kensington Court installation. These mains consist of bare copper strips supported on insulators within a brick and cement culvert.

Mr. Crompton, in referring to these tables, adversely criticised the habit of basing systems of distribution on the cost of copper, with but a small percentage added for insulation and laying, as liable to lead to erroneous calculations, and giving a fictitious value to high pressure distribution. He also alluded to the great difficulties which will be encountered in laying underground mains, which have to carry currents at 2000 volts pressure. As an example of the system advocated by the author, he cited the Vienna central station, where four groups of storage cells, each containing fifty-two cells, are charged in series, the pressure varying from 430 volts at the time the batteries are giving off currents, to 480 volts at the shorter time during which the charge is being completed. This includes the loss in the mains, the generating station being 1400 yards from the distributing station. During five hours of lighting, about two-thirds of the current comes direct from the dynamos; but during this time, for short periods, the demand for current often increases to such an extent that these proportions may be reversed, and the batteries supply two-thirds of the total. This system has been in use for upwards of nine months without any hitch or trouble in connection with the electrical work, and the author therefore considers it proved that there is no danger or difficulty in using currents of 480 volts, when the charging circuit is permanently connected to the distributing circuit.

A comparison between the two rival systems of distribution was made from four points of view: First, trustworthiness, steadiness, and quality of the lighting; second, first cost of the plant; third, the working cost and maintenance; fourth, probable output and maximum income which can be obtained in each case. The author took it for granted that the storage system must be superior to a system in which the continuity of the lighting depends entirely upon moving machinery. As regards the cost, he adopted for the alternating system the figures given in our article of the 2nd December, but with the modification that instead of £12 per indicated horse power he only allowed £8. 12s., thus reducing the cost of steam plant to £12,470. The buildings, chimney stack, water tanks, and all accessories were estimated at £11,000, bringing up the total cost of the station to £29,040. For the battery system he proposed a plant of similar type to that erected in Vienna. The dynamos would have to supply two-thirds of the maximum net output of 600 kilo.-watts, which, with the addition of 8¼ per cent. loss in the charging mains and 20 per cent. of reserve power, brings the dynamo output at the station up to 600 kilo.-watts or 1000 i.h.p. This plant can be divided into six sets of combined engines and dynamos, each of 100 kilo.-watts, and the total cost of the station, allowing £8,000 for buildings, &c., comes to £21,500. In estimating the cost of alternating transformers, Mr. Crompton rejects Mr. Kapp's proposal to lay down a network of low pressure distributing mains, and feed this by a few large transformers, on account of the difficulty of providing space for these transformers, and

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CENTRAL STATION LIGHTING.

TABLE I.—Cost of Laying 100 Yards of Double Conductor Underneath the Footway of a London Street.

	Single. No. 16.	$\frac{7}{16}$	$\frac{12}{18}$	$\frac{12}{14}$	·1⅝	$\frac{37}{16}$	Two Sets. $\frac{37}{16}$	Four Sets. $\frac{37}{16}$	Six Sets. $\frac{37}{16}$
Area, square inch	·0032	0·225	·0773	·1613	161·25	0·5	1·0	2·0	3·0
Area, square millimetres	2·08	14·6	50	104	0·25	322	645	1290	1935
Weight per 100 yards run.....lb.	7½	53½	183½	392	576	1153	2306	4612	6918
Cost of copper, at 7¾d.	£0 4 10	1 14 6	5 18 0	12 13 0	18 15 0	37 5 0	74 10 0	149 0 0	224 0 0
Cost of insulation	1 3 2	4 8 6	11 2 0	24 17 0	35 17 0	70 15 0	141 10 0	283 0 0	424 0 0
Total cost of cables	1 8 0	6 3 0	17 0 0	37 10 0	54 12 0	108 0 0	216 0 0	432 0 0	648 0 0
Casing, bitumen, and cement	5 3 0	5 5 0	8 0 0	12 10 0	12 10 0	16 0 0	22 0 0	40 0 0	55 0 0
Labour laying	3 0 0	4 0 0	5 0 0	5 0 0	6 0 0	10 0 0	18 0 0	35 0 0	50 0 0
Trenching and repairing	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	30 0 0	35 0 0
Surface boxes and connection	5 0 0	7 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0
Engineer and superintendent	3 0 0	4 0 0	5 0 0	5 0 0	6 0 0	10 0 0	10 0 0	20 0 0	25 0 0
Total	£42 11 0	51 8 0	70 0 0	95 0 0	114 2 0	179 0 0	301 0 0	567 0 0	823 0 0
Add extra, if copper, at 9½d.	0 1 1	0 8 0	1 7 0	2 17 0	3 5 0	8 10 0	17 0 0	34 0 0	51 0 0
	£42 12 1	51 16 0	71 7 0	97 17 0	117 7 0	187 10 0	318 0 0	601 0 0	874 0 0
Cost of copper per lb. laid complete	5 13 6	0 19 4	0 7 9	0 5 0	0 4 1	0 3 3½	0 2 8¾	0 2 7¼	0 2 6¼
Current in ampères	1·2	8·1	28	58	90	180	360	720	1080
Cost per ampère	35 10 0	6 8 0	2 10 6	1 13 9	1 6 0	1 1 0	0 17 6	0 16 8	0 16 1

TABLE II.—Cost of Laying 100 Yards of Double Conductor of Bare Copper Carried on Insulators in a Culvert.

Area in square inches	0·25	0·5	1·0	2·0	2·55	3·00
Area in square millimètres	161·25	322·5	645	1290	1645	1935
Weight of copper in lbs. per 100 yards	576	1153	2306	4612	6125	6918
Cost of copper, at 7¾d. per lb.	£18 15 0	37 5 0	74 10 0	149 0 0	190 0 0	224 0 0
Laying	9 0 0	9 12 0	9 12 0	9 15 0	9 15 0	10 0 0
Insulators	0 4 6	0 4 6	0 4 6	0 4 6	0 4 6	0 4 6
Six surface boxes and connections	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0
Culvert, 18in. × 12in., for two lines conductor, in brick work and cement, replacing pavement	53 8 0	53 8 0	53 8 0	53 8 0	53 8 0	53 8 0
Engineers and superintendence	6 0 0	10 0 0	10 0 0	10 0 0	10 0 0	15 0 0
Total	£97 7 6	120 9 6	157 14 6	232 7 6	263 7 6	312 12 6
Extra for copper, at 9½d. per lb.	3 5 0	8 10 0	17 0 0	34 0 0	43 10 0	51 0 0
Total	£100 12 6	128 19 6	174 14 6	266 7 6	306 7 6	363 12 6
Cost of copper per lb. laid complete	42d.	27d.	18·2d.	13·8d.	12d.	12·6d.
Current in ampères	90	180	360	720	910	1080
Cost per ampère	1 2 3	0 14 5	0 9 8	0 7 5	0 6 9	0 6 8½

TABLE III.—Cost of 10,000-light, or 600-kilo.-watt, Plant.

A.T.—Alternating Transformer Distribution.		*B.T.—Accumulator Transformer Distribution.*	
Generating station, buildings, chimney shaft, water tanks, and general fittings	£11,000	Generating station, buildings, chimney stack, water tanks, and general fittings	£8,000
Dynamos and exciters—865 kilo.-watts, including spare sets, divided as convenient	5,540	Dynamos—600 kilo.-watts, in six sets of 100 kilo.-watts each	4,800
Motive power, *i.e.*, engines, boilers, steam and feed connections, belts, &c., at £8. 12s. per i.h.p.	12,470	Motive power, *i.e.*, engines, boilers, steam and feed connections, &c., at £8. 12s. per i.h.p.	8,600
500 transformers, *i.e.*, one to every pair of houses, at £15 each	7,500	Four groups of accumulators, in all 240 cells, in series, at £40 per cell, including stands	9,600
2000 yards primary or charging main, exterior to area of supply, at £308 per 100 yards	6,160	2000 yards charging main, at £306. 17s. 6d. per 100 yards (*see* Table II.)	6,137
20,000 yards distributing main, 50mm. sectional area, at £71. 7s. (*see* Table I.)	14,270	20,000 yards distributing main, 161·25mm. sectional area, at £100. 12s. 6d. (*see* Table II.)	20,125
Regulating gear	500	Regulating gear	2,500
	£57,440		£59,762

TABLE IV.—Working Expenses and Maintenance of 10,000-light, or 600-kilo.-watt, Plant.

	A.T.		B.T.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Materials—				
Coals: 4380 tons at 17s.	3,723 0 0		2,167 0 0	
„ 2550 „ 17s.	.....		.....	
Oil, water, and petty stores: 1500 hours at 7s. 6d. + 7250 at 1s.	925 0 0		350 0 0	
„ „ 1400 „ 5s.	.....			
Total cost of material		4,648 0 0		2,517 0 0
Labour—				
Two foreman drivers at 45s.; six drivers at 30s.; nine firemen at 24s.; sundry labour	1,388 8 0		.....	
One foreman driver at 45s.; two drivers at 30s.; three firemen at 24s.; sundry labour	.....		975 0 0	
Salaries—				
One chief at £500; two assistants at £200 each; four clerks at £80 each	1,220 0 0		.....	
One chief at £500; one assistant at £200; four clerks at £80 each	.....	2,608 8 0	1,020 0 0	1,995 0 0
Maintenance of plant—				
Motive power and dynamos: 10 per cent. on £18,010	1,801 0 0		.....	
„ „ 10 per cent. on £13,400	.....		1,340 0 0	
Buildings and Fittings: 5 per cent. on £11,000	550 0 0		.....	
„ „ 5 per cent. on £8,000	.....		400 0 0	
Transformers: 10 per cent. on £7,500	750 0 0		.....	
Accumulators: 15 per cent. on £9,600	.....		1,440 0 0	
Mains: 7½ per cent. on £20,430	1,532 5 0		.....	
„ 2½ per cent. on £26,262	.....		656 10 0	
Regulating gear: 10 per cent. on £500	50 0 0		.....	
„ „ 10 per cent. on £2,500	.....		250 0 0	
		4,683 5 0		4,086 10 0
		11,939 13 0		8,598 10 0
2100 units × 365 days = 766,500 units. Cost per unit	.....	3·75d.	.....	2·7d.

he assumes that small transformers would have to be used, one to every two houses. The cost of these was estimated at £7,500. The accumulators to be used as transformers must be of sufficient capacity to supply 200 kilo.-watts for the hours during which the demand exceeds the 400 kilo.-watts supplied by the dynamos. The author therefore provides four groups of accumulators, each of which has a total capacity of 259 kilo.-watts and a storage sufficient for five hours of extreme demand. In order to meet a possible interruption in the charging current, which, however, need only last a short time, as spare machinery would be provided, the accumulators should be capable of being discharged without damage to themselves at the rate of 650 kilo.-watts, and it is this latter requirement which has so long delayed the introduction of accumulators for central station lighting. Too much attention has been paid to the capacity and too little to the rate of possible maximum discharge. The author, however, considers this state of things now remedied, and he has been told that there are several makers who can supply accumulators which will give an exceptionally large maximum discharge without being damaged. He estimates the price of the batteries, consisting of 240 cells in series, inclusive of stands, at £9,600. Sub-stations, which contain the battery transformers, can be placed on mews property within 300 yards radius of the houses to be lighted. The sub-station would consist of a battery room and a living room for the man in charge. The cost of the central station for both systems is given in Table III.

The last section of Mr. Crompton's paper dealt with the working expenses and the cost of maintenance in both systems. He assumed the same commercial efficiency of 75 per cent. from the i.h.p. to the electrical output for both the continuous and alternating current plant when working at full output; but whilst allowing 80 per cent. efficiency from the output at the dynamo terminals to the power delivered to the lamps when batteries are used, he only allowed 70 per cent. efficiency for the transformers during the time of maximum supply, and less than 30 per cent. for the remaining twenty-one hours during the day. During that time he estimated the efficiency of the generating plant at only 50 per cent. for the alternate current system, so that the total efficiency from the i.h.p. to the energy delivered to the consumers' lamps would only be 15 per cent. The items of labour also tell in favour of the battery system, and we give below Table IV., which gives the estimate of the working and maintenance expenses in detail.

In conclusion, Mr. Crompton pointed out that whilst the battery system admits of an increased sale of current by simply working the engines for longer hours, but without any increase in the plant, the transformer system does not admit of an increase in output without a proportionate increase of the plant.

The discussion was opened by Mr. Kapp, who congratulated the makers of storage batteries upon the extremely able way in which Mr. Crompton had advocated these appliances. The paper they had just listened to could not fail to greatly increase the confidence of users and suppliers of the electric light in batteries, and would give considerable stimulus to this industry. He thought that Mr. Crompton's estimate of an average sale of 2100 units per day was fairly representative of the London load diagram; but if they looked to the load diagram of Boston or Cincinnati, they would find that the estimate of the writer in *Industries*, which was for 3600 units, was nearer the mark. Referring to the cost of mains, the speaker thought Mr. Crompton had rather over-estimated the cost of laying insulated mains, as with lead covered cables no culvert, channel, or trough, nor filling in with bitumen or cement, was required, and on this account the difference of price between the insulated mains and the author's bare copper mains would not be so great as represented in the tables. On the other hand, lead covered cables can now be obtained with an insulation resistance of several hundred megohms per mile, whereas Mr. Crompton's mains would necessarily have a much lower insulation, and the speaker did not think it wise to sacrifice high insulation for a comparatively small difference of price. Regarding the difficulty of using underground mains for currents of high pressure, the speaker alluded to the fact that such cables have been in use with perfect success for over two years at Milan, under pressures varying from 1200 to 2000 volts, and in the latter case with alternating currents, so that there was no insurmountable difficulty in laying down an underground high pressure system. It would, however, be well to have the high pressure mains as short as possible, and on this account his own plan of using high pressure cables as feeders only, and of distributing by a network of low pressure mains, was preferable to the plan suggested in Mr. Crompton's paper, where the whole 22,000 yards of double main were under high pressure. For a supply system of the size referred to in the paper, the speaker would instal ten feeding centres, each consisting of a transformer capable of maintaining from 1000 to 1200 lights, and according to the demand all the ten

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or a smaller number of transformers would be used. By this means it would be possible to work each transformer with a reasonable output, and at a very high efficiency. He thought the author's estimate of an efficiency of 70 per cent. was purely conjectural. Professor Ayrton's experiments had shown that when the output fell to one-third, the efficiency of the transformer was still 85·8 per cent., and even with an output of only one-fifth of the full load, the efficiency was 80 per cent. These considerations would reduce the working expenses of the alternating current system. On the other hand, the speaker thought that the working expenses of the battery system had been over-estimated by the author, who allowed only four feeding centres for the whole of the district. With mains one quarter of a square inch in section, it would be impossible to keep the variation of pressure within the limit of 2 or 3 per cent., which is essential in order to satisfy the just demands of the householder for a light of constant brilliancy. It would therefore be necessary to have heavier mains or more feeding centres. If they compared Mr. Crompton's proposal with the installation for Bradford, which had recently been designed by Mr. Shoolbred, they would find that Mr. Shoolbred, who was using mains of ·177 sq. in. section, had provided for a supply of 1000 lamps from each feeding centre. With mains of the author's section, the supply might be increased to 1400 lamps. It must also be remembered that in Mr. Shoolbred's installation at Bradford, full advantage could be taken of cross connections in the network which would relieve those portions of the mains which are heavily loaded, whereas, on Mr. Crompton's plan, such cross connection would be inadmissible, because the five wires were each at a different potential. Allowing then for the loss of conductivity by the want of cross connections, the speaker thought that to obtain an equally satisfactory distribution as that designed for Bradford, the author would, with ¼ sq. in. mains, have to employ at least ten battery feeding centres, instead of four. He would therefore have to allow an additional £600 in his working expenses for the wages of the attendants at six additional battery centres; or, if he wished to save this item, and to retain only four battery centres, he would have to employ mains of 1½ sq in. section, costing £20,000 more than estimated. In this case, the working expenses would have to be increased by about £1,500 on account of maintenance. The speaker also drew attention to the fact that Mr. Crompton had not allowed in his working expenses anything for the rent of the localities where his battery centres were to be established. Since they must necessarily be near the houses to be lighted, the rents would be rather high, and he thought that at least £500 per annum should have been added to the working expenses on this account. The system proposed by the author was a five-wire system, with batteries parallel to the lamps, and the speaker asked in what manner the pressure would be regulated. They all knew that a storage cell requires about 2½ volts to charge it, whereas on discharge it would only yield 2 volts, and it would therefore be necessary either to work the lighting circuit through rheostats, as is done in the Edison central sections, or to change the number of cells coupled to the lighting circuit, so as to maintain a constant pressure there, whatever be the rate of supply. In the latter case, he wished to ask Mr. Crompton, or any other battery maker, how it was possible to obviate the difficulty of charging certain of the cells more than others.

Mr. Parker, of Wolverhampton, also dwelt upon the difficulty of regulation, and considered the standard pressure of from 400 volts to 500 volts, as adopted by the author, as too low for long distance lighting. He regretted to see that no mention had been made in the paper of the Colchester installation, with which he had been connected, having supplied the charging dynamos. The regulation adopted in this installation was fairly simple, and the reason of failure, the speaker thought, was partly due to the restricted size of the whole scheme, and to difficulties in the storage cells, which had since then been remedied. As regards the Vienna installation, he did not think this differed in principle from any private installation, as it was not, properly speaking, a central station for public supply. Mr. Parker thought that the author's estimates were fairly correct, and that central stations on the battery system might be carried out at the cost mentioned. As regards the reliability of high pressure alternating current distribution, he would draw attention to the Eastbourne installation, which has been running without any hitch and without stoppage for the last two years. The credit for this success was in a great measure due to Mr. Lowrie, the engineer in charge.

Mr. Preece considered the question raised by the author's paper as one of the greatest importance. At the present moment there were from thirty to forty corporations anxious to introduce the electric light, and wanting to take scientific advice on the subject; but consulting engineers had to delay taking their fees, because they could not make up their minds which system to recommend. The speaker might perhaps be prejudiced in favour of the battery system, as he had employed batteries for lighting his own house for several years, and had found them to answer perfectly. If the charging and discharging currents are small, he thought 90 per cent. efficiency might be obtained from a battery; but with heavy currents the efficiency might fall to 60 per cent., and the speaker thought Mr. Crompton had neglected to take account of this circumstance. Batteries require very careful treatment. The density of the liquid in each cell of his own battery is tested every morning, and each cell is inspected daily to see that the plates are clear. His present battery has been in use for two and a half years, and is now as good as ever. He has also an old Planté battery which has been used for five years, and which still appears to be in perfect condition. For these reasons Mr. Preece was inclined to think that the low depreciation of 10 per cent. adopted by the author is admissible. There are various reasons in favour of either system. If it were a question of efficiency only he would be inclined to prefer the alternating current transformer; but batteries have the great advantage of providing a store of energy, so that an interruption of the service at the generating station, or damage to the charging mains when taking up the streets, would not put the houses into darkness. The speaker thought that the voltage adopted by Mr. Crompton was too low, as it did not admit of long distance supply. Electrical engineers were at the present moment debating the famous clause of the new Electric Lighting Bill, under which the station might be bought up without any allowance for goodwill by the local authorities after forty-two years. If, however, the supply were on a high pressure system, the generating station could be placed outside the radius over which the local authorities for the district lighted have command, and in that case it would not be to their advantage to compulsorily acquire the distributing plant, because they could not work it without at the same time buying the generating station, to which the compulsory purchase clause does not apply. High pressure and long distance distribution would give therefore to electric light contractors the power to resist this compulsory purchase, which they all regard as objectionable. Mr. Preece had not completed his remarks when the meeting was adjourned till the 19th inst., at which time he intends to re-open the discussion.

GOVERNMENT TESTS OF THE STRENGTH OF SPIRITS.

On the 9th inst., at a meeting of the Society of Chemical Industry, Dr. B. Derham read a paper on "Defects in the Method of Charging the Duty on Spirits," one of the chief points in which was that it is an erroneous assumption that at every degree of temperature the same relation of strength to the gallon of proof spirit at 51°F. is preserved. One hundred gallons at 51°F. expand to about 101 gallons at 80°F., yet under the present system each of these 101 gallons is assumed to be of the same strength as at the lower temperature, whereas it contains less spirit. At temperatures below 51°F. each gallon contains more spirit; hence the tables compiled by Sikes for use with his hydrometer are vitiated, and under the present system of Government testing there is a gain to the Revenue at temperatures over 51°F., and a loss at temperatures under 51°F. The authorities suppose these two errors to about balance each other; but this is not so. Taking even the South of England, the mean temperature of Greenwich is 49·1°F.; at Liverpool and Manchester it is 47°F., and at Inverness about 45°F.; it is 41°F. in Scotland during the nine cooler months of the year. About two-thirds of the whole store of bonded spirits are warehoused in Scotland, and the remaining one-third in England. He believed 46°F. to be the mean temperature of the spirits stored in the United Kingdom, and because of the errors he had pointed out he calculated that the Revenue lost at least £50,000 a year by its method of testing with Sikes' hydrometer and tables.

Mr. David Howard, the chairman, was in favour of the present system of calculating by proof gallons. It might be an unscientific standard, but it was convenient and practical.

Mr. Keen had long been in the Customs service, and had found that the system of gauging was such that in calculating the contents of a cask of 130 gallons it is easy to make a mistake of four or five gallons, of which latter the merchant gets the benefit after sending the rest to be methylated, there being a tendency to conclude in his favour all doubts about measurement. The kind of hydrometer required is one easy to use, not liable to get out of order, and one fit to be handled by day or night by a class of men not well paid. Sikes' hydrometer meets these requirements fairly well, although its tables are doubtful. Most spirits do not pay duty at much above proof; in Scotland it is 11 over proof, and that reduced Dr. Derham's estimate of £50,000 loss. At one time account was not taken of saccharine matter in spirits; but one of Mr. Gladstone's governments began the separating of the spirit from the saccharine matter, and charging duty on it at its real strength, with a gain to the Revenue of £180,000 a year.

Mr. Helm remarked that Sikes' hydrometer is infinitely superior to Dr. Derham's, because it can be used by all kinds of people not very highly educated, and has fewer figures on it. Besides, it has less wearing surface, so will not so frequently require re-adjustment. The authorities have satisfied themselves that they lose nothing by the hydrometer being standardised at 51°F., and he knew that Dr. Derham's figures about the temperature of warehouses were all conjectural. For instance, the mean temperature in warehouses in London is nearer 55°F. than 46°F. If only £50,000 be lost over the immense quantity of spirits consumed in these islands, he thought it a very satisfactory result, considering the low pay of the officers employed.

Professor Dewar said that Dr. Derham's main argument was for more scientific accuracy in testing, and commercial points were of a secondary nature. Still, if the Government could save £50,000 in the way pointed out by Dr. Derham, he wished that they would give some or all of the amount to provide decent alcohol at a moderate price for use in the laboratories of the scientific chemists of this country, who in this matter are heavily handicapped as compared with the position of their brethren in Continental Europe. A Russian chemist has recently proved that at certain different temperatures of diluted spirit, different hydrates of alcohol are formed, and has succeeded in separating them from each other.

Dr. Derham did not see why errors due to gauging should be brought forward as an argument against rectifying errors due to testing. He did not know about the average temperature of London warehouses, but possessed exact information about the temperature of warehouses in the Midland Counties, and in Scotland.

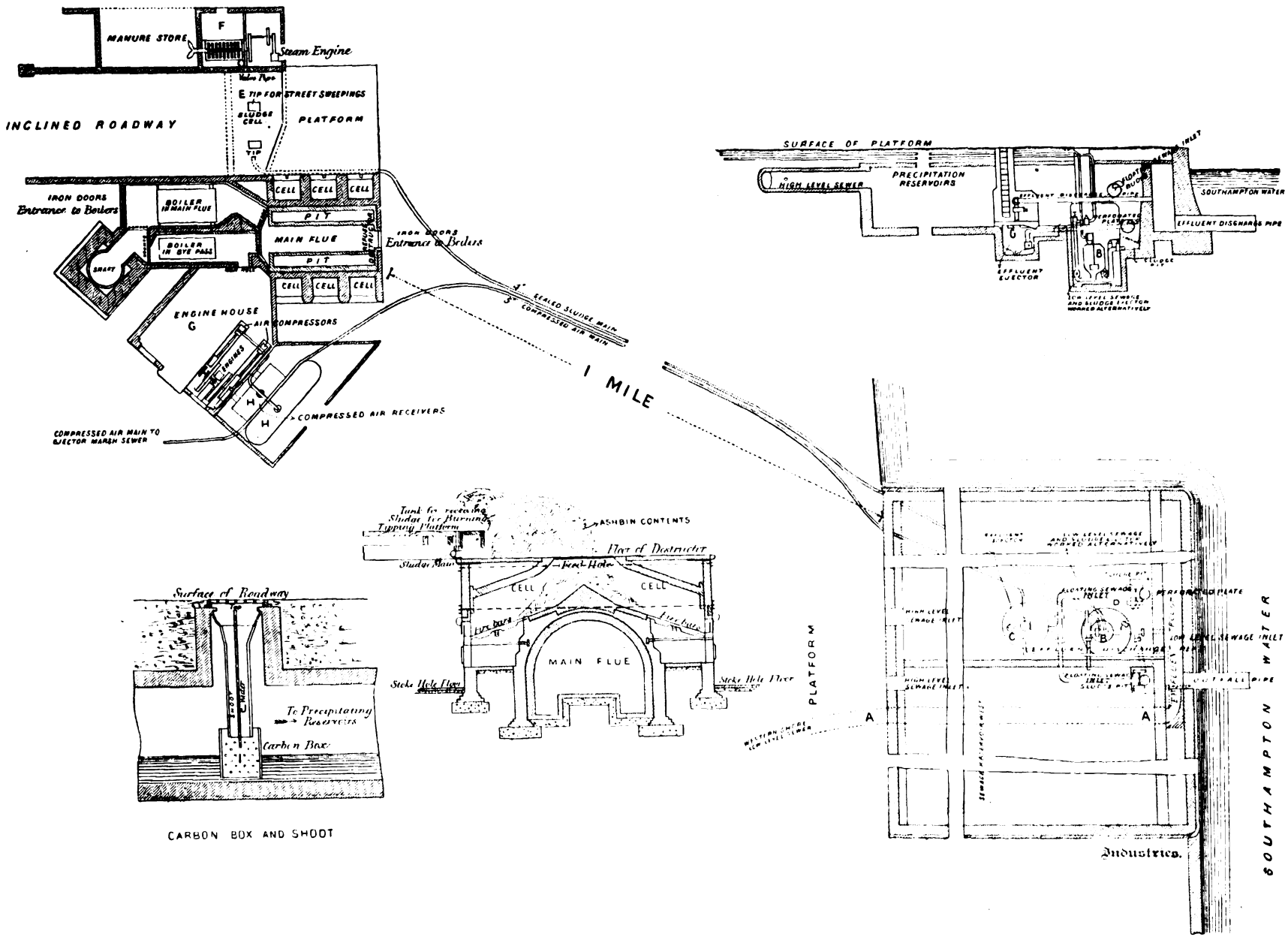
THE WIMBLEDON SEWAGE DISPOSAL WORKS.

At a meeting of the Society of Engineers, held on the 9th inst., a paper was read on the above subject by Mr. W. Santo Crimp, Assoc.M.Inst.C.E., F.G.S. The author stated that the population of the district at the present time was about 25,000, and its area 3220 acres, 640 acres of which form the Wimbledon portion of the common. Three main outfall sewers had been constructed for the drainage of the district; the sewage from one of them requires to be pumped, whilst that from the other two gravitates to the Sewage Disposal Works. Several miles of sewers were in existence at the period when the works described were commenced, and these were retained for the disposal of the surface water. The works have been largely added to by the author, and a new outfall for the western portion of the district constructed. Concrete tubes have been largely used. All the roads now made up under the 150th section of the Public Health Act are provided with duplicate means of drainage, and the entire scheme offers a good example of the "separate" system. The works designed by the author for remedying the defective portions of the low level outfall consist of a pumping station and about two miles of new outfalls, situated in the western part of the district. The new western outfall was constructed sufficiently deep to admit of all the building land in that part of the district being drained. The pumping station is provided with pumping machinery in duplicate, operated by a pair of "Otto" gas engines. The sewage is lifted into a large tank holding nearly 20,000 gallons, which, when full, discharges its contents into the 18in. outfall, which is thus effectively flushed at least twice daily. Five automatic flushing tanks were also constructed at various portions of the system where most required, each tank being provided with one of Field's annular syphons. The total cost of the remedial works was about £12,000. All the sewers were originally ventilated by means of open street gratings; but these have for the most part been closed, and ventilating pipes put up in lieu of them. The total sum expended by the Local Board on the main drainage works amounted to £60,000, but in addition large sums have been spent by private land owners in the construction of roads and sewers, for the purpose of developing their estates; so that the whole of the main sewers of the district have cost not less than £100,000.

The author then described the main pumping station and machinery, and the six settling tanks for the reception and precipitation of the sewage from the mid and low level outfalls, arranged to work either on the continuous or separate system as desired. The sewage is treated with milk of lime and sulphate of alumina in the proportion of eight and six grains per gallon respectively. The solids are precipitated and the effluent water is then conducted over the farm, which is seventy-three acres in extent. In very hot weather a little permanganate of potash is also used. The normal sewage flow is 750,000 gallons per day. The precipitated solids are dealt with by means of filter presses, three of which presses are now employed. Experiments made with this sludge prove it to be of slightly higher value as manure than ordinary stable manure. The farm, as originally laid out, consisted of forty-seven acres of somewhat clayey land, but a further area of twenty-six acres has since been added. There are also three filters of burnt ballast, having an aggregate area of two and a half acres, and a depth of three feet, for the treatment of storm waters. Great care is taken in applying the sewage, so as to prevent any of it finding its way direct to the subsoil drains. The principal crops grown on the farm are rye grass, mangolds, and osiers. The total receipts for produce for the year ending 25th March, 1888, was £20 per acre, and the inclusive working expenses were about £12 per acre. After deducting the profit on the farm, the net annual cost of pumping, deodorising, and purifying the sewage, including all expenses, is £3,690, equal to a rate of 6·15d. in the pound.

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THE SOUTHAMPTON SEWAGE WORKS.



THE SOUTHAMPTON SEWAGE WORKS.

The utilisation of waste products is a distinctive feature of modern industry, and many substances which twenty or thirty years ago were regarded as an absolute nuisance to be got rid of at any cost, are now collected, stored, and subjected to manufacturing processes of which the previous generation knew nothing. The importance of such processes was recognised as long ago as 1873, when at the Vienna International Exhibition a special group of exhibits was set apart to illustrate the various ways in which waste products might be utilised; but the exhibits referred mainly to such waste products as are obtained by the manufacturer in his industrial operations; and in this direction industrial development, stimulated by keen competition and low prices, has within the last decade been very remarkable. There are, however, other kinds of waste products which do not lend themselves readily to any useful art, and which, nevertheless, must be disposed of, and the mere disposal of which taxes the resources of the sanitary engineer to the utmost; but if the process of disposing of such matters as sewage, street sweepings, and the contents of the domestic dust bin is accompanied by a manufacturing process yielding useful substances in return for objectionable matter, it will be admitted that the sanitary engineer has achieved perfection in the art of utilising waste products. This result has actually been attained by Mr. W. B. G. Bennett, the borough surveyor of Southampton, at the destruction and sewage clarification works of that town.

Although the works in their present form were planned about two years ago, and some particulars of the utilisation of sewage sludge and dust bin refuse as carried on in Southampton, Wimbledon, Ealing, and other places were brought before the Institution of Civil Engineers about a year ago, and discussed with the heat and vigour so characteristic of sewage doctors, the engineering profession generally have hardly paid to these improvements the attention they deserve; and it was only after Mr. Bennett had the brilliant idea of utilising the waste heat energy of his destructors for electric lighting, that public attention was directed to the subject. We call this idea brilliant because it appeals to the imagination. What could be more seductive to the British householder than the prospect of getting a soft, white, and healthy light in return for the contents of his dust bin? Here was a way to get motive power gratis, and therefore the great obstacle to the introduction of the electric light into our houses, viz., the cost, had now been overcome. Thus argued many persons unacquainted with the real nature of electric light supply business; but the argument is fallacious. In the first place the amount of heat available is insufficient for electric lighting on a large scale, and in the second place the saving in the coal bill would not compensate for the disadvantage of having the electric light station dependent upon some other works for power. It must not be forgotten that the cost for fuel is only one of the items in the general cost of supplying electricity; it may reach perhaps 20 or even 30 per cent. of the total expenditure, and to secure this small advantage the electric light station would have to sacrifice its independence and, to a large extent, the ability to vary the output simultaneously with the demand. The supply of electric light or power is a hand to mouth business, and unless the boilers, engines, dynamos, and all necessaries are under perfect control, it will be found impossible to comply with the ever varying demands of the subscribers. In making these remarks, we do not wish to detract in any way from the value of the experiment in electric lighting made by Mr. Bennett, which has conclusively shown that any surplus heat from the destructors can be used to supply power for a small electric light installation; but this does not prove that large central stations can be worked on this plan.

With the above limitation, we welcome Mr. Bennett's plan to obtain electricity as a by-product in sewage works as a distinct impovement, which is likely to be adopted by other local authorities, and we give below a description of the electrical plant in use at Southampton. To render our description intelligible, we must briefly allude to the works as a whole, by the aid of the plan shown above, for which we are indebted to the courtesy of Mr. Bennett; and for a detailed description of these works and the process of treating town refuse there carried on we would refer our readers to the "Minutes of Proceedings of the Institution of Civil Engineers," Vol. XCI., which has just been issued, and which contains, amongst the selected papers, one by Mr. Bennett, on the "Southampton Sewage Clarification and House Refuse Disposal Works." The works deal with about 500,000 gallons of sewage daily, coming from a district containing 13,000 inhabitants, and with the whole of the dust bin contents and street refuse of the borough, amounting to about 70 cart loads per day. The carts are brought up an inclined platform at the Chapel Wharf, and their contents are discharged into hoppers above one of Messrs. Manlove, Alliott, Fryer, & Co.'s refuse destructors, with six cells or furnaces, each able to deal with from eight to nine tons of dust bin contents per day; and the products of combustion pass through a main flue into one of two flues containing each a multitubular steel boiler—one of 30 h.p., and the other of 10 h.p. These boilers can be cleaned alternately, suitable dampers being provided for shutting off either flue. The necessary draught is obtained by a chimney 160ft. high, not shown in the plan. The steam from the boilers is used for working an air compressing engine G indicating 31·5 h.p., and the compressed air is stored in the reservoirs H. There is also a small steam engine driving the incorporator F, for mixing road sweepings and sewage sludge for manure, which is sold to neighbouring farmers at 2s. 6d. per load. The sewage is clarified in two reservoirs at the Southampton Water, about a mile

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distant from the works at Chapel Wharf, the precipitation being effected by porous carbon mixed with sulphuric acid and water into a stiff paste, and led through a shoot J into the perforated box I placed into the sewer, a small jet of water preventing consolidation. At the reservoirs there are two of Stone's ejectors, the air supply being by a 5in. main from the engine house; one of the ejectors has 360 and the other 700 gallons capacity. The object of installing the ejectors was to render the discharge of the effluent independent of the tide, and to force the sludge back to the incorporator through a 4in. main. The details of the arrangement will be understood from our diagram.

The electric light installation, which was put down by Mr. A. I. Baron, comprises a 10 kilo.-watt Gülcher dynamo, twelve glow lamps of 16 c.p., and four 3000-candle arcs, representing a total output of about 75 ampères at 65 volts pressure. The dynamo is worked from the main engines G, and speeded at 820 revolutions per minute. The glow lamps are fitted in the office, engine house, and wheelwrights' shop, &c., and the arc lamps are placed in the yard, over the main gate, and on the wharf. Mr. Baron estimates that the present boilers at the works could work up to 110 i.h.p., of which 60 i.h.p. would be at all times available for electric lighting. By putting down a separate engine this power could be utilised at night for street lighting by arc lamps, and during the day for charging storage batteries, from which a limited district could be supplied with incandescent light.

THE GRIFFIN GAS ENGINE.

Comparative Table of the more important Results of Tests on an 8 n.h.p. Griffin Gas Engine obtained independently by Professor Kennedy, of University College, London, and Professor Jamieson, of the Technical College, Glasgow.

Table of the More Important Results.	Brake Tests.		Electrical Tests.	
	Kennedy.	Jamieson.	Kennedy.	Jamieson.
1. Average mean pressure during working stroke in lbs. per square inch	56·71	64	59	63·2
2. Revolutions of engine per minute	223·8	183·6	210·4	187·7
3. *Indicated h.p. from working stroke diagrams*	18·62	17·28	18·26	17·4
6. Mean net brake load in lbs.	126·4	140·0	...	...
7. Mean radius of brake load in feet	2·775	2·78	...	...
8. *Brake h.p.*	14·94	13·6	...	...
9. *Electrical h.p.* (effective found in external circuit)	...	...	10·3	9·74
10. Ratio of brake h.p. to indicated h.p. (working stroke)	80·2 %	18·7 %	...	...
11. Ratio of electrical h.p. to indicated h.p. „	...	...	56·4 %	55·9 %
12. *Gas used per indicated h.p. per hour in cubic feet*	18·92	19·27	18·87	19·13
13. *Gas used per brake h.p. per hour in cubic feet*	23·58	24·48	...	...
14. *Gas used per useful electrical h.p. per hour in cubic feet*	...	...	33·4	34·2
15. *Percentages of the whole heat of combustion*—				
Converted into indicated h.p.	20·0 %	19·2 %	...	...
Carried away by jacket water	37·6 %	30·4 %	...	...
Discharged in exhaust, blank charge, &c	42·4 %	50·4 %	...	...
Total	100·0	100·0	...	...
16. Equation to the actual expansion curve	$p v^{1\cdot373}$	$p v^{1\cdot382}$	...	...
„ expansion curve from ratio of specific heats	$p v^{1\cdot384}$	...	...	...
„ actual compression curve	$p v^{1\cdot262}$	$p v^{1\cdot4}$	...	...
„ compression curve assumed same as air for air	$p v^{1\cdot408}$	...	...	...

Notes.

COLZA OIL

The British Vice-Consul at Caen reports that the cultivation of colza, which a few years ago was very extensive in his district, appears to be gradually dying out altogether, though it was formerly the mainstay of the farmer, to which he looked forward to paying his rent. Colza is now meeting with very little demand, owing to the introduction of cheap mineral oils for lighting purposes. Colza oil was also extensively used for lubricating machinery, but it is now superseded by heavier and cheaper oils.

THE AMERICAN CANALS.

In considering the question of the Panama Canal, the *Engineering News* of New York expresses the opinion that even if M. de Lesseps should die with his task incomplete, and the entire work were abandoned by its present promoters, there should be no difficulty in re-organising it on a new basis; but it would probably always remain a lock canal. Our contemporary also states that the Nicaragua Canal surveying expedition will probably not return as a body, as some of the members will be employed in the construction of the canal, which will follow closely upon the completion of the survey. The first work will be to build a wharf at Greytown, at which to land the necessary plant.

ENGLISH CAPITAL IN SPAIN.

Our Madrid correspondent has on various occasions pointed out cases in which English capital might be advantageously employed in Spanish industries, and Consul Woolridge, of Barcelona, in a Foreign Office report, also draws attention to this subject. He says that Spain is rich in raw materials, and that Englishmen could manufacture articles there which would be quite as good as if they were manufactured in England, whilst the wages which would have to be paid would be less. The Consul complains in general terms of the want of enterprise which is shown by English manufacturers and exporters in meeting the competition of other countries in Spain.

EXHIBITION IN ROUEN.

It is proposed to hold in Rouen, from the 20th of May to the 20th of June next, a hygienic exhibition, at which lectures will be given by the most competent French hygienists. The idea of holding this Exhibition was suggested to the town authorities of Rouen by the Normandy Society of Practical Hygiene, which is under the patronage of the Minister of Commerce and Industry. The object of the Exhibition is to bring under the notice of those interested in sanitary appliances, and to give them an opportunity of examining, the best apparatus and the most perfect models which should be adopted for the sanitation of public and private dwellings, workshops, and towns. The exhibits should exemplify the best methods of supplying light and air to dwellings, also their ventilation, heating, artificial lighting, cleansing, disinfecting, also the drainage and removal of night soil, and the various means to be taken to prevent the spread of contagious diseases. Models will be on view of artisans' dwellings, night refuges, and mortuaries. All communications respecting this exhibition should be addressed to the president of the Normandy Society of Practical Hygiene, 7, Rue Jeanne d'Arc, Rouen.

THE GRIFFIN GAS ENGINE.

In our last issue we published a report by Professor Jamieson, of Glasgow, on this engine, and we have since received a copy of a report by Professor Kennedy, of London, on the same engine, given quite independently, and with his own apparatus and by his own methods. We have taken the trouble to extract from each report the more important results for the full brake and electrical horse power tests, and now place them before our readers in the above table, so that they may see at a glance any differences or discrepancies, as well as to enable easy comparison with tests of other gas engines. In the brake horse power tests Professor Kennedy has evidently made the very most of the engine's capabilities, for he has run it at a considerably higher speed and with a lighter brake load than Professor Jamieson did; yet, nevertheless, the more important final results, such as the gas consumed per indicated brake and electrical horse powers, as well as the several efficiencies of the engine, are remarkably close, seeing that the results were arrived at by different observers, and in several cases by different methods and apparatus. Professor Kennedy finds the absolute efficiency of the engine (or the ratio of the indicated horse power to the total possible calculated heat of combustion) to be 20 per cent., while Professor Jamieson makes it out to be 19·2 per cent. These are excellent results, and obtained by independent and able experimentalists. Messrs. Dick, Kerr, & Co. certainly deserve to be congratulated upon their perseverance and skill in bringing the Griffin engine up to its present perfection.

THE POLLUTION OF AIR AND WATER BY CHEMICAL WORKS AND MANUFACTURERS.

At the ordinary meeting of the Society of Arts, held on the 11th inst., Mr. Alfred E. Fletcher, H.M. Chief Inspector of Alkali Works, read a paper on "Legislation Concerning the Pollution of Air and Water," in which mention was made of the hurtful gases thrown off during the preparation of chemicals used in the bleaching of cotton and wool, the preparation of paper, the dyeing of cloths, the smelting of metals, and many other such operations. In 1863, the first Act was passed compelling the condensation of the hydrochloric acid liable to be thrown off from alkali works. This was followed by a second Alkali Act in 1874, and a third in 1881. Several other chemical trades are placed within the scope of this last Act. In all 1060 works are registered under it. The method of working the Act by means of a chief inspector and district inspectors was described, and the success attending their work referred to. The manufacturers, at first alarmed, now welcome the inspectors as being an assistance to them in saving material which, though valuable, caused great nuisance when allowed to escape. The nuisance arising from black smoke was dealt with, and shown to be in nearly all cases curable. No less than thirteen Acts of Parliament were mentioned, dating from 1845 onward, in which the emission of black smoke is prohibited under heavy penalties. Yet the offence is continued. The reason why the law is so sparingly enforced is because its administration is in the hands of the local authorities, who themselves are often chief offenders. The smoke from private houses was also referred to, and a method of heating described which would increase the comfort of our homes and wholly prevent smoke. Reference was made to the thermometer of Mr. Hargreaves and Mr. Mond's gas producer, both being arrangements useful in effecting the combustion of coal without causing smoke. In 1876, a Rivers Pollution Prevention Act was passed. That also has been inoperative from the reason that its working is left in local hands. Some weak points in it were pointed out. If slightly modified, and placed in the hands of an inspector and district inspectors, a like success might be expected as has attended the working of the Alkali Act.

CHEMICALS IN FRANCE.

In reporting on the trade of Rouen during 1887, the British Consul at that port states, that though little business was done in chemicals, prices were maintained. Ammoniacal produce advanced in price, and nitrate and nitric acid rose 10 per cent., owing to a better demand for agricultural purposes. Colouring matter and pyroligneous acid and soap remain the same. The rise in volatile alkalies continues, on account of the orders from the South of France, as a preventive against the mildew in the vines. In the third quarter of the year a rise occurred in sub-products of wood, and a further improvement took place at the close of the year. The arrangement between the large manufacturers has kept up the price of bicarbonate of soda, and the increasing demand for chemical manure has caused a change for the better. The situation of the trade generally is favourable.

EXHIBITION IN ATHENS.

It is proposed to hold in Athens during the latter portion of October and the beginning of November a national industrial exhibition, to which foreign exhibits will also be admitted. This will be the fourth national exhibition held in Greece, and its object is to develop native industries. It is expected to be a great success, since the festivities in connection with the celebration of the twenty-fifth year of the reign of King George, which will take place simultaneously, will attract a considerable number of people to Athens. The undertaking has been placed under the protection and management of the Government. Those Greeks residing abroad will be permitted to take part in the Exhibition, whilst exhibits from foreign countries will be admitted, but not allowed to compete. These exhibits may comprise agricultural and manufacturing machinery, apparatus and tools which are already in use in Greece, or whose introduction would assist in the development of native industries; also inventions of all kinds. These objects will be installed in pavilions, the cost of erection of which exhibitors will have to bear, as well as the expenses connected with the insurance and superintendence of exhibits. The Exhibition will be held in the new building Zappion, so named after its founder. The Government have taken no steps for reducing the cost of transport on foreign goods, nor the Customs dues, and it is stated that they have no such intention. From the above it will be seen that the expenses which foreign exhibitors must incur at this Exhibition will be somewhat heavy.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

6th April, 1888.

5105. Twigg & Turner..... Governing the speed of engines.
5115. Crowther, S. ..... Washing and scouring fabrics.
5116. Willis, J., & others..... Anti-corrosive steel propeller blades.
5117. Naughty, A..... Two-wheeled vehicles.
5122. Devis, E. C. J. ..... Moulding metal plates.
5135. Breadner, E. ..... Apparatus for damping woven fabrics.
5146. Mannesmann and Mannesmann..... Manufacturing toothed pinions.
5147. Mannesmann and Mannesmann..... Rolling metallic hoops.
5148. Mannesmann and Mannesmann..... Moulding tubes.
5149. Hassel, W..... Manufacture of scythe blades.
5150. Mills, B. J. B. ..... Brakes (*Guetton-Dangon & Des Georges*).
5151. Fell, J. C..... Mechanical cleaners for internal parts of boilers (*Bower*).
5152. Templeton & Schischkar..... Facing and flanging machine.
5153. Templeton & Schischkar..... Boring machine for pedestals.
5154. Wallace, J. S..... Sewing machines.
5157. Shapton, W..... Apparatus for shipping coal.

7th April, 1888.

5160. Hamblin, S. J. ..... Rotary engine.
5161. Peake, W..... Breech mechanism for battery guns and ordnance.
5163. Knowles & Whittaker Machines for printing fabrics.
5167. Thorp, T. ..... Automatic reciprocating fluid engine.
5172. Lang, J., & others..... Machines for cutting the teeth of racks.
5174. Bey, A. S. E..... Quick-steering ship rudder.
5184. Rittershausen, M..... Sack sewing machines.
5185. Allen, J. ..... Stuffing the tubes of surface condensers.
5188. Dodd, F. W. ..... Governor.
5190. Beck, W. H. ..... Jacquard cards (*Carbonelle*).
5199. Nisbet, W..... Colouring waterproof materials.
5202. Unwin, F..... Dabbing brushes of combing machines.
5204. Lake, H. H. ..... Ignition apparatus for gas engines (*Benggyer*).
5206. Ellis, O. J. ..... Motive power engines.
5207. Haddan, R. ..... Kneading machines (*Barenys*).
5209. Welch, S. S..... Steam engines.
5213. Cox, R. ..... Polishing glass and marble.

9th April, 1888.

5218. Shaw, H. ..... Automatic disengaging lever for starting engines.
5220. Stout, C. ..... Indicating the flow of water in pipes.
5223. Allen & Bowers..... Purifying water for boilers.
5225. Gregory, W. G. ..... Counterbalancing centre boards by means of springs.
5226. Hind, A..... Pattern designs for textile fabrics
5228. MacLaine, A. ..... Heating feed water.
5229. Murray, J. ..... Gutters for corrugated roofing.
5230. Watts, J. W..... Knitting machines.
5231. Mackay, F. N. ..... Combined motor & refrigerator.
5232. Seggie, A. H. ..... Printing machines.
5239. Kirk & Brook..... Card cylinders of loom dobbies.
5240. Hague, W..... Protecting boiler tubes.
5244. Mauser, P. ..... Breech loading fire arms.
5246. Breze, J. H..... Apparatus for condensing, cooling, and heating fluids.
5249. Hay & Grocock ..... Self sustaining hoists.
5251. Smith, H. J. ..... Moulds for casting.
5252. Hall, J..... Manufacture of leather.
5256. Williams & Hydes..... Washing engine waste.
5257. Glade, C. ..... Stopping steam engines from different parts of a factory.
5263. Woolnough, G. ..... Steam boilers.
5264. Nordenfelt, T. ..... Gun mountings.
5265. Wilcox, R. ..... Operating torpedoes.
5266. Mellor & Chadwick... Circular knitting machines.
5267. Davidson, J..... Manufacture of paper.
5274. Marcet, A. ..... Production of cold by the expansion of compressed air.

10th April, 1888.

5276. Leavitt, F. M..... Drop hammers.
5277. Paget, A. ..... Warp machines.
5288. Buckton & Buckton ... Automatically regulating the pressure of water in mains.
5290. Raymond & Raymond... Couplings for railways.
5293. Martin, B. D. ..... Manufacture of chill rolls.
5296. Aitken, H. ..... Generating steam.
5298. Gordon, J. ..... Safety hoist doors.
5300. Fry & Fry ..... Paddle propeller.
5301. Thompson, W. J..... Looms.
5309. Nichols, M. L..... Grain binding harvesters.
5310. Thompson, W. P..... Multiple cylinder motors (*Benham*).
5325. Lake, H. H. ..... Manufacture of cut nails (*McKay*).
5326. Lake, H. H. ..... Washing machines (*Schumpe and Hammelrath*).
5332. Haddan, H. J. ..... Portable bridges (*Herbert*).
5335. Binns, L. ..... Spinning and twisting machines.
5336. Preble, J. Q. ..... Weighing machines.
5338. Abel, C. D. ..... Treating textile fabrics with steam (*Koethe*).
5339. Bradbury, C. ..... Lifting doors (*Grimme, Natalis, and Co.*).
5342. Kirkaldy, J..... Heating feed water.
5343. Taylor, W. ..... Spinning, twining, and hanking.
5344. McDougall & McDougall ..... Boilers.
5348. Titt, J. W. ..... Wind engines.

11th April, 1888.

18037. Lake, H. H. ..... Universal shaft couplings (*Robes and Haskell*). (Received 11th April, 1888. Ante-dated 14th November, 1887, under International Convention.)
5352. Baines & McCulloch... Automatically controlling pneumatic pumps.
5353. Hall, J..... Wheels.
5355. Nicholas, T..... Moulding boxes.
5357. Wallis & Wallis ..... Steam and other motors.
5366. Hawthorn & Liddell.. Ironing, mangling, and finishing apparatus.
5377. Croom, J. M. ..... Lubricators actuated by electro-magnets.
5379. Rowland, G. ..... Steam boilers.
5380. Butterworth, J. ..... Pointing the wires employed in the manufacture of card clothing.
5381. Haigh & Green ..... Rudders.
5382. Haigh & Green ..... Signalling between and on navigable vessels.
5385. Black, J. M..... Number printing machines.
5386. Twynam, T. ..... Manufacture of ingot iron and steel.
5391. West, D. K. ..... Baling presses (*Thornton*).
5394. Mewburn, J. C. ..... Gig mills (*La Société Grosselin pere et fils*).
5395. Shepherd, J. W., and others ..... Carding engines.
5402. Mills, B. J. B. ..... Ships' propellers (*Bidauld*).
5406. Wyman, H. ..... Wool combing machines.
5407. Tarrillion, J..... Boats.
5408. Bryan, W. B. ..... Elevating and washing sand.
5412. Stannah & Pinker..... Hydraulic hoisting machinery.

12th April, 1888.

5431. Garrs, H. de ..... Slide valves.
5437. Schaeffer & Oehlmann Lubricators.
5441. Workman, W. ..... Hoists.
5442. Battersby, J. ..... Fire bars for boiler furnaces.
5443. Mole, F. M. ..... Printing machines.
5444. Merryweather and Jakeman ..... Fire engines.
5447. Caddy, T. E..... Moulding machines.
5448. Tangyes & Floyd ..... Reversing mechanism of the slide valves of direct acting steam pumps and engines.
5453. Brin's Oxygen Co..... Bleaching (*Brin*).
5454. Vaughan, G. E. ..... Manufacture of seamless tubes (*Mannesmann & Mannesmann*).
5459. Morgan & Jeffery ... Lifts.
5460. Marres & Randall ... Cartridge marking machine.
5463. Quinlivan, T..... Steam boilers.
5468. Gastrell, J. P. H..... Rotary engines.
5469. Brandy, J..... Automatic coupling apparatus.
5471. Colley, A..... Cartridge magazine.
5472. Colley, A..... Cleaning the chamber of Martini-Henry rifles.
5473. Brown, J., & others..... Combined railway buffer and automatic coupling.

ELECTRICITY.

2313A. Ferranti, S. Z. de..... Dynamo-electrical machines. (This Application having been originally included in No. 2313, dated 15th February, 1888, takes, under Patents Rule 23, that date.)

6th April, 1888.

5110. Baraclough & Ingall. Call bells.
5127. Gisborne, J. S..... Telegraphic apparatus.
5131. Randall, C. A..... Magneto-electro storage motor.

7th April, 1888.

5162. Mordey, W. M..... Electric generators.
5182. Stone & Gilfillan..... Telegraphic transmitters.
5191. Edmunds, H..... Storage batteries.
5196. Smith, M. H..... Conducting and collecting currents in electric rail or tramway systems.

9th April, 1888.

5233. Walton, A. H..... Fusible cut-outs.
5259. Capek, J. V..... Electrical heating.

11th April, 1888.

5362. Holmes, J. H. ..... Arc lamps.
5393. St. George & Bonne ... Batteries.

12th April, 1888.

5421. Robson, W. ..... Perpetual motion and electric current generator.
5433. Preece & Andrews ... Electric matting.
5436. Nussbaum, G. A..... Automatic call box for telephonic communications.
5452. Cunnington, J. G. S. ... Fusible device for protecting electric circuits.

CHEMISTRY.

7th April, 1888.

5212. McDougall & McDougall ..... Production of solutions containing sulphurous acid or its salts.

9th April, 1888.

5270. Chardonnet, Le Vicomte H. de ..... Denitrating and dyeing pyroxyl.

10th April, 1888.

5316. Pearson, S., & others... Aluminium.

11th April, 1888.

5371. Geary, G. J..... Manufacture of sulphide of zinc (*Keiller*).
5404. Leigh, H. H. ..... Colouring matters (*Williams*).

12th April, 1888.

5461. Cross, W..... Aluminium.

MISCELLANEOUS.

6th April, 1888.

5102. Williams & Thomas..... Gas lighting apparatus.
5103. Dufty, A. ..... Manufacture of wooden bungs.
5106. Disturnal, T. J..... Apparatus for heating and drying.
5108. Hartcliffe & Malkin. Full-way valves.
5109. Hartcliffe & Malkin. Water gauges for steam boilers.
5111. Barrodale, T. H..... Protractors and rulers.
5112. Duerden, J. ..... Manufacture of paper bags.
5114. Johnson, R. A..... Spinning rings.
5123. Maconochie, A. W..... Manufacture of metal cans.
5124. Williams, J. R..... Lubricating apparatus.
5126. Kincaid, S. B..... Street lamps.
5133. McKeon & McVey..... Cork drawing machines.
5134. Browett, T. ..... Power hammers and stamps.
5136. Slingsby, G..... Securing bobbins upon the spindles of shuttles.
5144. Hurley, E. J. ..... Fixing roofing slates.
5145. Fisher & Cramp ..... Treatment of slag for road making.
5156. McNish, J. ..... Glazing paper.

7th April, 1888.

5165. Burns, D. ..... Chimney cowls.
5166. Wier, M. A. ..... Rowing carriage and velocipede.
5171. Key, J. T. ..... Miners' safety lamps.
5177. Townsend, G..... Spoke tighteners.
5179. Walker, A. H..... A sea oiling cartridge.
5180. Walker, A. H ..... Sea oiling projectile.
5187. Newton, J. M..... Producing designs in relief upon sheets of ductile metal.
5193. The Sächsische Spulenfabrik & Ginzul... Spools.
5194. Schröder & Stuart ... Lenses.
5197. Bonwick, W. P. ..... Bottle stoppers.
5203. Pontois, L. J. le..... Transmitting sounds to a distance by means of light.
5208. Herzfeld, J. ..... Gas burners.
5214. Gooch, W. D., & others. Porous artificial stone.
5215. Aird, D. A. ..... Measuring taps.

9th April, 1888.

5217. Brooks, S..... Fastener for belts.
5219. Bratby & Hinchcliffe Reducing valve.
5222. Bishop, W. ..... Lenticular glasses of lamps.
5227. Foulston, G. J. ..... Preparation for protecting bright metallic surfaces.
5234. Wenger, A. F..... Colour mixers.
5235. Fletcher, S. H. ..... Taps.
5247. Pennefather & Dinsmore ..... Ventilators.
5253. Beer, F..... Improved plastic composition for moulding.
5255. Newell, C. L. ..... Lamps.
5260. Hart, A. ..... Lamps.
5272. Halot & Avedyk..... Manufacture of aerated waters.

10th April, 1888.

5275. West, J. P. ..... Extracting the dust from corn.
5278. Brown, F..... Locks and keys.
5280. Gaskell & Gaskell ... Automatic barrel tilter.
5282. Sandon, E. F. ..... Compressing and trussing hay.
5283. Brook, E. ..... Gas producers.
5284. Morris, E. G. ..... Lamps.
5287. Evans, J. ..... Paper tubes for holding yarn.
5291. Smith, T. ..... Stoppering bottles.
5294. Partington, E. ..... Stop valves.
5295. Aitken, H. ..... Valves.
5303. Chisholm, G. ..... Tap.
5305. Petri & Hausmann..... Syphons.
5307. Gouraud, G. E. ..... Phonogram blanks (*Edison*).
5312. Thompson, W. P..... Recording thermometers (*Draper*).
5321. Restall, G. F..... Disinfecting drains.
5323. Erckel & Engelhardt Sharpening scythes.
5324. Lake, H. H. ..... Machines for lasting boots (*Lancaster*).
5327. Peters, G. M. ..... Cartridges.
5330. Gamger, J..... Maintaining circulation of liquids
5331. Haddan, H. J. ..... Gas burners (*Jackson*).
5333. Lodge, T. H..... Portland cement.
5337. Abel, C. D. ..... Supplying cooled air to rooms (*Koethe*).
5350. Godfrey & Meeker ... Chemical fire extinguishing apparatus.

11th April, 1888.

18038. Uhlenhuth, H..... Joining the ends of bands. (Received 11th April, 1888 Ante-dated 26th October, 1887, under International Convention).
5354. Bartholomew, W. ..... Crucible tongs.
5359. Bunting, S. ..... Stoppering of bottles.

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5360. Siddaway & Hall ..... Shoe rivets.
5363. Hazeland, S. S. ..... Wood workers' plane irons.
5369. Wrigley, F..... Straining liquids.
5374. Gabriel, C. E. P. ..... Ball valves.
5384. Birchall, C. F. B., and others ..... Reproduction of designs upon glass.
5388. Klever & Storz..... Hose couplings.
5390. Sherrin & Sherrin ... Velocipedes.
5392. Pepys, W. C..... Thermometers.
5399. Stone, R. ..... Paint.
5400. Vale, H. ..... Gas lamps.
5405. Boutcher, A. G..... Adjustable wrench.
5409. Wern, H..... Tins.
5410. Ruck, R. M. ..... Releasing hooks or shackles.
5413. Gooch, W. D., and ors. Oil and spirit lamps.

12th April, 1888.

5418. Schmidt, W..... Cooling vapours.
5426. Sawrey & Collet ..... Separating liquids from solid matters in suspension.
5428. Crowley & Harris ... Gas burners.
5432. Heys, W. E. ..... Pulverisation of liquids (*Kron*).
5439. Ashberry, P. ..... Shears.
5445. Hill & Bryant ..... Indestructible lamp wick.
5464. Crundall, F. ..... Ships' signal lights.
5465. Pass, E. A. de ..... Water and gas cocks.
5466. Treeby, A. ..... Apparatus for carburetting air, gas, or other vapour.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

14th April, 1888.

1767. Dinsmore, J. H. R..... Manufacture of gas.
5005-6. Clarke, W., & others Steam pumps.
5040. Williams, J..... Wire rope grip.
5059. Powell & Jordan..... Haulage clips.
5209. March, W..... Wrench for axle caps and nuts.
5217. Keeble & Mumford.... Machine for cutting chaff.
5225. Long, J. E..... Hand fire extinguishers.
5929. Turner, J. ..... Looms for weaving gauzes.
6501. Dawson, H. T..... Engines worked by explosive mixtures.
6981. Thompson & Spence ... Type writing machines.
7086. Haddan, P. ..... Blinds of corrugated sheet metal (*Mitter.*)
7296. Sisson, W..... Clutch mechanism.
7350. Faber, J. ..... Gas motors.
7391. Frager & Michel ..... Liquid meters.
7654. Kemp, T. T. ..... Rotary steam engine.
7677. Davy, C. ..... Gas engine.
7715. Allen & Rathbone ... Wheels and pulleys.
7731. Blackburn & Lampen.. Clip pulleys.
7911. Brierley, W. ..... Automatic dyeing coppers (*Perzina*).
7986. Bailey, M..... Safety indicator for apparatus working under pressure.
8023. Corbett, T. ..... Ploughs.
8097. Tolhurst & Skinner... Slide valve.
8111. Laing, W. R. ..... Frames for spinning, doubling, twisting, or roving fibrous substances.
8134. Dowd, G. S. ..... Bearding, scouring, and polishing grain.
8169. Lankester, P..... Apparatus to facilitate seed sowing on the broad cast system.
8182. Johnson, J. Y..... Apparatus for propelling by reaction.
8207. Burrows, H..... Open hearth steel furnaces.
8224. Harman, H. J..... Attaching railway chairs to sleepers.
8285. Neilson, W., & others... Reversing valves for regenerative furnaces.
8304. Hughes, G. ..... Lifeboats.
8325. Sykes & Sykes..... Stop motion applicable to machinery for twisting and doubling yarns.
8328. Morgan, J. H..... Grabs for dredging and excavating.
8330. Blamires, T. H..... Manufacturing yarns.
8395. Cochrane, W. M..... Breaks for road vehicles.
8408. Shelton, J..... Elastic tyred wheels.
8413. Stechmann, G. H..... Automatic feeding apparatus and feed water heater.
8414. Yeadon & Middleton.. Machinery for desiccating substances of a granular character.
8422. De Hemptinne & De Hemptinne ..... Removing oil from the cards of carding machines.
8447. Westmacott, P. G. B.... Shipping coal
8451. Turton, G..... Coupling buffers for railway vehicles.
8485. Marinoni & Michaud... Printing machines.
8525. Smith, J. H. ..... Apparatus for drying woven fabrics, yarns, or fibrous materials.
8654. Bain, W. P. C. ..... Standards for wire fencing.
8671. Yeadon & Middleton.. Disintegrators.
8698. Cowper, E. A. ..... Hot blast valves.
8838. Binns, A..... Regulating the "drag" on the fibre under operation on finishing and roving boxes.
9136. Taylor, W. ..... Self acting mules.
9619. Reid, J. ..... Stopping the leaks in the tubes of tubular boilers without obstructing the draught.
9699. Scott, W. G..... Travelling hoisting gear.
9721. Thompson, W. P..... Wind motor and apparatus for propelling vessels (*Von Schlieben*).
11078. Shelley, T. R..... Securing sheets of zinc to roofs.
11125. Mudgemarchant and Brushett ..... Tubular steam boilers.
11337. Snyers, R..... New method of mechanical connection applied to brakes and clutches.
11458. Lake, H. H. ..... Winding cops (*Palmer*).
12960. Féraud, A. L. ..... Improvements in mounting the bodies of railway carriages. (Received 24th September, 1887. Ante-dated 14th June, 1887, under International Convention.)
14344. Horsfield & Porter... Hydraulic press for mining coal.
15652. Dickinson, M. F..... Printing machine.
15783. Nichols, J..... Machinery for making wire nails.
16280. Everitt, W. E..... Manufacture of brass, copper, and other metallic tubes.
16589. Eadie, J..... Carding machines.
72. Thompson, W. P..... Type writers (*Brown*).
384. Inman, H. ..... Paper box machines.
951. Richards, W. H..... Apparatus for cooling liquids.
1468. Barham, G. ..... Measuring and weighing fluids.
1670. Sinnette, F. J..... Anchor.
1830. Imray, O. ..... Embroidering machines (*Smith*).
1841. Lieb, C. A..... Automatic grain scales.
2252. Imray, O..... Duplex rotary pumps (*Dow*).
2561. Tilton, H. W. ..... Sewing machinery (*Angell*).
2608. Köhler, J..... Sewing knitted fabrics.
2922. Johnson, J. Y..... Sewing knitted fabrics (*Quinquarlet, Valton, & fils*).
3173. Grassnick, F. ..... Machine for drilling holes for planting potatoes.
3449. Justice, P. M. ..... Railway switches (*Isbell*).
3531. Taylor, W. H., & others Loom temples.
3542. Watson, C. T. ..... Machines for printing cards.
3587. Burtscheidt, G..... Weaving pile fabrics.
3656. Lund, E. ..... Pulsometers.
3718. Klauke, C. ..... Barbed wire for fencing purposes.
3789. Baker, G. W. ..... Leather staking machine.
3801. Selwig, J..... Rotary engine.
3816. Hainsworth, F. ..... Wire fabric for mattresses.
3819. Thompson, W. P..... Spark arresters (*Jessl*).
3837. Sleeper, F. H..... Lifting jacks.
3854. Ward, J. F. ..... Vessels' rams.
3918. Hamilton, H. ..... Apparatus for composing type (*The Thorne Machine Co.*)

ELECTRICITY.

14th April, 1888.

6221. Shippey & Hamilton... Governing motors by electro-chemical action.
6581. Manville & Madgen... Holders for electric lamps.
6744. Walkington, W..... Fire box and boiler.
9853. Watt, H. ..... Dynamo-electric machines.
12017. Verchère, P. L. ..... Carbons for voltaic batteries.
16709. Edison, T. A..... Electrical generators. (Received 5th December, 1887. Antedated 13th June, 1887, under International Convention.)
633. Coerper, C. ..... Dynamo-electric machines.
734. Noad, J..... Galvanic batteries.
3483. Schmidt, F. T. ..... Electrical switches.
3685. Sharp, S., & others..... Electrical switches.
3740. Bernstein, A. ..... Cut-out and switch.

CHEMISTRY.

14th April, 1888.

7761. Jones & Jones..... Oxides of iron.
7859. Staub, L. A..... Carbonate of soda.
7906. Schneider, R. ..... Hydrate of baryta.
8129. Staub, L. A..... Carbonates of soda.
8265. Pitt, S. ..... Naphthol disulphonic acid and dyestuffs therefrom (*Leopold Cassela & Co.*)
8387. Traube & Bodländer.. Separation of fusel oil.
1693. Nicolle, A. ..... Manufacture of phosphorus.

MISCELLANEOUS.

14th April, 1888.

5001. Whitehead, J..... Automatically tightening nuts for the adjustment of bearings to compensate for wear.
5270. Rappaport, L. ..... Utilising the waste of flour mills.
5470. Kendall, P. F..... Determination of the dip of rocks in deep bore holes.
6966. Phillips & Harrison... Reflectors of light.
6995. Catling, R. C. ..... Washing barley before malting.
7331. Ross, J. H..... Oil lamps.
7560. Ashley, H. M. ..... Internally stoppered bottles.
7952. Drake-Brockman, R. R. E..... Attaching ropes or cables to each other.
7996. Ross & Bilbie ..... Manufacture of boots.
8086. Lorrain, J. G..... Cable sleeves.
8174. Dutton, S. T. ..... Railway signal lamps.
8231. Alexander, W. ..... Sheaves for pulley blocks.
8319. Attock, F. ..... Draught and dust excluder.
8456. Beesley, J. ..... Velocipedes.
8501. Holland, H. W. ..... Telescopic sights for rifles.
8514. Leak, E. ..... Glass spinning rings.
8591. Wood, R. ..... Straining paper pulp.
8782. Wood & Wood..... Straining paper pulp.
9211. Crompton, R. ..... Colouring and drying tissue paper.
11452. Horton, E. ..... Oil lamps.
11654. Musgrave, S. H..... Bottle stoppering.
14364. Greenwood, J..... Valves.
4. Räuerle, T. ..... Lamp clocks.
1026. Beer, A..... Frictionless gate spring.
1794. Watkin, H. S. S..... Instruments for measuring distances.
1870. Shepherd & Shepherd Oil lamps.
2656. Thompson, W. P..... Dust and shavings collectors (*The Knickerbocker Co.*).
2774. Lake, H. H. ..... Manufacture of boots (*Ross*).
3172. Jones & Bridger..... Manufacture of boots.
3318. Bayer & Lease. ..... Tricycles.
3320. Surprenant, L..... Nut lock.
3716. Ibbotson, E. C. ..... Lock nuts.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 7th January, 1888, inclusive).

Year 1884.

6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 22, 31, 33, 38, 39, 44, 45, 47, 51, 54, 55, 56, 57, 58, 59, 61, 63, 68, 69, 70, 71, 74, 77, 78, 79, 80, 82, 85, 86, 90, 92, 93, 96, 99, 103, 106, 107, 108, 109, 110, 112, 115, 117, 118, 119, 120, 121, 122, 125, 127, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 144, 145, 146, 147, 148, 149, 151, 152, 153, 154, 155, 156, 162, 164, 172, 173, 175, 176, 180, 184, 185, 188, 189, 190, 191, 192, 194, 197, 201, 202, 204, 206, 207, 210, 211, 212, 215, 216, 219, 221, 224, 231, 233, 234, 237, 245, 250, 252, 253, 254, 259, 260, 265, 269, 271, 275, 276, 287, 288, 293, 294, 295, 296, 301, 303, 304, 305, 308, 311, 314, 316, 318, 320, 326, 330, 332, 338, 340, 341, 342, 345, 346, 349, 350, 357, 358, 359, 362, 365, 366, 367, 369, 370, 372, 373, 375, 377, 379, 381, 383, 384, 385, 386, 387, 389, 391, 392, 393, 394, 396, 397, 402, 406, 407, 408, 409, 410, 411, 416, 420, 421, 422, 425, 426, 427, 432, 434, 435, 413, 444, 451, 453, 454, 455, 457, 458, 461, 462, 466, 469, 470, 476, 477, 478, 480, 481, 483, 484, 485, 486, 487, 489, 491, 492, 494, 495, 496, 497, 498, 499, 500, 503, 504, 505, 507, 509, 512, 513, 517, 519, 521, 522, 524, 526, 531, 534, 538, 539, 542, 547, 548, 550, 553, 557, 559, 561, 562, 567, 569, 570, 571, 575, 578, 579, 581, 586, 587, 588, 589, 590, 601, 602, 603, 605, 607, 608, 610, 611, 612, 614, 617, 621, 623, 625, 626, 627, 628, 630, 634, 637, 642, 644, 645, 653, 654, 655, 659, 661, 662, 663, 664, 667, 671, 672, 677, 681, 685, 692, 700, 703, 704, 705, 706, 710, 711, 718, 725, 727, 728, 729, 730, 740, 745, 748, 750, 753, 756, 759, 760, 762, 764, 765, 769, 770, 771, 773, 775, 776, 778, 782, 784, 786, 787, 788, 789, 790, 793, 797, 799, 801, 802, 806, 807, 812, 817, 821, 822, 823, 825, 834, 837, 839, 840, 844, 848, 851, 852, 853, 858, 859, 867, 871, 872, 873, 874, 880, 886, 889, 891, 892, 894, 896, 898, 899, 903, 2675, 2754, 3336, 3576, 5131, 6503, 7056, 12522.

Year 1883.
33, 62, 66, 84.

Year 1882.
49, 76, 92, 100, 104, 106.

Year 1881.
9, 14, 43.

Year 1878.
34.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

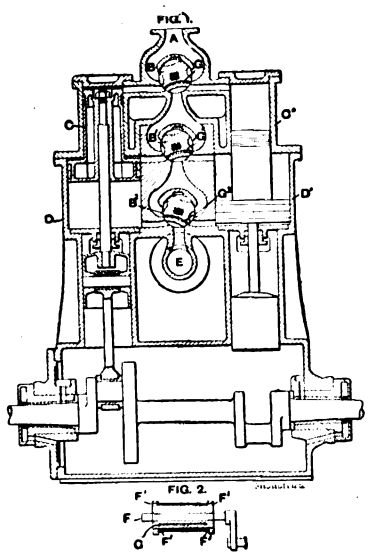
ENGINEERING.

Breech Mechanism for Ordnance.—*T. Nordenfelt, London.*—In the guns to which this invention is applicable, the breech is closed by a block entering the breech opening, and screw threads on the block engage with threads within the breech of the gun. In the improved mechanism the necessary movements are given to the block by a lever handle and axis, which revolves through the arc of a circle, and the extractor is also actuated by the same means. A flanged ring is fixed on the breech end of the gun, and upon it are bearings for a vertical axis, which carries the lever handle. This axis is on one side of and a short distance in the rear of the breech opening. An arm at the upper end of the axis carries a stud to engage with a notch in a sliding bar, which is carried in guides and moves transversely to the bore of the gun. The same bar has another notch in it, which engages with a stud upon the breech block. During the first part of its movement in opening the breech, the bar slides in its guides, and turns the breech block through an angle of 60°, and disengages the screw threads upon it from those within the gun; the stud on the lever handle then escapes from its notch in the transverse horizontal bar, and travels on while the bar remains at rest. A collar on the rear end of the breech block turns freely, and carries a stud which projects downwards through two different slots. One of the slots is cut longitudinally in a support which receives the breech block when it is withdrawn, and the other slot is formed in an arm by which the withdrawal of the breech block from the gun and its replacement after loading are effected. This withdrawing arm and the support or tray are mounted loosely on the axis of the lever handle; both of the parts remain stationary during that portion of the movement already described. In opening the breech a shoulder on the lever handle comes against a similar projection upon the withdrawing arm, and the latter commences to turn, while the lever handle moves rearwards from the breech. The breech block is drawn out and landed upon the tray, which then turns round with the lever handle. In closing the breech the same movements take place in the reverse order. In order to insure this sequence of movements, a bolt is provided on the withdrawing arm, and a piece fastened to the axis of the lever handle gives motion to it. A stud upon the piece enters an inclined groove in the bolt while the unlocking movement is in progress. The extractor slides in a horizontal groove

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on one side of the breech opening. It has a lip which overlaps the flange at the base of the cartridge, and has a screw thread formed upon it at the side. When the breech block is turned to open the breech, the thread upon the block engages with the thread upon the extractor, which is consequently withdrawn, and the cartridge case is loosened in the bore. When the block is drawn rearwards, the extractor is also drawn back, carrying the cartridge with it. When the breech block has been landed upon the tray, its screw thread leaves that on the extractor, which afterwards remains at rest at the rear end of its guide groove, and is locked by a sliding bolt. The face of the breech block is inclined at the sides, and, in loading, this cavity effects the centreing of the cartridge and insures it entering the gun truly. Seven claims are made.—No. 7195. May 17th, 1887. 11*d*.

Slide Valve.—*A. G. Brown, Cathcart, North Britain.*—The valve here described is adapted for use in multiple cylinder single acting engines, and is substantially of cylindrical outline, but is cut away at certain points, so that the section resembles a Maltese cross. The motion of the valve is reciprocating, and its travel extends through less than one quarter of a revolution. The method of working will be understood by reference to Fig. 1, which represents a section of the valves when employed in a four cylinder engine. Fig. 2 shows detached a longitudinal view of one of the valves. Steam is admitted into the steam chest A on both sides of the valve B. The steam passes through a recess on one side of the valve to the port of the cylinder C, and also through the auxiliary groove G. While steam is being thus admitted, the exhaust from the second cylinder C^1 is open, and the discharge takes place through the recess between the bearing surface of valves $B B^1$ to the top of the cylinder D. The exhaust from beneath the cylinder D is open through the recess in B^2 to the final exhaust E, while the exhaust from the top of the

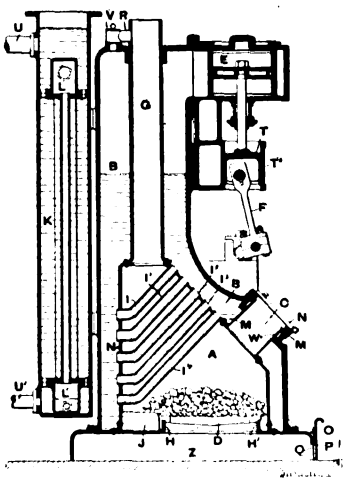


piston in the cylinder D^1 is open through the valves $B^1 B^2$ to the bottom of the same cylinder. It will thus be seen that while pressure is being exerted upon the top of the pistons in the cylinders, the final exhaust, if connected with a condenser, is pulling in the same direction from beneath the lower pressure piston. When the valve motion is reversed, the steam inlet to the cylinder C is closed, and just before the inlet to the cylinder C^1 is opened, the supplemental passage G opens communication momentarily between the two cylinders C and C^1; the expanded steam from the first cylinder thus exhausts partially into the second cylinder, just before the full steam pressure is admitted. The further movement of the valve B closes communication between the cylinders $C C^1$, and opens the latter to full steam pressure; the former completes its exhaust through the valve B^1 to the top of the cylinder D^1, and the final exhaust from beneath the piston in the cylinder D^1 is at the same moment opened through B^2 to E, while the exhaust from the top to the bottom of the cylinder D is opened through the valves $B^1 B^2$. The passages $G^1 G^2$ open communication momentarily between the cylinders $D D^1$ in the same manner as the passage G. The stems F are journalled at each end and are carried in bearings, with the object of holding the valve centrally in its seat and of decreasing the wear. Any ordinary means may be employed for operating the valves; and for the purpose of balancing with regard to exhaust, communication is made between the bottom and top recesses of the valve. This may be done conveniently by the passages F^1 shown in Fig. 2. Three claims are made for the form of the valve, and for the supplemental passage.—No. 5134. April 6th, 1887. 8*d*.

Excavators.—*J. Garvie, London.*—This invention relates to the combination of an ordinary traction engine or portable engine with an excavator. Any known form of excavator worked on slides, or by an arm or jib, is to be driven by a portable engine by means of belt or other gearing. The excavator is preferably in a separate frame, so as to be easily attached to and detached from the engine, and is arranged in such a position as to obtain the full advantage of the engine for the purpose of a counterbalance. One claim is made for this combination.—No. 7081. May 14th, 1887. 4*d*.

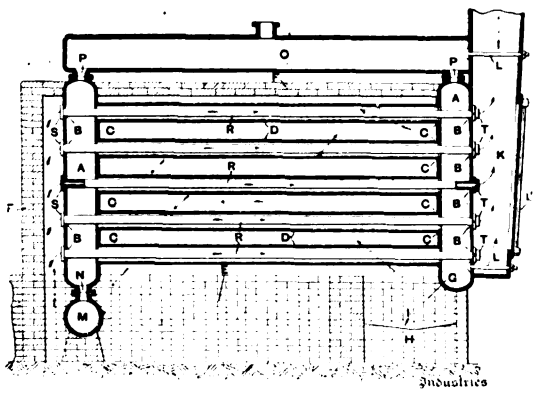
Flax Spinning Machinery.—*L. MacLaine, Killyleagh, Down.*—The object of this invention is to improve the quality of the rollers used in flax spinning frames, in which it is desirable that the surfaces of the bosses on the drawing rollers shall be equally dense all round, and free from cracks and flaws. The roller shafts are to be constructed of iron, steel, or other material, and the fluted bosses are cast on intermediate cylinders. The fluted bosses are placed either at the centre or at one end, or in any other position on the intermediate cylinders. The bosses and intermediate cylinders are cast under pressure, and then bored out and shrunk on the roller shaft; they are then turned up and fluted. The inventor claims the construction of the roller shafts of flax spinning frames, with bosses and intermediate cylinders fitted on separately.—No. 7845. May 31st, 1887. 6*d*.

Steam Boilers.—*H. Davey, London.*—These boilers are intended for the generation of steam for low pressure motors, and are specially designed for the purpose of insuring safety against explosion, although requiring comparatively little attention. The boiler shown in vertical section in the accompanying figure embodies several improvements in the boiler which forms the subject of Patents Nos. 3833 and 15185 of 1884. The boiler B and fire box A are secured to the bed plate Z. The bed plate has two projections $H H^1$ for the support of the fire bars D, and is



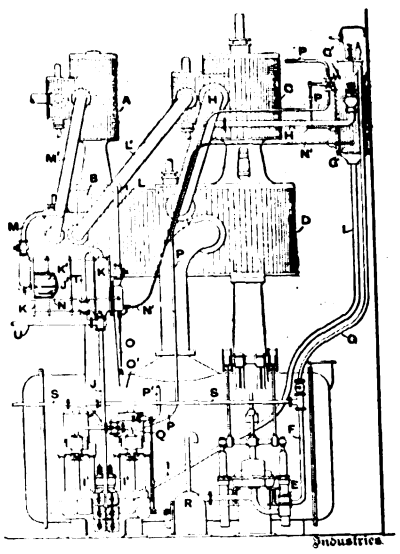
provided with a damper door O, which slides on a plate P in front of the opening Q. By adjusting the position of the damper door in front of the opening the supply of air may be reduced to any degree. The fire box A is provided with additional heating surface by the tubes I, which are placed at an angle, so that the water in them will rise and produce a general circulation in the boiler. The mouth piece C is fastened to the fire box A, and serves for the introduction of fuel; its junction with the boiler is made by means of the packing in the recess L, which is kept tight by the ring M. The block of fire brick J prevents the coal from lodging behind the projection H. The cylinder E and the cylindrical guide T^1 are made in one piece, and are fastened to the boiler; the cylinder is so arranged that the steam is allowed a free passage around it. The distribution of steam in the cylinder, its subsequent exhaustion into the condenser K, and the extraction of the condensed water from the latter, are described in the previously mentioned specifications. The blow-off valve box V contains an ordinary single beat valve, and is provided with a pipe R for conducting the surplus steam into the flue G. Two claims are made for the construction of this boiler as described, and for another modification.—No. 1160. January 25th, 1888. 6*d*.

Steam Boilers.—*O. H. Gentry, Opelousas, Louisiana, U.S.A.*—The accompanying figure represents a longitudinal central section of a steam boiler embodying the present improvements. A pair of circular drums A are provided with openings B in their outer sides, and with larger openings C on their inner sides. The series of horizontal water tubes D have their ends connected to the openings C, and extend from one drum to the other. The



drums are supported upon a setting of brick work E, and are retained in their vertical position by the connecting pipes D. The casing of brick work F surrounds the boiler completely, and in one end of it a combustion chamber G is built. The smoke stack K is secured to the drum A and steam drum O by means of the bolts L, and communicates with the openings B in the front drum. The door L^1 enables the attendant to clean out the smoke stack periodically. M represents a mud drum which is arranged transversely under the lower side of the rear drum A. The outer sides of the drums A are connected by means of the horizontal flues R; one end of each of these flues is swaged and provided with an annular flange S, which extends laterally, and bears upon the outer side of the rear drum A. The opposite ends of the flues are screw threaded, and extend through the outer side of the front drum A; non-corrosive nuts T are screwed on these extremities, and bear against the outer side of the rear drum, and so secure the flues. The outer sides of the nuts are bent over inwardly, so as to form lips that cover the ends of the flues and protect them from direct contact with the fire. The inner edges of the lips are made flush with the inner sides of the pipes R, in order to prevent the lips from obstructing the passage of the products of combustion through the flues. When the boiler is filled, the water in the drum A and tubes D entirely surrounds the flues R. When a fire is lighted in the furnace the smoke and hot gases pass upward round the water tubes, and circulate round them in the direction indicated by the arrows until they reach the rear drum A. The current is then deflected, and passes under the rear drum and through the flues R into the stack K. It is claimed that by providing the drums with the water tubes D and tubes R, the boiler is given a maximum amount of heating surface, and that, consequently, the steam is generated with the smallest possible consumption of fuel. Two claims are made: (1) For the combination of the drums A, water tubes D, and flues R, with the mud drum M, steam drum O, and smoke stack K; and (2) for the combination with the tubes R of the nuts T screwed over one end of the flues, the outer sides of the nuts being bent inwardly to form lips that covers the ends of the flues, as described.—No. 1329. January 28th, 1888. 6*d*.

Feed Water Heater.—*J. Weir & G. Weir, Glasgow.*—The object of this invention is to economise fuel by heating the feed water by steam which has operated to a certain extent in the engines, but which is applied for that purpose before its final exhaust. The accompanying figure illustrates the application of this invention to a quadruple expansion screw propeller engine. The feed water is first pumped by the engine E, and is delivered at a moderate pressure through the pipes F G into a feed heater G^1, in which the water is brought into immediate contact with the steam. The steam for this purpose is supplied through a pipe H, which is connected to the exhaust pipe H^1 of the third cylinder C. The partly heated feed water passes from G through a pipe I to a set of donkey pumps I^1, which supply the requisite pressure to the water to enable it to enter the boiler. The pipe J conducts the water to one compartment J^1 of a feed heater casing K, which is composed of the two compartments J^1 K^1. These compartments are surface feed heaters, and the steam which heats the water acts inside a tubular apparatus. The steam in the lower compartment is supplied by a pipe L, connected with the exhaust pipe L^1 of the



second stage cylinder B; the steam in the upper compartment is supplied by a pipe M, connected with the exhaust pipe M^1 of the high pressure cylinder A. The water of condensation in the tubes of the high temperature surface heater K^1 is led by a pipe N into the steam inlet compartment of the next lower temperature feed heater J^1. The water will here impart its heat to the feed water, which is at a lower temperature than the water of condensation. In a similar way the water proceeding from the heater J^1 is led by the pipe N^1 into the lowest temperature feed heater G^1. If found preferable the water may be led by a pipe O directly to the main condenser O^1. Several automatic regulating devices are used in different parts of the engine. The steam to work the donkey pumps I^1 is supplied by a pipe P, which has a regulating valve controlled by a float within the feed heater G^1; or the steam to I^1 may be supplied by the pipe P^1, which is provided with a regulating valve Q, worked by a float in the hot well R. The feed water may be pumped from the main engine pumps E directly to the boilers through the pipe S connected to the delivery pipes of these pumps. When the feed water passes through all the heating apparatus, it proceeds to the boiler from the compartment K^1 through the pipes T U. The latter pipe is also connected to the donkey pump delivery pipe J. The inventors make three claims for the arrangements for heating the feed water for the boilers at successive stages with portions of steam which have worked to different extents, the feed water being pumped to its highest pressure before passing through the highest heating stages.—No. 6190. April 28th, 1887. 8*d*.

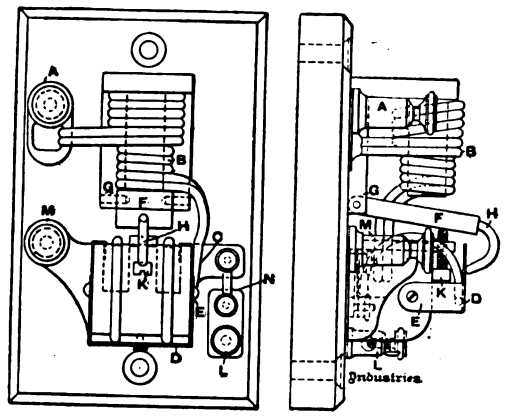
Rolling Chambers for Ships.—*G. P. Thomson & J. H. Biles, Glasgow.*—The inventors introduce two improvements into the construction of the water chambers used for the purpose of reducing the rolling of ships. The chamber is to be made narrower at its middle line than near the sides of the ship, by one or both of the transverse sides being made concave in plan. The other modification of previous forms is the provision of movable partition plates for varying the extent of the contraction of the rolling chamber at the middle line. The period of flow of the water from side to side can in this way be varied according to the period of roll of the ship, and the shock of the water against the sides is considerably diminished. Two claims are made: (1) For the contraction of the chambers at their middle lines, and (2) for the movable partitions for varying the contraction.—No. 1296. January 28th, 1888. 6*d*.

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ELECTRICITY.

ELECTROMOTORS.—*J. D. F. Andrews, Glasgow.*—The construction of electromotors devised by the present inventor makes the action of the machine independent of the alternations of the current. The inventor employs any known form of dynamo which may have several polar fields; the cores of the magnets are of iron wire or thin iron plate. The coils of the armature and commutator plates are arranged and connected to the field magnet coils in such a manner that, whether the supply current be in one direction or the other, each armature coil has for the moment a polarity opposite to that of the field pole towards which it is presented; the reversals of the current act similarly and synchronously on both the armature and field magnet coils. Whatever may be the period of the reversals of current produced by the generating machine, the movement of the motor is independent of them in respect of time. In a modified arrangement the field magnets are made without iron, and the coils are arranged so as to envelop the armature and act on it direct. The armature may also be made without a core of iron. Two claims are made: (1) In an electromotor adapted to be worked by alternating currents, connecting the commutator brushes through the field magnet coils to the leads from and to the generator, so that alternations of current produce synchronous alternations of polarity of the field magnets and of the armature coils; and (2) for dispensing with the cores of the field magnets, as above described in the modification.—No. 6621. May 5th, 1887. 8*d*.

MAGNETO-ELECTRIC CUT-OUT.—*W. H. Scott & E. A. Paris, Norwich.*—The construction of this cut-out is shown in the two accompanying figures. Fig. 1 represents a front elevation with the circuit broken, and Fig. 2 a side elevation with the circuit complete. The current is led from a contact A, round the core B, to the contact C, through a mercury cup across the pivoted bridge piece D, into a second cup, and thence through the circuit. The bridge between the mercury cups is pivoted at E, and an armature F, which is pivoted at G, is provided with a detent H, in order to hold the bridge in position and to keep the circuit complete. On any increase of current through the coil of the



electromagnet, the armature is attracted and the detent releases the bridge piece; in its fall the contact fingers are withdrawn from the cups, and the circuit is broken. The distance of the armature from the pole piece is made adjustable by means of the screw K. A small extra terminal L may be connected to the main conductor. In incandescent lamp circuits a lead from one or more lamps might be connected to this terminal, and the other lead connected to the terminal M. The lamp would be short circuited when the main circuit was complete; but when the main circuit was broken the lamp would be in circuit, and the current would pass through it instead of through the bridge and cups, and would indicate, by the comparative brightness of the lamp, the nature of the cause which had brought the cut-out into action. By means of the extra terminal any resistance might be brought into action automatically; and a small safety fuse N might be inserted between the cut-out conductor and the small extra terminal. The inventors claim: (1) The combination of an electromagnet with a pivoted adjustable armature normally holding a bridge piece completing the circuit, but which, on excess current causing the armature to be attracted, allows the bridge to drop and the current to be broken; (2) the combination of such a device with an auxiliary circuit containing the lamp; (3) the combination of this device with the safety fuse.—No. 6590. May 5th, 1887. 6*d*.

SECONDARY BATTERIES.—*R. E. B. Crompton, Chelmsford, and J. C. Howell, Llanelly.*—Certain improvements are introduced by this invention into the arrangement of the lead plates employed in electrical accumulators. The separators which keep the lead plates apart are strong cylindrical rods of insulating material, which will withstand the attacks of sulphuric acid. At the bottom of the cells are placed frame works or grids, which are made of lead; the lower ends of the separator rods enter grooves in the grids, so that the rods are maintained in a vertical position at the proper distance apart even when the plates are removed. When this grid is made of lead it may be used as the piece on which the spongy or grey plates are electrically connected. These plates are sometimes attached in such a manner that they stand on the lead grid, and are burned on to them. The peroxide or brown plates are supported by one or more stout cross bars resting on the edges of the cell. In another form of supporting rods the inventors make the grid of insulating material; in this case both the grey and the brown plates rest on the ribs of the grid. In another form the grid is dispensed with altogether, and the plates rest on insulating ribs at the bottom of the cell. The supporting rods may also be made U shaped. These separators are supported in the cells by being placed so as to hang astride of bars above the upper surface of the plates. This form has the advantage of being laterally elastic, and by suitable hanging pieces it can be made to expand with the plates. The most suitable materials for the rods are xylonite, vulcanite, glass, and vitrified porcelain. Another form of separator employed by the inventors is of a corrugated form, and pierced with a number of holes. The present invention also includes several methods of attaching the wires to the plates. These connecting wires are to be made of lead, and are burnt into the plate. A wire is burnt to the side of the plate at two points near together, and sometimes a second wire is burnt to the top of the plate at two points also close together. One or both of these wires are carried from each plate to a connecting bar, in which taper holes have been punched for the purpose of receiving these wires. The holes are punched in such a manner as to raise a burr on the upper surface of the bar. The wires, after being inserted, are lightly riveted over, and the soldering flame is passed over the burr; a sound metallic connection is thus made, which, however, can be easily disconnected for purposes of repair by removing the burr with a chisel. The connection from cell to cell is made by an upright cylindrical insulated pillar of lead. Eight claims are made.—No. 6681. May 6th, 1887. 8*d*.

DYNAMOS.—*R. E. B. Crompton & W. A. Kyle, Chelmsford.*—This invention relates to an improved method of coupling the bars or wires which form the conducting circuit of drum armatures. The difficulty experienced in coupling the bars across the ends of the drum has been that the bars and connections first put on to the core cannot be removed for repair without necessitating the removal of the superincumbent portions. In overcoming this defect the inventors connect the ends of each pair of bars by means of a peculiarly shaped connecting piece or coupler. This coupler is formed of copper or other similar material, and consists of a flat strip cut so as to be cranked in one plane and curved in the other plane; the cranking and curvature is such that the desired number of bars can be coupled, and the longitudinal space occupied is not greater than the width of one coupler. The couplers are sometimes divided at a convenient point, so that they can be withdrawn in two pieces, and the two halves are connected to the bars by a screw or other connection. When in position the couplers are arranged in a ring, whose inner edge has a slightly greater radius than the outer edge of the circle of bars. The ends of the couplers can thus be attached to the outer edge of the bars, and when any one bar is released it can be drawn out longitudinally. The field magnets of the dynamo are made of the single limb type. The machine is arranged vertically with the armature below; the limbs of the magnets are made of wrought iron, and the pole pieces for the lower side of the armature are made of cast iron, or of separate blocks of wrought iron, and these are so joined to the wrought iron field magnets that the latter may be detached and removed bodily to allow the armature to be inspected. Two claims are made: (1) For the pole pieces constructed with the capability of detachment from the magnets, to admit of easy access to the armature, as described; and (2) for the connectors applied to the armature externally to its circumference.—No. 6409. May 2nd, 1887. 8*d*.

CHEMISTRY.

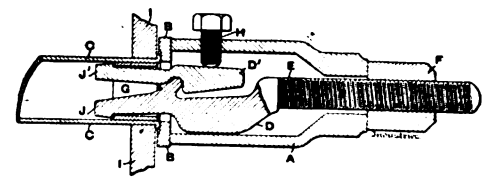
SEPARATION OF METALS.—*C. B. Schultze, Leipzig.*—This invention is applicable to the treatment of factory waste and to the recovery of iron from scrap tinned plate. Dilute sulphuric or hydrochloric acid is added to the raw material. If there is any zinc or cobalt contained among the metals, the solution is allowed to filter over sheet zinc; the copper, bismuth, lead, tin, cadmium, and nickel are first separated, and afterwards iron and cobalt, in the form of insoluble basic sulphates. If there is but little zinc present the solution is treated with a neutral or acid solution of sesquioxide of iron, or with a free acid in which the hydrated peroxide or sesquioxide of iron is suspended. If the mixture contains tin, copper, bismuth, nickel, or cobalt, the oxides of these metals are formed. If iron is not present in the raw material the solution is brought into contact with iron, and the copper and bismuth are precipitated in the metallic state, while the lead is partly precipitated as a metallic powder and partly in the form of sulphate. The remaining solution is then neutralised by the addition of metallic tin and hydrated peroxide of iron, and pure metallic iron is brought into contact with the neutral solution, by which means the tin and nickel are deposited. The undissolved residue is well mixed with scraps of metallic iron, and dilute sulphuric acid is poured over it. This mixture is allowed to stand for several weeks, during which period it is several times turned over. The insoluble oxides are converted into metals and soluble oxides, and any iron which is present is converted into protoxide of iron. Metallic copper, lead, and bismuth are ultimately formed together with the sulphates of tin, iron, nickel, and cobalt. The latter substances are neutralised, and the tin and nickel recovered by the addition of metallic iron. Seven claims are made for the various modifications of this process.—No. 3669. March 10th, 1887. 6*d*.

EXTRACTION OF ZINC FROM ORES.—*A. Watt, London.*—In order to extract zinc from the ore, or from an impure mass containing zinc, the inventor uses the impure mass as the anode of an electric battery. The acid employed as the electrolyte is to be some vegetable acid, preferably acetic. On a current being passed through the solution, the zinc is deposited in a purified state on the negative electrode. In treating some of the ores of zinc—for instance, calamine or native carbonate, the zinc is first digested in the vegetable acid, and the solution thus obtained is employed as the electrolyte. In this case the anode and cathode are carbon or platinum and zinc or carbon respectively. The latter process may be employed on a large scale for the separation of zinc. Two claims are made, one for each method.—No. 6294. April 29th, 1887. 6*d*.

DRY CALCIUM HYDROXIDE.—*J. Pfeiffer, Kaiserlautern, Germany.*—This invention relates to an improved apparatus for treating caustic lime with water, whilst under considerable pressure. The process is carried on inside a large cylindrical iron retort which is built in brick work. At one end is a door, through which the workmen can introduce a long semi-cylindrical iron vessel. This vessel is supported on runners, and is filled with the caustic lime. The retort is provided with a pressure gauge and a safety valve. A definite amount of water is showered over the lime by means of a series of longitudinal perforated water pipes. The pressure rises as the lime becomes hydrated, and the steam which is given off is prevented from condensing by the retort being heated by some external means. The advantages of this apparatus are that the charge of lime is easily introduced into the cylinder; that the chance of injury to the workmen is very much reduced, and that the hydrated lime is prevented from absorbing more water than is requisite. Two claims are made.—No. 43. January 2nd, 1888. 6*d*.

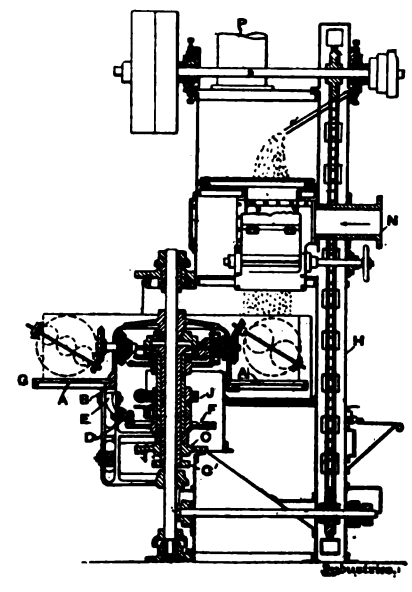
MISCELLANEOUS.

EXTRACTING FERRULES FROM BOILER TUBES.—*H. W. Swift, Ince, Lancashire.*—This invention has been designed for the purpose of extracting the ferrules out of boiler tubes without entailing any damage to the boiler. In the accompanying figure A represents a stout cylindrical box, with its open face abutting on a ring B placed against the tube C. The box has two jaws D D¹ inside it; one of these jaws D terminates in a screw E, which passes through a hole in the end of the box A, and is provided with a nut beyond. This jaw is so shaped as to be supported against the contiguous side of the box, and its end has a projection J to overlap and hold to the ferrule G. On the opposite side the jaw D is provided with a projection fitting a hollow in the other jaw D¹. It might, instead, have a hollow fitting in a projection on the jaw D¹, or might be hinged to the top jaw in an equivalent manner, so as to form a fulcrum for the top jaw, and be able to drag the top jaw with it when screwed up. The jaw D¹ has also a projection J¹, which catches the ferrule G. Through the side of the box A is fixed a set screw H, which, by pressing the tail of the jaw D¹ beyond its



fulcrum on the other one, keeps the jaws distended. I is the boiler plate, to which the tube C is fixed. In operating this apparatus the box A is placed against a ring B, which is cut to the right size, and the claws are inserted beyond the ferrule; the screw H is then tightened until the claws fit over the ferrule. The main screw E is now screwed up until the ferrule is drawn out of the tube. Instead of two jaws a single stem projecting into the tube may be employed, which has two hinged wings pointing obliquely outwards, or hinged grippers pointing inwards, and kept apart by a spring. It is also possible to substitute a spring for the set screw H, but the method illustrated in the figure is preferable. The inventor makes two claims for the extractor having the two expanding jaws D D¹ provided with claws J J¹, and for the combination of the set screw, main screw, and washer, with the jaws, for the purpose described.—No. 6078. April 26th, 1887. 8*d*.

SAND BLAST.—*G. R. A. Gutmann, Ottensen, Germany.*—The objects of this invention are to obtain a regular distribution of air over the whole length of the air nozzle, and to facilitate the transport of the pieces to be treated by the current of sand. The pieces are arranged on an intermittently rotating annular table; inside the air nozzle are two or more partitions, which distribute the air over the whole length of the nozzle slot. The air nozzle is surrounded by the sand nozzle, and suitable dampers regulate the admission of air. An application of this method is illustrated in the accompanying figure. The rotating table G is fixed to a vertical shaft, which carries a cylindrical casing and

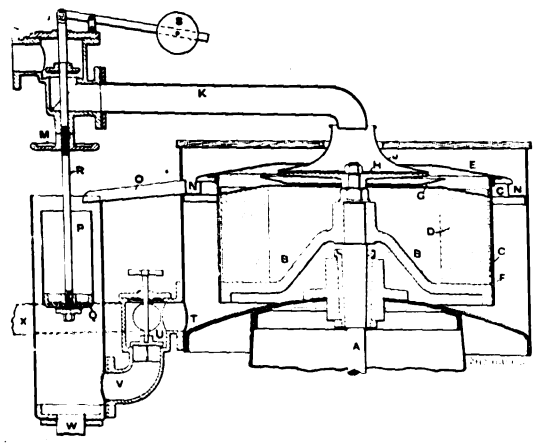


a bell-shaped casting; the latter serves to support the mechanism for holding and revolving the pieces to be sanded. The revolving mechanism consists of a shaft and bevel gear, a loose socket and its outside extension, a spring, and other bevel gear. The table is periodically turned so as to bring one of the objects under the sand blast for a certain interval of time; this movement is effected by a click which actuates the ratchet wheel B. A sleeve is connected with the stationary frame, and forms a bearing for an intermittently rotating shaft. A cam on the upper end of the sleeve acts upon the horizontal shafts in such a manner as to disengage the holding mechanism at the place of the operator, and to allow the replacement of a new piece. The two discs C C¹ bring the sleeve out of gear, and the sleeve also serves to guide a hollow shaft which carries two bevel wheels gearing with those on the horizontal shafts. The worm wheel J and the disc F have an annular course formed in them for the roller D, and the worm wheel J is driven continuously

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by a worm which has motion imparted to it by the main shaft. The motion of the pieces to be sanded corresponds to the form of the object and the character of the design. Five claims are made.—No. 4217. March 21st, 1887. 11*d.*

CENTRIFUGAL FILTERS.—*W. Jäger, Könkendorf près Pritzwalk, Germany.*—The chief difficulty which is met with in getting an ordinary centrifugal machine filter to work is that the charcoal will not rise and form a solid wall against the rotating cylindrical surface of the casing when the water is mixed with it. The machine here described and illustrated is designed specially for the purpose of overcoming this fault. The rotating drum is mounted on the vertical shaft A, and its cylindrical surface C is composed of perforated metal lined with metal gauze F. The filtering material D is shown in the position it assumes when the machine is rotated. After the charcoal and water have been placed in the interior and the drum set in motion, a jet of water from a rubber hose is made to play on the charcoal until the latter has reached the top of the drum. The vertical wall of charcoal is thus formed, and the difficulty before mentioned is



overcome. The ordinary distributor is then fastened to the shaft A; it consists of the flat, round, fluted plate H and the bell J. The upper space above the charcoal serves to break the shock of fluid coming from the distributor. From this space the fluid runs along the lower edge of the ring G, and passes over the upper edge of the plate on the top of the charcoal, and into the filtering space B. By means of the centrifugal power the fluid escapes through the charcoal D, gauze F, and perforated shell C, and runs off through the hole T. The fluid is not clear at first during the time that the machine is being prepared, so the valve U is lifted to allow of its being conducted through the outlets T U V W to waste. After a short time the valve U is closed, and the filtered fluid runs off through the pipe X. In order to keep the fluid always at the same level above the inlet surface of the filter, the influx of the fluid is regulated automatically. The valve L in the inlet pipe K can be adjusted by the hand wheel M, and is connected by means of the rod R to the bell P. The bell catches the fluid that runs over the edge E through the gutter N and spout O, and lets it escape through the adjustable valve Q. When the outflow increases the bell P sinks together with the valve L, and consequently decreases the influx of the fluid. The weight S counterbalances the rod R and bell P. Five claims are made for the method of establishing the vertical wall of filtering material, for the means of destroying the first shock of the water, and for the regulating apparatus.—No. 2599. February 19th, 1887. 8*d.*

SAFETY PLUGS FOR BOILER TUBES.—*E. H. Parry, Swansea.*—The object of this invention is to protect the fusible metal of the plug from the chemical action of the water in the boiler, and the gases in the furnace. The body of the plug consists of a short brass tube turned and finished all over, and screwed at the lower end into a hole tapped in the furnace tube crown. At the upper part the body is formed with a valve seating for the support of the cap, which consists of an inner conical plug and an outer conical ring of brass. The outer ring or shell is formed at its narrower end with a circular rim projecting inwardly; the internal diameter of the opening inside the rim is slightly smaller than the outside diameter of the conical plug at its smaller end; and the rim overlaps this end of the plug. Both parts are turned and fitted together by grinding, so that the rim forms a flat or conical water tight valve seating for the plug. Circular grooves are cut on the outer surface of the plug and on the inner surface of the ring. The two parts are held together upon each other at the water tight seating, while the molten white metal alloy is poured into the annular space between them. The metal, on cooling, holds the two parts together. The larger end of the cap thus formed is turned and ground to fit the valve seating on the top of the body of the plug, and is held in position by a cotter which is passed over the top of the cap and through lugs cast upon the seating tube. The inside diameter of the valve seating is $\frac{1}{16}$in. to $\frac{1}{8}$in. larger than the greatest exterior diameter of the conical plug; the cap thus rests upon the seating partly with its outer ring and partly with the fusible alloy, and the inner plug can drop through the valve seating when the alloy becomes fused. The fusible metal is thus protected from the water by the water tight lip of the ring, and from the action of the gases by the seating. Three claims are made for forming the outer shell of the cup with an internal flange, and for arranging the cup so that the fusible alloy rests on the seating of the cup.—No. 6713. May 7th, 1887. 8*d.*

ANCHORS.—*W. C. Johnson & S. E. Phillips, London.*—The ordinary mushroom anchors have the disadvantage of becoming useless in the case of breakage. The present inventors make the cast iron head and shank in two separate parts; the mushroom head is cast with a central boss, having a hole through it for the passage of the shank. The shank is preferably of a square section, and after being placed in its position through the hole in the head a shackle is fixed to it by a screwed pin passing through a traverse hole. The mushroom may either be left loose on the shank or it may be retained in position by a pin or set screw. By this construction of the anchor a great saving is made in the stowage space on board ship, as the parts can be kept separate until required for use. The inventors claim the construction of mushroom anchors with the cast iron head and the shank in two separate parts.—No. 7675. May 26th, 1887. 6*d.*

BOLTS AND RIVETS.—*T. Woodhead, Bradford.*—In order to strengthen the bolt or rivet the inventor forms a curved or rounded recess in the head at its junction with the body of the rivet or bolt. The advantage of this form is that the fibre of the metal is not weakened by a sharp joining edge, while it necessitates no special shape for the holes which they are adapted to work in. One claim is made for this form of bolt and rivet.—No. 770. January 18th, 1888. 6*d.*

KNITTING MACHINES.—*L. A. Groth, London.*—Arrangements are made in this invention by which hose material of any width may be made on the Lamb machine, without the use of stoppers for regulating the cam when the lever is pulled. In order to work the back and front needles alternately, the middle lifter portions of the corresponding cams must be alternately thrown out of action. The triangular cam has one of the lower angles detached, and is kept in its lowest position by means of a spring. The work will be carried on as usual in one direction; but on reversal the needles will stop against the surface of the cam where the corner has been taken off. The cam will be raised by the push of the needle into a sufficiently high position for it to slide over the feet of the needles. On the last needle passing, the cam is restored to its normal position by means of the spring. The middle part of the cam will thus act upon the feet of the needles while working in one direction; but whilst working in the contrary direction the needles will remain at rest. One claim is made for this method of automatically operating the cams.—No. 846. January 19th, 1888. 6*d.*

FILTERING SPENT OILS.—*T. Turner, Preston.*—The apparatus designed by the inventor for the purpose of filtering oil consists of a cistern which has a slanting bottom, and a coiled pipe underneath the vessel for heating the oil. The vessel contains one or more horizontal filtering chambers placed over the receiver, and the filters are filled with clean cotton waste. A funnel is attached to the receiver, and the oil passes from the filters through the funnel into the receiver. In the funnel are a series of sieves, which catch the dirt. Taps are placed at the lowest extremity of the filter and receiver, in order to draw off the dirty oil and the clean oil respectively. The apparatus may be made of tin or of wood. Three claims are made for this apparatus.—No. 6756. May 9th, 1887. 6*d.*

GAS FURNACE FOR GLASS MELTING.—*J. Yelland, York.*—In constructing a combined pot and tank gas furnace, the inventor forms pockets or reservoirs at each side of the lower part of the structure for the gas to pass into. Towards the inside of the furnace, and near to these gas pockets, are metal or glass pockets for the reception of waste glass or metal. Further inwards are air pockets, from which the air is passed in circulation through the furnace and through the air flues between these pockets. Above these pockets is the furnace proper, over which is placed a series of platforms, tanks, and pots, which contain the ingredients for making the glass. In the upper part of the frame work and between the pots are several gas purifiers in the shape of small clay crucibles with holes in their centre. The gas passes from one of the gas pockets through a valve into the pot, thence through the purifiers and into the other gas pocket. The air passes under the "seige," and is consequently made much hotter than in ordinary furnaces; afterwards it is taken back through an air box to the furnace. By placing the metal or glass pockets one between each gas and air chamber the depth of foundation is considerably reduced, and the furnace is made more effective. The mixed gas and air is lighted at the entrance to the furnace "seige," and travels across the tank to the other gas and air ports between the pots and tanks, where there is a flue for cooling the various surrounding parts. The inventor makes one claim.—No. 2948. February 25th, 1887. 8*d.*

GERMAN PATENT ABSTRACTS.

LIQUID FUEL.—*Aerated Fuel Company, Hampden County, Mass.*—This invention relates to an improvement in boilers heated with liquid fuel. The boiler is provided with a diaphragmatic

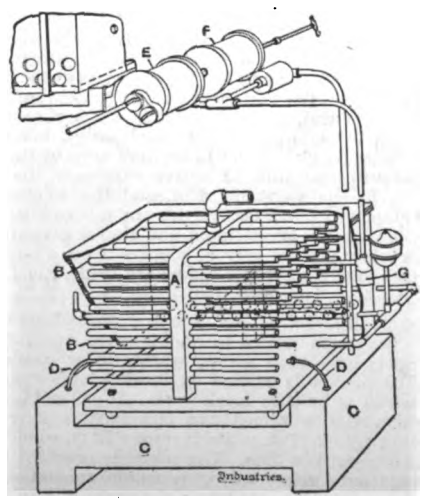
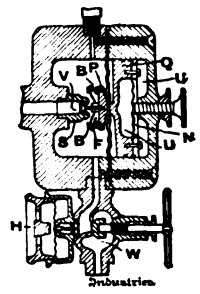


plate A and a number of tubes B. The liquid fuel is stored in a tank C, and forced against the tubes B by means of an air pump E F through the tube D, which is fitted with a nozzle. Out of this nozzle the liquid escapes in form of spray, and is ignited by a small flame burning inside the boiler. If the steam pressure in the boiler exceeds a certain limit the steam is cut off by the valve G from the cylinder E of the air pump F, thereby stopping the supply of fuel until the steam has again assumed the normal pressure, when G is opened, and the air pump actuated.—No. 42690. July 6th, 1887.

REDUCING VALVE.—*G. Fulda, Berlin.*—This valve is intended to use gases or liquids stored at high pressure in a tank at an even and lower pressure. The valve V, with the seating S, is



connected to the piston Q, which is provided with the diaphragm N. The connection between V and Q is effected by a spring arrangement F B B P. The tension of the diaphragm N may be regulated by a screw and two air cushions U U, and by altering this tension the amount and pressure of gases or liquids passing through V in a given time may be controlled.—No. 42335. February 20th, 1887.

UNITED STATES PATENT ABSTRACTS.

INCRUSTATION OF BOILERS.—*J. Mullica & B. F. Mullica, Williamstown, New Jersey.*—The inventors have discovered an improved composition for removing and preventing the incrustation which forms in the interior of boilers. Sand is prepared by burning, grinding, and washing, and is combined with powdered charcoal and elm bark in certain proportions. This combination, when applied to the interior of the boiler, is claimed to have the desired effect. One claim is made.—No. 380340, dated 3rd April, 1888.

CIRCULAR KNITTING MACHINE.—*L. E. Salisbury, Providence, Rhode Island.*—These improvements are applicable to the mechanism for knitting plushing threads over the front and back of the wales of a knitted fabric. Two needle carrying cylinders revolve together, and a needle shunting wheel is placed in each cam section, in order to guide the needles alternately to the upper and lower cylinders. Needles of a specially designed shape retain the loops of the fabric while passing one cam section, and there is also an improved yarn guide and stopping device provided. There are eight claims.—No. 379819, dated 20th March, 1888.

CARBONISING VEGETABLE MATTERS IN WOOL.—*C. Schrebler, Methuen, Massachusetts.*—The wool is first treated with a weak acid solution, and afterwards a current of warm dry air is forced through the entire mass; the wool is thoroughly dried by this air. A second current of air is subsequently drawn through the wool; this air is heated to a temperature of 180°F., and serves to carbonise and destroy all vegetable matter which is contained in the wool. Two claims are made.—No. 380599, dated 3rd April, 1888.

PAPER FOR WRAPPING METALLIC ARTICLES.—*J. C. Pennington, Paterson, New Jersey.*—This new article of manufacture has been designed for the purpose of preserving metallic articles from rust and tarnish when they are stored. On the surface of the wrapping paper is incorporated a coating of finely powdered zinc. This coating is found to prevent the surface of the metal with which it is in contact from tarnishing and rusting. Two claims are made.—No. 380516, dated 3rd April, 1888.

FEED FOR CLOTH FINISHING MACHINES.—*J. J. Scholfield, Providence, Rhode Island.*—The mechanism consists of a pair of obliquely set spur belts, with or without superimposed spur rollers, for pressing the fabric upon the spurs of the belts. The belts are preceded by temple rollers held in pivoted frames, which are swung by the traction of the cloth whenever it runs to one side or the other; the cloth is thus caused to travel in an approximately true line to the finishing machine. The temple roller may be operated by regulating mechanism, and power dispensed by the machine, instead of by the tractive force of the cloth. Four claims are made.—No. 380139, dated 27th March, 1888.

TREATING ZINC ORES.—*C. F. Croselmire, Newark, New Jersey.*—The ores are first pulverised and roasted in a furnace; during the latter operation a blast is passed through the ore. Afterwards the roasted ore is immersed in dilute acid, and another blast is passed through the solution until all the impurities are oxidised. The zinc solution is finally drawn off, and the zinc is precipitated in the usual way. Two claims are made.—No. 379764, dated 20th March, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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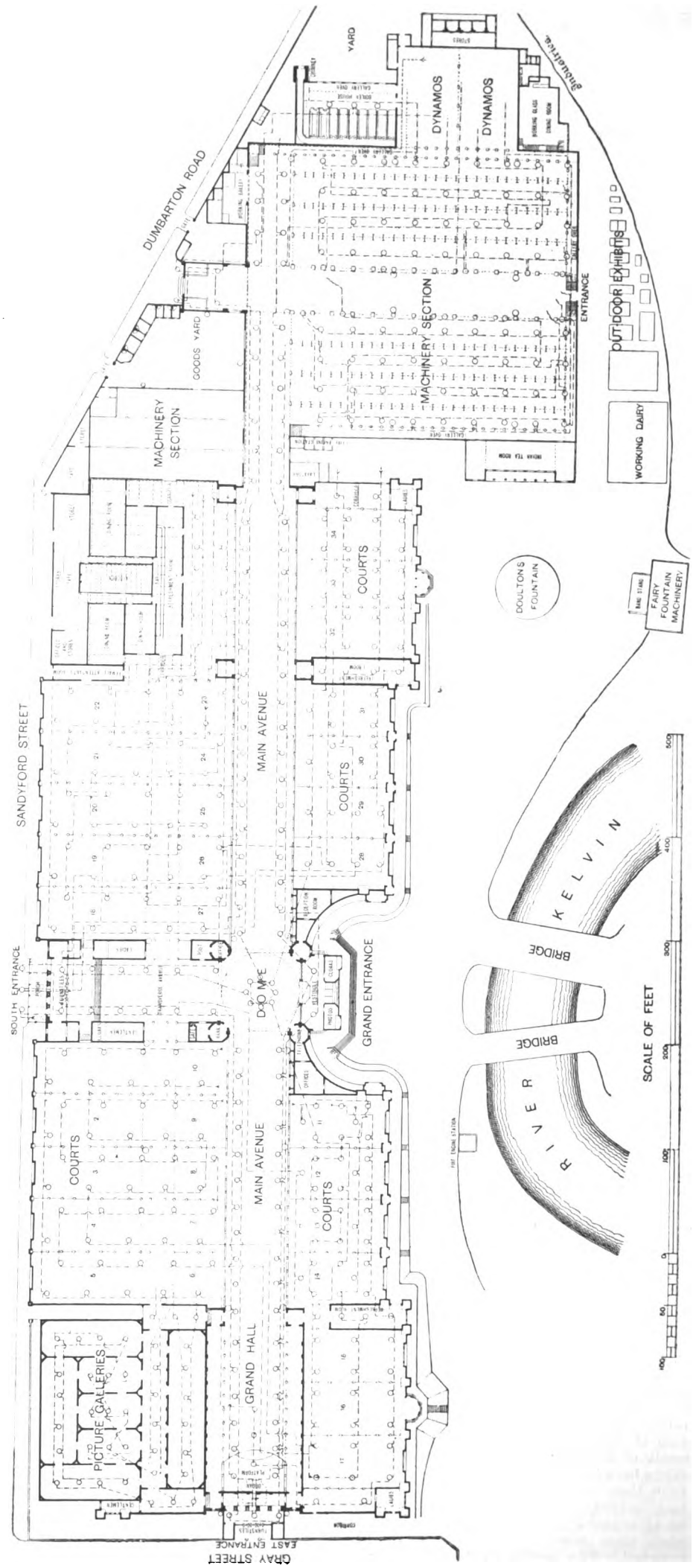
GLASGOW INTERNATIONAL EXHIBITION.

One of the important exhibitions of the year is that of Glasgow. In October, 1886, the initial steps of the undertaking were made, premiums were offered for plans, a design was selected—the successful competitors being Messrs. Campbell, Douglas, & Sellars—and on the 2nd May, 1887, the first sod was cut. The elevation of the buildings was illustrated by us in our issue of 13th May, last year, and a plan of the grounds in our issue of 11th November. The site offers unusual advantages. The main building of the Exhibition occupies a broad level stretch of ground on the south bank of the Kelvin, directly opposite the University, and the river cuts the Exhibition grounds into two nearly equal parts. The main building covers almost the whole disposable area on the south bank, while the north slope of the Kelvin is partly in grass plot and partly occupied by buildings. Access is obtained to this portion of the grounds from the main front of the Exhibition by two bridges; one a permanent iron bridge, the other a temporary wooden structure, with parapet of a design in keeping with the design of the buildings. Directly opposite the centre of the main front are the fairy fountains, supplied by Messrs. W. & J. Galloway and Sons, of Manchester. The manipulation of the fountains is effected from a tower erected near the river, and the pumping engines and dynamos are situated in an engine house on the south bank, the pipes and wires being conveyed across the Kelvin over a trestle bridge. It is understood that Messrs. Galloway have considerably improved the design of the fountain since they manipulated it at Manchester and that several novel effects will be shown. On either side of the bridges, and between them and the fountains, are large and gaily decorated kiosks, to be tenanted one by a confectioner and the other by a tobacconist. On the lower slope of Gilmorehill, immediately under the University, is a reproduction after the manner of "Old London" and "Old Manchester," though on a much smaller scale, representing the Bishop's Palace, a mediæval building which was removed at the end of last century to make way for the Royal Infirmary. This building contains an archæological collection, and forming as it does a museum of curiosities of interest in Scottish national history and antiquities, is one of the attractive features of the Exhibition. Disposed on the slopes of Gilmore-hill are several refreshment rooms, the architecture of which, differing as it does in each case, is in keeping with the general character of the design of the main buildings. The high north bank of the Kelvin, crowned by the University, offers a number of striking views of the whole of the buildings of the Exhibition, and this constitutes one of the chief advantages of the situation. In addition to the external attractions already mentioned, there is in the angle formed by the main building and the machinery annexe, a fountain erected by Messrs. Doulton & Co., London. This fountain will become the property of the Corporation of Glasgow after the Exhibition is over. It is built of terra cotta, the design representing symbolically the British Empire. A statue of Her Majesty crowns the fountain, and the niches below are occupied by groups representing the characteristics of our Colonial dependencies. In the Kelvingrove Museum, a permanent building situated in that portion of the Kelvingrove Park which has been included within the green boarding of the Exhibition grounds, have been placed the Queen's Jubilee presents. When the Exhibition opens, these will then be on public view for the last time. It is understood that they will be removed to Windsor permanently in November next. The cabinets, illuminated addresses, gold boxes, umbrellas of ostrich feathers and other examples of barbaric and semi-barbaric magnificence which compose the Jubilee presents, have often been described. On the north side of the river, and hidden from view by the high banks, there is a double switchback railway connected with the other side of the river by a low trestle bridge built by the 1st Lanarkshire Engineer Volunteers. From the grounds the main entrance to the Exhibition building is by the transept. On either side of the doorway are the Royal reception rooms, and on passing these we then enter under the great dome in the centre of the main avenue. The view right and left from this view point is unfortunately much impeded by the height of some of the exhibits; but it is, notwithstanding, impressive enough. The space under the vault of the dome is occupied by a fernery and fountain, and to this the dome itself, with its prevailing tints of red and yellow, offers an effective contrast. The spring of the vault is decorated with four round panels, upon which are painted symbolical figures of industry, science, art, and agriculture. These decorative panels are by four young Glasgow artists, Messrs. Guthrie, Henry, Lavery, and Walton, and form an important and successful feature in the scheme of decoration.

Eastward and along the main avenue are the large and attractive exhibits of the section of naval architecture. These will hereafter receive special description; but

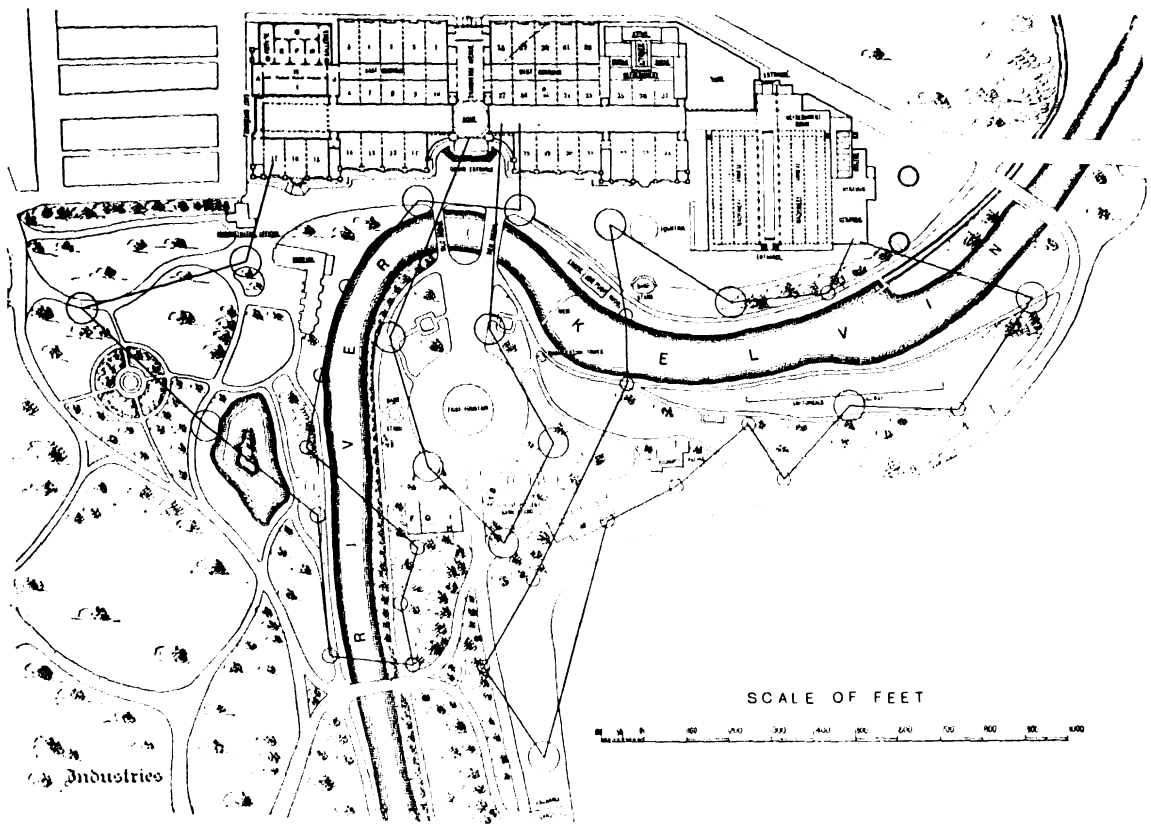
GLASGOW INTERNATIONAL EXHIBITION, 1888.

General Plan of Buildings showing the Electric Light Circuits.



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GLASGOW INTERNATIONAL EXHIBITION, 1888.



GENERAL PLAN OF GROUNDS SHOWING THE ELECTRIC LIGHT CIRCUITS.

meantime there may be noted the two-storeyed saloon and music room shown by Messrs. Denny Brothers, Dumbarton. The wood work and fittings of this cabin are such as are placed in the highest class of passenger steamers, and offer an excellent example of substantial workmanship and superior design. The stands of Messrs. R. Napier & Sons, Alexander Stephen & Sons, the Fairfield Shipbuilding Company, the London and Glasgow Shipbuilding and Engineering Company, Lobnitz & Co., D. W. Henderson & Co., J. & G. Thomson, A. J. Inglis, Wm. Simons & Co., and Palmer & Co., are all extremely interesting; and, along with some models familiar to Exhibition visitors, show many examples of the most recent developments of naval architecture. The section includes other exhibits in the side avenues, and taken as a whole is, as one should expect in one of the chief homes of shipbuilding, an exhibition of great scientific and historical value. Eastwards, also, along the main avenue one finds the large cases of textile exhibits of Messrs. Horrockses, and Copland & Lye, the trophy of Messrs. Clark and Company, of the Anchor Thread Mills, Paisley.; the model mill and electric spooling of Messrs. J. & P. Coats; and the immense panelled erection upon which Messrs. J. & J. S. Templeton & Co. display their carpets. When we come to estimate the value of the Exhibition as a school of design, we shall have occasion to notice very specially the achievements of Messrs. Templeton as leaders in the development of artistic industry. Messrs. Templeton's rather too lofty case forms the western limit of the grand hall. At the opposite end is the orchestral and choral platform and the organ. This instrument is by Messrs. J. W. Walker & Co., of London. On either side of the grand hall are arranged the exhibits of the photographic section. Parallel with the hall, and occupying the south-east corner of the buildings, are the picture and sculpture galleries, and at the north-east corner are the courts devoted to the women's industries section. The exhibits in the picture galleries are in two divisions—the loan collection and the collection of works for sale. In the former, many well known pictures have been lent by private owners and by public galleries. In the fine art section the international intention of the Exhibition has been kept in view, and probably more successfully achieved than in some of the other sections. The collection of the products of women's industry has been the result of a vast amount of labour. Preliminary exhibitions have been held in a number of local centres, and from these exhibitions selection has been made of the best exhibits. This has involved an immense amount of organisation. The result can hardly yet be estimated, since comparatively few of the exhibits are unpacked. The courts to the left of the main avenue, as one turns again westwards, are occupied by the education section, in which the exhibits of the Glasgow and West of Scotland Technical College, and of the Glasgow School Board, are prominent; the chemical industries section, in which the Tyneside case is conspicuous; the exhibition of scientific instruments, in which Messrs. James White, who show Sir William Thomson's syphon recorder, compass, and sounding apparatus; Baird & Tatlock, George Mason & Co., and McGhie & Bolton have large and interesting cases. In these courts also there are the exhibits of the agricultural section, the artisan section, and the jewellery section, in which the stand of Messrs. Edwards & Sons, in the south transept under the dome, is specially interesting, since they show a number of historical presentation caskets and swords, which have been made by the firm. Here also is the carriage section, and the exhibits of the mining and metallurgical section, in which the Tharsis Sulphur and Copper Company show enormous ingots of copper, and other specimens of their manufactures. The courts to the right of the main avenue looking westwards are occupied by textile exhibits, leather manufactures, by musical instruments, and by furniture. In the latter class the rooms fitted by Messrs. Wylie & Lockhead, Bennett, and Balfour, are instructive examples of local decorative skill. In these courts also is the Indian exhibit, the largest and most important of the foreign collections. At the extreme west end of the main avenue, and placed at right angles to it, is the machinery annexe. At the junction between the annexe and the main avenue is the large exhibit of Messrs. Walter Macfarlane & Co., of the Saracen Foundry. This consists of a number of very large pieces of cast iron work—a fountain, gateways, &c. Next to it are four immense steel exhibits. These are the exhibits of the Steel Company of Scotland, Messrs. David Colville & Son, the Hadfield Steel Company, and Messrs. Cammell & Co., both of Sheffield. The copper exhibit of the Birmingham Battery and Metal Company, and the large cast iron trophy of the Sun Foundry, are at the avenue end of the machinery annexe. The annexe is capacious, and the exhibits are not unduly crowded. A gallery runs round the walls, and on this there are disposed some of the lighter machinery exhibits—beltings, for example. In the first line of machines are those connected with paper and printing. Messrs. Mollison and Co. print upon a machine made by Mr. Alexander Seggie, of Edinburgh, and the patent folder of Messrs. F. Martini & Co., of London, is exhibited with newspaper wrapping and bookbinding machinery by Mr. W. C. Horne, of London. In the same line are the exhibits of Messrs. J. Greig & Son, Miller & Richard, and Andrew Elliott, all of Edinburgh. In a general view of the machinery section, among the most prominent exhibits are the sugar machinery and powerful engines shown by Messrs. Mirrlees, Watson, & Co.; the large engine shown by Messrs. D. Adamson & Co., of Dukinfield; and the 100 h.p. engine shown by Mr. John Cochrane, of Barrhead. This last engine is fitted with Corliss gear, and the fly wheel is arranged for nine groove rope gearing. The rope used in this case is a novelty. It has been made by Messrs. John Tullis & Son, and consists of a combination of wood and leather. Important positions are also occupied by the tubes exhibited by Messrs. A. & J. Stewart, Coatbridge; by the furnaces of the Leeds Forge Company; the corrugated iron flues shown by the Farnley Iron Company, Leeds; and by the patent hydraulic mangle shown by Messrs. Urquhart, Lindsay, & Co., of Dundee. Besides the stand of the Birmingham Battery Company already noticed, the copper exhibits include the copper pipes and cylinders shown by the Broughton Copper Company, Manchester, and the distilling plant shown by Messrs. J. Miller and Co., Glasgow. In addition to the steel exhibits already mentioned, there is the exhibit of heavy forgings of Messrs. Beardmore, of Glasgow; and among the miscellaneous exhibits are those of Messrs. Tullis & Son, who show belting and belting machinery; Messrs. R. & J. Dick, who also show belting and belting machinery; the patent disintegrator of the Disintegrating Grinding Machinery Company; the carpet weaving machinery of Messrs. W. & G. Millar, Glasgow; and the working confectionery plant of Messrs. John Gray & Co.

In describing the plant in the dynamo room in last week's issue we noticed the fact that the shafting is driven by rope gearing. The belting by which the dynamos are driven is the canvas belting of the Rossendale Belting Company, and is fastened by Jackson's patent fastener.

Among prime movers, in addition to the engines mentioned above and in our issue of last week, there is the marine engine of Messrs. Ross & Duncan, Whitefield Works, Govan. This is the only marine engine of full size in the Exhibition, and is accordingly specially worthy of honourable mention. It is of the triple expansion type, 400 i.h.p., is fitted with the Bremme valve gear, and is attached to a Duncan's patent propeller. There are also engines of various types shown by Messrs. Tangye and Co., Birmingham; Alley & Maclellan; Sharp, Stewart, and Co., and J. Goodwin & Co.

The central avenue of the machinery section is fitted with an overhead crane, supplied by Messrs. George Russell & Co., Motherwell, and the heavy exhibits have all been placed without mishap.

Our illustrations this week show the internal arrangements of the buildings and grounds, and the wiring arrangements of the electric light installation. It will be observed that the grounds are lighted by three circuits, in which there are respectively fifteen, fourteen, and five sets of lamps. Fifteen of these are on 60ft. masts, the remainder being erected upon 25ft. poles. The arrangement of the leads in the interior of the buildings will be readily understood by reference to the plan. The whole of the engineering arrangements have been carried out under the superintendence of Mr. W. A. Bryson. On Saturday last, the Executive invited the Press to a preliminary view of the Exhibition, and upwards of 120 journalists from all parts of the kingdom availed themselves of the invitation, the leading London, and many of the foreign, newspapers being represented. The Exhibition will be opened on the 8th May by the Prince of Wales, and this day will be held in Glasgow as a public holiday.

NOTES ON FOUNDRY WORK.

BY THE AUTHOR OF "PATTERN MAKING."

(Continued from page 237.)

XIV.

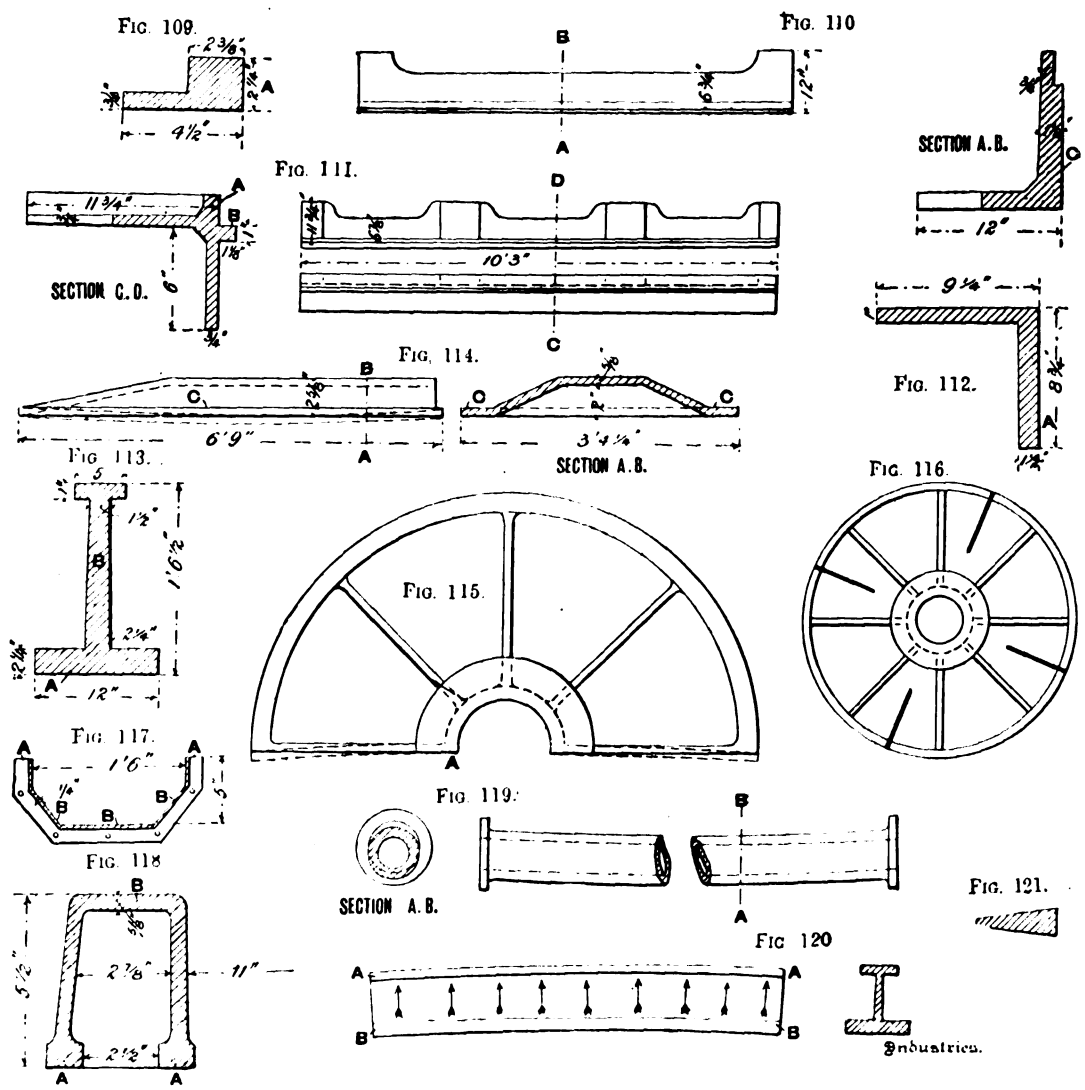
THE CURVING OF CASTINGS.—In the last article the shrinkage of castings was dealt with, and the present one will be devoted to an equally important subject in foundry work, viz., the curving of castings. It is very difficult even for experienced founders to judge how and to what extent an ill proportioned casting will curve, since slight alterations in the disposition of the metal may materially assist in producing or preventing curvature. I will now briefly consider the conditions which affect the curving of castings, and then give some typical examples selected from my own experience.

As a rule castings will show a curve in those places where the amount of metal is considerable. In some cases, however, those portions which cool most rapidly curve most. The harder the iron is the greater is the tendency to curve. Figs. 109 and 110 show two plain castings 10ft. 6in. in length. In these castings the metal is considerably thicker in the places marked A and C, and in each case the sides A and C showed a curvature of $\frac{1}{4}$in. Fig. 111 shows the bottom sill of a hatch or sluice. Both flanges are $\frac{3}{4}$in. in thickness, but the ribs A and B are thicker than the flanges. These ribs occasioned a curvature of $\frac{3}{8}$in. along the face A, and of $\frac{1}{4}$in. along the face B. Fig. 112 shows a stanchion 11ft. 9in.

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long, with a uniform section throughout, in which the flange A is $\frac{1}{2}$in. thicker than the other flange, and the larger amount of metal on that side produced a curvature of $\frac{3}{8}$in. These examples illustrate the fact that castings curve in those parts which contain the greatest amount of metal. This rule, however, is subject to modifications in cases where the castings are sufficiently rigid to resist the internal strains which tend to curve them. Fig. 113 shows the section of a girder 18ft. long, which was expected to curve at A, hence the bottom flange of the pattern was curved $\frac{3}{8}$in. The first casting, however, was exactly like the pattern, and after substituting a straight pattern the castings showed no curvature. I was unable to account for the absence of curvature, especially as a set of girders of a similar but rather heavier section had been made a short time before, with lengths varying from 22ft. to 26ft., and these all curved from $\frac{3}{8}$in. to $\frac{1}{2}$in. along the heavy flange, so that the pattern had to be curved to the same extent. As the girders just mentioned and the one shown in Fig. 113 were cast in the same foundry by the same methods, and were not uncovered until the next morning, I assume that their different behaviour as regards curvature is to be attributed to the relative disproportions in length, and to the different disposition of the metal. The web B of the girder shown in Fig. 113 is 1ft. $2\frac{3}{4}$in. deep, and it would require an enormous strain to curve it in the direction of its depth. The average thickness of this web is $1\frac{3}{8}$in., against $2\frac{1}{4}$in. of the flange, so that the section of the web equals 28 sq. in., while that of the flange only equals 27 sq. in. The web offers, therefore, by reason of its depth and area, a great resistance to the curving force in the bottom flange. The smaller flange has such a light section that it need not be considered at all, so that only the relative proportions between the web and the bottom flange have to be ascertained. Light castings are more apt to curve when disproportioned than heavy ones, and heavy engine bases, especially if stiffened with ribs, do not curve appreciably, while narrow and light beds curve considerably. The buckled plate, shown in Fig. 114, may be taken as a good illustration of this fact. The pattern was straight along the flange C, but the first casting showed a curvature of $\frac{1}{2}$in., assuming the shape shown by the dotted line. The body of the casting being one solid mass of metal, cooled more slowly than the flanges, and continued shrinking after the flanges had partly set, thereby curving them. This example confirms the previous remarks I made, that light castings are more liable to curve than heavy ones, and it also illustrates the tendency of a light plated casting to buckle or curve in any direction. Thus, plates cast in open sand will often curve or dish upwards, as the top surface cools more rapidly, and thereby curves the other surface. In a covered mould, however, a plate may in some cases curve downwards. It appears that there is much analogy between the buckling of cast plates and that of sheet metals, the castings while red hot being plastic, and while in that state accommodate themselves to the strain. In the case of Fig. 114 the flange was curved by the shrinkage of the buckled portion alone. But when the curve was imparted to the flange in the reverse direction, it resisted that buckling tendency; the flange, when partially solidified, acting like an arched spring. There is, probably, a curve which would have counteracted the bending tendency of the buckled portion, and the casting would have been, if I may use the term, in a condition of equilibrium as regards the strains set up by solidification; but a little initial movement in one direction would have caused curvature in that direction. A further illustration of the buckling of a circular plate is furnished by the tank bottom shown in Fig. 115. The metal in the plate is $\frac{1}{2}$in. thick, and the diameter of the tank 9ft. 2in. To obtain a straight joint at A in the casting the pattern was curved, as shown by the dotted lines, demonstrating very clearly the excess of shrinkage of the parts near the circumference over those nearer the centre. These tank bottoms were formerly cast in one piece instead of being jointed, but the plates were sometimes fractured in a radial direction by the excess of shrinkage near the circumference. Then four slots, $\frac{1}{4}$in. wide, were cast in the plate, as shown in Fig. 116, by means of metal splitting plates. These slots widened in cooling, allowing the plates to fall out, and they were afterwards filled up and rendered water tight by caulking with borings and sal-ammoniac. This effectually prevented fracture; but still better results were obtained by casting the plates in two pieces and planing the joint, making due allowance for shrinkage near the circumference by curving the joint face A as shown. Castings like those shown in Figs. 117 and 118, illustrate the same fact as Figs. 109-112. Fig. 117 shows the section of a gutter 7ft. $4\frac{1}{4}$in. long, which required a curvature of $\frac{5}{16}$in. along the edges A A of the pattern, in order to produce straight castings. The edges A A, being thin, cool almost immediately; but the sides and bottom B B B take considerably longer, and would, if the pattern were made straight, curve along the inside bottom face, thereby also curving A A. An engine bed of the half section shown in Fig 118, which was 11in. between the sides and 9ft. 6in. long

NOTES ON FOUNDRY WORK.



required curving $\frac{3}{8}$in. at A A to make the casting straight. Ordinary tank plates, 4ft. square and $\frac{1}{16}$in. thick, curve about $\frac{3}{8}$in. on the side opposite to the flanges. The greater the disproportion between these parts, that is, for example, between the plate B and the ribs A A, Fig. 118, the greater the amount of curvature. If the casting were symmetrically plated at the top and bottom it would not curve at all. Fig. 119 illustrates an apparent exception to the cases hitherto given, as it represents a column which has curved in the direction of the least mass of metal, the metal being thinner at the top than at the bottom. The metal in a column being equally thick all round, curving upwards will take place if the cope be removed while the casting is still hot. A very slight difference in thickness, however, suffices to curve light castings. We may assume that curving is due either to difference in the amount of metal or to unequal rate of cooling, for it is obvious that if a casting be equally proportioned and cooled equally, as, for instance, a column in which the core is perfectly central, the heat radiates equally all round, and the casting will be quite straight. When a disproportioned casting like that shown in Fig. 109 is poured, one part—the thinnest—cools first, the thicker parts cooling afterwards. The extent of shrinkage of the parts which cool first varies, being influenced by the adjacent amount of metal. That part of the casting which cools slowly is, to a certain extent, held by the part which is solidified, and is therefore not free to contract regularly. The whole casting will therefore assume a shape which is determined by the proportions of the casting. In the examples shown in Figs. 109 to 113 the casting has curved in such a manner as to shorten the heavy flanges, while we have shown before that heavy castings shrink less than light ones. In Fig. 120 the distance from A to A is greater than the distance from B to B, yet as regards shrinkage only the distance from A to A should be shorter than from B to B. In this instance we must consider what takes place when the metal is poured into this mould. The cooling of this casting is of a complicated character, as the light and heavy masses of metal influence each other by means of the web, which transmits the heat. The thin flange soon becomes partially set, but not rigid, as it is supplied with heat from the more massive flange and web, in the manner indicated by the arrows. Its shrinkage is thereby delayed and diminished, but not sufficiently, as the heavier flange continues to shrink after the light one has finally set, and there is nothing to diminish its full shrinkage. The heavy flange therefore becomes shorter than the other one, and the casting assumes the shape shown in Fig. 120. In a casting of the section shown in Fig. 121 the process just described is more regular than in any other section. As we explained before, a casting of the shape shown in Fig. 119 is liable to curve upwards if the metal be of unequal thickness, or one side of the casting be exposed to the air. In this case the disproportion in thickness or in rate of cooling cannot be very great, as the metal is thin, and the heat radiates at once. There is not sufficient heat to influence conductively, and the initial curving remains permanent. If a bent casting placed on end supports be made red hot by a fire underneath, and then weighted, it will in some cases become straight. Near the outside of the casting, which sets rapidly, the crystals are small, while the inner parts, which cool slowly, crystallise in larger prisms, and when the mass of metal is very large, actual cavities will often occur in the casting. Hence the use of "feeder heads," by which the supply of fresh metal is maintained to "feed" the mass until solidification occurs.

The main point to be considered, in order to prevent the curving of castings, is to make all parts cool uniformly in proportion to their mass. This, of course, cannot always be insured; but a moulder may sometimes do much in this direction by opening out and cooling the heavier parts, or by taking the casting out of the mould while still hot, and putting it on supports and weighting it. Other precautions are to swab, weight, or pack up the casting; but in all these operations the casting has to be constantly watched until it is nearly cold, since curving and shrinkage will go on, even when the metal is black hot. Wherever it is practicable, it is safer, however, to make provision beforehand by curving the pattern, and then allow the casting to remain *in situ* until quite cool.

(To be continued.)

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THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery.

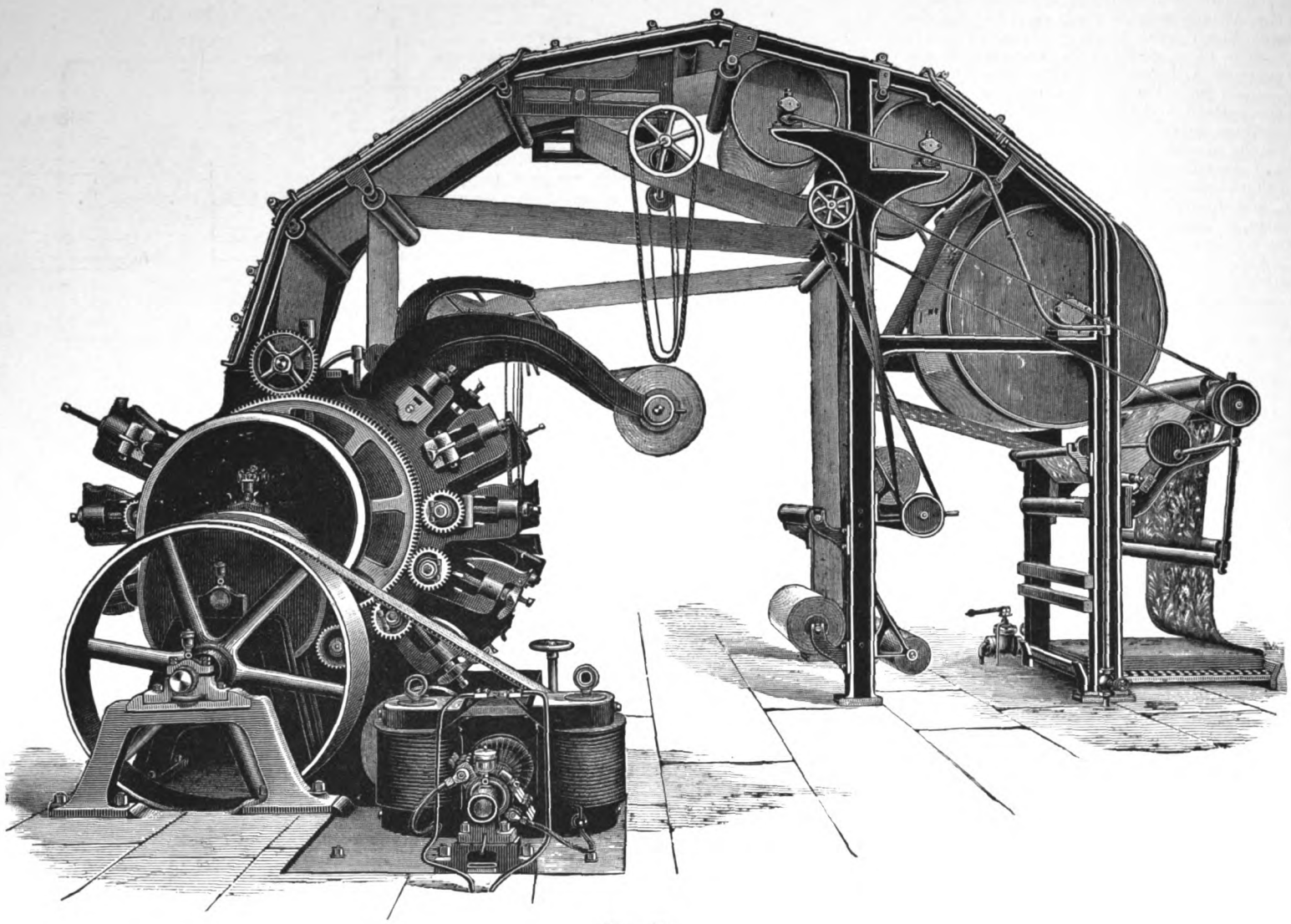


Fig. 73.

THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Textile Machinery *(concluded from page 393)*.—The cloth having been produced, may be treated in various ways, according to the class of fabric it is desired to manufacture. A printing machine for ten colours was exhibited by Messrs. Mather & Platt, Salford, Manchester, of which we give an illustration in Fig. 73. As it did not differ materially from those of ordinary construction, it does not require any special description. The most interesting feature in connection with this machine was that it was driven by an electric motor. Mr. William Birch, Broughton, Manchester, to whose exhibits we briefly referred in our last issue, exhibited an open soaping machine, shown in Fig. 74, intended for the cleansing of fabrics after bleaching or printing. When the cloth enters the machine it is passed over a scutcher or revolving beater, thus having the creases taken out, the straightening process being aided by its subsequent traverse over an angular guide. An expander, which is formed of a number of grooved discs placed on a shaft, next receives the cloth, the discs being of different diameters, so that each set forms a truncated cone, the tops being placed together. Special provision is made for the bearings of this shaft, in order that it may run with very little friction. It is not absolutely essential that these appliances should be affixed to the soaper, they being more used in connection with drying machines. The soaping machine is constructed in the usual way, with a trough containing the scouring liquor in which the rollers are immersed. The cloth is passed round these rollers and others carried in a frame, and thus travels several times through the liquor. The lower rollers are constructed in a peculiar manner, so that the water is forced through the fabric, thus effectually scouring it, as shown clearly in Fig. 74. The body of the roller has radial grooves formed in it, in which bars extending longitudinally are placed. On the roller shaft at each end of the roller are plates formed with internal grooves, in which the ends of the bars referred to are made to slide. All the bars have near their ends a slot, through which passes a ring which holds them together. The width of the bars added to the diameter of the ring is such that the edges of the bars will always project a little beyond the surface of the roller. If the bars are pressed at one side, the recesses in the roller allow them to lift, so that those on the other side of the roller project much further than when no pressure is exercised. In this way, when the cloth is passed round the roller, it lifts the bars until the edges of those which are lowest are level with the body of the roller. As the revolution of the roller takes place and the bars come alternately in contact with the cloth, a small volume of water is confined between the bar engaging the one which has preceded it and the cloth. The continued revolution of the roller causes the bar to move upwards in the way explained, and, consequently, the water being unable to get away, is squeezed through the interstices of the cloth, which is thus thoroughly washed. This is a very ingenious device, and worthy of special notice. As all fabrics in their course through machines of this class have a tendency to gather in the centre of the machine and form a rope, it is necessary in some way to counteract this, the preservation of the open condition being most essential for success. Mr. Birch employed a specially constructed conical expander. This consists of two truncated cones of copper or brass, fixed on adjustable shafts, and fluted or corrugated on their outer surfaces. The form of the flutes is such that the tendency is to grip the cloth firmly and pull it away from the centre. The cloth is passed over the rollers, by setting which it can be drawn to either side of the machine, and can be stretched in the direction of the width as much as desired. After being thoroughly scoured and washed, the cloth is taken between a pair of squeezing rollers, and then under a tension roller connected with the strap guide, so that any increase or decrease in the amount of tension is followed by a similar variation in the speed of the machine. A relieving motion is also fitted, in order that the tension may be taken off the cloth if it is necessary to handle it.

Messrs. Jas. Broughton & Co., Manchester, exhibited a three-bowl calendering machine, which was of very strong construction and powerfully geared. The driving was effected by means of a friction clutch, put into operation by worm gearing. Special arrangements for weighing and relieving the bowls were provided, and taken altogether, the machine was a very fine specimen of its class. In addition to this exhibit, one or two bowls made of cotton and paper were shown, the former being partially finished, in order to illustrate the method of construction.

Mr. John Oliver, Manchester, had a small but very complete exhibit of the materials used in the construction of calender bowls, and also of the finished articles. The materials comprised coir, cotton, paper, linen, and wood pulp; the latter being now very largely used by Mr. Oliver, and is obtaining an increasing sale. A specimen bowl made of this material was very finely finished, and appeared to possess all the properties which are essential to success in this direction.

Before closing these articles it is necessary to briefly refer to the various exhibits of accessories which are used in this connection. Several cases of spindles and rollers were shown, in which examples of all varieties of each were fully illustrated. Not the least interesting feature of this display consisted in the advance shown in the methods of construction, the use of special tools being now much more general than formerly. As the various kinds of spindles are commonly understood, and some of them have been described, it is not necessary to make any further reference. Messrs. Wilson Brothers, Todmorden, had a very complete case of bobbins of various shapes. The noticeable feature in this case was the extensive use which is made by the firm of metallic shields applied to the top or the bottom of each bobbin, so as to prevent damage. There is also a special throstle bobbin shown, lined with a metallic tube, by which the saturation by oil which often occurs is prevented. A thin metallic binder applied to the heads of winding or warper's bobbins is also a valuable feature. This forms a tyre or hoop, and binds together the two portions of the flange or head of the bobbin, and at the same time

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protecting it from breakage. Messrs. Wilson & Sons, Barnsley, Messrs. Irvin & Sellars, Preston, and others also had complete show cases of bobbins. Mr. R. Pickles, Burnley, exhibited his patented compressed wood shuttles, which are made of ordinary woods, the blocks of which are subjected to a hydraulic pressure of 20 tons to the square inch. In this way the density and tightness of the wood is greatly increased, and wood such as ash and beech can be used with great success.

Several samples of card clothing were shown by Messrs. Horsfall & Bickham, Manchester, Messrs. J. Walton and Son, Woodley, and Messrs. Wilson & Ingham, Liversedge, which together showed clearly the immense advance made in this material latterly. Several cases of paper tubes used in spinning were exhibited, and Messrs. Swailes & Son, Oldham, exhibited a patented machine, which enables a mule to be re-tubed in much less time than is possible by hand. It is not possible or necessary to do more than refer to the fact that roller leather, banding, and the numerous accessories used in spinning and weaving were all fully exemplified.

Among the minor appliances which were shown may be mentioned Staub's yarn balance, exhibited by Messrs. G. Thomas & Co., Manchester. This ingenious little instrument enables the counts of yarn in the warp or weft of cloth to be readily ascertained, this being accomplished as follows: A little square of the material, corresponding in size to a small template which is supplied with the balance, is cut out of the cloth. The threads are drawn out of the square and placed in a hook suspended at one end of a light lever, which is sustained in a special manner. As soon as the lever balances, which can be easily seen at a glance, the number of threads placed in the balance are counted, and correspond to the counts of yarn employed. Yarn indicators and testing machines were shown respectively by Messrs. Goodbrand & Holland and Messrs. Wallwork & Co., both of Manchester.

In concluding our notice of the textile machinery at this Exhibition, we are conscious that there are many exhibits to which a longer notice could be given; but the most important and typical ones have been fully noticed. The object of these articles has been to indicate the latest developments in textile machinery as shown, and in this way to create a record which would be valuable to our readers. It will be many years probably before such a complete illustration of this class of machinery will be again given, and the full details which we have furnished will then be of value to the student and manufacturer.

(To be continued.)

BERDAN'S COMBINED RAM AND TORPEDO.

The object of the system proposed by General Berdan is the defence of the coasts from an enemy's ironclad; he proposes to attack and destroy them while still out of range of the land, and in spite of any means of defence they may possess. The system consists of a ram with bows at either end, 250ft. long, 24ft. to 36ft. beam, 14ft. to 16ft. draught, and four engines, each of 1500 i.h.p. Each engine is to drive a separate propeller, two at either end. At each end are also two torpedoes, and a spur 6ft. long. The spur is to be protected, when in contact with a ship at a greater angle than 45°, by a guard like that used in ferry boats. The screws are to be placed under these guards. There are to be four rudders, each to be placed in front or outside of a screw, and supported by the bracket that supports the screw shaft. The two rudders at either end to be connected, and operated by one helm. There are to be four funnels, which can be telescoped by machinery when making an attack. There is to be a conning tower, and the bows are to be plated and protected by guards made of steel beams placed edgewise, leaving spaces for the water to splash through. There will be two levers at either end of the ram for operating the torpedoes, which will be attached to the outer end, whilst the other end is keyed to a transverse shaft operated by a spur wheel, rack, and air piston. The lever is intended to reach well under the bottom of the ship to be attacked. The bottom of the ship is so weak that, according to General Berdan, the gas at once enters the ship without lifting the water at the side, or doing damage to the ram itself. Small boats on the same principle should be employed to protect the ram during its attack from torpedo boats, &c. The inventor supposes that a charge of 20lb. of gun cotton would destroy a torpedo boat or ordinary merchant vessel. The important features of this system are the guards which protect the spurs and propellers; the method of swinging the torpedo in a circle, instead of causing it to run straight on, by means of which the nets may be avoided, and the torpedo applied to the bottom of the ship, where its action is all powerful to damage the enemy, but harmless to the ram; and the positive motion given to the torpedo by means of the lever.

THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Improved Soaping Machine for Textile Fabrics, Constructed by Mr. W. Birch, Manchester.

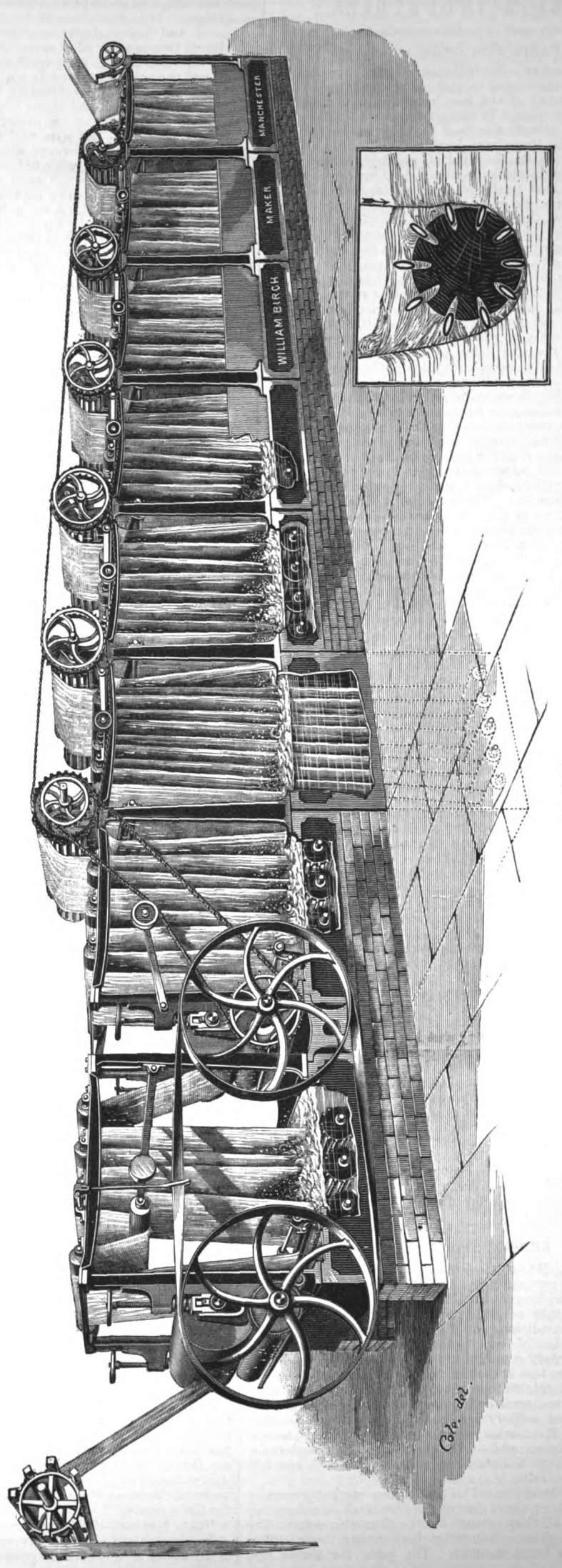


Fig. 74.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 24TH APRIL, 1888.

THE IRON MARKET.—Notwithstanding the issue of circulars last week announcing to customers an advance in the prices of iron, many of the merchants continue to sell at the former quotations. To bring this state of things to a speedy end the manufacturers of the North have resolved to take the step they have long contemplated, viz., to establish agencies in the capital, through which they will deal directly with consumers. As a measure of this character must lead to the utter destruction of the trade of the merchants, we may expect to see an immediate "face about" on the part of the latter. The reports to hand this week from the principal centres of the iron industry are very encouraging. Despite the uncertainty of the political situation business is reviving everywhere. The resumption of building operations has served as a stimulant to the trade in joists, which is now animated. Bars, too, are in better demand, and prices, outside of Paris, are firm or steadily rising. On the whole the prospect has greatly improved within the last few days.

THE METAL MARKET.—The fluctuations of the market for copper and tin have now no significance from an industrial point of view. Every movement is the result of speculation. This week, on a report of a sudden rise in the United States, copper advanced a few shillings a ton, though genuine business has shrunk to a mere shadow of what it was some months ago, and stocks constantly increase. A slight reaction has shown itself in tin, which may be bought for future delivery at lower prices. Lead is weaker, notwithstanding the higher rates in England, Holland, and Germany. The expected fall in spelter has taken place. Present quotations are 8s. a ton below those of last week, and the tendency is still downward.

THE IMPORT COAL TRADE.—The rapid development of the coal mining industry in the North of France is, in spite of the larger consumption of fuel occasioned by the revival of trade, beginning to tell upon the imports of foreign coal. The total imports of coal in the first quarter of the current year, destined for consumption in the country, amounted to 1,974,715 tons, against 2,035,288 tons in the corresponding period of 1887. The falling off is observable in all directions. Thus the imports from Great Britain were 911,947 tons, against 914,257 tons; those from Belgium were 910,179 tons, against 946,267 tons; those from Germany were 151,672 tons, against 173,365 tons; while from other countries there were but 916 tons, against 1400 tons last year. On the other hand, the imports of coke have increased from 239,862 tons in 1887 to 245,502 tons in 1888. The increase here is wholly in the trade with Belgium, from whence the greater amount of the coke is derived.

THE WINE DUTIES AND FRENCH TRADE.—The proposal of the British Chancellor of the Exchequer to increase the duties on bottled wines imported into the United Kingdom has caused consternation in France, not only among the wine growers and merchants, but also in the glass bottle making industry. The disastrous effect which that measure, if passed into law, must have on French trade has induced the Minister of Commerce to protest against it to the English Foreign Office. M. Lalonde, Deputy for Bordeaux, in bringing the matter to the notice of M. Goblet, pointed out that the proposed duties will be almost prohibitive, and will have two consequences: (1) To greatly lessen the consumption of French wine in England, and (2) to cause the bottling to be done in England instead of in France. The latter consequence will deprive French industry and French workmen of the supply of bottles, corks, and cases requisite, and the labour of bottling and packing. Last year, the quantity of wine exported from France to England amounted to 7,070,162 gallons, of which quantity, nearly half, viz., 3,164,656 gallons, were sent in bottles. The importance of the export wine trade to the glass bottle making industry is seen in the fact that in 1887 the whole of the bottled wine exported from France amounted to 6,803,236 gallons. The quantity of full bottles of all sorts exported from France last year amounted to 988,689cwt. Add to this 319,362cwt. of empty bottles, and we have a total of 1,308,051cwt.—a trade of no mean importance.

BERLIN, 23RD APRIL, 1888.

THE COAL MARKET.—Great activity prevails in the coal market, especially in household coal. There is also a good demand for coal for blast furnace purposes, and for the manufacture of coke. The export trade is in a satisfactory condition, and the reduced rates of freight for the carriage of coal to Italy on the Gothard railway, which have lately come into force, will have a favourable influence upon this branch of trade. In tenders made for the supply of 224,000 tons of coal for the Elberfeld railway, sixteen of the largest collieries quoted 5·80 marks per ton at the pit; one colliery quoted 5·90 marks, and another 5·75 marks. The lowest prices were those of the Neuessen colliery of Essen, and of the Vereinigte Bommerbünker Tiefbau colliery of Bommern, which were 5·45 and 5·40 marks respectively.

THE IRON MARKET.—The crude iron market generally has been rather quieter during the past week, as consumers have bought all they require for the present quarter. The prices obtained were somewhat higher than those paid in the previous three months. The rates for rolled iron continue firm, and an improvement is expected in the trade in girders. Fine sheets are in good demand for roofing purposes, and heavy sheets are also in greater request. The Hörde Company is busy manufacturing armour plates at remunerative rates. The export trade in rolled wire is weak, and the prices obtained do not allow of much profit; but the home rates are considerably better. The demand for wire nails is good, and there is every prospect of its being maintained. Prices are firmer owing to the Saxon works having joined the wire nail syndicate; the Westphalian Wire Company, however, still holds aloof. Waggon works are well supplied with orders, and steel manufacturers who supply wheels and axles will therefore benefit. Engineering works and boiler makers are also busy. The rolling mills in Upper Silesia are well supplied with work, and orders are plentiful for bar iron and iron sheets. The business with Russia is still in an unsatisfactory condition. At a recent contract for the supply of 4000 tons of steel rails for the Erfurt railway, the following tenders were received: The Bochum Union, 116 marks at Bochum; the Aix-la-Chapelle Hüttenactienverein, 114 marks at Rotte Erde; and Messrs. Bolckow, Vaughan, & Co., 116·20 marks free at Stettin.

THE EXCAVATIONS FOR THE NORTH SEA BALTIC SHIP CANAL.—Tenders have been received for the excavation of two portions of the North Sea Baltic Ship Canal. A remarkable feature of this tendering is the wide differences in the estimates. The volume of earth to be removed amounts in one case to 1,488,000 cubic metres, and in the other to 878,000 cubic metres. The lowest of the thirteen tenders received was 9d., and the highest 1s. 3¾d. per metre. The canal commission will take four weeks to consider those tenders. Work has already been commenced on the canal at Brunnsbüttel, and as a part of the soil to be excavated consists of clay, it is intended later on to utilise it for the manufacture of bricks. No barracks have as yet been erected for the workmen; but one of the buildings of the Ducker Portable Barracks Company is to be put up, and if this is found suitable for the purpose, it will probably lead to a good business.

INDUSTRIAL EXHIBITION AT BREMEN.—An industrial exhibition of considerable importance is to be held at Bremen in 1890. Active steps are already being taken to secure the success of the undertaking. This exhibition, which will be open from June to September inclusive, will recommend itself to English manufacturers and export merchants. A committee has been formed, at the head of which is Herr Charles Papendieck, to make and carry out the preliminary arrangements.

LEATHER.—The Berlin leather market has been more active during the past week than for some time past, this being due to large purchases having been made by provincial dealers. There is a good demand for inner sole leather of the cheaper kinds. Cow hides are not in much request, and leathers for uppers is quiet.

TOBACCO.—Some years ago the cultivation of tobacco in the Palatinate was an important industry of this country; but according to recent reports the prices obtainable have sunk so low that the cultivation of the article is almost entirely unremunerative. This is partly due to over production, and it is stated that only the better kinds of tobacco, cultivated under the most improved methods, will in future be able to be produced advantageously.

VIENNA, 23RD APRIL, 1888.

THE COAL MARKET.—There has been greater activity in the coal market during the past week, owing to the continuance of cold weather. A proposal has been laid before the Vienna Town Council to establish a municipal coal depôt in that city. Another suggestion which has been made is for the establishment of a coal consumers' union, which would buy coal in large quantities, and thus be in a position to supply its members at cheap rates.

THE IRON MARKET.—There is not much change to report since my last letter, business being satisfactory in Austria, and decidedly active in Hungary. There is a good demand in Austria for bar iron, constructive iron work, and black plates, and it is expected that there will be a rise in the syndicate price for merchant iron. The crude iron market is firmer, and forge pig has slightly advanced in price. There is at present a very good demand for axes. In Hungary, building iron has been in greater request. Owing to the keen competition amongst middlemen, the prices have slightly fallen, although the works maintain the rates of the syndicate. The balance sheet of the Alpine Mining Company for 1887 shows a great improvement on the previous year.

THE METAL MARKET.—Some spasmodic movements have taken place in the copper market during the past week. These commenced with a series of rises which have, however, not proved permanent, as the rates fell again slowly to the same figure at which they stood last week. There is a better demand for zinc sheets; but tin, lead, and antimony are neglected.

TEXTILES.—The movement in cotton yarns is slow, and prices remain about the same. Owing to the continuance of the cold weather, woollen goods are firm. An improvement has taken place in the demand for mixed cotton and woollen goods. The linen trade is one of the few in Austria of which no complaint can be made regarding want of business, there being at present a strong demand for linen goods.

GOLD MINING.—The prospects of gold mining in Transylvania appear to be very favourable, as at one mine near Brad about £70 worth of gold is being produced daily. American stamps are being used for treating the ore. An English company has commenced operations at Boitza with equally satisfactory results.

RAILWAYS.—The Bulgarian portion of the Oriental Railway will be opened on the 13th of next month, but the Turkish part of the line is not yet completed. The additional facility for communication thus afforded will probably prove of special benefit to Austria, and a commission has been sent by the Austrian Manufacturers' Club to the Balkan districts in order to inquire into the possibility of developing our trade there.

MALT.—As last year's barley harvest in France has been much below the average, and as at the same time the consumption of beer has increased, French brewers had to look abroad for their supplies of malt. Considerable exports of malt have in consequence taken place from Hungary and Moravia to France.

ELECTRIC LIGHTING.—The wiring of the Burg Theatre, which is now being fitted by the Imperial Continental Gas Company, and will be supplied with current from their central station in the Schenkenstrasse, has been officially examined and tested for insulation and conductivity by the president of the Vienna Society of Electricians. He found that the slate basis for cut-outs and other fittings were only poor insulators. Professor von Waldenhofen has just concluded at the Electro-Technical Institute, a comprehensive series of experiments with storage cells of Fahrbaky & Schenek, Reckenzaun, and Julien. The chief object of the experiments was to ascertain the efficiency of each type, especially for tramway purposes, and to eliminate errors in estimating the degree to which the cells had been charged or discharged, the experimenter based his investigation on three measurements—viz., the electromotive force on open circuits, the density of the electrolyte, and the potential difference when at work. The efficiency of the Reckenzaun accumulator was found to be 89·3 per cent. for the quantity, and 80·85 per cent. for the energy. For the Julien accumulator, the figures were respectively 89·7 per cent. and 83·4 per cent.; whilst the Schenek-Fahrbaky accumulator gave 91 per cent. efficiency for quantity and 78·5 per cent. for energy. In connection with the Salzburg central electrical station, a number of electromotors are now in use, the type employed being that of Messrs. Siemens & Halske marked K. This motor is made only for small powers—viz, $\frac{1}{10}$, $\frac{1}{5}$, $\frac{1}{4}$, and 1 h.p., running respectively at 2500, 2200, 1800, and 1200 revolutions per minute. They are used in Salzburg for ventilating and other domestic purposes.

BRUSSELS, 24TH APRIL, 1888.

THE COAL MARKET.—Notwithstanding the approach of spring, the coal market continues active. The recent cold weather has had the effect of clearing the stocks in the hands of dealers, and household coal is still in good demand. Considerable business is being done in coal for industrial purposes. Prices are well maintained, as producers keep firm on account of the contracts which are shortly to be given out by the State railways. Small coal is scarce.

THE IRON MARKET.—The market this week is unchanged, and prices continue firm; but there are signs that the demand will fall off. The scarcity of pig is still making itself felt in the market, and the result is that although at this period of the year a large influx of orders for summer requirements usually takes place, business this year is comparatively quiet. Tenders will shortly be invited for the supply of 18,000 tons of railway material for delivery next year. Tenders will also be invited for the supply of 3000 tons of Goliath steel rails, also for delivery in 1889. The steel market is quiet. Although Government orders for armour plates and other work have given employment to a number of firms, other engineering shops are not very busy, and locomotive builders in particular find business very slack.

ELECTRIC LIGHTING.—The Grand Place has up to now been lighted by two arc lamps of 30 ampères, the motive power being a 12 h.p. steam engine. Two new masts are being erected, each of which will carry two lamps, and the installation will be so arranged that the four new lamps will absorb nearly all the motive power available. The dynamos are compound wound for 70 volts, and the lamps will be coupled parallel, the resistance coils being put inside the foot of the mast. The total expenditure of energy will be 80 ampères at 70 volts.

BRICKS.—From the Liège district numbers of brick makers are leaving for Germany, the demand for labour being good. At Amay alone seven hundred hands have been engaged for Saxony.

THE MEUSE FORTIFICATIONS.—The contracts for these fortifications have at last been given out. They are divided into four parts, of which two include the Liège forts and the other the Namur forts. There will be required for these works 3,300,000 cubic yards of earth work, 1,300,000 cubic yards of concrete work, and 25,000 cubic yards of brick work.

GLASS MANUFACTURE.—The general adoption of the *four-à-bassin* by Belgian manufacturers is causing some stir in France, where it is felt to be necessary to have recourse at once to the same means of cheap production, and where the relative merits of the large and small type are being earnestly discussed. The latter are in use at Marseilles, where they are said to have given excellent results. A new design, just adopted by M. Casimir Lambert, of Charleroi, is much talked about, and commended. This furnace is 8m. broad by 14m. long. The depth of the glass, or "metal" as it is technically termed, in fusion is 1·80m.

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instead of the usual 1·10m. The mixing chamber into which the gas and air are led has been superseded by a new method of distributing the jets, which is not only more convenient, but saves 25 per cent. of fuel.

DÜSSELDORF, 23rd April, 1888.

The Iron Market.—The iron market is settling down to a state of relative calm. There is, however, a steady and fairly strong current of business, and it is only in relation to the extraordinary activity of the last few months that the market can be described as quiet. The calm is chiefly observable in the business in crude iron. There is nothing being done in spiegel pig on United States account, and forge pig for home consumption is much less actively sought after. For other kinds there is a fairly brisk demand, but the tendency is towards weakness. Prices are, however, firmly maintained, for the situation is favourable to the blast furnace owners, there being practically no stocks in hand. At the end of February the stocks at the thirty works comprised in the Rhenish-Westphalian Pig Iron Association amounted to only 36,341 tons, and this quantity was reduced to 33,582 tons at the end of March—about nine days' production. Moreover, coke prices have still an upward tendency. The markets for finished iron and steel are distinguished by activity in most classes of goods. Bars are in better demand for export, a change in the course of business that has imparted an improved tone to the market. The trade in joists is somewhat wanting in life, but as building operations are more actively prosecuted this market may be expected to revive. Although the Siegen plate manufacturers complain of a scarcity of orders, in this district there is a strong demand for plates. The syndicated works rolled 10,575 tons of plates in March, delivered 10,320 tons, and booked fresh orders for 10,661 tons. Hoops may be bought from 2s. to 3s. a ton below the prices prevailing at the beginning of the month. Manufacturers of boiler plates are now so pressed with work that they are unable to contract for prompt delivery. Business in wire and wire nails is also reviving. Founders and engineers are everywhere busy. The great iron and steel works of Tardy and Bericoh at Savona, in which the Bochum Union holds a third share, has just obtained a contract for 25,000 tons of steel rails for the Italian railways, at the price of £7. 2s. a ton.

Linen Yarn.—The market continues very active for linen yarns. The influence of a steady and strong demand in the presence of constantly diminishing stocks is seen in gradually hardening prices. The demand is partly supplied by increasing imports.

LILLE, 24th April, 1888.

Textile Manufactures.—The disturbing influence of the elections, and the consequent threatening attitude of political affairs, may be clearly traced in the business of the country during the last week. No large transactions have been recorded, nor has any disposition been shown on the part of buyers to push their dealings beyond the needs of the moment. The linen goods trade of this locality has become less animated; but we are now in the dull season, and the calm is in part to be attributed to ordinary influences. The woollen goods trade of the Roubaix district remains quiet, though there is a steady if not strong current of business, and in certain classes of goods the demand is fairly brisk. Our manufacturers have bought largely at the London wool auctions, exhibiting thereby some confidence in the situation. Business at Rouen has revived a little, but the markets are yet far from active. Nothing approaching to animation is to be expected within the next two or three weeks.

Flax and Yarn Markets.—There is but little to be said of the flax market this week. In common with business of all sorts, flax has suffered from the political excitement attending the recent elections. Dealings have been restricted within narrow limits; a small quantity of Walloon has changed hands at former prices, and a few unimportant transactions in Russian have been recorded. The Ghent markets have been equally void of life. Business in yarns has remained active; some large dealings have taken place in linens at full prices. Jute yarns are in good demand. In hemp a larger amount of business has been transacted. The Customs returns for the first quarter of the current year show for that period a degree of activity in the foreign trade which compares favourably with that of the corresponding quarter of 1887. Thus we have as the declared value of the imports: For linen yarns, £82,760 (£58,920); for cotton yarns, £242,720 (£365,920); and for woollen yarns, £133,120 (£112,760), and as the value of the exports of the same classes of goods we have: £65,640 (£64,960); £23,360 (£25,920); and £291,520 (£272,520) respectively. It will be seen from these figures that there has been shrinkage in cotton, and expansion in linen and woollen yarns.

The Iron Market.—Consumers show some hesitation, being apprehensive of disturbing influences arising out of the political situation; but there is no indication of weakness in the market. Two instances have become very clearly apparent, viz., that the manufacturers are firmly banded together to maintain prices; and secondly, that the raw materials of the iron manufacture, ore, coke, and consequently pig iron, are steadily advancing in price. A relapse is thus out of the question, and on the other hand a further advance in finished goods is not to be expected for some weeks to come, for the merchants have in stock, or contracted for, considerable quantities of iron purchased at lower rates than those now ruling

AMSTERDAM, 24th April, 1888

Dutch Commercial Policy.—The new Ministry is the direct result of the recent elections, which were the first held under the reformed Constitution. The Liberals were hopelessly beaten, and the new Cabinet consists of Ministers of a decidedly reactionary character. Protection or "Fair Trade" was one of the platforms upon which the last electoral battle was fought, and the victory of the anti-Liberals means an instant revival of former endeavours to protect inland trades, Dutch industry, and national agriculture, by imposing heavy import duties upon all foreign goods, fabrics, and produce.

Telegraphy in the West Indies.—News has reached the Hague that the English steamer "Roddam" has successfully laid the cable between La Guayra, in Venezuela, and Curaçao. The same telegraph vessel is now engaged in laying the cable from Willemstad to San Domingo, which places Curaçao in direct telegraphic communication with Europe.

WINTERTHUR, 23rd April, 1888.

Electric Lighting.—Progress is being made in various directions in electric lighting. The steamers "Helvetia" and "Thurgau" have been fitted with the electric light, and the North-Eastern Railways intend adopting it for all their steamers on the Lake of Constance. At the Hotel Engadiner Kulm at St. Moritz, 10 arc and about 700 glow lamps are installed. This lighting can be greatly extended, as only half of the water power of 180 h.p. available is at present utilised. A scheme is also on foot for lighting the town of Interlaken electrically, and a commencement will be made by the erection of arc lamps in the Höheweges and the large hotel situated there.

A New Railway on the Righi.—The line between Vitznau and Righi has proved so profitable an undertaking that the Righi is regarded by railway promoters as a most fertile field for their enterprise. In addition to the other line up the mountain on the opposite side, there has now been projected a line from Weggis to Righi Kulm, which will, in the main, follow the old footpath. A concession for this line has recently been asked for, but no particulars regarding the engineering details have yet transpired.

Export Trade.—A company with a capital of £1,000,000, divided into 5000 shares, has been formed at Basle, under the title of Société Générale pour le Développement de l'Industrie Ottomane. Their object is to establish various industrial undertakings in Turkey, and to acquire land, buildings, and machinery for this purpose. It is therefore expected that our export trade will benefit from the purchases of plant which will be required.

MADRID, 23rd April, 1888.

The Agricultural Industry.—Steps are being taken by the Government to establish agricultural schools and laboratories, in order that the methods of cultivating the soil may be improved. The opinion is held by the educated classes that the depression in agriculture is mainly due to want of knowledge. Whether professors who could not manage a farm themselves will be able to teach much is doubtful, but they will probably have an influence in causing the introduction of agricultural machinery and implements. In my opinion, at least one-half of the country can be ploughed by steam, and it will be cultivated in that manner in the course of time.

Manufacture of Dynamos.—The works of Xifra and Co., at Barcelona, which are turning out dynamos of the Gramme type, are conducted on purely co-operative principles. It was established by a society of ten workmen, which now, however, numbers forty. It has proved very successful, mainly owing to the ability of Mr. Xifra, the engineer, whose advice has been of great service to the workmen.

NEW YORK, 14th April, 1888.

The Coal Market.—The anthracite coal trade is dull, and concessions of from 10c. to 15c. a ton are made on circular rates by some of the operators in New York; but the companies are maintaining prices fairly well. The trade has been a good deal disturbed during the week on account of the failure to make any agreement as to the production for the year. The shipments for April will not be over 2,700,000 tons, a decrease of 180,000 tons as against last year. The demand for coal for the Eastern trade is beginning to spring up. The bituminous trade is quiet.

The Iron and Steel Markets.—The volume of business is gradually increasing, but the very bad weather and the agitation on the tariff question have had a tendency to check anything like activity. Besides this, the unusually small amount of work on hand at most of the rolling mills stimulates them to sharp competition for new business, and keeps prices at a point where there is no margin for profit. The present condition of affairs does not furnish any substantial basis for expecting more than a fair average amount of business at a very low range of prices. Some few choice brands still command full prices, but the increasing supply of other brands is beginning to be felt throughout the market. The Thomas Iron Company have made a nominal reduction of $1 per ton on their No. 1 foundry pig. As the Glendon and Andover furnaces are out of blast, besides others which usually supply No. 1 foundry, prices may not yield so readily as they would under other circumstances. There is a considerable accumulation of inferior irons, and this, with the liberal output of the Cornwall furnaces, will furnish ample supplies to the consumers of that class of material. The Lehigh companies estimate that the present cost of making pig iron is $3 greater per ton than it was in 1884. The pig iron producers in Eastern Pennsylvania and the Lehigh Valley are pressing the railroad companies for a reduction in the freight charges on coal, ore, limestone, &c. They take up the position that they can no longer compete with the South and West and pay the heavy charges demanded by the railroads. Some furnaces pay freight on coal at 10c. per ton per mile, while the furnaces on the line of the Pennsylvania Road pay only three-quarters of a cent. The iron masters say that they must have relief or keep their furnaces closed. Business in manufactured iron has been better during the past week, but there has been no improvement in prices. Mill owners are so anxious for work that they are quite willing to duplicate orders taken at the low prices recently prevailing, and the prospects for better rates are not encouraging. Mills are running on an average at perhaps two-thirds of their capacity; but though orders do not extend far ahead, there have been indications during the past few days of a prospect of greater activity during the spring months. The steel trade has been allowed an additional allotment of 200,000 tons, or 1,050,000 tons for the year; and it is stated that the Eastern mills have sold nearly all their share already. They are all tolerably full of work for the next sixty days, and from the number of inquiries in the market it is expected that they will be kept busy all summer. Prices are firm at $31·50 per ton for large lots, to $32 for small ones.

The Metal Markets.—The copper market has been very dull, but prices remain steady. There is some talk of a pool sale to American consumers, and this may be looked forward to as one of the events of the near future. It is once more announced that the Calumet and Hecla mine fire is out, and that the mine will be opened to-morrow, Sunday. The market closed at 15¾c. to 16c. per lb. for present delivery. Tin has been weak, with only a moderate amount of business, prices being 35·50c. to 36·25c. per lb. for spot. Tin plates are dull, and the price is declining. What little business has been done in lead was purely speculative. Domestic was offered at 4·90c. per lb., with no buyers. Spelter is weak and dull, selling at 4·90c. to 5c. per lb. for domestic.

Telegraphing from Trains in Motion.—The practical value of the induction system of train telegraphy, by which messages can be sent from and received by moving trains, was well illustrated on the Lehigh Valley road during the recent great storm. Each of the trains carried a telegraphic outfit and a skilled operator. The wires are set upon poles only 16ft. high, which expose but little surface to the storm, and while the heavily loaded poles carrying the general wires were blown down, stopping the general service, these remained intact, and telegraphic communication was carried on without intermission. The messages are transmitted from the metal roof of the cars to the line, a distance of nearly 10ft., by induction; and when both cars and wires were buried in the drifts, the system was found to work well, the dry snow having apparently no bad effect. Every train was located, and more than two hundred messages were sent back and forth during the three days of the storm, while on all the other roads, as soon as a train passed out of sight, it became lost to the train dispatcher.

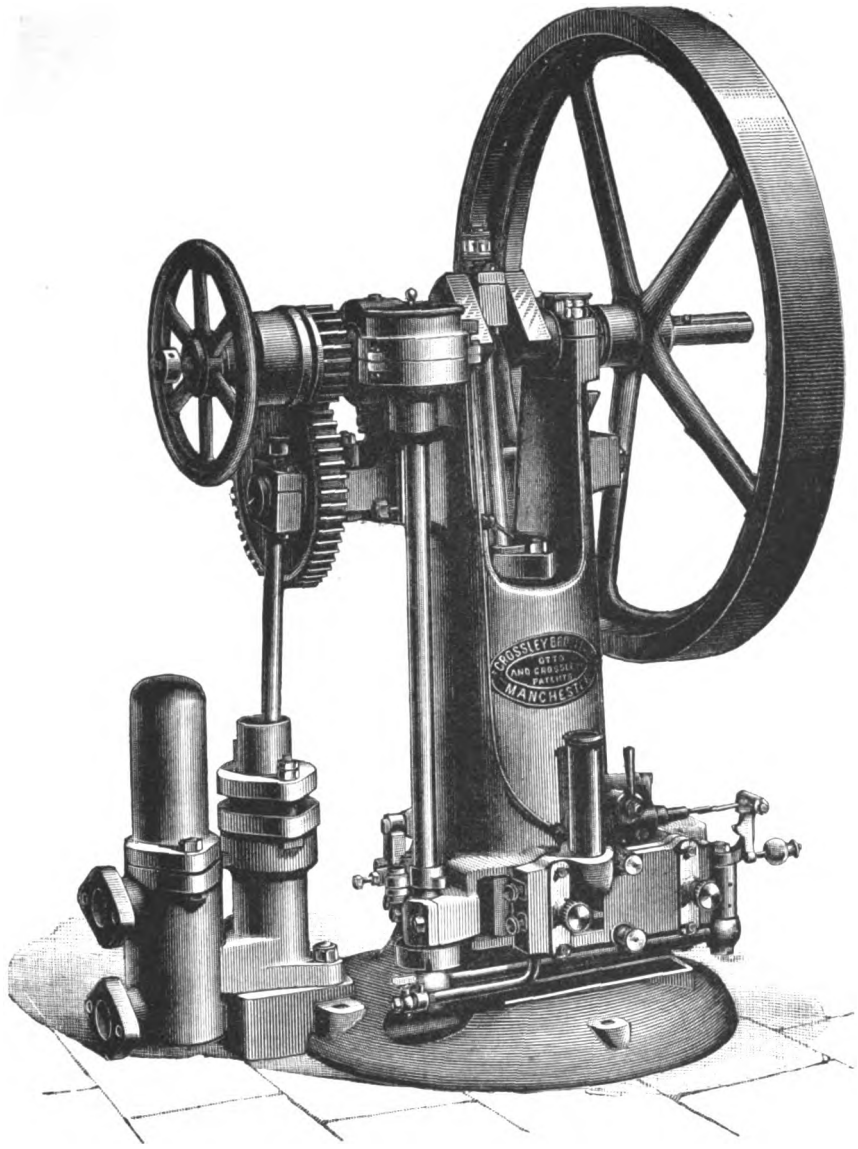
PHILADELPHIA, 14th April, 1888.

Sugar.—An estimate of the production of sugar in this country places it at 1,370,000 tons for 1888. Of this amount the refiners not in the Sugar Trust will melt 370,000 tons, or about 27 per cent. of the entire production, leaving the balance of 1,000,000 tons to be turned out by the Trust refineries. Mr. Spreckels has decided to build a new sugar refinery in this city. For this purpose he has purchased a piece of ground which gives him a water frontage of 450ft., and extends back 1500ft., for which he has paid £100,000. The new refinery will have a capacity of 7000 barrels per day, which is 50 per cent. more than is at present produced by the two refineries we have now. Plans are being made for the machinery and buildings, and it is hoped to have the refinery in operation in a year.

Steel Pipes.—The Riverside Iron Works, of Wheeling, West Virginia, have been engaged in the manufacture of steel pipes since August last. These pipes have been introduced to take the place of iron pipes, and are now announced to be a commercial success. Test pieces were cut from both iron and steel pipe and hung in dilute nitric acid. In twenty-four hours the iron had lost 3·6 grains, while the steel had lost but 1·15 grains, and after forty-eight hours the losses were 6·53 and 2·21 grains respectively. When the edges of the test pieces were protected, of course the loss was much less, but still largely in favour of the steel. Test pieces were taken from machine welded tubes, cut to contain the weld, and on being broken in the tensile machine the steel broke at 52,000 and 66,000lb., and gave 18·75 and 17·25 per cent. elongation in 8in., while the iron broke at 42,480 and 35,240lb., with 2·25 and 0·5 per cent. elongation. None of these pieces broke in the weld. Tests were also made of pieces taken from hand welded tubes, and, while they all broke in the weld, the steel tubes proved to be better

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COMBINED GAS ENGINE AND PUMP.



COMBINED GAS ENGINE AND PUMP.

We illustrate above a very neat form of combined vertical gas engine and pump, which has recently been put on the market by Messrs. Crossley Brothers, Limited, Openshaw, Manchester. This convenient and compact combination is made in various sizes, from 5 man to 5 horse power, and will no doubt be found specially useful for domestic installations. The engine can be used for driving a small dynamo or other machinery when not required for pumping purposes, by simply disconnecting the pump from the engine by means of a clutch operated by a hand wheel shown on the left of the illustration. It will be seen that on the fly wheel end of the crank shaft there is room left to fix a pulley for the driving of general machinery. The design of the engine is extremely good, and the whole of the details have evidently been well thought out, with the view of making the combination both simple and effective.

INSTRUCTION IN ELEMENTARY SCHOOLS.

There has been so much said and written on the subject of technical education during the past few years, that people are apt to overlook what should be the foundation of all education, viz., that obtained in the elementary school. Members of School Boards, and a certain class of educationalists, are apt to dwell too much on the statistics of education; but they fail to inquire if what the scholars obtain is education in the proper sense of the term. They point to the fine new schools which have been built, the number of scholars attending them, the passes they make and the grants they earn, and they are satisfied. It never occurs to them that we may have all these, and yet that education may be going backwards. The report which was recently issued by a special committee of the London School Board "to consider the present subjects and modes of instruction in the Board's schools, and to report whether such changes can be made as shall secure that children leaving school shall be more fitted than they are now to perform the duties and work of life before them," must have given a rude shock to the statistical educationalists on the Board, as some of the opinions therein expressed are very strong indeed. For instance, the Rev. J. E. Symns states, that after examining the picked boys from the elementary schools of London his conclusion is, that *the boys are machines*, and he considers the present system of teaching in elementary schools a very poor foundation on which to construct a satisfactory education.

It is quite evident that the special committee have considerable sympathy with some of the severe criticism which is offered on the present system, and they advise that very considerable modifications be made. They find it necessary to define the object of all education as the "harmonious development of all the faculties, bodily and mental, with which the child is endowed by nature," and they state their belief that a great part of the benefits of education are moral benefits, and that "fearless truth, bravery, honour, activity, manly skill, temperance, hardihood, welded into a great national character," are objects of national education. "Noble character comes first, the training of skill and strength comes next." When they inquire if the present system does produce such harmonious development of all the children's faculties, bodily and mental—that they leave school fitted, as far as possible, for the battle of life, they find there is an almost universal consensus of opinion in the negative on the part of the witnesses of all classes. The evidence shows in the first place that the physical or bodily side of education, including the development of muscular strength, of the accuracy and the sense of colour and of proportion, and of the pliancy and dexterity of the hand, is almost entirely neglected; and that in the second place, the mental or brain work, which occupies the great part of the time in schools of all kinds, is composed far too much of appeals to the memory only, resulting at the best in the retention in the child's mind of a mass of undigested facts, and far too little of the cultivation of intelligence. The committee quote with approval the opinion of Professor Huxley, that elementary education is "too bookish, too little practical. The child is brought too little into contact with actual facts and things, and there is no education of those particular faculties which are of the utmost importance to industrial life—the faculty of accurate work, and the faculty of dealing with things instead of words." They point out that the results are such as might have been expected. There is not in the curriculum anything which ennobles labour, and the boys are given an undue bent towards clerkly and non-manual pursuits. On the other hand, children are not prepared when they leave the elementary school to profit by the training given in secondary and technical schools, and are often discouraged from taking the first steps in an industrial career.

The special committee believe that it is possible to improve the school curriculum by bringing manual work to the aid of the intellectual, and thus throw life into the formal and parrot-like instruction which now leaves so little impress on the children's minds; and they remark that it is significant that these changes are demanded alike by educational theorists, teachers, men of science, leaders of industry, and statesmen, and it rests with the Board to carry them out. The committee point out that the problem before the Board may be regarded as divided into the following heads, to each of which they give special consideration: (1) Just balancing of the claims of mental and manual work in an elementary school; (2) gradual specialisation of school work, so as to meet the separate needs of the various classes of children; (3) relation of elementary education to continuation and technical schools; (4) teaching power; (5) school buildings; (6) cost; (7) powers allowed by the code of the Education Department. Each of those topics is very fully discussed; but for details we must refer to the report, as our space will only allow us to notice a few of the more important points. The committee recommend that arrangements be made for the more thorough teaching of science in the higher classes by means of the peripatetic system, until at least there are ordinary teachers in all the schools capable of giving efficient instruction in science subjects, and they further recommend that special manual instruction should be given under the following principles: (1) That manual work should always be taken in connection with school teaching of underlying sciences and of drawing; (2) that no special trade be taught. They are of opinion that teachers and managers should have liberty in making experiments in methods of giving this teaching, as there is not sufficient experience of it in England to enable an opinion to be given regarding the adoption of any general system, even if that course were desirable. They think, however, that wood work supplies the most convenient mode of giving manual instruction to older boys. The material is cheap and easy of manipulation, and can be made illustrative of the intellectual work of the school. The tools used are simple. The articles made should illustrate educational principles, and in no case should the school be turned into a manufactory of saleable articles. The making of mechanical models and apparatus of various kinds necessary for explaining science teaching would stimulate the boys' intelligence. The committee do not recommend the use of the lathe in the work room. The evidence given before the committee shows that artisan class objections to manual training in elementary schools disappear when it is known that the object is entirely to improve general education, and no attempt is made to teach any trade, or to turn out boys who can fancy that they are skilled workmen. Special recommendations are made for the teaching of cookery, needlework, and knitting to girls, and suggestions are given for the improvement of the ordinary branches of an English education, and for drill and physical exercises. Specialisation of school instruction to meet future circumstances can only exist outside the elementary subjects, and as the majority of children require to leave Board schools before they are able to get much beyond the general elements of education, they can only proceed with their industrial, commercial, or literary education in evening classes or continuation schools; and to these special attention should be given. The committee think that wide power should be granted to the Board in organising the curriculum of its classes, so as best to meet the wants of scholars; and that the grants, whether of the Education Department or the Science and Art Department, should be given for efficient and complete class teaching rather than for the individual examination of the evening scholars. Also with regard to science and manual teaching, the committee think it is desirable that individual examination in writing should be applied as little as possible, and that in manual instruction a Government grant similar to that for cookery should be given, where payment is made for qualified instruction and regular attendance.

The evidence printed along with the report should be carefully studied by all interested in education; for as the committee remark, they cannot exaggerate the importance of the question with which they deal. It vitally affects the future of the mass of London people. "Everybody suffers when education goes wrong. The failures are the lives of men. The teacher's workshop is strewed, not with shavings and wasted wood, but with wasted years and broken lives."

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SHIPBUILDING NOTES.

Messrs. Dobson & Co., Newcastle, launched on 12th inst., a vessel named "Ben More," built to the order of the Grampian Steam Shipping Company, Dundee. The vessel is 255ft. long by 34ft. 6in. wide, and 17ft. 6in. deep, and will be fit to take about 2500 tons of cargo. The engines are by the North-Eastern Engineering Company, Wallsend.

Messrs. Readhead, South Shields, launched on 12th inst. a vessel named the "Harperly," built to the order of Mr. William Wright, South Shields and London. The vessel, which is 300ft. long by 29ft. wide and 20ft. deep, has a dead weight carrying capacity of 3350 tons. The engines will also be supplied by Messrs. Readhead.

Messrs. Brown & Co., Newcastle, launched on 12th inst., a wooden screw steamer, intended for the coasting trade. The vessel is 90ft. long by 20ft. wide, and 9ft. deep. She is specially constructed for light draught, so as to be able to enter rivers and harbours where the depth of water is insufficient for the safe navigation of larger vessels.

On the 13th inst. the oil-in-bulk steel steamer "Caucase," built by Messrs. Armstrong, Mitchell, & Co., Limited, at their Walker-on-Tyne shipbuilding yard, proceeded on trial, loaded to her ordinary draught of water, with 2400 tons of water. The vessel is constructed on Swan's patent, and with the usual good workmanship necessary for this class of craft. The engines and boilers have been supplied by the Wallsend Slipway and Engineering Company, Limited.

On the 13th inst. Messrs. W. Gray & Co., West Hartlepool, launched the steel screw steamer "Lowlands," built to the order of Messrs. Hardy, Wilson, & Co., West Hartlepool. Her principal dimensions are: Length over all, 270ft.; breadth, 36ft. 6in.; depth, 19ft. 5in., having 2500 tons dead weight capacity. The engines—triple expansion—19in., 30½in., and 51in. diam. of cylinders, 36in. length of stroke, to indicate 700 h.p.; the two steel boilers of 150lb. working pressure have been constructed by the Central Marine Engineering Company, Limited, West Hartlepool.

Messrs. Wm. Hamilton & Co., Port Glasgow, launched on Saturday, the 14th inst., the steel twin screw steamer "Macassa." The vessel, whose dimensions are 166ft. by 24ft. by 16ft. 3in., moulded depth, is of 459 tons gross, and is intended for passenger service on Lake Ontario. The engines, 750 i.h.p., have been built by Mr. Kemp, Govan. The "Macassa" is luxuriously furnished for a high class passenger traffic, and is fitted throughout with electric light.

On the 14th inst. the steel screw steamer "Ben Clune"—the eleventh vessel built to the order of Messrs. J. Morrison & Sons, North Shields, by Mr. James Laing, Deptford Shipbuilding Yard, Sunderland—proceeded on her trial trip, fully loaded with 2850 tons dead weight at 19ft. 6in. draught of water. The vessel's registered dimensions are: Length, 273·5ft.; breadth, 38·25ft.; depth of hold, 19·35ft. The engines are of the triple expansion type, with cylinders 21in., 33in., and 54in. diam., and 39in. stroke. The steel boilers, of 150lb. working pressure, have been constructed by Mr. George Clark, Southwick Engine Works, Sunderland. The vessel had a trial trip extending over several hours, and ran the measured mile at Whitley at progressive speeds, the engines working satisfactorily. The maximum speed was 10 knots against wind and tide, and 11½ knots with wind and tide, or a mean of 10¾ knots per hour.

Cleveland Institution of Engineers.—The fourth meeting of the session was held in the Society's Lecture Hall, on the 16th inst., Mr. Richard Howson, president, being in the chair. After some preliminary business, Mr. D. D. Wilson, general manager of the Stockton and Middlesbrough Corporations' Water Board, read an exhaustive paper on the undertakings of the Water Board, being chiefly historical, financial, and statistical, leaving the engineering subjects to be hereafter dealt with in a paper which Mr. Mansergh, C.E., has promised to furnish. Mr. Wilson traced the history of the water supply to the towns of Stockton and Middlesbrough from the time when the source of supply was a few pumps and wells, supplemented by the storage of rain water in tubs and the river Tees, down to the present time, when a splendid supply is obtained from the several large reservoirs in the upper reaches of the Tees. He also explained the progress of the works in connection with the further supply from the Hury reservoir. A vote of thanks to Mr. Wilson brought the meeting to a close, the discussion having been postponed till next meeting.

We have just received a new catalogue and price list from Messrs. Crossley Brothers, Limited, Openshaw, Manchester, which contains a number of new and neat designs of gas engines, and combinations of gas engines, with other machines. One of the most noteworthy features of this catalogue, are the excellent illustrations throughout the work. The first part is occupied with illustrations of gas engines; the second part contains different combinations of gas engines and machines, and in the end pages is given a short description of the Dowson gas plant used in connection with Messrs. Crossley's engines. In the early pages is shown a small domestic motor capable of indicating up to ¾ h.p., and a new design of a 20 n.h.p. horizontal "Otto" gas engine, which we understand is now largely used. Further on are shown two designs of combined gas engine and dynamo, a combined gas engine and pump, which we illustrate on page 422 in the present issue, and a gas engine combined with a dry air refrigerator. The artistic appearance of this catalogue, and the several novelties contained in it, make it well worthy of attention.

Notices of Meetings.

THIS WEEK.

Royal United Service Institution.—Friday, 27th April, 3 p.m. Paper to be read on "The Mechanism of the Counter Attack," by Major W. W. M. Smith.

Physical Society.—Saturday, 28th April, 3 p.m. Papers to be read on "Electromotive Force by Contact," by Mr. C. V. Burton; on "A Theory concerning the Sudden Loss of Magnetic Properties of Iron and Nickel," by Mr. H. Tomlinson; and "Note on the Graphic Treatment of the Lamont Frölich Formula for Induced Magnetism," "Note on the Conditions of Self Excitement of a Dynamo Machine," and "Note on the Conditions of Self Regulation in a Constant Potential Dynamo Machine," by Professor S. P. Thompson.

NEXT WEEK.

Society of Arts.—Monday, 30th April, 8 p.m. Cantor lecture on "Decoration," by Mr. G. Aitchison, A.R.A.—Wednesday, 2nd May, 8 p.m. Ordinary meeting. Paper to be read on "Drawing, a Means of Education," by Mr. T. R. Ablett.—Friday, 4th May, 8 p.m. Indian Section. Paper to be read on "The Injurious Effects of Canal Irrigation on the Health of the Population of the Punjab," by Surgeon-General H. W. Bellew, C.S.I.

Institution of Civil Engineers.—Tuesday, 1st May, 8 p.m. Ordinary meeting. Paper to be further discussed, on "The Distribution of Hydraulic Power in London," by Mr. E. B. Ellington, M.Inst.C.E.

Royal Institution of Great Britain.—Tuesday, 1st May, 1-30 p.m. Annual meeting, Tuesday, 1st May, 3 p.m. Lecture on "The Plant in the War of Nature," by Mr. W. Gardiner. Thursday, 3rd May, 9 p.m. Lecture on "The Chemical Arts," by Professor Dewar.

Chemical Society.—Thursday, 3rd May, 8 p.m. Papers to be read on "The Determination of the Molecular Weights of the Carbohydrates," by Mr. Horace T. Brown and G. H. Morris, Ph.D.; on "The action of Heat on the Salts of Tetramethylammonium," by Mr. N. Collie and Dr. Lawson; and on "The action of Heat on the Salts of Tetramethylphosphonium," by Mr. N. Collie.

Institution of Mechanical Engineers.—Thursday, 3rd May, 7-30 p.m., and Friday, 4th May, 2-30 p.m. Ordinary general meeting. Papers to be read: "Third Report of the Research Committee on Friction: Experiments on the Friction of a Collar Bearing;" "Description of the Emery Testing Machine," by Mr. Henry R. Towne; and "Supplementary Paper on the use of Petroleum Refuse as Fuel in Locomotive Engines," by Mr. Thomas Urquhart.

Architectural Association.—Friday, 4th May, 7-30 p.m. Ordinary meeting. Nomination of officers. Paper to be read by Mr. H. H. Statham.

Geological Association.—Friday, 4th May, 8 p.m. Ordinary meeting.

Junior Engineering Society.—Friday, 4th May, 7-45 p.m. Paper to be read on "The Elements of Stresses in Structures, illustrated by Models and Diagrams," by Mr. W. Quick, C.E.

PRICES CURRENT, 26th April.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/7	Cash
Scotch Warrants, m/n		38/8	"
Hematite Warrants, m/n		41/5	"
Stocks in Stores. Scotch	973,829—Inc. for week,	1620	Tons
Middlesbro'	310,533—Dec. "	2020	"
Hematite	209,086—Dec. "	1235	"

Exclusive of stocks in makers' yards.

Market disappointing, inquiries very few, but not much change in prices. Scotch shipments 10,912 tons, against 6969 tons for same week last year.

	No. 1.	No. 3.	
Coltness	47/9	42/9	f.o.b. Glasgow.
Gartsherrie	44/6	41/6	" "
Dalmellington	39/9	38/3	" Ardrossan
Eglinton	38/9	37/–	" "
Glengarnock	43/9	39/9	" "
*Derbyshire	—	35/–	f.o.t. Works.
*Lincolnshire	—	32/–	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 17 6	5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	5 0 0	5 10 0	"
Staffordshire Bars	5 0 0	5 10 0	Manch'r.
" Angles	5 10 0	6 0 0	"
Crown Sheets	6 5 0	6 10 0	"
" Hoops	5 5 0	6 5 0	"
"Siemens-Martin" Steel Boiler Plates		8 0 0	"
" Ship and Girder		7 15 0	"

METALS.

Spelter: Ordinary	£18	0	0	to	——		
Copper: British Cakes and Ingots	81	0	0	"	——		
" Chili Bars	80	5	0	"	80	10	0
" Manufactured (strong)	88	0	0	"	90	0	0
Lead: Common Pig	15	0	0	"	15	5	0
" English Sheet	16	0	0	"	16	5	0
Tin: Straits	166	0	0	"	——		
" Australian	167	0	0	"	——		
" English Ingots	140	0	0	"	145	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Quotations for Chili cash parcels are practically unaltered, £80. 5s. to £80. 10s. per ton; three months £77. 5s. to £77. 7s. 6d. Manufactured continues inactive, and this influences the market for raw copper adversely, so that the quotations for three months later delivery are gradually falling.

Tin.—Irregular. Spot parcels of Straits are still quoted £166 per ton, for deliveries a week hence £128 per ton, and for three months down to £110 per ton. English is lower. The prices are thus giving way very rapidly, because of the great increase of stocks.

Lead quiet. Quotations for Spanish rather better, £13. 17s. 6d. to £14 per ton.

Spelter steady at about £17. 10s. per ton for warrants. The present price being so much lower than it was a few months ago, is attracting buyers, and a large business is doing in this metal.

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/–	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/–
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/–
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/–

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	27	0	0
" Ceylon	"	24	0	0
Cottonseed	"	21	0	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	18	12	6
Palm, Lagos	"	21	0	0
Rapeseed: English	"	24	0	0
Seal: Pale	"	23	0	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	10	3
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6
" Spirit	"	0	0	8¼

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	6¾	—	0	1	7
" Oxalic	"	0	0	3½	—	0	0	4
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6⅛	—	0	1	6¼
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3¼	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	12	2	6	—	12	5	0
" Liquor	lb.	0	0	3¼	—	.....		
Bleaching Powder	ton	7	12	6	—	7	15	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	31	0	0	—	31	10	0
Benzole (90%)	gal.	0	3	4	—	0	3	6
" (50/90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	0	0	5¾
" Prussiate (Yellow)	"	0	0	7	—	0	0	7½
" Sulphate (Basis 90%)	ton	8	15	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	0	4	1
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	7	0	0	—	.....		
" " (" 60%)	"	6	0	0	—	.....		
" " (Cream, 60%)	"	5	18	9	—	.....		
" Crystals	"	3	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1½	—	0	1	2½
Tartar, Cream of	cwt.	6	7	6	—	7	10	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

We have just received the catalogue and price list of the Brown & Sharpe Manufacturing Company, and of Messrs. Darling, Brown, & Sharpe, both of Providence, Rhode Island, United States. The first part of the catalogue contains prices and illustrations of machinery, tools, and castings, including milling machines, cutters, and gear wheels, made by the Brown & Sharpe Company; while the second part is occupied by a selection from Messrs. Darling, Brown, & Sharpe's measuring instruments, comprising United States standard rules, cast steel squares, standard wire gauges, and instruments for accurate measurements, of which numerous illustrations are given.

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HOME INDUSTRIES.

MANCHESTER, 26TH APRIL, 1888.

THE COTTON TRADE.—The condition of business does not show any material change since our last report. On the whole spinners have plenty of work, and in some cases are under contract for some months ahead. There is a little abatement of prices for new orders, but the reduction is much more than covered by the lower price of cotton. A profitable margin exists in all departments of the trade, but it is not so large as to cause any feeling beyond satisfaction. The wants of spinners are covered, and the weekly average of the sales during this season is about 75,000 bales. This would indicate a large increase in the amount of yarn spun, and this increase continues in spite of the small number of mills being built, and, no doubt, arises from the gradual improvement of the speed of the machinery employed. Unless better counsels prevail, the spinning trade will be disturbed in the course of a month by an extensive strike. The conference to which we referred last week not having resulted in any agreement between the two parties, the operatives have given notice of their intention to strike, if an advance of 5 per cent. on spinners' wages and of 10 per cent. on those of card room hands, is not conceded. These notices expire on the 21st May, and although at present the formal notice has only been given in Oldham and Blackburn, the dispute practically affects a very much wider area. It is to be hoped that before the time for the expiration of the notices a more reasonable spirit will prevail. In the cloth market there is little animation, and where contracts are expiring, fresh ones can only be had at a reduction on the old rates. There is abundant evidence that there is sufficient productive power for the existing demand, and that the additions which are being made are likely to have the effect of bringing quotations down to an unprofitable figure. Unless there is a considerable increase in the demand, there will shortly be several stoppages of looms owing to shortness of work. The Union Manufacturing Company, Limited, of Rochdale, have placed an order for 1350 looms for their new shed with Mr. George Keighley, of Burnley. It is the intention of the directors of this concern to manufacture the better classes of cloth, rather than compete in ordinary grey cloths. There is an agitation going on in the Blackburn district among the drawers and twisters, for an equalisation of their wages list.

NEW WORKS.—The Roburite Explosives Company, Limited, of which Sir John Stokes is chairman, are rapidly completing their new works at Gathurst, near Wigan, the site of which covers thirty-eight acres. It is expected that the manufacture of the new explosive will begin early in May, and we understand that there are a large number of orders already on the books. The peculiarity of this explosive is that it does not explode by fire contact, but only by detonation, and it is intended to supply it in the form of two powders, which can be mixed together when required for use, both being harmless when separate. The works are accordingly laid out in two departments, connected by tramways.

THE IRON TRADE.—There is only a very small demand for pig iron in this market, and the continual weakening of prices prevents buyers from purchasing. There is always a steady flow of orders, but there is no inclination to do more than buy for present requirements. The market therefore is very lifeless, and as makers do not yield to any large extent, most of the transactions are passing through the hands of merchants. Bar iron is only in slow request, and prices are nominally about £5 per ton for common qualities of bars. Except for a few special purposes in connection with cotton machinery, the use of marked irons is becoming very small, and the price of these is closely approximating to common grades. A rather large parcel of this quality has been recently placed at £5. 5s. per ton delivered in North-East Lancashire, less 2½ per cent. The use of steel is on the increase, and several large sheds are being fitted with steel shafting. In machine making establishments, however, where every turner is paid by piece work, the extra time consumed in turning steel makes the cost of production too great, and, in consequence, best turning iron is still largely used. It is reported by many makers of machinery that rollers made of steel do not wear so long as those made from best iron, as they grind away in the necks. This is worth the attention of steel makers, as if the two defects named could be overcome, a largely increased use of steel would follow.

LONDON, 26TH APRIL, 1888.

THE MONEY MARKET.—After a quiet week, in which the absence of demand was denoted by rates gradually going lower and lower, the money market has strengthened a little on account of the Stock Exchange settlement, which has occupied the past three days; but the improved demand is only temporary, of course, and there is still a prospect of a continuance of cheap money. The settlement has rather checked business on the Stock Exchange this week, but the tendency of the markets is all in the direction of improvement. Continental news having been more reassuring, the markets have been firmer. All foreign stocks have participated in the upward movement, Egyptian securities, in spite of the rumours about the possible conversion of the Five per Cent. Preference Loan, having gained in price. The British funds are better than they have been for a fortnight. Home railways show no inclination to mend in price, and will not do so until the weather becomes a little more seasonable. As regards American railways, Wall-street and Capel Court, after waiting on one another for a long time, have concluded to go hand in hand in the right direction, and the prices of the more substantial securities have gained several points. Were it not that such a movement in Americans is nearly always followed by a pause, this market would offer at present a good opening for speculative investment.

COMPANIES.—The number of new companies registered lately has been quite abnormal, on account of the proposals of the Chancellor of the Exchequer. The following among others have been registered since our last report: The Gatling Gun Company, Limited, with a capital of £800,000; Turney Brothers, Limited, with a capital of £120,000, to purchase a leather manufacturing business at Nottingham; Alton and Co., Limited, with a capital of £110,000, to acquire the business carried on at Wardwick Brewery, Derby; Ashby's Cobham Brewery Company, Limited, with a capital of £48,000; Southampton Electric Light and Power Company, Limited, with a capital of £30,000; the Town Hall Brewery (Salford), Limited, with a capital of £20,000; the Low Moor Iron Company, Limited, with a capital of £300,000; Schmidt Brothers, Limited, with a capital of £75,000, to manufacture steel fencing wire, &c.; the Hull Portland Cement Company, with a capital of £10,000; Fenner & Co., Limited, with a capital of £60,000, to deal in and manufacture oils; South American Petroleum Company, Limited, with a capital of £501,000, to sink petroleum wells in Peru; Kerosene Company, Limited, with a capital of £300,000, to trade in and manufacture oils; Central Quartz Milling Company, Limited, with a capital of £150,000, to carry on the business of crushing quartz in the Transvaal or elsewhere; Dorado Railway Company, Limited, with a capital of £172,000, to acquire a concession for a railway in the Republic of Colombia; Hutchinson Petroleum Motors, Limited, with a capital of £60,000; New Organos Gold Mining Company, Limited (South America), with a capital of £75,000; the New Astor Mine Company, Limited (Colorado), with a capital of £250,000; Cerro Blanco Mines, Limited (Mexico), with a capital of £150,000; New Gold Hill Company, Limited (North Carolina), with a capital of £350,000; New Akankoo (Gold Coast) Mining Company, Limited, with a capital of £150,000; Pioche Mining Company, Limited, with a capital of £250,000; the New Flagstaff Mining Company, Limited, (Utah Territory), with a capital of £300,000; Mapoota Land Syndicate, Limited, with a capital of £50,000, to acquire mining rights in South Africa; Montrose Gold Mining and Exploration Company, Limited (Africa), with a capital of £70,000; the Hungarian Bonanza Mines, Limited, with a capital of £20,000; Golden Gate Alluvial Syndicate, Limited (U.S.A.), with a capital of £50,000; Santa Catalina Gold and Silver Mining Company, Limited (Arizona Territory), with a capital of £225,000; the Kaiser Gold Mines, Limited (Arizona), with a capital of £200,000; and the Madras Presidency Diamond Fields, Limited, with a capital of £190,000.

SHIPPING.—Very little change has taken place in freights, but those to and from the Black Sea have improved to some extent. Though the rates from India to England are poor, the outward freights are sufficiently high to make a return voyage profitable. American freights continue to be unsatisfactory.

HEMP.—Although the state of business at present does not compare very favourably with the position at the commencement of March, affairs are nevertheless on a sound basis. There is no change in the prices of Baltic hemp and yarns. Business in Manilla hemp has been very moderate.

THE NAVY.—The tender of Messrs. Humphrys, Tennant, and Co., of Deptford, for the engines and the torpedo depôt ship to be built at Portsmouth, has been accepted by the Admiralty. The engines are to indicate 12,000 h.p. A number of shipwrights have been discharged at Devonport Dockyard. At Portsmouth material has been received for the construction of the "Beagle" and the "Barossa;" the former is a sloop of the B type, and the latter a protected cruiser of the third class. The "Nymphe," which was laid down at Portsmouth in June last, is to be floated out of dock on the 1st of May. She is a twin screw, wooden sheathed sloop of 1140 tons displacement. The work of repairing the old "Victory," which had been temporarily suspended, has been resumed, and is likely to last for three months. The total cost will be about £10,000. The "Sans Pareil," which is being built by the Thames Iron Works Company, is to be completed for sea at Portsmouth, and not at Chatham, as was originally intended. We have received from the secretaries of the bazaar, a very neat hand book of the Royal Naval and Military Bazaar to be held at the Hotel Metropole next month.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 15th April amounted to £1,189,237 on 15,850¾ miles, as compared with £1,221,156 in the corresponding period of 1887, when the mileage was 15,708¾ miles. An increase is thus shown in the mileage of 142 miles or 0·9 per cent., and a decrease in the receipts of £31,919 or 2·6 per cent.

THE WRITING TELEGRAPH.—In *Industries*, Vol. III., page 259, we gave a description of a writing telegraph invented by Mr. J. H. Robertson, which was exhibited at the American Exhibition. The Post Office authorities now state that they decline to grant a license for the use of the writing telegraph, and think it preferable that if there is a substantial demand for the establishment of exchanges to be worked by that instrument, they should be in the hands of the Post Office, and that the system should not be worked as telephone exchanges are at present.

IRON AND STEEL INSTITUTE.—The annual meeting of the Institute is arranged to be held on the 9th and 10th prox., at the hall of the Institute of Civil Engineers, 25, Great George-street, Westminster. Business will commence each day at 10-30 a.m., and will be resumed on Friday, the 11th prox., if necessary. The following papers will be read as far as time will permit. Adjourned papers: (1) "On the Mutual Action of Sulphur and Silicon in Iron at High Temperatures," by Mr. T. Turner, Mason College, Birmingham; (2) "On the Use of Water Gas for Metallurgical Purposes," by Mr. A. Wilson, Stafford; (3) "On an Imperfection in Mild Steel Plates, considered Chemically," by Mr. H. Eccles, Port Talbot; (4) "On the Mechanical Apparatus for Continuous Moulding at the Works of M. Godin, Guise," by Mr. Jas. Johnston, Manchester; (5) "On the Effect of Arsenic on Mild Steel," by Mr. F. W. Harbord and Mr. A. E. Tucker, Bilston; (6) "On the Manufacture of Ordnance at Trubia;" by Major Cubillo, Trubia. New papers: (7) "On the Melting of Wrought Iron or Steel Scrap mixed with Ferro-Silicon in Cupola Furnaces," by M. F. Gautier, Paris; (8) "On the Behaviour of Arsenic in Ores and Metals during Smelting and Purification Processes," by Mr. John Pattinson, Newcastle-on-Tyne, and Mr. J. E. Stead, Middlesbrough; (9) "On a New Instrument for the Measurement of Colour, more especially as applied to the Estimation of Carbon in Steel," by Mr. H. Le Neve Foster, West Hartlepool.

EXHIBITIONS.—Rapid progress is being made in alterations and re-decoration in connection with the forthcoming Italian Exhibition, which promises to be very successful. It is intended to open the exhibition about the 12th of May. The Anglo-Danish Exhibition will be opened at South Kensington on the 14th of May.

GLASGOW, 26TH APRIL, 1888.

GENERAL BUSINESS.—A slight accession of business was observable in the operations on the Stock Exchange in the beginning of the week. Quotations, especially in the more speculative stocks, were higher, and there was less disposition to sell for a fall than there has been of late. The iron market is steady but inactive. Shipments are still fairly well maintained. Coal shipments still continue to show a large increase over those of 1887, the shipments to date being about 50 per cent. in excess of those for the corresponding period last year. The freight market is thus fairly active, and outward freights are taken at full rates. Demand for steel continues to keep the steel makers busy, and several very large contracts are now in the market. Among these are a contract for 8000 tons of rails for the Danish State Railways, and one for a railway in Egypt.

SULPHATE OF AMMONIA.—Messrs. Wm. Dixon, Limited, have resolved to manufacture sulphate of ammonia as a by-product at their Govan Iron Works. This has long been done at the works of Messrs. Baird and of the Summerlee Iron Company at Coatbridge, but Messrs. Dixon have not hitherto attempted it. The price of sulphate of ammonia may not improbably suffer from the considerable addition to the supply which this will involve.

THE LIFE SAVING APPLIANCES BILL.—The Clyde shipowners held a conference in Glasgow, on Monday, for the purpose of considering the bearing of the provisions of the bill upon their interests. They ultimately decided to ask Lord Ravensworth to move a series of amendments. These proposed amendments refer chiefly to the constitution and to the duties of the committee. The proposal is that a committee be appointed for the purposes of the Act, and that this committee should consist of the President and three members of the Board of Trade, the President of the Chamber of Shipping, one member of Lloyd's Committee, three members jointly representing the Institution of Naval Architects and the two Institutions of Engineers and Shipbuilders in Newcastle and Glasgow; two practical seamen representing seamen's societies, and eight members representing the shipping interest chosen by the owners in the chief shipowning districts, each owner having a vote for every hundred tons of shipping owned by him. The duties of this committee, as laid down in the proposed amendment, would be to make and vary rules with reference to the subjects covered by the Act, to act as advisers of the Board of Trade in the administration of the Act, and to form a Court of Appeal between the officers of the Board of Trade and any shipowner.

FIRE IN MESSRS. DENNY'S YARD.—The saw mill at Messrs. Denny's yard at Dumbarton was completely gutted by fire on Monday afternoon. The whole of the machinery was rendered practically useless, the loss amounting to upwards of £4,000. As the firm are at present very busy, the occurrence of the fire is a serious inconvenience. The fire is attributed to the heating of the journals of the main shafting.

GLASGOW EXHIBITION.—The boilers and connections being now practically finished, steam was got up in the beginning of the week, and the dynamo machinery put in motion for the purpose of trying the electric light. This was done in some of the courts on Monday evening with success. The mechanical section, now rapidly getting into order, contains many very important exhibits, and altogether the Exhibition compares very favourably with any of the provincial exhibitions, and by common consent excels them all in advantage of situation.

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(From our own Correspondents.)

LIVERPOOL, 25th April, 1888.

Sale of the Liverpool Exhibition Buildings.—The whole of the constructional iron work and wood work forming the buildings of the late exhibition, was sold by public auction last week, on the site. The buildings were divided into different sections, and sold in separate lots; the total amount realised by the three days' sale was about £10,000. Purchasers were present from all parts of the country, and in many cases fairly good prices were obtained for the material. Although the total amount realised was considered satisfactory, it is much below the estimated amount published in a former statement of the committee. The full sized model of Eddystone Lighthouse was sold previously by tender for £235 as it stands, exclusive of all machinery.

Enormous Emigration from Liverpool.—The great increase in the emigration from this port which was noted last week has since been greatly exceeded, for last week over 14,000 emigrants sailed for the United States and Canada. Great pressure has been put upon the different Atlantic lines, and they have been compelled to run extra boats to meet the traffic; twelve boats sailed last week fully loaded.

SHEFFIELD, 25th April, 1888.

The Heavy Industries.—The call for pig iron is extensive, and the trade is steady. Customers are buying for present wants, and obtaining slightly easier rates. There is a great demand for steel, and the Bessemer makers are very busy. There is little change to note in the price of billets, except that quotations are a little firmer for best quality. Though the promise of reviving trade has scarcely been borne out this month, still the heavy industries are on the whole in a satisfactory state of activity. The crucible steel makers have good orders on hand, and this fact is indicative of profitable business in the best steel Sheffield can produce. At the works of Messrs. W. Jessop & Sons much heavy material is being turned out, and this firm is steadily developing its trade in castings. Most of the well known Brightside firms are tolerably employed on ordinary material, and Brown's, Cammell's, Firth's, Vickers', Spear and Jackson's, and Jowitt's are doing well in most of their departments; but there is just a slight feeling of soreness among some of these Sheffield firms about the conduct of the War Department. Messrs. Charles Cammell & Co., and one or two other concerns, have put down the most modern plant for the manufacture of heavy ordnance, partly on the understanding that Government orders would pour in. But the orders do not come, and it is whispered that the Government still contemplate, on economical grounds, the manufacture of this heavy ordnance themselves. It is doubtful, however, whether the Government can produce the material so cheaply as these Sheffield firms or Messrs. Whitworth.

Hadfields' Steel Foundry Company.—This well known firm was registered as a limited liability company on the 24th inst.

NORTH STAFFORDSHIRE, 25th April, 1888.

The Pottery Trade.—Manufacturers are working on orders booked some few weeks ago, most of them derived from the American market. The feeling in this staple trade of the district is of a more hopeful character than that which prevailed a few months ago, although no material advance in prices has yet been secured.

North Staffordshire Chamber of Commerce.—At the meeting of this chamber held last week, the question of applying to the Government to constitute the Pottery towns a county under the Local Government Bill was discussed. It was unanimously felt that the close affinity of manufacturing and commercial interests which exists in the Potteries as a whole, would be materially benefited and strengthened by union in a county, and that there were ample grounds for making the application referred to. The proposal is that Longton, Fenton, Stoke, Hanley, Burslem, and Tunstall, which now form one uninterrupted line of separate towns, should be amalgamated. From whatever point of view the matter is regarded, and more particularly from an industrial one, there can be no doubt that the formation of the Potteries into a county for local government purposes, will conduce to the welfare of that commercial centre.

BIRMINGHAM, 25th April, 1888.

The Iron Trade.—The new quarter has opened rather quietly in the iron trade. There is some uncertainty as to prices, and new orders are far from plentiful, especially for high class iron. Makers of the common varieties are better off. The galvanisers have had to give way in price, with the result that orders are being booked more freely; the rates are £11. 5s. to £11. 10s. for 24-gauge, free in Liverpool. There is a fair demand for constructive iron work, and steel is in good request.

The Hardware Trade.—This trade is fairly busy, and the rise in copper has imparted strength to the market by increasing confidence in the maintenance of the price of metals. Most of the manufacturers of tools and implements used in agriculture are busy, both for the home trade and for the Colonial markets. The indents from the Cape continue to indicate sustained prosperity in that quarter, and South Africa and South America are also both absorbing a large quantity of goods. Australian and American requirements are not large, but Canada and the northern ports of Europe are evincing a disposition to buy freely just at present. The approach of the travelling and building seasons is rendering the makers of ironmongery and carriage furniture rather busy. The unfavourable situation of silver as a medium of exchange is telling heavily against trade with India. Burmah, however, is gradually creeping forward into the position of a market for goods such as corrugated sheets and agricultural implements.

DERBY, 25th April, 1888.

Textile Fabrics of Japan.—At a conversazione given last Thursday by Mr. Bottomley, the president of the Derby Chamber of Commerce, Mr. Charles Holme gave an account of the textile industry of Japan, which he illustrated by a display of specimen fabrics. Amongst these were some rare specimens of the dyer's art, the designs on which had been obtained by methods which show the patience and laboriousness of that people. In one case the outline of a complicated geometrical design had all been drawn by hand with a certain composition. When this composition dried it raised a wall which was impenetrable by the dye stuff; the outline of the design was left untouched, while the various portions of the pattern were dyed with different colours. After this had been done, the piece was subjected to the action of steam, which softened and removed the stiff composition. Another specimen, although produced by a totally different method, was no less noticeable. The design in this case was obtained by small squares, about $\frac{1}{25}$ths of an inch across, arranged in rows and forming the outlines. Each of these squares had been formed by raising the fabric at that point and tying the slight elevation with a piece of string, through which the dye could not penetrate. The fabric thus prepared was steeped in the dye, which covered every portion except those parts protected by the strings. When the strings were untied, the design remained in the form of little squares, having the original colour of the fabric on a ground of colour imparted by the dye. It is clear that such productions take rank more as works of art than of industry, although they are not so costly as might be imagined, on account of the wages of a skilled Japanese workman being much lower than in England.

LEICESTER, 25th April, 1888.

Wool Spinning and Yarn Trades.—Trade continues to remain in an unsatisfactory condition. The recent London wool sales have tended to sustain the late quotations for the raw material, but have not in any way improved the market. There is no confidence in the stability of prices, hence transactions continue to be for only small amounts. Country dealers and growers still hold on, but owing to the small demand staplers do not press operations, and as the season advances the holders will part at a reduction. Spinners buy frequently, as their stocks of raw material are, as a rule, not heavy. Orders for spinners are neither large nor plentiful, and most of the mills are not working up to the average. Prices have to be cut so low to obtain commissions as to make the bulk of the trade very unremunerative. Yarn merchants find much difficulty in doing business, as consumers are holding off in anticipation of lower quotations.

Hosiery Trade.—The late alteration in the weather has caused some improvement in the plain department, and there has been an increased demand for cashmere goods; but the trade is done at very close rates, and profits are very small. Cotton goods are very slack in demand. Business is somewhat better in the fancy branch, but there is still room for great improvement.

BARROW-IN-FURNESS, 25th April, 1888.

Iron and Steel.—The market for Bessemer pig iron is briskly maintained because of the great demand on the part of steel makers. Large orders for steel are being offered on home and foreign account, and these will insure an active period for some time to come. Prices, however, are unchanged. Bessemer in parcels of mixed numbers is quoted at 43s. 6d. to 44s. per ton net f.o.b.; and steel rails of heavy sections are quoted at from £3. 18s. 6d. to £4 per ton net f.o.b., and at £4. 3s. 6d. to £4. 5s. for lighter sections. These prices have now practically ruled the market for a month. In the ordinary hematite pig iron trade the business being done is comparatively slow, and prices range from 42s. 6d. to 43s. per ton net f.o.b. There is no diminution in the number of furnaces in blast, nor in the output of pig iron, although stocks remain very large in the hands of the holders of warrants. Makers hold some stocks, but generally speaking they do not represent any great weight of iron. In the steel for shipbuilding purposes there is a brisk business being done. Makers are very fully supplied with orders, and are preparing to increase their output by doubling the productive capacity of their mills. There is every indication of a good trade in the immediate future of shipbuilding, and this is doubtless one of the reasons why at the present moment makers of plates and angles are in receipt of so many inquiries. Plates are quoted at £6. 17s. 6d. per ton net f.o.b., and angles at £6. 17s. 6d. There is a brisk trade also in billets at £3. 18s. 6d., a growing demand for blooms at £3. 15s., principally on American account, and a steady and active industry in tin plates, which are being bought largely, both for the home and foreign markets.

MIDDLESBROUGH, 25th April, 1888.

Pig Iron.—There is still the same depressing influence at work on the market caused by the political situation, whilst an increasing trade is steadily resisting the depression. Makers, indeed, are so confident of better times being close at hand, that they will not lower their prices. No. 3 has been bought for 31s. 9d., but not in any quantity, and sellers who are strong enough to hold out are asking 32s. Makers, as a rule, will not part with their iron under 32s. 6d. Connal's warrants are fluctuating. The price of these is declining, notwithstanding the reduction of the stocks and the increased shipments. Forge iron has for some time now been in good request, and the consequence is that the stock has been almost entirely cleared out in the case of mottled and white. The price has in consequence been abnormally high.

Tees' Revenue.—The surest sign of an increasing volume of trade, is the fact that the revenue of the Tees Commission is increasing month by month. The total dues received on ships and goods for the month of March amounted to £5,357. 7s. 6d., being an increase of £400. 18s. upon the amount received for the corresponding month of the previous year. The total receipts for the five months of the financial year amount to £25,784 16s. 2d., being an increase of £2,026. 5s. 3d. over the corresponding five months of the previous year.

NEWCASTLE, 25th April, 1888.

Iron.—There is at last a prospect that the two large blast furnaces belonging to Messrs. Bell Brothers, at Low Walker, which have stood idle for several years, will once more be utilised for productive purposes. The furnaces were re-built a couple of years ago, and an immense quantity of ore was at the same time accumulated on the premises. Owing to the extreme flatness of the pig iron trade at that period, however, it was not thought advisable to light up, the intention being, no doubt, to await a more favourable opportunity for commencing operations. That time appears to have now arrived, for a dredger was set to work a few days ago to deepen the mooring place beside the quay, so as to allow steamers or sailing ships to take in pig iron, or discharge ore, without the intervention of lighters. Other preparations are also being made for starting the furnaces at an early date, and it is not improbable that the first "charges" will be put in by the end of May. The machinery at the Walker rolling mills, which have also been standing for some years, is now being taken to pieces, but for what purpose has not at present transpired. The iron works at Jarrow and Gateshead continue to work steadily, and the tone of the finished iron trade is on the whole very healthy.

Steel.—The second Siemens-Martin furnace, which Messrs. Hawks, Crawshay, & Sons have erected in connection with their Park Road rolling mills, is now completed, and will be put in operation in the course of a few days. The furnace which is now working will then be temporarily stopped for repairs; but afterwards both furnaces will be kept going simultaneously. At present the output of these new steel works falls far short of current requirements, and it is considered likely that the putting down of other furnaces will not be long delayed. The producers of steel and iron sheets are still exceedingly busy, and for these classes of goods prices continue to be firm.

Chain Works.—The chain making department of Messrs Abbot's works, Gateshead, is still idle, owing to the continuance of the wages dispute recently referred to.

Bridge Works.—The bridge shops at Messrs. Hawks, Crawshay, & Sons' works are just now rather slack; but Messrs. T. Alder & Co., Heworth Shore, are busy with the construction of two iron bridges for India.

The Coal Trade.—The demand for steam coals continues to improve, and prices are tending upwards. The shipments of coal and coke from Tyne Dock for the week ending 21st April were, however, less by over 21,000 tons than those for the corresponding week last year. This falling off was doubtless due to the unfavourable weather, which hindered the departure of vessels.

DUNDEE, 25th April, 1888.

Flax and Jute Trades.—During the past fortnight business in both branches of the trade has improved in tone. Advices from New York indicate a firmer market for jute goods. In the linen branches, although prices are unaltered, a steady business is being done. The demand for flax on the spot is not brisk, as recent large purchases on contract are now beginning to arrive, and consumers are well supplied. Manufacturers' stocks of yarns are low, and an extensive business has been done. In most cases late prices have been accepted, but spinners now incline to be firmer in their demands. Makers of linen goods are well employed, and the outlook is encouraging so far as the finer class of linens is concerned. American orders are coming in freely, but the home demand is not equally active. The heavier classes of goods are somewhat difficult to dispose of, and the tendency of prices is rather against buyers. There is not much doing in sail cloth. The prospects of the new jute crop are favourable, there having been heavy rainfalls in the growing districts. Some new crop has been sold in London at from £12. 5s. to £12. 10s., good first marks. There have recently been large arrivals of last season's crop. For jute yarns there has been more inquiry, and the tendency is to advance rates. More jute goods are being bought.

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DIAGRAMS RELATING TO THE PROPERTIES OF WATER AND SATURATED STEAM.

I.

By Professor R. H. Smith.

In the scientific practice of steam engineering one has frequently to make calculations based on the physical properties of water and steam. Our knowledge of these properties, so far as it is accurate, is chiefly due to Regnault's experiments. The direct and calculated results of these and later experiments have been set forth in the form of numerical tables. These tables are deficient in two respects: (1) Although they contain the elements from which all quantities appearing in steam calculations can be reckoned, still this reckoning often entails the loss of considerable valuable time. For practical purposes we want a larger number of tables giving these elements combined in a larger variety of useful forms. (2) The accurate use of the numerical tables involves troublesome interpolation. The interpolation actually always adopted is linear (*i.e.*, by simple proportion); any other would use up too much time. But for very few of the tables is linear interpolation at all exact; indeed, when the interpolation is to be only linear, it is little less than absurd to tabulate the quantities and their differences with five or six significant figures, when the difference is from $\frac{1}{10}$ to $\frac{1}{100}$ even of the quantity itself. By reference to the curves on the diagrams connected with these articles, it is easy to obtain any number of illustrations of the degree of error resulting from linear interpolation. To do so one has only to lay a straight edge between two points on the curve corresponding to two successive values in the numerical tables, and note the deviation of the straight line from the curve. The interpolation in English tables is peculiarly inconvenient, because these are usually tabulated for successive temperatures, 9°F., 18°F., or 27°F. apart. This results from the tables being simple translations from the French, the 9°F., 18°F., and 27°F. corresponding to the much more convenient intervals 5°C., 10°C., and 15°C. Again, it is not with a knowledge of the temperature, but much more commonly of the pressure, that one refers to the tables; and the tabulated pressure having quite odd fractional parts, the interpolation becomes still more awkward.

The employment of fairly drawn curves instead of numerical tables does away at once with all the inconvenience and inaccuracy of interpolation, and in other ways saves a world of trouble. The saving of trouble in these matters is of great scientific importance; because those acquainted with practical office work will readily acknowledge that the necessity of employing intricate and very tedious calculations simply prohibits the use of the method involving them, from sheer lack of time and weariness of spirit. The curve is continuous, and the result desired is read off directly, without error, and without calculation.

The advantage of a curve over a table of numbers in enabling one to grasp the general law of variation is well and widely understood. The present writer considers it a further important advantage that the impossibility of reading from curves with excessive minuteness prevents those engineers who use them from making ill use of their time by dealing with absurdly long strings of figures. The curves shown on the diagrams connected with these articles have been accurately reduced from others of rather more than twice the size, but the scale of the two-page engraving is sufficient for all ordinary purposes. A very few of these curves have been published in such books as Rankine's "Steam Engine," but to so small a scale as to render them rather simple illustrations of the general law, than accurate tables of reference for the various exact quantities.

In connection with these articles it is intended to publish two diagrams on two double-page supplements, one of which (Diagram I.) will be found in this week's issue, while the other (Diagram II.) will appear with the second article. It is hoped that both diagrams may find a place in drawing offices and other places where calculations in steam engineering frequently require to be made.

In the first diagram twelve distinct curves are given, corresponding to twelve complete and continuous tables ranging from 60°F. to 430°F. Although each curve has for its vertical co-ordinate the temperature, still it is as easy to find a quantity corresponding to any given pressure as to any given temperature. If the pressure be known, one has only to find the corresponding point on the pressure curve, and from this point to run along the horizontal line to the curve from which the desired quantity is to be read.

There is only one vertical scale, viz., that of temperatures, in Diagram I. There are, however, three horizontal scales for the various quantities tabulated. One of these is marked P, and is used for the pressure curve. A second scale is marked V, and is used chiefly for the volume curve. Most of the other curves represent quantities of energy—heat energy and mechanical energy spent in doing mechanical work. These quantities are all given in foot-pounds, the foot-pound unit being more convenient for engineering calculations than the "English heat unit," which latter is 772ft.-lb. The third scale, marked E, is that to which these various quantities of energy are plotted.

The twelve curves or graphic tables are the following:—

1. Total Heat of Water from 60°F.—This is the heat needed to raise 1lb. of water in temperature from 60°F. to any other temperature read off on the vertical scale. It is reckoned from 60°F. because one may always without serious, or almost without appreciable, error take this as the average feed water temperature, unless the feed be from a hot well. The curve is nearly, but not quite, a straight line; the deviation being due to the slight variation of the specific heat of water.

2. Pressure of Saturated Steam.—This is given in pounds per square inch, and is to be read to Scale P. The diagram runs down to 60°F. for the sake of condenser pressures. At 60°F. the pressure is only $\frac{1}{4}$lb. per square inch. Below 200°F. the pressure curve to Scale P slopes so very little, and the ordinates are so small, that in order to enable the pressures corresponding to different low temperatures to be accurately distinguished, this part of the pressure curve is drawn out a second time, with the horizontal scale increased ten times. Of course, the Scale P can still be used; but, for example, 25 on scale P must be read as meaning 2·5. The full line pressure curve is plotted directly from Regnault's experiments. The dotted curve represents the author's approximate formula $p = \left\{ \cdot 005644\, t + \cdot 4360 \right\}^{\frac{100}{18}}$ where t is the temperature on the ordinary Fahrenheit scale. The three constants of this formula are so chosen as to make the curve coincide with Regnault's curve at $\frac{1}{10}$lb., 45lb. and 300lb. per square inch, and to give at 212°F. the pressure about $\frac{3}{4}$lb. per square inch too high; it being considered that for engineering purposes it is more important to get a coincidence at low condenser pressures, at medium and very high boiler pressures, than at 212°. In using these graphic tables, however, readings should always be taken from the full in preference to the dotted curve. The pressures tabulated here are "absolute," *i.e.*, from zero (not in excess above atmospheric pressure).

3. Specific Volumes of Saturated Steam.—These are given in cubic inches per pound of steam; and the upper part (from 212°F. to 430°F.) is drawn out a second time with horizontal ordinates increased ten times to make it more readable. For this enlarged curve 100,000 on Scale V must be read to mean 10,000 cub. in. per pound.

4. Latent Heat of Evaporation of Steam.—Scale E gives this in foot-pounds of heat energy per pound of steam. It is nearly but not quite a straight line.

5. Total Heat of Saturated Steam from 60°F.—This is read to Scale E in foot-pounds per pound of steam. It is reckoned from 60°F., as this is the average feed temperature. Its horizontal ordinate is the sum of those of 1 and 4, and it is, therefore, also very nearly a straight line.

6. P (V − w).—The so-called latent heat tabulated in 4 is the total heat that has to be supplied to effect the evaporation; but not the whole of this is absorbed, because during the evaporation the steam does mechanical work in expanding against resistant surrounding bodies, and part of the heat energy supplied is immediately spent in doing this work. The amount of this work in foot-pounds per pound of steam evaporated is tabulated by the P (V − w) curve. It is plotted out twice: first, to Scale E, in order that its amount may be readily comparable by eye with the latent and total heats; and secondly, to ten times that scale, in order that its amount may be accurately read off, this being, perhaps, the most important of all the curves from a mechanical point of view. It runs from about 45,000 foot-pounds when the steam pressure is about $\frac{1}{4}$lb. per square inch, up to about 66,000 foot-pounds at 300lb. per square inch pressure. Its rate of increase decreases only slightly towards the higher temperatures and pressures. 66,000 being just double 33,000, it is useful to remember that one boiler mechanical horse power is afforded by the evaporation of $\frac{1}{3}$lb. of water per minute, or 30lb. per hour, to steam at 300lb. per square inch absolute pressure. This quantity is found by multiplying P, the pressure, by the excess of the volume of steam (V) over the volume of water (w).

7. $\left\{ \text{L} - \text{P}\,(\text{V} - w) \right\}$.—This is called the *real latent heat*. It is the apparent latent heat (L) minus the quantity of heat not really absorbed, but spent in doing mechanical work during evaporation. Scale E gives it in foot-pounds per pound of steam evaporated. It is the difference between Curves 4 and 6.

8. $\left\{ \frac{\text{L} - \text{P}\,(\text{V} - w).}{\text{V}} \right\}$.—This is the last quantity calculated per cubic foot of steam evaporated instead of per pound, as in Curve 7. It is often found more convenient to have it per unit of volume.

9. Total Heat from 60°F. *less* P (V − w).—This, also to scale E, is that part of the total heat which is really absorbed, the rest being spent in doing the evaporative mechanical work. It is the difference between Curves 5 and 6.

10. Ratio of P (V − w) to Total Heat from 60°F.—This is the proportion of the whole heat spent in raising the steam from feed temperature 60°F. that is developed in the form of mechanical work done during evaporation. It is the $\frac{\text{B.M.H.P.}}{\text{B.H.H.P.}}$, or boiler mechanical horse power divided by boiler heat horse power, explained in a series of articles by the author a few months ago (see *Industries*, Vol. III., page 1). This is a numerical ratio. To avoid multiplying scales, the volume scale is utilised for this curve, unity being represented by 10,000,000 on Scale V. Thus the ratio runs from ·053 at very low pressures up to ·073 at the top of the diagram.

11. Ratio of Total Heat to P (V − w), or $\frac{\text{B.H.H.P.}}{\text{B.M.H.P.}}$—This is simply the reciprocal of the last quantity. It is often convenient to be able to find this reciprocal by reference to a table such as this; indeed, this quantity is of more frequent practical use than 10. It is to be read by help of Scale V, 100,000 on that scale representing unity. Its value runs from 18·8 to 13·8.

12. Total Heat from 60°F. Divided by Latent Heat at 212°F.—In tests of boilers the actual evaporation is usually reduced to an equivalent evaporation of feed water taken at 212°F. into steam at same temperature. This reduction is performed by finding the ratio of the actual heat supplied in the boiler to each pound of water, taken here at 60°F. feed temperature, to convert it into steam to the latent heat of evaporation at 212°F., and multiplying the actual evaporation in pounds of water per pound of fuel by this ratio. For convenience in making this reduction this ratio is tabulated by this last curve. It is read on Scale V, 1,000,000 on that scale representing unity. The ratio runs from 1·11 to nearly 1·23.

(To be continued.)

THE LATE MR. THOMAS R. CRAMPTON.

It is with regret that we record the death of Mr. Thomas Russell Crampton. Mr. Crampton had been in failing health for some time before his death, and passed quietly away on the evening of the 19th inst. He was born in 1816, at Broadstairs, Kent, and after receiving a liberal education at a private school was articled to Mr. John Hague, of London, where he obtained a knowledge of mechanical engineering, and was at the time a fellow pupil of Sir Frederick Bramwell. After serving his pupilage he was engaged under the elder Brunel for several years, and afterwards with Mr. Gooch, under whose direction he designed the first locomotive for the Great Western Railway. He afterwards held a responsible position under Messrs. Rennie, and in 1848 commenced practice on his own account as a civil engineer. Between the years 1842-7 Mr. Crampton perfected the type of locomotive bearing his name, and in which a long boiler, outside cylinders, and a low centre of gravity are the essential and distinguishing features. A locomotive on this principle was built and run on the London and North-Western Railway, and was a special feature at the Great Exhibition of 1851, where it obtained for its designer the grand medal. In that year Mr. Crampton succeeded, under exceptionally difficult circumstances, in laying the first successful cable for a submarine telegraph between Dover and Calais. He undertook the whole engineering responsibility in this pioneer work of submarine telegraphy. Among the numerous other works executed by Mr. Crampton, either by himself or in conjunction with others, may be mentioned the Berlin water works, in which he was associated with the late Sir Charles Fox; the Ottoman Railway from Smyrna to Aidin; the Varna and Rustchuk Railway; the East Kent Railway from Strood to Dover; the Herne Bay and Faversham Railway; the Sevenoaks Railway to Swanley, and after the various lines became absorbed into what is now known as the London, Chatham, and Dover Railway, he was interested in the construction of other portions of that system. Mr. Crampton took an active part in the controversy on broad *versus* narrow gauges for railways, known as "the battle of gauges," in which he advocated the narrow gauge. Besides his improved locomotive, he invented a furnace for burning powdered fuel, revolving furnaces for the manufacture of iron and steel, brick making machinery, cast iron forts, and tunnel boring machinery. Mr. Crampton was a prominent member of the leading technical institutions, and, until his health gave way, took an active part in the discussions on the various subjects brought before them, especially those relating to matters which had occupied his attention in early life.

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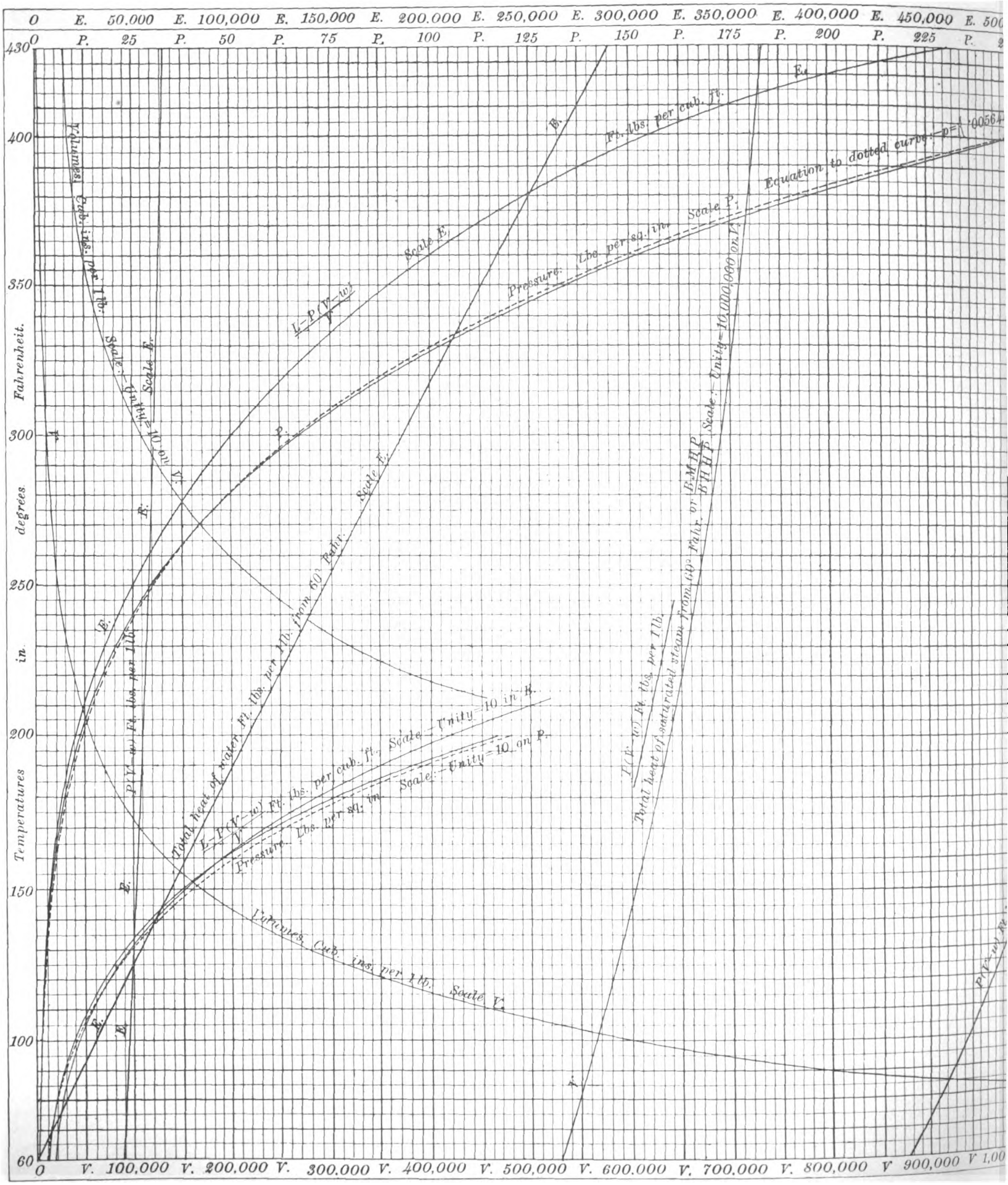
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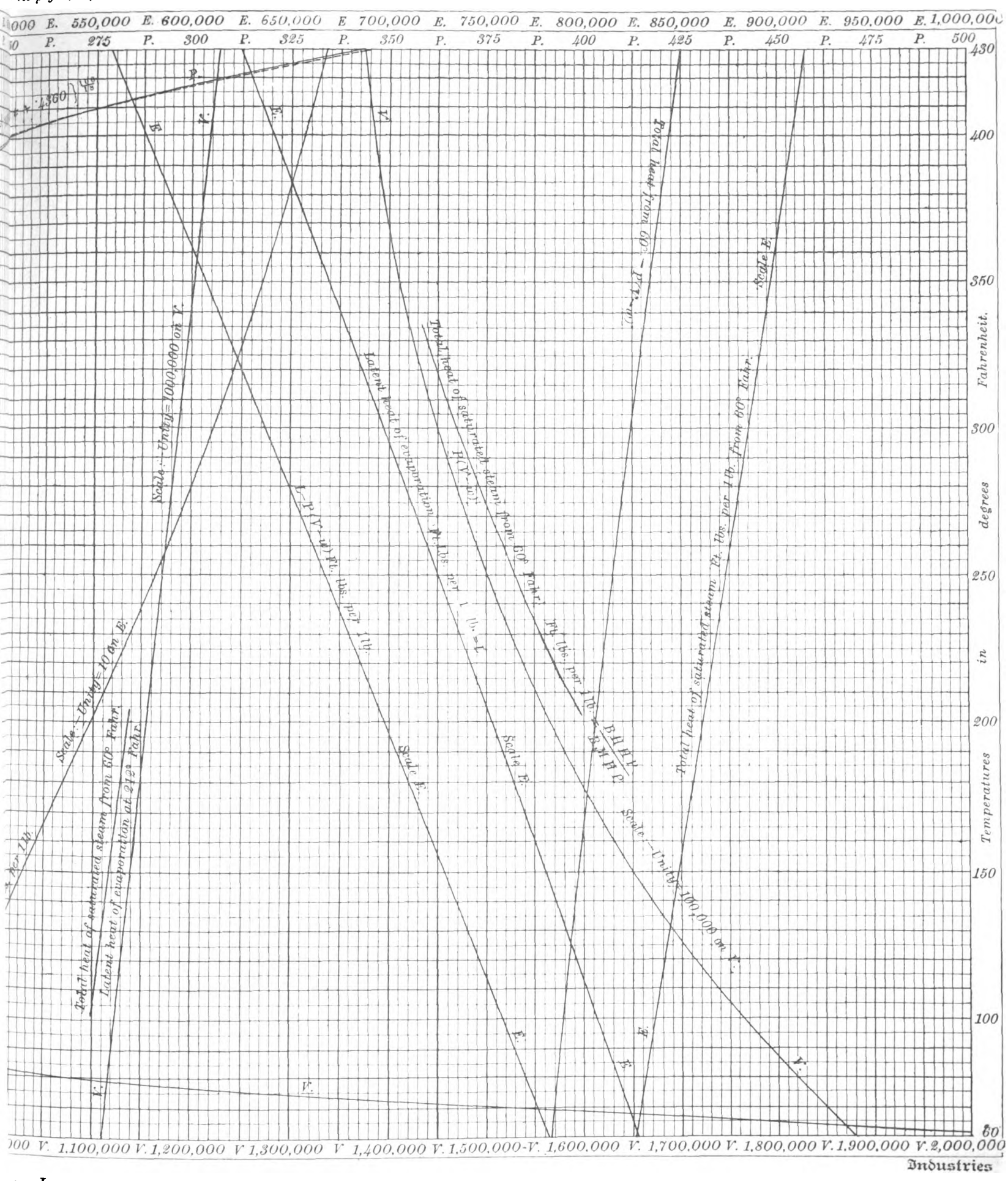
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ES OF WATER AND SATURATED STEAM.

R. H. SMITH.

(see page 426.)



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Offices for Publication:
22, Wellington-street, Strand, London, W.C.
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Advertisements:
London: 22, Wellington-street, Strand, W.C.
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Industries, VOLS. I., II., & III.

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FRIDAY, 27TH APRIL, 1888.

INDUSTRIAL ACTIVITY AND THE CONSUMPTION OF COAL.

IT is a generally accepted maxim that the consumption of coal at any given time is a true measure of industrial activity in the country in that period. Hence we find manufacturers and political economists constantly adducing as irrefragable evidence of reviving or languishing industry and commerce, the animated or depressed state of the coal trade; and we as often see colliery owners and those who distribute the produce, merchants and shipowners, anxiously watching for indications of the probable course of the coal trade among the circumstances and influences which determine that of the great manufacturing industries. Up to a certain point the reasoning of both parties is just. They know that some four-fifths of the coal consumed in this country is burned to generate steam, or to serve some other industrial purpose, and it is obvious that a greater or less production of manufactured goods must augment or diminish the demand for coal. But the question is not one of this degree of simplicity. The consumption of coal is, no doubt, a measure of industrial activity; but it is at the same time a measure, in some degree, of scientific progress. We have not gone on year after year burning a pound of coal to produce a certain effect. On the contrary, the effect produced by the pound of coal has constantly and steadily increased, in consequence of wider and more accurate knowledge. Hence, the standard by which we measure our industrial activity is continually changing. We have here an explanation of the blunder so often fallen into of late by writers and public speakers who have dealt with the question of reviving trade. The mineral statistics issued from the Mining Record Office are made to show that the recent period of depression in trade was, despite all statements of well informed persons, and other evidence, to the contrary, not only one of low prices, but also one of greatly restricted production; and the conclusion thus arrived at is made use of whereon to base a prediction concerning the immediate future of the coal trade. This erroneous teaching is a matter of more serious consequences than it appears at first sight to be; for not only does it tend to obscure the prospect and puzzle the inquirer, but false hopes are raised or undue depression caused in those who, from the active participation in our great national industries, have need of a true estimate of the influences operating to direct the course of events. This is true in a special manner of colliery owners and all occupied in the coal trade. For a long period of years the production of coal steadily increased, till in 1886 it reached the colossal figures of 160,000,000 tons. This was a quantity somewhat in excess of the requirements, and since that date the output has diminished. The falling off is attributed wholly to the depression of trade generally, which, by restricting production, occasioned a smaller consumption of fuel in the great coal consuming industries; and it is argued that the revival which is now in progress must necessarily be attended with a larger demand for coal. If this be a valid conclusion, we are on the eve of a period of increasing activity in the coal trade, and consequently of greater prosperity for the mining industry. But there is yet no sign of improvement, notwithstanding the generally admitted fact that trade and commerce have revived, and that there is now considerably more activity in some manufacturing industries than there was a year ago. How is this fact to be accounted for? The answer would seem to lie in the changing character of fuel consumption as a standard of measurement. And if it be true that we have in this circumstance a sufficient explanation of the apparent contradiction, we must cease to expect, for some time to come at least, a resumption of that progress which in the past has marked the development of coal mining in this country in the matter of output.

From an industrial point of view, one of the most noteworthy results of the growth of knowledge in recent times is the reduction in the quantity of fuel burned to produce a given result. The blast furnace practice of the present day, for example, contrasts strongly with that which prevailed at the beginning of the second half of the current century. Instead of 1·50 to 2 tons of coke, we have now but 0·80 to 1 ton consumed in the operation of smelting 1 ton of pig iron. The change has taken place gradually and continuously, so that we find a distinct and important improvement even when we take a shorter period for our comparison, say the last ten years. The full significance of this change will be perceived by considering it in relation to the annual production of 7,500,000 tons of pig iron in this country. A similar saving of fuel has been effected in other metallurgical operations. Of even greater importance than this progress in the science of metallurgy, is the saving effected in the cost of generating steam. Here our growth in knowledge has enabled us to make a still more striking contrast with past times. The adoption and extension of the compound system, combined with numerous improvements in the detail of boiler and engine construction, have led to economy in the matter of coal consumption so great that we shall be well within the truth in asserting that the weight of coal which twenty years ago it was necessary to burn to obtain one horse power in steam, now yields two horse power. The progress here indicated has been gradual, as in the case of blast furnace practice; that it has not occasioned a corresponding gradual shrinkage in the home trade in coal is due to the fact that its effects have been counteracted and masked by new applications of steam power throughout the same period. But we have now reached a stage of development in our industrial and commercial life in which comparatively few new applications are possible. The change from hand to machine labour is complete. Our country is covered with a network of railways that admits of no further important extension, and our commerce is restricted by the competition of foreign rivals. For this reason the effects of the reduced consumption of fuel to perform a certain amount of work are now making themselves felt, and hence proceeds the languor which persists in the coal trade despite the greater activity prevailing in other branches of industry. Let us take, as another illustration and proof of the truth we are seeking to enforce, the remarkable progress made within the last few years in marine engineering. Here the adoption of the compound system of engine, often in its highest development of triple expansion, and in a few recent instances of even quadruple expansion, has led to notable economy in fuel. In these circumstances we cannot assume that the 6,868,790 tons of coal shipped from our shores last year for the use of steamers engaged in the foreign trade, represents, when compared with the shipments of 6,400,594 tons in 1883, an increase of only 7·3 per cent. in the

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horse power expended in that trade. Thus we cannot validly deduce the conclusion, in this or in any one of the preceding cases, that a smaller consumption of fuel necessarily implies diminished industrial activity.

An obvious inference from the foregoing facts is that there must be a constantly increasing volume of trade to maintain the consumption of coal stationary in quantity. To put this truth in another way, a consumption of coal that is sensibly stationary over a given period implies a steadily increasing degree of activity in our manufacturing industries. In this way we may, without risk of error, use it as standard of measurement. The lessons, of no small practical utility, to be learned from this view of the question under consideration are briefly these: (1) The actual state of the coal trade, which shows little or no advance on that of 1887 and 1886, is not in contradiction with the evidence of reviving trade generally which we discover in other directions. On the contrary, it is to be accepted as proof of steadily increasing activity. (2) Colliery owners, colliers, and all occupied in the coal trade who are building up hopes of more active markets on the evidence of revival in our manufacturing industries, are probably preparing the way for bitter disappointment. A genuine and lasting revival of trade must be one which proceeds gradually and slowly, and such, we have reason to believe, is now in progress. Moreover, with the keen competition we have now to contend with, it is hard to conceive how a return to prosperity can be other than slow. But a progress of this character, for reasons already stated, is incapable of augmenting in an appreciable degree the consumption of coal in the country. Fluctuations there may and probably will be; but we are considering only average results. (3) Manufacturers may reckon on cheap coal for some years to come. Production is now slightly in excess of consumption, and there are heavy stocks at the pits. Under these conditions it seems in the highest degree improbable that within the next few years the circumstances of trade will so far change as to force the demand above the supply.

THE EDISON GLOW LAMP PATENTS.

The action of the Edison and Swan United Electric Light Company, Limited, *v.* Holland and others, was commenced at the Royal Courts of Justice, before Mr. Justice Kay, on Tuesday, the 17th inst., to restrain the infringement of Edison's patent for the filament, No. 4576 of 1879, and Cheesbrough's Sawyer Manns "flashing" patent, No. 4847 of 1878. The Attorney-General (Sir Richard Webster), Mr. Aston, Q.C., Mr. Moulton, Q.C., and Mr. Bremner, instructed by Messrs. Ashurst, Morris, Crisp, & Co., appeared for the plaintiffs; and Sir Horace Davey, Q.C., Mr. Finlay, Q.C., and Mr. J. C. Graham, instructed by Messrs. Renshaw, appeared for the defendants. Our readers will recollect that these two patents have already been the subject of litigation, in the case where Messrs. Woodhouse & Rawson were the defendants, and in that case the plaintiffs were successful, both before Mr. Justice Butt, who tried the case in the first instance, and subsequently in the Court of Appeal. The present case is one of very considerable importance both to the public and to the electrical world, because if the defendants succeed in establishing the invalidity of those patents, the manufacture of glow lamps will be thrown open to the public.

The case came into Court in the following manner: Mr. Holland, the well known caterer, had purchased the lamps complained of by the plaintiffs from the Jablochkoff Company, for the purpose of illuminating the Albert Palace at Battersea; that company had purchased them under an indemnity from the Anglo-American Brush Electric Light Corporation, Limited, and the last named company obtained leave to defend the action, and are therefore the real defendants in the action. The Attorney-General opened the case by describing the inventions contained in Edison's and Cheesbrough's specifications, and pointed out that among the merits of Edison's invention, one of the most conspicuous was the carbonising of the filament after it had been formed into a filament. He dwelt upon the fact that no incandescent lamp which could be called a practical success, had been made, or even described, before the date of Edison's patent, and that soon after that date such lamps were made and sold, and have since been made and sold in millions. He pointed out that, so far as the plaintiffs were aware, the only lamp which came at all near to Edison's was one which had been made by Mr. Swan, some time very early in 1879 or in the autumn of 1878, at Newcastle, where it had been publicly exhibited by him at lectures. This lamp, which was produced in Court, contained a thin straight pencil of carbon of circular section about 1¼in. long and $\frac{1}{25}$in. in diameter, enclosed in a glass egg-shaped vessel, from which the air had been exhausted. The carbon pencil was supported at each end by platinum wires fused into the glass. Sir Frederick Bramwell was the first witness called on behalf of the plaintiffs. He was examined by Mr. Aston, and cross-examined at some length by Mr. Finlay, who endeavoured to elicit from him the fact that Edison had not given sufficient information to enable that hypothetical person, the skilled workman, to carbonise a filament, more especially by reason of his having omitted to state that in carbonising it is absolutely necessary to take elaborate precautions to exclude the air from the vessel in which the filament is carbonised. Sir Frederick Bramwell stated that in his opinion the vessel in which the carbonisation was effected might be packed with sand, so as to exclude the air, and that this would succeed. Sir Frederick Bramwell was asked whether he had ever seen any lamps made in this country according to Edison's specification pure and simple, without any additions; and although he at first stated that he had seen one lamp so made out of a carbonised cotton thread, he subsequently admitted that the cotton thread which he had seen carbonised had been treated with sulphuric acid so as to parchmentise it before carbonisation, and that he had never seen Edison's directions pure and simple followed. Sir Frederick Bramwell was then pressed to point out the advantages to be obtained from the use of a filament, and was unable to point out any except that of high resistance. The witness admitted that electricians at the date of the patent were perfectly familiar with the laws of electricity, and knew both how to obtain high resistance, and what were the advantages resulting from it; and this was more especially the case with Mr. Lane-Fox, who had explained the whole theory of electric lighting in a marvellously clear manner in several specifications of his patents taken out before the date of Edison's patent. In fact, had Mr. Lane-Fox only made use of the term carbon in his specifications, he would apparently have given all the information to the world which the plaintiffs now wish to place to the credit of Mr. Edison. The witness was asked to explain in what respect Mr. Swan's lamp differed from Edison's. At first the witness endeavoured to differentiate them by suggesting that the pencil of Swan's lamp had been cut out of a larger piece of carbon, that is to say, had not been in the form of a pencil before it was carbonised; but here again, when pressed, he admitted that he knew little about Swan's pencil, and that it might have been made either way. Upon various chemical points, arising on both Edison's and Cheesbrough's specifications, more especially upon a very remarkable passage in the latter—in which Cheesbrough says that his invention is not confined to the treatment of carbon alone, but includes many infusible non-conducting bodies—Sir Frederick Bramwell gave no opinion, preferring to leave them to the chemical witnesses. The next witness called on behalf of the plaintiffs was Dr. John Hopkinson, who agreed generally with Sir Edward Bramwell except upon the question of the use of sand for excluding the air in carbonisation. He thought that a competent working man would know that he must avoid using sand, the use of which would certainly lead to failure in the case of fine filaments, inasmuch as they would, without doubt, be burnt in the carbonising vessel by the air contained in the interstices of the sand. Dr. Hopkinson expressed a decided opinion upon the chemical questions arising on the specifications of both Edison and Cheesbrough; but, like the last witness, he admitted that he had neither made nor seen any experiments on the subject. Mr. John Imray was then called. He too had not made any lamps according to Edison's specification, but he had made certain experiments as to the electrical properties of certain lamps which had been made by some person in the employment of the plaintiffs, and which, he was told, had been made according to Edison's specification. Nearly all these lamps had the globes dimmed and discoloured. Sir Horace Davey asked the witness to point out any material point in which one of the lamps, produced by Mr. Imray, made from cardboard and said to be constructed according to Edison's specification, differed from Swan's lamp. The witness was apparently unable to point out any material distinguishing feature. Mr. Gimingham was next called, and stated that he had followed precisely almost all the different methods described by Edison for making a filament, and had succeeded in the whole of them. He further stated that he had tried the lamps so made for duration, and found the average life of the lamps to be a considerable number of hours. The last witness for the plaintiffs was Dr. Fleming, the electrician of the plaintiffs, who agreed in the main with the evidence given by the others. He, however, stated that secret processes were used in every stage of the manufacture of lamps by the plaintiffs, an admission which was scarcely consistent with the opening remarks of the Attorney-General, that millions of lamps were made by the plaintiffs according to Edison's specification.

No other witnesses were called, and Mr. Aston stated that that closed the plaintiffs' case. Sir Horace Davey then opened the defendants' case. He said that he intended to rely upon the following grounds, viz., that Edison's patent was bad for want of novelty; that his specification did not contain sufficient directions to enable a competent working man to make a filament of carbon; and that if the Court construed the specification in the way in which he construed it, there was no infringement, but if it was construed as the Court of Appeal had construed it, he would admit infringement. The case had not concluded at the time of going to press.

CANAL EXTENSION.

In previous issues we have examined the relative merits of canal and railway carriage, and pointed to the necessity, if cheap transit is to be obtained, of a healthy competition between the two systems of conveyance. We described in some detail the scheme for improving the Worcester and Birmingham Canal, and that for opening up communication between Birmingham and London, by an extension and alteration of existing waterways. Reference has also been made to alternative suggestions for adopting the route to Liverpool, or *viâ* the Trent to Hull. If the industrial position of the Midlands is to be maintained and strengthened, the serious inception and rapid completion of one of the projects in question appears to us to be a matter of the highest moment, and for reasons stated in our issue of the 23rd ult. the London route has many advantages over the other schemes, and is best calculated to meet the immediate requirements of the district which it is intended to benefit. A point which engaged the attention of the Ship Canal Inquiry Committee of the Birmingham Town Council is of primary importance, viz., the adoption of adequate precautions to prevent the subsequent acquisition by the railway companies of whatever canal communication is decided upon. In the report of this committee we find the following suggestion made: "The plan of carrying out the work by means of a public trust appears to the committee most likely to insure and preserve the interests of the town, and secure the lowest possible rates to traders and consumers; and it is probable that with such a trust under the operation of a sinking fund, the capital account being ultimately extinguished, the canal might become almost free, such tolls only being levied as would be sufficient to provide for its maintenance. The committee therefore recommend that they be empowered to take such steps as may appear desirable to induce the Government either to insert clauses in their Railway and Canal Traffic Bill, or to introduce a separate measure authorising the formation of canal trusts."

A great contrast is apparent if we compare the advance which has been made in the development and improvement of railway transit with the stationary condition of canal carriage during the past half century. During that period in the former case the rate of travelling has increased from three to four fold, both in the case of goods and passengers. On the other hand, transit by canal is now little less cumbersome and protracted a process than it was fifty years ago; and it is apparent that until our waterways are so widened and extended as to admit of steam propelling power, no material improvement can well take place. While we consider the Birmingham to London route most suited for development in view of the immediate requirements of the Midland district, we may direct attention to a valuable pamphlet, written by Mr. Samuel Lloyd, under the title of "National Canal between the Four Rivers." In it is elaborated a scheme for the intersection of the Midland Counties by water communication, of sufficient ordinary depth to allow of the passage of small steamers, between the Thames and the Mersey and the Severn and the Trent. The contents of this work will doubtless do much towards educating public opinion with regard to the necessity and practicability of taking advantage of England's natural position to insure a complete system of efficient canal transit as a competitor and concomitant of railway carriage. While, as our columns indicate, we do not ascribe all the existing depression in trade in the Midland district to the lack of means for the cheap transit of goods, we point to the removal of this drawback as being likely to afford some alleviation to that and all land locked positions.

Bismarck's Paper Mills.—The Varzin paper mills, the property of Prince Bismarck, which were destroyed by fire last year, have been re-built at a cost of £50,000. These mills are capable of turning out 15 tons of paper a day.

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Letters to the Editor.

AN APPEAL FOR THE ROYAL VICTORIA HALL BY LADY FREDERICK CAVENDISH.

TO THE EDITOR OF "INDUSTRIES."

SIR,—May I ask a little of your valuable space for calling attention to a proposed memorial to one whose death was a national loss—the late Mr. Samuel Morley? So deeply was he impressed with the dangers arising from the extremes of wealth and poverty, and the dreary lives led by the very poor, that he used often to speak of Society as existing on a volcano, and spared neither labour nor money to lessen the evils he deplored. Among the many good works in which he was engaged none was nearer to his heart than the Royal Victoria Hall, which has for its object to brighten the lives of the poor by providing healthy recreation (apart from temptations to drink), and opportunities of instruction for those who desire them. The work has been carried on under many difficulties for more than seven years. Once a gift of £1,000 from Mr. Morley (towards buying the remainder of the lease) saved it in a crisis, and from that time he regularly took the chair at the committee meetings. It has occurred to those who worked with him there, that there could be no more fitting memorial of his unselfish life, none more in accordance with his own wishes, than to establish this work on a permanent basis. During his lifetime he caused inquiries to be made as to the possibility of buying the freehold; but the then owner refused to sell, and there appeared to be no prospect for the future, but that the hall should relapse at the end of the lease (which has now ten years to run) into the state from which the present trustees rescued it. What that state was we may learn from the pages of "Alton Locke," or from the reports of any of the police who frequently helped to take thirty or forty from the old theatre to the lock-up on public holidays. But an opportunity offers now of making a return to the old horrors impossible. The ground landlord is willing to sell the freehold, and the trustees' committee propose to raise a memorial fund to buy it. If they succeed, the Charity Commissioners will take over and manage the hall for the future, as part of the scheme for People's Palaces in South London. In that case there would be no more appeals to the public for the Royal Victoria Hall; its future would be provided for, and Mr. Morley's name associated for ever with the work he did not live to finish. But the proposal is for the Commissioners to meet the public with an endowment, after the freehold has been bought, and for this £17,000 must be raised, and unless it is raised by September a deposit of £500 (already paid) will be forfeited. The value of the freehold, we are told, is much more than this. The landlord has abated several thousands in consideration of the public utility of the object, and £4,000 is allowed for the present value of the lease, which is freely given by the trustees and committee. The £17,000 covers the remainder of the price, law expenses, &c. Towards this, individuals on the committee have promised £3,500.

I will not trespass on your space with details of the entertainments, concerts, lectures, technical and other classes, temperance societies, working men's club, &c., all flourishing at the Hall. Let those who wish to know come and see. The popularity of the place is shown by the fact that £1,825 was taken in nine months for admission at the doors, and chiefly in sums of twopence and threepence. All who wish to help in perpetuating the name of a good man in the way he would have chosen, are invited to communicate with Miss Emma Cons, hon. sec., at the Hall, Waterloo Road, S.E. The work is like Mr. Morley's generous sympathy, inasmuch as it takes no account of differences of creed or party, so that all may fitly share in it.

Yours &c.,

LUCY C. F. CAVENDISH.

London, 21st April, 1888.

THE CORROSION OF PROPELLER BLADES.

TO THE EDITOR OF "INDUSTRIES."

SIR,—I was very much interested in the abstract you gave in your last week's issue of the paper by Mr. W. C. Wallace on the material best suited for propeller blades, and should be glad if any of your readers could tell me where—that is, on what portion of the steel blade—corrosion generally takes place. Is it found on the side nearest to the hull or the opposite side? also is it chiefly near the tip of the blade or near the boss? I ask this as I think it is quite possible to prevent it, and at a comparatively small cost. I would also like to know whether steel blades are cast or forged to shape.

Yours, &c.,

Bolton, 24th April, 1888. O. KAY.

PROPOSED LEGISLATION FOR STEAM BOILERS.

TO THE EDITOR OF "INDUSTRIES."

SIR,—The rejection of the Steam Engines and Boilers Bill by the House of Commons, on the 17th inst., is a gratifying confirmation to me of the correctness of the opinion expressed in my letter published in your issue of the 9th ult.—"that the question of certificating attendants might be dismissed from consideration." In face of the overwhelming evidence as to non-requirement of State interference in this matter, it was difficult to imagine any other result. It appears also to be generally understood that Lord Stanley's Registry and Inspection of Boilers Bill is dead, and will not be brought forward by Sir Michael Hicks-Beach; but on the other hand, Mr. Provand, member for one of the Glasgow divisions, has obtained leave to bring in a Bill to provide for compulsory inspection of steam boilers; but as it does not appear to be yet printed, its provisions are so far unknown.

During the years 1882 to 1887 inclusive, 150 deaths have been caused by boiler explosions and accidents to such steam apparatus as are reported upon under the Boiler Explosions Act, 1882. These numbers are taken from the Assistant Secretary to the Board of Trade's fifth annual report. From other statistics I find that 200 persons are killed and about 3000 injured annually by accidents in the streets of London, from various causes. Yet no member of Parliament seems to have discovered what opportunities for Bills, talk, and notoriety might be obtained from this fact. Like the famous authors of the Architects' Registration Bill, some gentlemen, specially qualified by knowing nothing about the subject they are about to take in hand, might bring in a Bill to register and certify all coachmen, cab, 'bus, van, and cart drivers, and to provide for the examination of any person who took reins in hand. As but 150 lives have been lost in five years by boiler explosions, it may be fairly assumed that it would take from one to two years more to increase the number to the appalling annual death rate by accidents in the London streets; and yet no one proposes to make any laws, restrictions, or rules regarding the matter, although six or seven times more fatal in its results. Instead of spending about £50,000,000 capital, and imposing £500,000 annual taxation, for the purpose of attempting to prevent boiler explosions causing an average of thirty deaths per annum, is there not here verge and room enough for a truly valuable effort by M.P.'s in search of a cause and a mission?

In my previous letters to you on this subject, I have constantly urged the importance of the Board of Trade holding "Formal Inquiries" under the Boiler Explosions Act. The first "Formal Inquiry" was held on the 11th, 12th, and 13th January, 1888, upon the explosion of a "Rastrick" boiler at Dudley, which happened in October, 1887. No report, however, has so far been made public, although it is now about six months since the explosion occurred, and upwards of three months since the inquiry was held; this is an admirable instance of the manner in which the Act has been and is being worked—upwards of five years elapse before a "Formal Inquiry" is ever held. Will it be as long before the first report is issued? Why make a formal inquiry at all after so many years, if there has been no sufficient reason in the interim. The Dudley explosion certainly offered no special features rendering it more deserving of notice than many others which have occurred during that time. The ways of the Board of Trade, in relation to the Boiler Explosions Act, are undoubtedly dark, and cannot be "understanded of the people."

Last week, in your extremely interesting and valuable letters on "Foreign Industries," it is stated that "In the beginning of 1883 a law was passed putting boilers erected within the town of Vienna under police regulations; but this law was found to impose too many restrictions upon the owners of small boilers, and thus to damage domestic industries. The owners of small boilers have repeatedly asked for an amendment of the regulations, and now the Vienna Society of Engineers have taken the matter in hand, and, at their last meeting, they resolved to petition the Ministry to pass a new law which would facilitate the employment of small steam boilers." This information is opportune, and supplies just the kind of evidence which might be expected of the result of governmental interference with the working of steam boilers. Here we have the same tendency, as in Lord Stanley's Bill, to oppress the comparatively defenceless small steam user, allowing railway companies and wealthy corporations to take their own unrestricted courses, which should be sufficient warning to the manufacturers and steam users of this country.

Yours, &c.,

Manchester, 21st April, 1888. ECONOMISER.

THE TESTING OF STEEL.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Metallurgists and manufacturers are often confronted when testing steel with results contrary to previous experience, and which do not always appear capable of explanation, either from variations in chemical composition, or the methods of working. For example, it is within my experience that a steel containing traces of silicon carbon 0·17, sulphur 0·03 to ·06, phosphorus ·06 to ·07, manganese 0·40, after corresponding for a time to the mechanical test required, viz., a tensile strength of 27 to 30 tons per square inch, suddenly showed an increase of tensile strength of 31 to 35 tons per square inch, and it was only by reducing the percentage of carbon to ·12 or ·13 that the steel could be made to stand the normal test of 27 to 30 tons tensile strength, while the other constituents remained the same. It may be here noted that sulphur, unlike phosphorus, appears not to affect tensile strength. Steel containing sulphur ·16 per cent., carbon 0·12, stood a breaking stress of 27·15 tons. Another sample containing sulphur ·05, carbon ·13 per cent., stood 27·26 tons. The other constituents, phosphorus and manganese, were practically the same, with only a trace of silicon. The cause of this sudden change in quality could not on inquiry be satisfactorily explained. The steel made at various periods for this particular test was always free from silicon. The sulphur never exceeded ·07, and the phosphorus from ·06 to ·07 per cent. It may be reasonably inferred that the variations in sulphur, judging from the results of testing the abnormal sample containing ·16 per cent. of sulphur, could have no appreciable effect.

I have no doubt that these discrepancies can be confirmed; indeed, I believe it is an open secret that manufacturers have no really reliable chemical method or process whereby steel of definite mechanical quality can be manufactured, consequently they have no resource left but that of continuous mechanical testing and repeated chemical analysis. I understand that some have even gone so far as to altogether repudiate chemical analysis, and assume that iron possesses some unknown property insensible to such analysis, and in some degree beyond the control of the manufacturer. Various fanciful names, such as "body," "nature," "temper," &c., have been assigned to this unknown constituent, or, perhaps, mythical property of iron; but the book has not yet been written which fully explains or defines it. It is often assumed that these unaccountable variations may be due to overheating or undue oxidation; others again maintain that the metal has not been heated sufficiently, or unequally heated, or improperly annealed; in fact, on examination of such steel, experts usually state that the discrepancy observed must be ascribed to one of the causes I have named. It will thus be seen that the anxious investigator is forced to leave matters pretty much as he finds them, and the weary round of trials and tests has to be repeated until in some haphazard manner the object in view has been attained. Having explained the difficulty of steel makers, I may say that I think it probable that a plausible explanation of these differences may be traced to variations in temperature, and that, strictly speaking, steel of a given chemical composition requires a certain temperature at which it must be worked to insure good results. But the question is, What is this temperature? For without knowing it we are practically helpless, and still remain under the domain of "rule of thumb" practice. It appears, however, possible that on due consideration some clue may be obtained to the temperature required. It will, I think, be granted that the fusion point of iron or steel varies with the quantity of foreign matter alloyed with the pure iron; but while admitting this it may be urged that differences only amounting to a few hundredths per cent. of carbon, silicon, or other elements would not materially alter the fusion point. As the results of a somewhat extended experience both in the rolling and heating of steel, I think it probable that this may not be so. All persons daily engaged in manipulating either steel or wrought iron know well that hot or cold rolling makes a great difference, and that the critical welding heat point of the metal admits of but a very narrow limit. In the days of puddling the regulation of temperature was a most important factor. The adjustment of the proper quantity of fettling—the oxide of iron necessary for the oxidation of carbon and silicon, and the removal of phosphorus and other material—could be easily done; but the adjustment of the critical temperature for balling and rolling, so as to secure good results, required some care. More especially in the manufacture of puddled steel it was found that a lower degree of heat sufficed for the balling, &c., which was due to the simple fact that the fusion point of steel was lower than that of wrought iron. At the heat required for the latter the steel remained in a fluid or semi-fluid state, and even with this knowledge to guide the operator we know that it was often a matter of great practical difficulty to decide on the critical point of temperature specially suitable for the best work. I may refer to the fact that the practice at different Bessemer steel works differs in some degree, and that with notable variations in chemical composition rails corresponding to given fixed tests are made. This is especially noticeable as regards silicon, steel containing a sensible quantity of silicon being passed at one works, whilst it is rejected at another, although the same person may conduct the tests in each case. As before suggested, a clue to some of these discrepancies may be traced to variations of temperature. It is well known that steel may be seriously damaged either by under or over-heating. In the first instance the steel may be too hard to pass through the rolls, or even if passed through it may not be sufficiently plastic to yield readily to pressure. We may in that case imagine that minute cracks are formed, which cause a corresponding deterioration in strength. On the other hand, it is known that if we heat steel beyond a certain point it falls to pieces when manipulated, and the reason of this is apparent, for the metal is approaching to the semi-fluid state, and therefore, for the reason given when referring to the puddling process, it cannot be rolled without a reduction of temperature.

It seems, therefore, that for the sucessful working of steel it is not enough to rely entirely on chemical analysis or on simple experience. The foregoing facts would seem to indicate that steel must be worked at a certain fixed, but as yet unknown, temperature below its fusing point, at which heat the flow of heated metal undergoing compression and elongation in the rolls is such as to insure the best practical results. It also follows that if the degrees of heat between these points can be ascertained, it may only be necessary to ascertain the fusion point of any other unknown sample of steel, from which the rolling temperature can be determined; for the welding heat will obviously be a constant range of temperature below this. It seems, therefore, probable that the discrepancies we have referred to are simply due to differences in the temperature of the heating furnace—the welding or rolling heat in one case suitably corresponding to the fusion point of steel with ·17 per cent. of carbon, and in another to that of steel having ·12 to ·14 per cent. of carbon.

Yours, &c.,

METALLURGIST.

South Wales, 20th April, 1888.

CLYDE SHIPBUILDING FOR MARCH, 1888.

THE heavy contracts booked in the autumn are now beginning to tell upon the tonnage launched. In March sixteen vessels were launched, with an aggregate tonnage of 25,015. Nearly one-half of this large tonnage was composed of the 10,500 tons of the "City of New York," built by Messrs. J. & G. Thomson, and launched during the month. The fresh contracts booked during March include a steel screw steamer of 4000 tons, to be built by Messrs. D. and W. Henderson & Co., Meadowside; one of 2800 tons, to be built by Messrs. Russell & Co., of Greenock; a fast paddle steamer for channel service from Dover to Ostend, to be built by Messrs. Denny Brothers & Co.; a screw steamer of 1200 tons, to be built by Messrs. Simons & Co., Renfrew; a screw steamer of 500 tons, to be built by the Ailsa Shipbuilding Company. These and other orders bring up the total of new contracts to rather over 12,000 tons.

The following is a list of the vessels launched during the month: "Algonquin," steel, 1800 tons, built by Messrs. Napier, Shanks, & Bell, for Messrs. Thos. Marks & Co., Port Arthur, for service on Lake Ontario; "Bio-bio," steel, twin screw, 750 tons, built by Messrs. R. Napier & Sons, for the Compania Sud Americana de Vapores, Valparaiso; "Brunner," steel screw, 550 tons, built by Messrs. Macarthur & Co., Paisley, for Mr. Martin Kennedy, New Zealand; "City of New York," steel, twin screw, 10,500 tons, built by Messrs. J. & G. Thomson, for the Inman and International Steamship Company, Limited; "Conscript," composite, screw, 750 tons, built by Messrs. A. Macmillan and Sons, for mail and passenger service on coast of Newfoundland; "Domira," steel, 1800 tons, built by

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Messrs. Alexander Stephen & Sons, for Messrs. Maclay and Macintyre, Glasgow; "Pharaon" and "Philœ," hopper barges, each 400 tons and 300 h.p., built by Messrs. Lobnitz & Co., Renfrew, for the Suez Canal Company; "Princess Henriette," paddle steamer, 1250 tons, built by Messrs. Denny Brothers & Co., for the Belgian Government postal service between Dover and Ostend; "Princess Louise," steel, 900 tons, built by Messrs. D. & W. Henderson and Co., for Messrs. M. Langlands & Sons; "Saikio Mara," steel, 2800 tons gross, built by the London and Glasgow Shipbuilding and Engineering Company, for mail service in Japan; "Virginia," steel, 1800 tons, built by Messrs. Russell & Co., for Mr. Frederick Woods, London; Nos. 259 and 260, steel, screw steamers, built by Messrs. Simons and Co., for passenger service in the Mediterranean. Sailing vessels: "Olymp," steel, 1665 tons, built by Messrs. Chas. Connell & Co., Scotstown; "Moss Rose," three-masted schooner, 150 tons, built by the Ardrossan Shipbuilding Company. We append our usual statistical table:

MERCANTILE MARINE.

	Steamers. No.	Tonnage.	Sailing vessels. No.	Tonnage.
United Kingdom	4	14,000	1	150
Colonies	3	3,100	—	—
Belgium	1	1,250	—	—
Egypt	2	800	—	—
South America	1	750	—	—
Japan	1	2,800	—	—
Foreign (destination withheld)	2	500	1	1,665
March, 1888	14	25,000	2	1,815
March, 1887	16	11,697	4	7,500

COAL, IRON, AND COGNATE INDUSTRIES.

THE Board of Trade returns for the month of March and the first three months of the present year are now before us. The total value of the imports for the month shows a decrease of £204,109, as compared with March of last year, and of the exports an increase of £45,224. For the three months there is an increase of £4,589,039 in the imports, and of £2,557,450 in the exports, as compared with the corresponding period of 1887. The total quantity of iron and steel exported in March was 295,418 tons, a decline of 47,516 tons as compared with 1887, and an increase of 40,208 tons with 1886. For the quarter the total was 866,005 tons, valued at £6,173,312, a decrease in quantity of 27,428 tons, but an increase in value of £686,815, as compared with the first three months of last year, and an increase of 167,332 tons and £1,060,099 in value as compared with the corresponding period of the previous year. We append our usual tabular statement.

	Month of March. 1888. £	1887. £	Three months. 1888. £	1887. £
Pig and puddled	167,147	229,673	393,617	549,731
Bar, angle, &c.	144,775	123,458	415,385	325,030
Railroad	327,836	272,122	1,196,674	782,816
Cast and wrought	404,333	393,512	1,184,953	1,039,781
Hoops, sheets, &c.	343,253	246,211	962,942	692,469
Steel, unwrought	120,036	207,577	338,001	551,821
Tin plates	491,906	451,656	1,312,822	1,047,303
Unwrought copper	161,858	84,007	594,916	233,564
Coals	768,187	818,371	2,277,503	2,215,948

The above figures must, on the whole, be regarded as satisfactory proof of an improvement in our foreign trade. In the details of the returns there are one or two points which merit the attention of traders interested in the industries under review. We have frequently pointed out the probability of the iron masters of the United States finding themselves in a position to satisfy the bulk of the home requirements of that country, and the material falling off in our exports of crude metal, both iron and steel, is mainly due to the increasing independence of that market. On the other hand, it is gratifying to note that, recognising this situation, British traders have been able to more than balance the falling off in the demand for crude metal from the American Union by an appreciable increase in their exports of railroad and finished iron to other centres of consumption, amongst which may be mentioned India, Japan, and the Argentine Republic. The augmented value of the exports of unwrought copper is, of course, due to the action of the French syndicate with regard to prices, which have advanced more than 100 per cent. during the last few months. The maintenance of our export coal trade, in face of the keenest competition by Continental colliery proprietors, is a gratifying feature of the returns. In this connection it may be noticed that while the coal industry in England is being affected by the operation of the new Mines Regulation Act, in Germany also legislative enactments, dealing with mining, have recently passed into law; and now in France and Belgium as well we hear of proposals in the same direction.

Turning to the home markets, we can only describe a retrospect of the quarter as an unpleasant one, and the outlook for the immediate future as anything but satisfactory. The year opened with promises of a distinct revival in trade, and the January quarterly meetings at the different centres of the iron trade were noticeable for the firmness of makers at somewhat advanced prices. Those held a few days ago afford indications only of a retrograde movement. At Wolverhampton and Birmingham both pig iron and finished iron were unsaleable at anything above the lowest rates of 1887. In the North the price of Scotch warrants is 3s. below the opening prices of 1888, and during the past twelve months stocks of iron in Connal's stores at Glasgow have increased by nearly 110,000 tons. The price of Middlesbrough pig iron stands at about 32s. per ton. This condition of things is mainly due to the fact that the anticipated revival in trade, and the improved prices which obtained in January, called into activity a portion of the powers of supply which were then lying dormant. For instance, during the quarter there have been twelve additional blast furnaces blown in. The result is that, as the requirements of consumers expand, the productive capacity of the country likewise increases, and the adjustment of the relations of supply and demand is thereby retarded. While we conclude this article by using the words of one which we published in our issue of April 22nd, 1887, viz., that "so far as we have been able to judge, the condition of the iron trade is at this moment very nearly as bad as it was towards the close of last year," still encouragement may be gleaned from the consideration that the process just referred to is a necessary prelude to a stable revival in trade, as, before such a revival can occur, the requirements of consumption must overtake a normal power of supply, and this would certainly include a proportion of that now lying dormant.

ELECTRIC LIGHTING AT THE VICTORIA HOTEL, MANCHESTER.

THIS elaborately finished hotel has recently changed hands, and the Manchester Corporation as owners, in leasing the hotel to the present proprietors, arranged that the principal rooms and passages should be lighted by the electric light. As the building has for some time been provided with ample boiler power, the question of providing driving power for the dynamos was to some extent simplified. The electric light installation now erected is made up of two independent plants fixed in the basement, each plant being capable of supplying current for 250 16 c.p. lamps. Connected with each plant is a 12 h.p. Tangye vertical engine, fitted with improved continuous lubricating appliances, and driving a compound wound Crompton dynamo by means of a linked belt. The dynamos are arranged to run at 700 revolutions per minute, with the engine running at only moderate speed.

Distributed throughout the hotel are some 400 incandescent lamps; but the chief feature in connection with the lighting arrangements is in the large billiard room, where ten tables are electrically lighted, the incandescent lamps taking the place of the usual ring of burners placed over each table. The grill room and large dining hall are lighted by three-armed pendant fittings, suspended from the ceilings by flexible twin conductors. These fittings are of light design, and contrast very favourably with the existing heavy gaseliers. The switches, cut-outs, and terminal blocks from which the pendant fittings are suspended are all mounted on porcelain, with neat covers of the same material. The casing carrying the wires has been neatly fixed around and along the mouldings and cornices, and is hardly perceptible.

The contract for this work was placed in the hands of the Manchester Electric Supply Company, Limited, and has been carried out under the superintendence of Messrs. Holme & Vaudrey, the engineers to the company.

Books Received.

Transactions of the Institute of Engineers and Shipbuilders in Scotland. Meeting, 24th January, 1888.

The Technical Schools (Scotland) Act, 1887, and Some of its Relations to Elementary and Higher Education. By HY. DYER, C.E., M.A. Read before the Philosophical Society, Glasgow, 30th November, 1887.

Marble Decoration: A Hand Book for Students. By GEO. H. BLAGROVE. London: Crosby Lockwood & Son.

Potts' Mining Register and Directory for 1888. North Shields: W. J. Potts, Colliery and Nautical Publisher, Atlas Works.

Proceedings of the Cleveland Institute of Engineers. Session 1887-88. No. 2.

The Phœnix Fire Office Rules for Electric Light Installations. Twelfth Edition. London: Phœnix Fire Office.

The Mercantile Year Book and Directory of Exporters, 1888. Edited by WALTER LINDLEY JONES. London: Lindley Jones & Co.

The Merchandise Marks Act, 1887. By HOWARD PAYN. London: Stevens & Co.

A Text Book on Steam and Steam Engines. By ANDREW JAMIESON, M.Inst.C.E. London: Chas. Griffin & Co.

Sell's Dictionary of the World's Press and Advertisers' Reference Book. London: 167 and 168, Fleet-street.

Reviews.

A HAND BOOK TO COTTON SPINNING. By J. E. Holme. Manchester and London: JOHN HEYWOOD.

This little book is intended to furnish the carding and spinning overlooker with a series of rules by which the calculations necessary for the various processes of spinning can be made. The rules are stated in plain language, and are supplemented by examples worked out so clearly and simply that no one possessing a rudimentary education need find a difficulty. In addition to these rules and examples the author gives brief descriptions of the various machines, with a number of hints as to their management which are eminently practical, and founded, no doubt, on personal experience. In dealing with the revolving flat carding engine, Mr. Holme has described a special machine, which is not the one in most general use, nor can it be taken as a leading type. This, we think, is a mistake, as it is always well in a work of this description to avoid specialisation, seeing that the aim is to give information which may be generally valuable. This, however, is the only adverse feature in a book which is likely to be of good service to cotton spinners. At the end of the book are a number of tables of useful character.

AMERICAN CHEMICAL JOURNAL. Vol. IX., Nos. 3 and 4 Edited by IRA REMSEN, Baltimore.

These two numbers of the ninth volume of the *American Chemical Journal* contain several papers of great interest to the theoretical chemist. The two papers by Professor A. Michael on the subject of allo isomerism deserve careful reading, as does also the reply to the former of the two papers by R. Anschütz, of Bonn, concerning the isomerism of fumaric and maleic acids. Professor Michael also contributes papers on "the action of phosphorus pentachloride on the ethers of organic acids, and on acetanilide." Two papers of importance to the analyst are: (1) A method for the determination of butter in milk, by H. N. Morse and W. M. Burton; and (2) The estimation of carbonic acid in beer, by Messrs. Crampton and Trescot, of the Laboratory of the United States Department of Agriculture. An improved form of Elliott's gas apparatus is described by J. B. Mackintosh, and the new pyrometer by E. H. Keiser is of simple construction, and likely to be found of general use in laboratories in which work at high temperatures is conducted.

ALL ABOUT OUR RAILWAYS. London: CARR & Co.

This is a small book published at a shilling, and is intended to convey a considerable amount of information about railways which is not to be found in ordinary guide books, and which at the same time is likely to be of use to those who require to travel much. As the editor remarks, there is a great dearth of railway literature of a nature likely to attract the public. Most of the existing volumes on the subject, though interesting enough to those who are intimately acquainted with railway work, are too ponderous for the million. Learned discussions on gradients, horse power, or tractive force, may give a thrill of enjoyment to the scientist; but the everyday reader is desirous of obtaining information concerning matters coming under his immediate notice. He is anxious, in a word, to glean anything interesting about the universal means of travel. Although the book scarcely justifies its claim to tell us *all* about railways, still it does tell a good deal which is not generally known, and will be found both useful and interesting by the large numbers whom either business or pleasure impel to travel.

THE MERCANTILE YEAR BOOK AND DIRECTORY OF EXPORTERS. 1888. Edited by Walter Lindley Jones. London: LINDLEY JONES & Co.

This is a little book, the scope of which is explained in the title. It commences with a street itinerary of the city of London, which gives the names of the firms of exporters to be found there, together with the class of goods shipped by them. A map of the city has been added to this year's issue in connection with this section. The second part contains information which is more valuable, because not otherwise so readily accessible, and gives a list of merchants and importers in the Colonies and abroad, with the names of their English representatives and buying agencies. A list of the classes of goods shipped from London, with the names of the shippers, and an alphabetical list of the merchant exporters of London, with their addresses and the markets with which they trade, are also given. What will be found of use by

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exporters for reference is the fifth part of the work, which gives the tariffs in force in the British Colonies and possessions, and particulars of the services of some of the great ocean lines, in addition to miscellaneous information.

PATENTS CONVEYANCING: A COLLECTION OF PRECEDENTS IN CONVEYANCING LETTERS PATENT. By Robert Morris, M.A. London: STEVENS & SONS, 119, Chancery Lane.

Hitherto there has been no work of reference devoted exclusively to the sale and transfer of patents, to agreements for licenses, and to other transactions in relation to Letters Patent, and practitioners have been compelled to refer to precedents which have arisen in their own practice with such inadequate supplementary aid as they could obtain from "Prideaux." In such works as the one before us, one generally turns first to the table of contents and to the general index as a preliminary investigation of its value. To show how thoroughly and with what painstaking care this book has been produced, we may say that the text occupies 384 pages; the table of contents, thirteen pages; the table of cases cited in the text, nine pages; and the index, fifty-nine pages. In the arrangement of the work, the author has followed a simple system of classification of his subject which renders reference extremely easy. He commences with a dissertation on practice under the old and the existing Acts of Parliament relating to patents; this is followed by a chapter on agreements, in which the author discloses his authorities for the precedents which follow, and discusses their operation and effect. The precedents in this section, as in each of the others, consist of forms of recitals and clauses which are of common application, followed by a set of agreements. Together these meet all cases which have arisen within our experience, and we can scarcely imagine a case in which they could not be employed almost literally, by discriminating collation and application. The same may be said of the precedents included under the other headings. The precedents for assignments and mortgages of patents have likewise an explanatory chapter, as have also those relating to licenses. In each case the opinions and observations advanced are well supported by cases referred to in foot notes. There is appended to the book a reprint of the principal statutes having reference to the subject matter. Mr. Morris has approached his work systematically, and accomplished it so thoroughly as to leave little or no room for addition or improvement. Although intended primarily for the use of solicitors, very few of whom, unfortunately, have any practical acquaintance with patent law and practice, it cannot fail to be extremely valuable to inventors and manufacturers, if they will only bear in mind that they cannot safely act as their own lawyers by its guidance alone.

THE PROSPECTOR'S HAND BOOK. By J. W. Anderson, M.A., F.R.G.S. London: CROSBY LOCKWOOD & SON. 1888.

The third and enlarged edition of this hand book, which, as its title states, is a guide for the prospector and traveller in search of metal-bearing or other valuable minerals, contains a few important additions upon the previous issues. The author has traversed the mineral fields of New Zealand, New Caledonia, New Mexico, and Colorado, and has, therefore, practical experience as well as considerable theoretical knowledge of the subjects upon which he writes. The book is divided into short chapters upon the operations necessary for the opening up and discovering new mineral localities, and is not burdened with too much scientific padding of a geological or chemical nature. The second chapter, dealing with rocks, is short and much to the point, while another chapter later in the volume treats of the composition of the more important rocks which the prospector is likely to meet with. The chief metallic ores and minerals have two chapters devoted to their consideration, and brief rules for their detection are given, which are sufficient even for the inexperienced to form a comparatively accurate judgment of the value of any rock specimen he may meet with. We cannot say much in favour of Chapters VIII. and IX., which deal with testing by the wet process, and the assay of ores. The author, on page 9, while advising a prospector to be independent of the opinion of others, says that he should "never grudge a few shillings or dollars in obtaining the advice of a proper assayer." This is a sound doctrine, and we are of opinion that it is a mistake for the miner to attempt anything in the shape of an assay or chemical quantitative estimation of the value of his ores. Although many of the methods used in assaying are comparatively easy, yet good results can only be obtained by men experienced in their use, and attempts at such estimations by novices are liable to give misleading results. If the notes on gold, silver, lead, and copper assaying are viewed in this light, no harm will be done; but we think that any mention of graduated burettes and details of weighing, without proper explanations of a burette and a balance, are apt to confuse rather than enlighten the reader. Chapter X. on surveying is a good one, and covers the methods of solution of problems connected with adits, shafts, and lodes of a mine, and distances from inaccessible places. The book is throughout of a thoroughly practical nature, and can be confidently recommended to emigrants, prospectors, and travellers generally, as the information it contains can be thus quickly acquired before the real work of prospecting commences. A useful addition to the book would be a list of necessaries for the "outfit" of a prospector, including the apparatus and few chemicals required in preliminary testing by the blowpipe, &c., which are admirably given in the third chapter, as well as in the chapters devoted to the consideration of the characteristics and occurrence of metals and other ores.

IMPROVED AUTOMATIC LUBRICATOR.

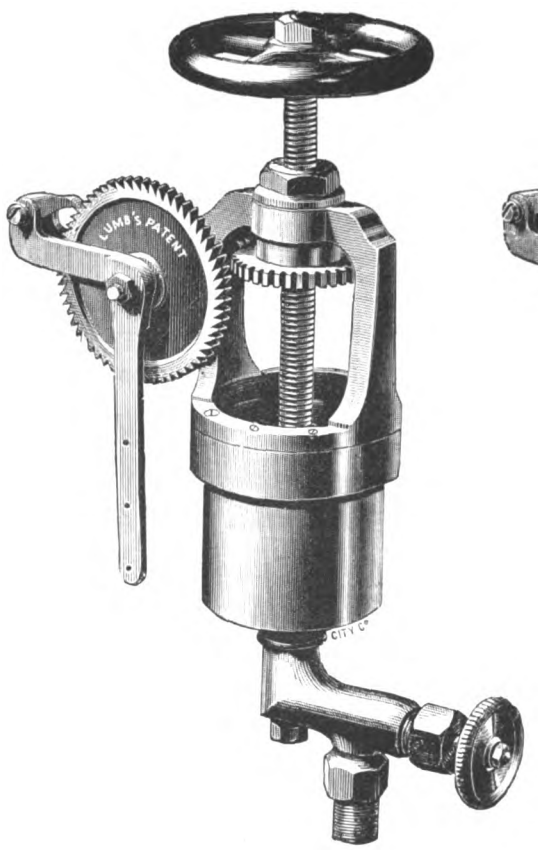


FIG. 1.

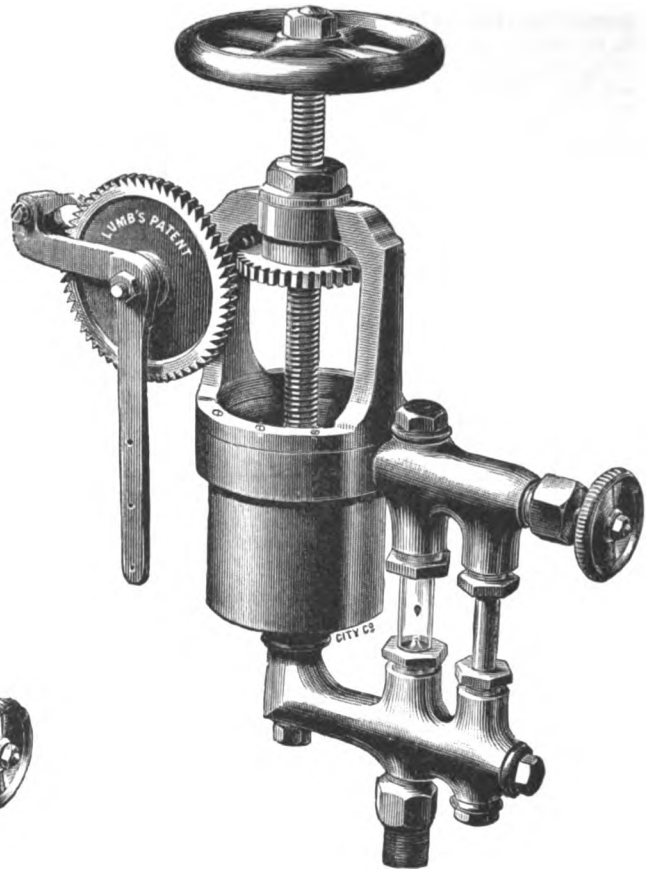


FIG. 2.

IMPROVED AUTOMATIC LUBRICATOR.

OUR illustrations show two forms of an improved automatic lubricator designed by Mr. J. Lumb, Perseverance Brass Works, Elland. Figs. 2 and 3 show the lubricator fitted with an arrangement by which the lubricant may be viewed as the piston is descending, Fig. 1 being intended for stiff and Fig. 2 for liquid lubricants. The lubricator works in the following manner: One end of the lever A, which is either bent or straight, is attached to a part of the machine which has a suitable motion. This lever carries a pawl B engaging with the ratchet wheel C. On the shaft carrying C the worm D is keyed, and gears with the worm wheel E, which is free to revolve, but is secured against sliding by a nut on the top of the frame. The boss of the worm wheel E is threaded, and serves as a nut for the screw F, which is connected to the piston P by a nut which is provided with a square hole G fitting upon the square part of the valve H. When starting the lubricator the piston P is raised by means of the hand wheel and the cylinder O filled with the lubricant, then P is lowered until it comes in contact with the lubricant and the pawl B is engaged with the rachet wheel. The lever A, swinging to and fro, actuates the ratchet wheel, thereby rotating the worm and worm wheel, and forcing the piston downwards. The lubricant is forced through the valve H, passes along I, ascends through the glass tube L, and then descends through the glass tube N to the part which is to be lubricated. The apparatus shown in Fig. 1 is constructed similar to Fig. 2, except that the glass tubes are omitted and the lubricant passes from H into I (Fig. 3), and from there to the parts to be lubricated. As soon as the piston P reaches the bottom of cylinder O the hand wheel on the top of spindle F comes in contact with the nut, thereby locking F and E together, so that the piston revolves with the worm wheel E. At the same time the square hole G engages with the square part of H, thereby rotating the valve on its seating. The amount of lubricant discharged at each

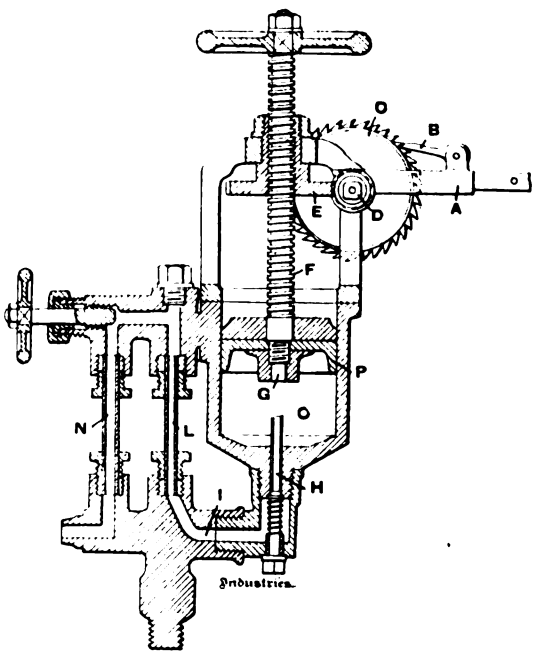


FIG. 3.

stroke of the lever is regulated by the number of teeth over which the pawl moves before engaging again. A larger amount of lubricant may be delivered at any time by turning the hand wheel on the spindle F. The advantages claimed for this lubricator are the following: It will work with any kind of lubricant, and does not depend on valves, taps, or condensation. It does not require any attention when starting or stopping the engine, can be fixed in any convenient position, the lubricant can be conveyed to the parts of the engine or machine by pipes, and the lubricator is not filled with water after the lubricant has been discharged. The maker claims that this lubricator will work against a pressure of 300lb. per square inch.

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THE HEATING EFFECTS OF ELECTRIC CURRENTS.

Table showing the Current in Ampères required to Fuse Wires of Various Sizes and Materials.

$C = ad^{3/2}$.

No. S.W.G.	Diameter. Inches.	$d^{3/2}$.	Copper. a=10,244.	Aluminium. a=7585.	Platinum. a=5172.	Ger. silver. a=5230.	Platinoid. a=4750.	Iron. a=3148.	Tin. a=1642.	Tin lead alloy. a=1318.	Lead. a=1379.
14	0·080	0·022627	231·8	171·6	117·0	118·3	107·5	71·22	37·15	29·82	31·20
16	0·064	0·016191	165·8	122·8	83·73	84·68	76·90	50·96	26·58	21·34	22·32
18	0·048	0·010516	107·7	79·75	54·37	54·99	49·95	33·10	17·27	13·86	14·50
20	0·036	0·006831	69·97	51·81	35·33	35·72	32·44	21·50	11·22	9·002	9·419
22	0·028	0·004685	48·00	35·53	24·23	24·50	22·25	14·75	7·692	6·175	6·461
24	0·022	0·003263	33·43	24·75	16·88	17·06	15·50	10·27	5·357	4·300	4·499
26	0·018	0·002415	24·74	18·32	12·49	12·63	11·47	7·602	3·965	3·183	3·330
28	0·0148	0·001801	18·44	13·66	9·311	9·416	8·552	5·667	2·956	2·373	2·483
30	0·0124	0·001381	14·15	10·47	7·142	7·222	6·559	4·347	2·267	1·820	1·904
32	0·0108	0·001122	11·50	8·512	5·805	5·870	5·330	3·533	1·843	1·479	1·548

Table giving the Diameters of Wires of Various Materials which will be Fused by a Current of Given Strength.

$$d = \left(\frac{C}{a}\right)^{2/3}.$$

Current in amperes.	Diameter in inches.								
	Copper. a=10,244.	Aluminium. a=7585.	Platinum. a=5172.	German silver. a=5230.	Platinoid. a=4750.	Iron. a=3148.	Tin. a=1642.	Tin lead alloy. a=1318.	Lead. a=1379.
1	0·0021	0·0026	0·0033	0·0033	0·0035	0·0047	0·0072	0·0083	0·0081
2	0·0034	0·0041	0·0053	0·0053	0·0056	0·0074	0·0113	0·0132	0·0128
3	0·0044	0·0054	0·0070	0·0069	0·0074	0·0097	0·0149	0·0173	0·0168
4	0·0053	0·0065	0·0084	0·0084	0·0089	0·0117	0·0181	0·0210	0·0203
5	0·0062	0·0076	0·0098	0·0097	0·0104	0·0136	0·0210	0·0243	0·0236
10	0·0098	0·0120	0·0155	0·0154	0·0164	0·0216	0·0334	0·0386	0·0375
15	0·0129	0·0158	0·0203	0·0202	0·0215	0·0283	0·0437	0·0506	0·0491
20	0·0156	0·0191	0·0246	0·0245	0·0261	0·0343	0·0529	0·0613	0·0595
25	0·0181	0·0222	0·0286	0·0284	0·0303	0·0398	0·0614	0·0711	0·0690
30	0·0205	0·0250	0·0323	0·0320	0·0342	0·0450	0·0694	0·0803	0·0779
35	0·0227	0·0277	0·0358	0·0356	0·0379	0·0498	0·0769	0·0890	0·0864
40	0·0248	0·0303	0·0391	0·0388	0·0414	0·0545	0·0840	0·0973	0·0944
45	0·0268	0·0328	0·0423	0·0420	0·0448	0·0589	0·0909	0·1052	0·1021
50	0·0288	0·0352	0·0454	0·0450	0·0480	0·0632	0·0975	0·1129	0·1095
60	0·0325	0·0397	0·0513	0·0509	0·0542	0·0714	0·1101	0·1275	0·1237
70	0·0360	0·0440	0·0568	0·0564	0·0601	0·0791	0·1220	0·1413	0·1371
80	0·0394	0·0481	0·0621	0·0616	0·0657	0·0864	0·1334	0·1544	0·1499
90	0·0426	0·0520	0·0672	0·0667	0·0711	0·0935	0·1443	0·1671	0·1621
100	0·0457	0·0558	0·0720	0·0715	0·0762	0·1003	0·1548	0·1792	0·1739
120	0·0516	0·0630	0·0814	0·0808	0·0861	0·1133	0·1748	0·2024	0·1964
140	0·0572	0·0698	0·0902	0·0895	0·0954	0·1255	0·1937	0·2243	0·2176
160	0·0625	0·0763	0·0986	0·0978	0·1043	0·1372	0·2118	0·2452	0·2379
180	0·0676	0·0826	0·1066	0·1058	0·1128	0·1484	0·2291	0·2652	0·2573
200	0·0725	0·0886	0·1144	0·1135	0·1210	0·1592	0·2457	0·2845	0·2760
225	0·0784	0·0958	0·1237	0·1228	0·1309	0·1722	0·2658	0·3077	0·2986
250	0·0841	0·1028	0·1327	0·1317	0·1404	0·1848	0·2851	0·3301	0·3203
275	0·0897	0·1095	0·1414	0·1404	0·1497	0·1969	0·3038	0·3518	0·3413
300	0·0950	0·1161	0·1498	0·1487	0·1586	0·2086	0·3220	0·3728	0·3617

THE HEATING EFFECTS OF ELECTRIC CURRENTS.*

I HAVE taken a great deal of pains to verify the dimensions of the currents as detailed in my paper read on December 22nd, 1887, required to fuse different wires of such thicknesses that the law

$$C = ad^{3/2}$$

is strictly followed; and I submit the following as the final values of the constant "a" for the different metals:—

	Inches.	Centimetres.	Millimetres.
Copper	10,244	2,530	80·0
Aluminium	7,585	1,873	59·2
Platinum	5,172	1,277	40·4
German silver	5,230	1,292	40·8
Platinoid	4,750	1,173	37·1
Iron	3,148	777·4	24·6
Tin	1,642	405·5	12·8
Alloy (lead and tin 2 to 1)	1,318	325·5	10·3
Lead	1,379	340·6	10·8

With these constants I have calculated the two tables given above, which I hope will be found of some use and value.

* By W. H. Preece, F.R.S.

CENTRAL STATION LIGHTING.

(TRANSFORMERS *v.* ACCUMULATORS.)

AT a special meeting of the Society of Telegraph Engineers and Electricians, held on the 19th inst., the discussion was resumed on Mr. R. E. Crompton's paper on the above subject, an abstract of which was given in our last issue.

Mr. Preece, in continuing his speech commenced at the previous meeting, recapitulated the three principal arguments in favour of batteries, viz., the convenience of storage, the utilisation of the current for motor purposes, and the fact that a small plant could be used during the whole of the day. He then pointed out that on the other hand, there were also several arguments in favour of transformers, viz., that a higher e.m.f. can be employed, and therefore a smaller current in the distributing mains; that transformers are simple in construction and can be easily stored away in odd corners or, as Mr. Kapp suggested, below the pavement, and that no supervision is required; and that the efficiency of transformers is undoubtedly much higher than that of batteries. With reference to the load diagrams for electric lighting during the twenty-four hours, he pointed out that it was necessary, in any case, to provide energy for the period corresponding to the high points of the diagram, and that it did not matter much whether the capital was expended in the purchase of more batteries, or in providing additional engine power. Electric lighting on the transformer system had been successfully carried out by Messrs. Gaulard and Gibbs at the Grosvenor Gallery installation, which had been a pioneer for electric lighting in this country. The transformer system had also been used with favourable results at Eastbourne and Brighton, largely on the Continent, and to a still greater extent in the United States. With reference to Mr. Crompton's remarks as to the waste of steam in the secondary generator system, he considered this to be a question which concerned the engineering principle adopted, rather than bearing on the question whether transformers or accumulators should be used. The loss took place in the engine room and not in transforming. An important question, not raised by Mr. Crompton in his paper, was whether 30-watt 10 c.p. lamps or 60-watt 16 c.p. lamps should be employed. He himself was in favour of the smaller candle power lamps, which gave satisfaction in all cases where the others had not been previously supplied. Another question which should be considered was with regard to the best voltage to be employed. In this country, all kinds of potential differences were used indiscriminately in different installations; but there ought to be uniformity. In America, 50 volts had been generally adopted, and the lamp had a longer life owing to the filament being thicker. With regard to the relative economy of transformers and accumulators, consulting engineers had to base their advice on the nature of the district proposed to be lighted. A compact neighbourhood such as the City of London could best be served by the Hopkinson-Edison three-wire system; but this would not be the case with a scattered district like Wimbledon, where the mains may be ten or twelve miles long. After having referred to the accumulator installation now being carried out by Mr. J. H. Gordon at Whitehall, he stated that he still kept his mind open on the subject of secondary batteries; but, until success was assured, he would give his opinion at present in favour of secondary generators.

Sir David Salomons agreed with the figures relative to the cost of lighting by means of transformers, which Mr. Crompton had given. The efficiency of accumulators might fairly be estimated at about 70 per cent., and the durability was greater than is generally supposed. With regard to Mr. Preece's statement about the paste falling, his experience showed that there was not more than 1lb. lost after three or four years' use. He thought the 4 per cent. margin of potential difference allowed by Mr. Crompton much too high, and that 2 per cent. was more than enough unless the lamps were over-run. The working of central stations without accumulators was much the same as having gas works without a gasometer. At the same time, he believed that the first installation would not see a return of sixpence. In the load diagrams given by Mr. Crompton the curve would become more regular, as electromotors are certain to come into extensive use. To avoid the possibility of a breakdown, accumulators should be arranged with two or more sets in parallel. In his own experience there had been a case where, if one series only had been used, a breakdown would have resulted. He agreed with Mr. Kapp that it was very important to have an efficient system of regulation, a point which had not been mentioned by Mr. Crompton. Old accumulator cells could be renovated and made practically equal to new at the expense of about 1 per cent. of their original cost.

Mr. Crompton explained his method of regulation by attaching the leads to intermediate cells in each series, allowing the current to pass simply through the outside cells in parallel, without any energy being taken from them. A simple mechanical arrangement was used for adjustment, which was at present performed by hand, and which could easily be rendered automatic if desired. This had been used at the Vienna installation for ten months, and also at the central station at Kensington Court, and no hitch whatever had occurred.

Mr. Swinburne referred to the practicability of employing alternating current machines in parallel, and stated that it all depended upon the kind of machine employed. He described a method which he had devised for automatically stopping machines which get out of step. The only objection to the use of alternating currents for driving motors was that the motor would have to be very large. Alternate current machines could be made to run at low speeds, and cheaper than direct current machines.

General Webber criticised Mr. Crompton's proposal to lay down bare copper conductors, suspended by insulators from the roofs of subways, with a cross section of two superficial feet. Such subways could not be made water tight. At first there would not be much difficulty; but within a couple of years the conductors and insulation would be completely destroyed, as the subways would leak, and would also very soon be tenanted by rats. The conductor could not be got at without taking up the roadway. He pointed out that no difficulty had been experienced in raising capital for the London Hydraulic Company, whose system was a far more costly means of distributing energy than by means of electricity, and he expected that there would be a large increase in the demand for electrical distribution of energy. Mr. Crompton's allowance of 20 yards of main lead for each house was excessive, 17 yards being amply sufficient in the case of a district with wide streets and long frontages. The use of bitumen concrete casing for underground conductors was, from his own experience, found to be very satisfactory, and could be employed in the City, where such a subway as Mr. Crompton's could not be laid down.

Mr. Sydney Walker pointed out that the apparatus to which they must look for progress, more than either to transformers or batteries, was the lamp, as a 200-volt lamp would greatly reduce the cost of copper. A cheap and more efficient lamp would largely assist in the development of central station lighting. The increased cost of providing durable insulation for dynamos and for mains with high potential currents, more than counterbalanced the advantages attending the use of transformers; and an absolutely efficient service could be obtained with accumulators.

Mr. Hammond vigorously repudiated Mr. Crompton's statement that the Brighton and Eastbourne installations were only of a temporary character. The installation at Eastbourne had been running for six or seven years, and the distribution there was not by means of overhead wires, as had been stated. At present they had to be contented with doing scattered lighting, and the transformer system was found to be undoubtedly the most suitable, and there was no difficulty in having the load just proportionate to the current required. With regard to the theory that the battery system was preferable on account of there being a reserve of force, the same was the case in the transformer system, as a spare engine was always in readiness in case of a breakdown, and an engine was

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hardly likely to suddenly stop without warning. He had some accumulators in use at Brighton, and these formed the only portion of the system of which they were at all afraid. They were by no means equal to the theoretical efficiency, as only 60 per cent. could be obtained, whilst their Eastbourne transformers gave an efficiency of 95 per cent. He considered 10 per cent. far too high an allowance for the depreciation of transformers which were of very simple construction, and had no moving parts; in fact, such an allowance was even too high for dynamos. On the other hand, Mr. Crompton's allowance of 15 per cent. for depreciation of accumulators was too low.

Mr. Trotter thought that until makers of accumulators were prepared to guarantee to keep them in order for a fixed annual payment few persons would care to risk the expense. He considered Mr. Crompton's assumption that two houses out of three would require the electric light, was too sanguine for some years to come, and that two out of ten was a much more reasonable estimate, and this told greatly in favour of the use of transformers. Some prejudice had been caused owing to the want of a spare engine at full load, and the example of water works should be followed, which always had a reserve of power in case of accident.

Notes.

THE ARCHITECTS' REGISTRATION BILL.

This Bill, which we have had occasion to criticise rather severely, was withdrawn on its second reading; but not before the promoters had shown their utter ignorance of the subject with which they were dealing. The Bill was opposed by the Attorney General, Mr. Giles, Sir Lyon Playfair, and others, and scarcely anybody had a word to say in its favour. We need not enter into the details of the debate, but we recommend them to the attention of those who believe in Acts of Parliament rather than in voluntary association and co-operation.

BOILER EXPLOSION AT BILSTON.

About five a.m. on Saturday last, a boiler exploded at the Capponfield Blast Furnaces, Ladymoor, Bilston, belonging to Messrs. Thomas & Isaac Bradley. The boiler, which was made of iron, was of the plain cylindrical externally fired type, 40ft. in length, and 7ft. 6in. diam., forming one of a battery of six, heated by gas from two blast furnaces, and were worked at about 23lb. per square inch. Upon examination it was found that a seam about 14ft. from the back end had ripped through the rivet holes, the fracture extending into the solid plate, but causing little damage beyond unseating the boiler, and scattering the brick work. No person was injured. From the appearance of the plates, the cause of the explosion would appear to be shortness of water, due to neglect of the feed supply.

ADULTERATION OF OLIVE OIL.

M. R. Brullé has made a number of experiments on the methods of detecting the presence of adulterating oils in olive oil, and has finally adopted the following process: To ·1 grain of dried white of egg powder 2 cub. cms. of nitric acid, and 10 cub. cms. of the oil are added, and the mixture is gently heated for some time. When the acid begins to boil the tube is inclined to cause the two liquids to react more completely. A greenish yellow colour indicates a pure olive oil; but if any other oil be present a brown amber tint will be produced, which is the more intense the greater the amount of adulteration. Colza, rape seed, cotton, and linseed oils all respond to this test, and the only exception which has been observed is the oil known in commerce under the name of exotic aveline, which gives a pink colour under these conditions. When the quantity of the adulterant present is less than 5 per cent., it is advisable to adopt the bromine method on the saponified oils devised by M. A. Levallois.

THE ENLARGEMENT OF THE SUEZ CANAL.

The International Commission on the Suez Canal, which assembled in 1885, made the following recommendation, which was accepted by the Canal Company: Between Port Said and the Bitter Lakes, the straight portions of the Canal are to be ultimately widened to 65 metres (213ft.) instead of 22 metres (72ft.) as at present. The widths at the apex of the curves of large radius in this part of the Canal are to be 75 metres (246ft.), and in the curves of small radius 80 metres (262ft.); these to be adopted instead of the normal width of 22 metres existing in 1885, when the report of the Commission was made. In the straight portions between the Bitter Lakes and Suez the Canal is to be ultimately widened to 75 metres, and in the curves the width is eventually to be 80 metres, all these widths being measured at the level of 8 metres below low water, that being the bottom of the Canal in 1885. As regards the deepening, the recommendation of the Commission, also accepted by the company, was that the Canal should be deepened from 8 metres (26ft.) below low water of ordinary spring tides to 8½ metres (nearly 28ft.) at the first, and to 9 metres (29½ft.) eventually. Mr. John Coode, of 5, Westminster Chambers, who was a member of the Commission referred to, states that he has good authority for stating that the first instalment of the deepening—viz., to 8½ metres—is expected to be completed for fully one-half the length of the Canal by the end of the present year, and that the entire length will be deepened to that extent by the middle of 1889.

DISINFECTION ON THE MISSISSIPPI.

Very careful precautions are adopted by the authorities to insure the disinfection of vessels entering the Mississippi from doubtful ports. Every accessible surface, except that of the cargo, is first sprayed with an aqueous solution of chloride of mercury (1 in 1000), the quantity used for a single vessel varying from 1500 to 3000 gallons of the solution. The hold is disinfected by burning roll sulphur in a battery of eighteen furnaces contained in a specially built tug, the gas being forced into the vessel by means of a powerful fan. By this method air rich in sulphurous acid is introduced into the hold at the rate of 180,000 cub. ft. per hour, and as much as 100lb. to 700lb. of roll sulphur is burnt for the disinfection of each vessel. Lastly, all wearing apparel and hangings are submitted to the action of moist steam at a temperature of not less than 230°F.

NEW PHOTOGRAPHIC SUNSHINE RECORDER.

At the last meeting of the Royal Meteorological Society, Mr. J. B. Jordan read a paper on the subject of his new pattern photographic sunshine recorder, in which he stated that the improvement over the previous pattern consists in using two semi-cylindrical or D shaped boxes, one to contain the morning and the other the afternoon chart. An aperture for admitting the beam of sunlight is placed in the centre of the rectangular side of each box, so that the length of the beam within the chamber is the radius of the cylindrical surface on which it is projected; its path, therefore, follows a straight line on the chart at all seasons of the year. The semi-cylinders are placed with their faces at an angle of 60° to each other. They are fixed on a flat triangular plate, which is hinged to a stand having levelling screws attached, and fitted with a graduated arc as a means of readily adjusting and fixing the cylinders to the proper vertical angle agreeing with the latitude of the station where used.

SEARCH LIGHTS WITH AUTOMATIC FEED.

Search lights for naval purposes have hitherto generally been made with hand feeding gear consisting of two screws, that actuating the positive carbon having twice the pitch of the other, while the focussing was effected by a separate screw. This type of lamp is extensively used in our own navy; but as it requires one of the men to constantly watch the arc, several attempts have been made by the manufacturers of arc lamps to produce automatic feed gear for search lights. These find favour in some foreign navies, and Messrs. J. G. Statter & Co., Limited, of West Drayton, have now in hand for the Dutch navy four projector arc lamps each for a current of 100 ampères, and self feeding. The carbons are 30mm. in diameter, and the feeding mechanism is similar to that of their ordinary type of arc lamp, with hand screw for focussing the arc. Two projectors are supplied with these lamps, with Chance silvered mirrors supported in elastic brackets, so as to protect the mirrors from concussion when the guns are fired. In addition to the mirror, the lanterns are fitted with divergers to fantail the light. The diverger when in use is put before the plate glass front, but can be swung back if a solid beam of light is required.

THE USES OF THE RAMIE PLANT.

In *Industries*, Vol. IV., page 383, we gave a note on the American experiences with ramie fibre. In Spain more advance appears to have been made in utilising it, and owing to many inquiries regarding the ramie plant having been received from England, Consul Woolridge, of Barcelona, gives some particulars as to the industries in which this plant can be employed, his information being derived from Señor Francisco Obiols, professor of agriculture in Barcelona. It is stated that the qualities of the plant are almost similar to those of flax, hemp, and jute. The resistance and durability of the fibre are much greater than those of jute, and it can therefore be advantageously employed for sacking. Its fineness and solidity make it also suitable for the manufacture of handkerchiefs and muslins. Compared with flax and hemp, the same weight of ramie will make about twice the number of yards of cloth, and it is at the same time less liable to rot when exposed to moisture. Ramie cannot be substituted for cotton, but it is suggested that it may be used in combination with it. It also cannot be used as a substitute for wool, owing to its being cool and light. The combination of ramie and silk is recommended instead of the common mixture of silk and cotton, as the tissues are more durable, and the gloss more lasting. It is specially suitable for sewing thread. There is no difficulty in colouring ramie, the best dies being indigo for blue, saffron for rose, the castor oil plant for orange brown, and turmeric for yellow. Señor Obiols states that the ramie is the most valuable fibre which industry can desire, as it can form threads to imitate cotton perfectly well, with the advantage of being of greater strength and duration; that all kinds of linen can be made from it, stuffs for trousers, shirts, and cloaks, sails for ships, sackcloths, cords, &c., as well as lawn and fine lace, which are much superior to those made of flax and hemp. He is of opinion that in a short time the ramie cultivation and industry will become the centre of a great industry in Spain.

THE BOARD OF TRADE RETURNS.

The returns for the month of March are on the whole fair, especially as there was some interruption of business owing to the commencement of the Easter holidays at the close of the month. The exports amount to £19,047,307, as compared with £19,002,083 in March, 1887, being an increase of ·2 per cent. Iron and steel shows a decrease in quantity of nearly 14 per cent., but an increase in value of about 1 per cent. The smaller quantity is mainly due to a decrease in the shipments of pig iron, old iron, and wrought steel, as most of the manufactured kinds, including railway materials, have made progress. Hardware and cutlery have slightly improved. The exports of copper have greatly decreased. The returns under the heading of machinery and mill work have increased 9 per cent. in value. Cotton goods are little altered, but in woollens the exports to France and Italy show a slight decrease. The imports amount to £32,590,821, as compared with £32,794,934 in March, 1887, a decrease of ·6 per cent. Raw cotton and cereals have decreased considerably. The imports of copper ore and regulus show an increase in quantity of about 76 per cent., and in value of 172 per cent.

PRIVATE FIRMS v. GOVERNMENT ESTABLISHMENTS.

At a time when our own military manufacturing departments have undergone such a thorough re-organisation, there may be interest in the following remarks, lately made in the Military Institution of the United States, on the occasion of the discussion of Captain Birnie's excellent paper on "Gun Making." Major J. B. Campbell, of the 4th Artillery, said that Captain Birnie doubted the advisability of taking the direction of military manufacture out of the hands of specially trained officers, and hoped that at all events the question, what guns the army shall use, will be entrusted to military men. If, by military men, he meant those who would have to use the guns, he would have a large following; not so, if the term is construed to mean the non-combatant corps of designers, constructors, and inspectors, that have heretofore controlled this question. Looking abroad, all great progress has been made in countries that have no national foundries and gun shops, and no exclusive corps of ordnance designers and manufacturers. Such nations were the first to be benefited by the ingenuity and skill of private manufacturers. In England, Whitworth and Elswick occupy the attention of the world rather than Woolwich, which latter has been successively driven from almost every one of its assumed positions by the superior practice and productions of other establishments. Germany, as well as some other nations, rely upon Krupp and Grusen; and France, recognising too late that the national shops and foundries of Gavre, Bourges, Ruelle, and Nevers were a poor reliance at the supreme moment, has called to her aid the emulation and progress of St. Etienne, Creusot, and St. Chamond. Austria, after years of official failure, has followed the example of Italy, and now gets her armament where it can be best and most cheaply made. In Russia alone Government establishments appear to prosper. This may be due to personal and despotic government; but as a rule the work is mere imitation, for rarely, if ever, are original conceptions produced by public functionaries. Government should never be a manufacturer or enter into any other kind of business, as in competition with private enterprise it falls behind and becomes extravagant. The vitality and progress inspired by successful competition, and supported by the acumen necessary to avoid the expense of failure, cannot be expected of those whose existence is equally comfortable in failure or success. Let the Government officers select the best gun suited for the purposes desired, or invent it if they can, inspect the material of which it is to be made, or even superintend the work of construction and test it when completed; but let the American manufacturer make it.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

13th April, 1888.

5474. Newsome, A. ..... Hoists.
5485. Jackson, A., & others ... Heating water.
5486. Cadle, C. ..... Turbine water wheels (*Ridgway*).
5496. Williamson, J. ..... Steam boiler furnaces.
5501. Butterfield, F. ..... Apparatus for grinding rolls.
5503. Moseley, J. ..... Body blocks for railway and tramway vehicles.
5504. Passman & Wake ..... Vertical steam boilers.
5505. Helm & Bridge ..... Looms.
5511. Woolley, T. ..... Coating iron ships.
5512. Pohl, O. E. ..... Submerged reciprocating propellers.
5513. Pohl, O. E. ..... Steam cylinders and equilibrium valves.
5514. Hadden & Weldon ..... Car couplings.
5519. Blessley, W. H. ..... Pulleys.
5520. Smith, G. ..... Inlaying metal.
5525. Hall, W. H. ..... Horizontal feathering wind motor
5526. Hall, W. H. ..... Feathering paddle propeller for navigable vessels.
5527. Le Las & Robin ..... Supplying furnace fires with moistened air.

14th April, 1888.

5533. Scott, P. ..... Air propellers.
5538. Noton, W. ..... Separating and cleaning cotton.
5544. Leane, G. H. ..... Buckled plates.
5546. Mackenzie & Wake ... Riveting, punching, and shearing machinery.
5550. McNab, A. ..... Bleaching and washing textile fabrics and yarn.
5554. Wood, R. ..... Apparatus for covering wire.
5556–7. Smith, J. W. ..... Locomotive engines.
5558. Collins, B. A. ..... Torpedo boats.
5559. Corssen, G. A. ..... Torpedo nets.
5560. Elwell, T. ..... Steam boilers.
5563. Dehaitre, F. ..... Apparatus for hot pressing fabrics.
5566. Russell & Cooper ..... Machines for building anchors.
5570. Innes, J. ..... Machine for sawing barrel hoops (*Ballew*).
5571. Innes, J. ..... Machine for setting saws (*Ballew*)
5572. Methley, R. A. ..... Appliance for preventing locomotive drivers over-running danger signals.
5573. Vine, J., & others. ..... Machine gun.
5576. Boult, A. J. ..... Scouring woollen fabric (*Alexandre et fils*).
5578. Bass, T. ..... Ratchet braces.
5581. Delanne, G. ..... Steam and gas engines.
5582. Schurr, A. E. ..... Blast pipes for locomotives (*Swinerd*).
5584. Bain, W. P. ..... Feathering paddle wheel.
5585. Bonvillain & Guyon ... Hydraulic apparatus for baling cotton.

16th April, 1888.

5592. Douglas, G. C. ..... Singeing machines for textile fabrics (*Cargill*).
5596. Maxwell, J. ..... Steam engines.
5597. Dorman, W. H. ..... Circular knitting machines.
5599. Taylor & Taylor ..... Railway chair.
5602. Bedford, C. ..... Looms.
5603. Boxall, S. ..... Fish plates.
5605. Bond, B. R. ..... Blocking and rolling machine.
5607. Schnee, G. H. ..... Repeating mechanism for fire arms.
5609. Richardson, F. A. ..... Spring motor.
5611. Hopkinson & Hopkinson Washing machines.
5614. Ainsworth & Catlow Looms.
5617. Barker, G. ..... Girders.
5622. Richards, F. H. ..... Button setting machines.
5627. Carmichael, J. D. ..... Utilisation of the exhaust steam of engines (*Petrini*).
5628. Tavernier & Casper ... Gas engines.
5630. Ewing, W. J. ..... Rolling stock for railways.
5632. Humes, R. ..... Hydrocarbon engines.
5936. Dynes, W. ..... Seed shelling machine.
5639. Hart, S. ..... Carriages.
5641. Mauser, P. ..... Breech loading fire arms.

17th April, 1888.

5644. Allison, H. J. ..... Apparatus for casting ordnance (*Gatling*).
5648. Scott & Scott ..... Cutting pile fabrics.
5661. Küchen, A. ..... Parallel vices.
5665. Evans, W. ..... Blast furnaces.
5670. Rankine, J. ..... Feed supply of boilers.
5672. Paulson, R. ..... Breech loading and repeating fire arms.
5676. Williams, H. A. ..... Cold rolling metallic rods.
5684. Nicholas & Fanshawe .. Magazine fire arms and ordnance.
5691. Shackleton, E. ..... Machinery for spinning & twisting fibres.
5692. Charlesworth and Booth ..... Stripping the doffers of scribblers and clearers.
5693. Moore, E. ..... Maclines for ironing and calendering.
5698. Fontenilles, J. M. E. ... Pneumatic machines.
5700. Edwards, E. ..... Polishing metal surfaces (*Vercaeren*).
5701. Edwards, E. ..... Apparatus for weaving bags (*Sanz and Echeverria*).
5702. Rutty, G. G. ..... Ramming stone paving.
5709. Mauser, P. ..... Cartridge expellers.
5712. Ellis & Sturla ..... Numbering machines.
5714. Hunter & Hunter ... Cartridge loading machine.
5717. Dillon & Doyle ..... Moulds for casting metals.
5719. Wells & Weber ..... Hot air motors.
5720. Cowburn, T., & others . Continuous brake apparatus.
5724. Abel, C. D. ..... Petroleum engines (*Gas Motoren Fabrik Deutz*).
5730. Cunliffe, W. ..... Sewing machines.
5733. Plunkett, E. W. ..... Permanent way of railways.
5736. Hogg & Hogg ..... Spindles for spinning machines.
5737. Unbehend, J. J. ..... Machines for slotting rivets.
5739. Gould, C. E. ..... Rolled metal articles.
5741. Lake, H. H. ..... Metal lattice work (*Golding*).
5742. Gaggino, G. ..... Navigable balloons.
5743. Nordenfelt, T. ..... Breech mechanism for guns.

18th April, 1888.

5752. Russell, G. ..... Hydraulic motors.
5759. Russell, G. ..... Hoisting shears.
5761. Birch, W. ..... Machines for washing and dyeing woven fabrics.
5769. Dickinson, H. ..... Testing the strength of yarn.
5774. Rowden, W. T. ..... Gas motors.
5775. Carruthers, J. H. ..... Pumps.
5776. Heppenstall, B. ..... Looms.
5777. Bélicard, J. P. ..... Looms for weaving pile fabrics.
5778. Carter & Whiting ..... Repeater small arms.
5788. Mudd, T. ..... Supplying feed water to boilers.
5792. Chandler, N. ..... Steam engines.
5795. Dickie, M. ..... Looms.
5797. Gibert, F. ..... Paddle wheel.
5800. Walford, E. J. ..... Raising sunken vessels.
5802. Redfern, G. F. ..... Water gauges for steam boilers (*Barclay*).
5810. Gostling, W. A. K. ..... Slide rest for rose engine turning.

19th April, 1888.

5812. Shackleton, R. ..... Superheating steam.
5815. Parkinson, J. ..... Drilling machines.
5816. Norton & Hellewell .. Beating pile fabrics.
5824. Tyrie, W. C. ..... Hoists.
5826. Holt, J., & others ..... Stop motion and picker check, and apparatus for guiding and actuating healds.
5828. Green & Douglas ..... Printing and dyeing cambric.
5829. Fairclough, W. ..... Removing impurities from boilers.
5832. Lumb & Holt ..... Hoists.
5838. Fuller, H. J. ..... Sewing machines.
5840. Henderson, A. C. ..... Motive power machine (*Couchemann*).
5846. Fletcher, T. W. ..... Knitted warp fabrics.
5850. Livingstone, J. ..... Securing of the rails of railways.
5859. Gutensohn, A. ..... Coating metal plates with tin.

ELECTRICITY.

13th April, 1888.

5522. Segnitz, A. H. G. ..... Telephonic apparatus (*Brand*).
5528. Hermite, E., & others ... Voltaic batteries.
5529. Merry, P. G. ..... Reflector for incandescent electric lamps.
5531. Statter, J. G. ..... Electric lighting.

14th April, 1888.

5586. Lake, H. H. ..... Electric incandescent lamps (*Grivolas*).

16th April, 1888.

5640. Edmunds, H. ..... Distributing electricity.

17th April, 1888.

5681. Snell, C. S. ..... Electrical switches.
5704. Raworth, J. S. ..... Switch boards.
5708. Lea & Julian ..... Dynamo-electric machines.
5713. Hallock & Blickensderfer ..... Electric elevators.
5723. Webster, W. ..... Production of chalybeate waters by electrolytic action.
5731–2. Lake, H. H. ..... Measuring electric currents (*Thomson*).

18th April, 1888.

5745. Gillam, S. H. ..... Making electrical contacts.
5753. Huck, G. ..... Long distance telephone and transmitter.
5764. Randall, C. A. ..... Electromotor velocipedes.
5782. Mountain, W. C. ..... Electric arc lamps.
5783. Mountain, W. C. ..... Electrical transformers.
5786. Cashel, G. ..... Telephones.

19th April, 1888.

5811. Crompton & Swinburne Generation and distribution of electrical power.
5831. Schönherr-Schöner, T. Electric batteries.

CHEMISTRY.

13th April, 1888.

5484. Dawson & Hirsch ..... Alpha naphtylamine monosulpho acid.
5515. Deacon & Hurter ..... Manufacture of chlorine.

14th April, 1888.

5543. Knecht & Rawson ..... Mordanting wool with chromium compounds.

16th April, 1888.

5600. Parnell & Simpson ... Production of sulphuretted hydrogen.
5612. Gerdes, W. ..... Production of spirit.
5613. Rödiger, W. ..... Manufacture of soap.

17th April, 1888.

5673. Cheswright. C. ..... Separation of alloys.
5740. Lake, H. H. ..... Calcination of lead ores (*Bair*).

18th April, 1888.

5762. d'Andria, M. N. ..... Ammonia salts.
5781. Pass, E. de ..... Azo colouring matters (*Ewer and Pick*).
5790. Steinach, H. ..... Non-metallic porous bodies for electro-metallurgic deposits.
5794. Clowes & Briant ..... Manufacture of soap.

19th April, 1888.

5832. Pitt, S. ..... Colouring matters (*Cassella & Co.*)
5856. Castner, H. Y. ..... Sodium and potassium.
5857. Castner, H. Y. ..... Anhydrous aluminium chlorides.
5858. Castner, H. Y. ..... Reduction of aluminium.

MISCELLANEOUS.

13th April, 1888.

5476. Bennett, T. ..... Rifle sight verniers.
5482. The Worcester Royal Porcelain Company and Ranford ..... Decorating pottery.
5483. Harrison, J. ..... Compressing hay.
5488. Wythes, F. J. ..... Manufacture of castor bowls.
5489. McNeil, C. ..... Manholes.
5490. Crowden & Brown ..... Tricycles.
5491. Crowden & Brown ..... Jointing for tubular frame work.
5493. Harvie, W. ..... Search lights.
5494. Thomson, D. E. ..... Feeding pulverised substances.
5499. Lowe, W. ..... Adjusting the capacity of earthenware.
5506. James, J. W. ..... Rust proof knitting pins.
5508. Hunter, A. T. ..... Burning liquid fuel (*Stewart*).
5517. Edwards, E. ..... Presses for hay (*Zur Lippe*).
5518. Lenders, F. H. ..... Lamps (*Van Gael*).
5524. Bouverie & Balch ..... Pyrotechnic signals.

14th April, 1888.

5541. Dorman, W. H. ..... Screwed wire.
5548. English, R. A. ..... Condensation gutters.
5553. Hill, C. A. ..... Machine for cutting button holes.
5561. Johns, T. H. ..... Bottles (*Johns*).
5564. Wolf & Friemann ..... Miners' lamps.
5568. Innes, J. ..... Guide for machines for sawing hoops (*Ballew*).
5569. Innes, J. ..... Removing gum from saws (*Ballew*).
5577. Thompson, W. P. ..... Waterproof material (*Rave*).
5580. Hummelinck, C. H. ..... Closing of tins.

16th April, 1888.

5587. Gould, H. I. ..... Bottles.
5588. Deeley & Tombs ..... Manufacturing brass knobs.
5591. Low, R. ..... Gun projectiles.
5595. Kochs, W. E. ..... Cleaning and dusting tin plates.
5601. McCulloch, F. ..... Soldering irons.
5604. Frost & Houghton ..... Taps.
5620. Willis & Willis ..... Manufacture of enamelled earthenware.
5623. Sugg, D. W. ..... Gas lamps.
5624. McEvoy, C. A. ..... Fuses.
5625. Accles, J. G. ..... Cartridge boxes.
5626. Woodruff, H. ..... Conical springs.
5633. Piper, J. H. ..... Nuts and nut locks.
5634. Bates & Bates ..... Grain mixers.
5635. Bariquand, L. F. J., and others ..... Shearing instruments.

17th April, 1888.

5645. Whitehall, E. W. ..... Finishing hosiery.
5650. Comyn, F. ..... Net for beam trawling.
5657. Leigh, H. ..... Baling press.
5659. Hoyle, J. ..... Humidifying the air in mills.
5660. Murray & Cathcart ... Moulding clay.
5662. Weir, M. A. ..... Driving gear for bicycles.
5663. Koss, W. ..... Valves.
5669. Thompson & Daines .... Paring knives.
5677. Johnson, J. Y. ..... Expansion spool for paper rolls (*Taylor, Wickens, & Watt*).
5685. Nicholas & Fanshawe Cartridges.
5686. Nicholas & Fanshawe Explosives.
5689. Swallow & Proctor ... Artificial fuel.
5703. Newton, P. A. ..... Watches (*Ansonia Clock Co.*).
5710. Mitchell, W. E. ..... Double ball valve.
5711. Hine, F. A. ..... Eliminators.
5715. Jensen, P. ..... Belting (*Shieren & Brock*).
5722. Imray, O. ..... Bunsen burners (*Von Welsbach*).
5728. Elphick, O. ..... Water waste preventers.
5735. Lake, H. H. ..... Separating grease from steam (*Lowden*).
5738. Lake, H. H. ..... Apparatus for indicating the pressure of liquids (*Herschel*).

18th April, 1888.

5751. Wybill, J. ..... Portable field armour.
5757. Claremont, E. A. ..... Fire alarms.
5765. Kenworthy, J. T. ..... Self registering lock.
5766. Hubert, J. H. ..... Velocipedes.
5767. Snell & Pearce ..... Hurricane lamps.
5770. Townsend & Thompson Adjustable telescopic standards.
5779. Warner & Warner ... Lace patterns in hosiery.
5787. Bannister, M. C. ..... Paints and varnishes for iron, wood, stone, or cement work.
5798. Needham, J. ..... Bicycles.
5803. Nash & Bond ..... Hanger for lamps.
5805. Hiller, G. ..... Apparatus for cutting cord.
5806. Cooper, R., & others ... Filter.
5808. Ponton, A. C. ..... Manufacture of artificial stone.
5809. Appleton, J. F. ..... Bottle.

19th April, 1888.

5813. Clough, T. ..... Manufacture of boots.
5821. Burt & Edmonds ..... Lanterns.

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5825. Haythorn, J. ..... Metallic packings.
5833. Surfleet, R. ..... Preventing the corrosion of propeller blades.
5836. Wood, C. H. ..... Cinder sifter.
5849. Evans, W. ..... Pump buckets.
5861. Bremner, G. W. ..... Precipitating sewage.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

21st April, 1888.

666. Vaughan, G. E. ..... Manufacture of pipes (*Mannesmann & Mannesmann*).
724. Bradley & Richardson Circular combing machines.
3992. Donnelly, J., & others. Axle boxes.
5526. Edoux, F. L. ..... Elevators.
5644. Hutchinson, W. N. ..... Navigation of aërial vessels.
6396. Wells, W. H. ..... Water pressure engine and pump.
7407. Lancaster, W. ..... Warping yarn.
7448. Winton, J. P. de ..... Sawing slate.
7528. Brewtnall & Brewtnall ..... Cloth folding frames.
7540. Martin, J. W. ..... Manufacture of cloth.
7725. Guy, C. W. ..... Crushing mills.
7734. Johnson, J. Y. ..... Looms for weaving pile fabrics (*Parmentier*).
7771. Wastfield, E. G. ..... Gas engines.
7872. Rickard, W. E. ..... Machine for felling trees.
7908. Barthel, A. E. ..... Gasometers.
8033. Wappler & Richter... Lubricators.
8049. Davis, E. ..... Automatic lathes (*Heyne and Heyne*).
8133. Bolton & Bolton ..... Apparatus for drawing wire.
8230. Anderson, A. ..... Swaging needle blanks (*Singer Manufacturing Co.*).
8327. Partridge, W. E. ..... Securing rails in chairs.
8364. Schofield, J. A. ..... Drying and bleaching textile fabrics.
8377. Stevenson, J. ..... Securing the rails of railways (*Despaux*).
8400. Burns, R. ..... Grist mills.
8421. Harris, G. H. ..... Equalising the motion of cranks.
8429. Orr, A. ..... Carpet beating machinery.
8487. Haylar, G. H. ..... Lowering boats from the sides of ships.
8519. Sample, J. ..... Lifeboats.
8535. Tynan, J. E. ..... Machinery for making silk warp.
8604. Ashworth & Ashworth Carding engine bearings.
8608. Buchanan, C. H. ..... Sewing machines.
8615. Scott, J. G. ..... Steamers.
8686–88. Colam, W. N. ..... Cable tramways.
8736. Cooper & Holdsworth Metallic wheels.
8783. Richards & Napier..... Belt pulleys.
8808. Hafner, E. ..... Safety valve.
8818. Beechey, C. G. ..... Gas engines.
8961. Jordan, F. ..... Brakes.
9012. Newton, H. E. ..... Sewing machines (*National Machine Co.*).
9135. Haskins, J. F. ..... Rolling and reeling wire rods (*Haskins*).
9167. Mewburn, J. C. ..... Printing machines (*Derriey*).
9238. Gould, S. ..... Hubs of wheels.
9262. Gawron, J. ..... Friction couplings.
9456. Willoughby&Gledhill Consuming smoke.
9862. Palmer & Brookes..... Tram car wheels.
11868. Gilligan, J. ..... Working up of scrap iron.
13185. Harrison, A. ..... Steam scouring dredges.
13220. Offroy & Pfeiffer ... Testing and cleaning cotton.
16024. Eastwood, G. ..... Carding engines.
16800. Andrews & Andrews... Omnibuses.
17019. Goodwin, S. B. ..... Harrows.
459. Andrews, S., & others.. Axles for carriages.
651. Barrow, J. ..... Edge planing machines.
695. Fenby, H. P. ..... Boiler flues.
1447. Anthon, H. J. ..... Moulding pulleys.
2119. Nichol, J. C. ..... Lubricator.
2862. Sedgwick, J. H. ..... Newspaper printing machinery.
2940. James, G. ..... Hydraulic presses for forming hollow articles from sheet metal (*Hobson*).
3000. Driggs & Schroeder... Breech loading ordnance.
3096. Laundry & Warren ... Twist augers.
3104. Johnson, J. Y. ..... Winding yarn (*Quinquarlet, Valton, et fils*).
3391. Vinton, J. H. ..... Ratchet drills.
3457. Shepherd, J. W., and others..... Winding yarn.
3546. Rollason & Hamilton. Gas engines.
3762. Mosher, S. H., & others Purifying feed water.
3939. Matthews & Yates ... Steam traps.
4102. Johnson, J. Y. ..... Nap raising machines (*Bauche and Bauche*).
4172. Dorman, J. F. W. ..... Printing presses.

ELECTRICITY.

21st April, 1888.

6204. Muller, W. J. ..... Induction coils.
7553. George, F. ..... Regulating dynamo-electric machines.
8181. Taylor, H. A. ..... Testing submarine electric telegraph cables.
8710. Nordenfelt, T. ..... Electrical apparatus for firing guns.
8855. Julien, E. ..... Electric piles.
10963. Fleming & Gimingham Measurement of electromotive force.
2515. Feaveryear, J. ..... Dynamo-electric generators.
3835. Copeland, H. P. ..... Telegraphic apparatus.
3995. Lake, H. H. ..... Galvanic batteries (*Walter*).
4274–5. Thompson, W. P. ..... Storage batteries (*Gibson*).

CHEMISTRY.

21st April, 1888.

6029. Hartley & Blenkinsop Manufacture of metallic sulphates.
6909. Claus, C. F. ..... Obtaining sulphur from metallic sulphides.
8217. Bolton, G. H., & others Permanganate of soda.
8253. Crane, F. ..... Pyroxyline compounds (*Field*).
8296. Paul, L. ..... Production of colours.
8504. Bennert, C. A. ..... Colouring matters.
8817. Simpson, H. J., & others Manufacture of cellulose.
8922. Hartley & Blenkinsop Preparation of cobalt sulphate.
9027. Crowther & Crowther Mordanting fibre.

MISCELLANEOUS.

21st April, 1888.

3802. Herzberg & Herzberg Manufacture of felt hats.
6120. Patterson, W. ..... Miners' safety lamps.
6472. Maxwell, E. G. ..... Fire extinguisher (*Druyff*).
7041. Hicks & Hurd..... Fire escapes.
7049. Gilchrist, J. ..... Lamps.
7536. Gurnsey, C. E. ..... Lamp.
7713. Dinsmore, J. H. R..... Purifying coal gas.
7752. Parkinson, W. C. ..... Gas governors.
7782. Defries & Feeny ..... Feeding oil for lighting and heating.
7811. Bäcker, W. ..... Producing illuminating gas and coke.
7956. Siemang & Breden..... Lamps.
8199. Shaw, W. T., & others.. Velocipedes.
8674. Gilmour, J. F. ..... Manufacture of boots.
8708. Oppenheimer, J. ..... Fixing telegraph posts.
8757. Shaw & Hayward ..... Barbed wire fencing.
8792. Rea, J. ..... Tanks for holding oil.
8800. Lacey, F. W. ..... Treatment of sewage.
8819. Martin, A. ..... Lamp extinguisher.
8925. Teideman, G. ..... Water meters.
9001. Johnson, H. ..... Rammers used in tamping blast holes.
11770. Juillerat - Berthoud and Leiser ..... Watches.
14415. Edwards & Britton ... Miners' safety lamps.
14721. Wood, F. ..... Regulating the flow of gas.
15542. Worthington, T. P..... Ventilating sewers.
1101. Wallace & Ward ..... Anti-corrosive for submerged surfaces.
2717. Wright, J. W. B..... Lamps.
2739. Wright & Wright..... Gas burners.
2997. Effer, W. ..... Lighting and extinguishing gas burners.
3753. Harmel, A., & others... Dyeing wool.
3774. Wade, J. L. ..... Solidified oil for lubrication.
3784. Gibbons, F. J. J. ..... Locks and latches.
3795. Coninck, F. D. ..... Incombustible paint.
3802. Tack & Girard ..... Manufacture of coke.
3830. Pitt & Van Vleck ..... Distilling petroleum.
3901. Lake, H. H. ..... Vent plugs (*Waggoner*).
3976. Leigh, H. H. ..... Heating liquids to be treated in centrifugal separators (*Bernström*).
4053. Macer, R. ..... Setting screws.
4064. Rylands, D. ..... Stoppering bottles.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(*To the 14th January, 1888, inclusive*).

Year 1884.

906, 907, 908, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 922, 923, 925, 926, 927, 930, 932, 934, 939, 940, 942, 944, 945, 948, 949, 951, 956, 957, 958, 959, 960, 962, 963, 966, 967, 968, 970, 971, 979, 980, 982, 983, 985, 987, 991, 992, 993, 995, 997, 998, 999, 1003, 1006, 1010, 1015, 1016, 1017, 1018, 1021, 1022, 1027, 1030, 1031, 1032, 1033, 1034, 1036, 1039, 1043, 1044, 1045, 1049, 1050, 1052, 1054, 1055, 1060, 1061, 1062, 1063, 1064, 1065, 1069, 1070, 1073, 1075, 1076, 1077, 1079, 1080, 1081, 1082, 1086, 1087, 1088, 1090, 1093, 1094, 1095, 1096, 1100, 1101, 1103, 1105, 1108, 1114, 1120, 1127, 1128, 1130, 1131, 1132, 1133, 1139, 1140, 1141, 1144, 1145, 1146, 1147, 1152, 1156, 1157, 1158, 1163, 1170, 1175, 1177, 1182, 1186, 1188, 1189, 1194, 1197, 1198, 1201, 1202, 1204, 1211, 1214, 1215, 1221, 1223, 1224, 1225, 1227, 1230, 1232, 1234, 1237, 1240, 1245, 1249, 1250, 1251, 1253, 1257, 1259, 1260, 1261, 1264, 1269, 1270, 1271, 1273, 1274, 1280, 1284, 1287, 1289, 1290, 1291, 1293, 1294, 1297, 1300, 1302, 1305, 1308, 1310, 1311, 1314, 1319, 1322, 1329, 1332, 1333, 1339, 1340, 1346, 1350, 1351, 1359, 1361, 1362, 1363, 1365, 1366, 1368, 1369, 1372, 1373, 1374, 1375, 1376, 1378, 1381, 1382, 1386, 1392, 1393, 1395, 1396, 1397, 1398, 1399, 1402, 1405, 1406, 1408, 1409, 1410, 1414, 1415, 1416, 1417, 1419, 1420, 1421, 1422, 1423, 1427, 1429, 1430, 1431, 1433, 3480, 4262, 4263, 4264, 7512.

Year 1883.
94, 125, 129, 162.

Year 1882.
120, 128, 180, 183, 209.

Year 1881.
110, 140, 156, 157, 180, 196.

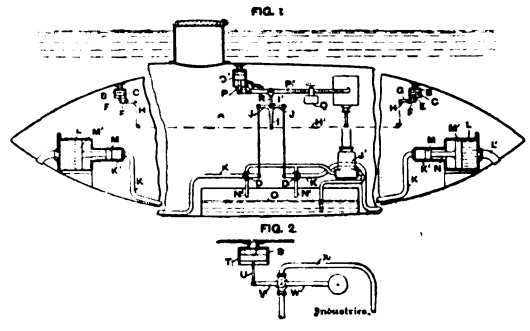
Year 1878.
110.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

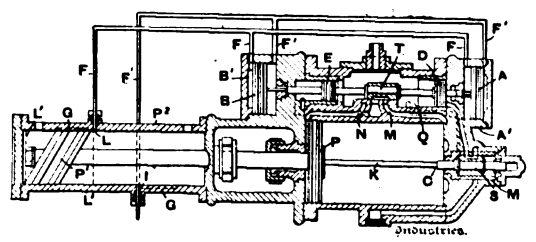
ENGINEERING.

Submarine Vessels.—*G. Poore & W. C. Storey, London.*—The objects of this invention are to maintain the vessel in a horizontal position when submerged, to enable the vessel to rise or sink with an even keel, and to raise the vessel by automatic means in the event of her reaching a greater depth than is compatible with safety. In attaining the first object two chambers B are arranged open to the external water. The pistons C are connected by the rods E, levers F H, and chain H^1 to the arm I of the double bell crank lever, whose other arms J are connected to the valves D. When one of the ends of the vessel is lower than the other owing to the displacement of bodies inside the vessel, the difference of pressure on the pistons C will automatically operate one or other of the valves D. The two ports of the cylinders K^1 L are connected by the pipes L^1 with the exterior water and with the pipes K. The valves D are three-way cocks, and communicate with the tank O by



means of the pipes N^1. The water in O is kept at high pressure by means of the pump J^1, and when one of the valves D is operated the water rushes through it into the pipes K, and the water from outside is admitted to one or other of the cylinders L, and so the balance of the vessel is restored. In order to enable the vessel to rise on an even keel, the piston O^1 is connected to the graduated lever P^1, and also by the lever I J to the valves D. By altering the position of the weight Q, the specific gravity of the vessel may be varied, and the vessel raised or lowered. In carrying out the third part of the invention, the cylinder S is fitted in the upper side of the vessel, and the piston T is connected to the lever V W. This lever works a valve which controls the passage of the fluid in X. The position of the piston T will vary with the depth of the vessel, and when the pressure becomes too great the valve is opened, and the water from a steam boiler is allowed to escape into the exterior water, and thus reduce the ballast. Four claims are made for these different improvements.—No. 4227. March 21st, 1887. 8*d*.

Pumping Engines.—*L. Soulerin, Paris.*—The main object of this invention is to effect the cut-off of the steam by means of the compressed air, or by means of the liquid which is being raised by the engine. The accompanying figure illustrates the mechanism employed. Two differential pistons D E are connected by a rod to the main slide valve T. One side of the piston E is in permanent connection with the exhaust, whilst the opposite face of D is made to communicate with the live steam or the exhaust, according to the position of the valve S in the chamber M. The chamber M is continually in communication with the valve chest through the passage indicated by the dotted lines. The ends of the rod connecting D E extend through stuffing boxes, and are made hollow so as to act as guides to the rods of the two pistons A and B. The opposite faces of these latter pistons communicate alternately by the pipes F F^1 with the



delivery side of a water cylinder P^2. The piston P^1 is inclined to the axis of its rod. When live steam is admitted into the valve chest it acts upon the larger piston D, and causes the rod and slide valve to move so as to admit the steam through the port N into the steam cylinder behind the piston P. At the commencement of the forward stroke the water pressure in the cylinders A^1 B^1 will be equal on both sides; but as the piston P^1 moves and brings the space at its back into communication with the space at the left side of the pistons A B, the pressure on the backs of these pistons will be reduced, and consequently they will be caused to travel in the reverse direction; the slide valve will thus begin to cover the steam inlet port N, while the exhaust passage from the front of P will remain open, and the piston P will complete its stroke by the expansive power of the steam. When P is about to complete its forward stroke it comes into contact with the shoulder C on the spindle of S; the valve S is thus opened to admit steam to act on the larger piston D, and the slide valve is consequently reversed in position. The port M^1 is opened to steam and the port N to exhaust, and the motion of the engine is reversed. The return stroke is conducted on similar lines to the forward stroke. Eleven claims are made for this method of working the slide valve.—No. 5775. April 20th, 1887. 11*d*.

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Blast Pipes for Locomotives.—*H. Appleby & J. G. Robinson, Limerick.*—The parts of this apparatus are arranged in such a manner as will allow the blast to be varied at will. The improved blast pipe A consists of a central steam nozzle B, which communicates with the exhaust of the motor cylinders. The

Fig. 1.

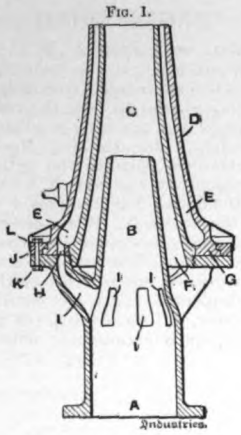
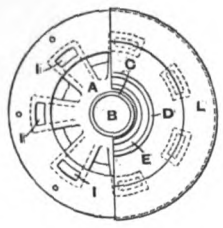
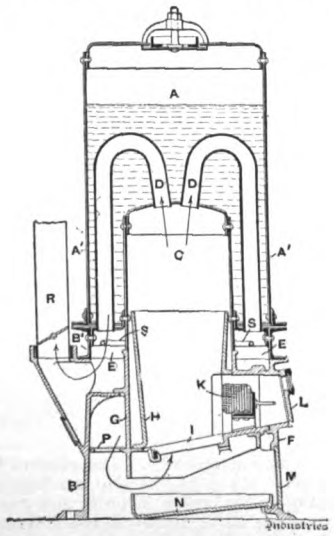


Fig. 2.



air passage C and second steam passage F surround the nozzle B. The openings F for the intake of air are placed at or about the level of the lower row of boiler tubes. The casing D is retained in its place by the flange G and ring J, which allow D to rotate partially over the lower part of the apparatus. The cap L revolves with the upper casing in order to exclude the ashes from its working face. The ports H correspond with passages I, and lead from the central nozzle B to the outer steam passage E. When these two sets of ports register with each other, the steam is free to escape by the annular orifice; but upon the external casing being partially rotated, the supply of steam to E is more or less intercepted, with the effect of increasing the draught. Six claims are made for this method of regulating the draught by means of the rotatable casing.—No. 6784. May 9th, 1887. 8*d.*

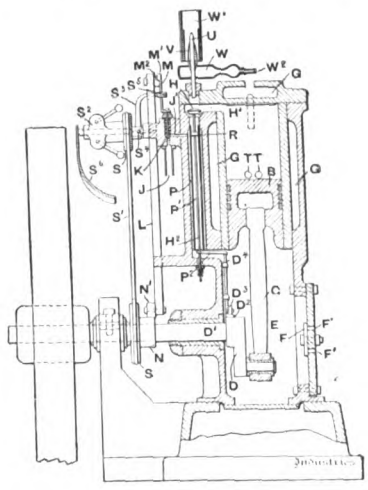
Steam Boilers.—*A. J. Boult, London.* (*A. Stehlik, Vienna.*)—The accompanying figure shows a vertical section of the boiler with its furnace and foundation. The boiler consists of two parts—the inner and lower part B¹, with the fire box C and flues D, and the outer shell A¹, which can be easily detached from the inner part. The boiler is mounted on a circular foundation B, which consists of the outer wall F, furnace G, fire grate I, and refractory wall H. The movable block K serves to regulate



the combustibles on the fire grate. The ash pit N can be reached through the door M, and is filled with water for the purpose of preventing the melting of the fire bars. The bottom of the boiler forms with the outer wall F and the furnace G a circular smoke box, into which the return flues D open. A circular air chamber P is formed round the furnace, and the air enters through an opening in it. The air is highly heated in this chamber before it passes into the grate. The return flues may be cleaned by means of a jet of steam from the tube S. The arrows indicate the course of the draught. The inventor claims the construction in two parts, and the combination of the return flues D with the smoke box E, air heating chamber P, and movable block K.—No. 1824. February 7th, 1888. 6*d.*

Twist Lace Fabrics.—*James Smith & John Smith, Nottingham.*—This invention relates to the production of alternately coloured diagonal squares on plain or spotted traverse twist lace. In any ordinary twist lace machine the inventors employ a warp of the required colour, and divide the width of the machine into groups of carriages and bobbins. Each group is sub-divided into two or more divisions, according to the number of colours of the thread on the bobbins. The carriages and bobbins are placed in whole groups or sub-divided groups of colours alternately, so that there may be an equal number of groups of each colour. The alternate diagonal squares are produced by traversing the front tier of carriages and bobbins from right to left or *vice versâ*, while the back tier is traversed in the reverse way. One claim is made.—No. 801. January 18th, 1888. 4*d.*

Gas Engines.—*C. Ridealgh, Sunderland.*—A sectional elevation of the vertical inverted type of gas engine is shown in the accompanying figure, with the present improvements embodied in its construction. D² is a cam on the crank D which actuates spindle H² of the valves R and H by means of the small roller D³ and bent rod D⁴. The crank and connecting rod work in the closed chamber E, and the air inside E is affected by the motion of the piston. The automatic suction valve F can admit air into the chamber through the holes F¹, and the valve H admits the combustible charge into the end H¹ of the cylinder. J is the gas supply pipe, and K is the gas admission valve, which is actuated by the rods L and M. A passage J¹ leads from the gas valve into the space P surrounding the pipe P¹; and opposite the end of J¹ are a series of holes in the pipe P¹, which when uncovered by the valve R give communication between the space P and the space between R and H. Through the valve R are a series of holes which control the passage of gas. There is a constant air communication between E and the under side of the valve H. The pulleys S drive the governor S², whose action is to throw the jaw M¹ out of gear with the catch piece M² on the end of the rod L, and thus to leave the gas valve K unmoved on its seat. The exhaust ports are shown at T; and U is a hollow tube closed at its upper extremity, and heated by the master light V. Starting from the position in the figure the piston commences to make its upstroke; the air inlet F and the gas inlet K are opened simultaneously, and the charges of air and gas are brought in until the piston reaches the upper end of the cylinder. The charge compressed in the former stroke is



now ignited, and the piston is driven downwards, compressing the air in E as well as the gas in P, until the exhaust ports are uncovered. At this point the cam D² raises the rod D⁴, which lifts up the valves R and H. The air in E rushes into the mixing valve R, and the mixed gases are thrust under pressure into the cylinder. The incoming charge is heated by the walls of the cylinder, and rapidly expands and helps to expel the products of combustion through T. The valves H and R are now closed, and the upstroke of the cylinder is made. The combustible charge is compressed, and a portion of it is forced up the ignition tube U. The gaseous mixture is fired at the conclusion of the stroke, and the operations are repeated as before. Four claims are made for the enclosed chamber, for the valves for mixing the gases, and for the arrangements for charging the cylinder.—No. 4511. March 26th, 1887. 8*d.*

Driving Carding Engine Cylinders.—*G. Ashworth & E. Ashworth, Manchester.*—In Patent No. 2432 of 1883, the present inventors provided for the vertical adjustment of the bearings of the cylinder shaft so as to make up for wear. In practice it is found that the reduction of the bearings by wear does not take place in a vertical direction on account of the pull of the belt gearing. In order to render the wear vertical the inventors have designed a new method of driving the shafts. The driving belt is passed over carrier pulleys so that the belt is deflected, and passes over the driving pulley in a vertical direction. The same means is employed to remove the disturbing effect of the driving of the "licker in," or the motion of the "licker in" may be transmitted from the other end of the driving cylinder. In the latter arrangement the ordinary pulley for driving the doffer is used as an intermediate pulley for deflecting the travel of the belt. Five claims are made.—No. 6586. May 5th, 1887. 8*d.*

Scutching Machine.—*W. S. Johnson, Newtownards, Down.*—The arrangements of the parts of this machine are designed for breaking and cleaning the fibrous material at the same time. Two pairs of cylinders revolve together, and are armed with flat angular blades. In between each angular blade is fixed a corrugated blade. One set of blades are placed radially on the ends of projecting arms, with their edges on the advancing side when rotating, and the other set with wavy edges are placed tangentially on the ends of angle iron arms. An inclined slide or rest is placed above the beaters and midway between their centres; the slide is curved for half the length, the remainder being level. The flax is held by clamps in the top of the inclined slide, with the ends hanging downwards. The flat blades break the hard wood, and the corrugated blades carry it away. When the flax is hung in position the clamps are pushed forward down the incline, and the drag on the fibre carries them on. Half the length of the fibre is cleaned in the first part of its passage through the machine; and after the clamp has been removed to the other end of the fibre the other half of the flax is cleaned on the return journey. Four claims are made.—No. 7050. May 14th, 1887. 8*d.*

Colour Printing Machines.—*J. Pollard, Hyde, and C. Mather, Manchester.*—This invention relates to the construction of machines employed in printing textile fabrics, &c., and the chief object is to add a supplementary vibrating motion to the thin steel blade which is used for removing the surplus colour from the printing rollers. The revolving part, in which the eccentric cam groove is formed, is mounted loosely on the bowl shaft, in such a manner that it can be moved longitudinally along the

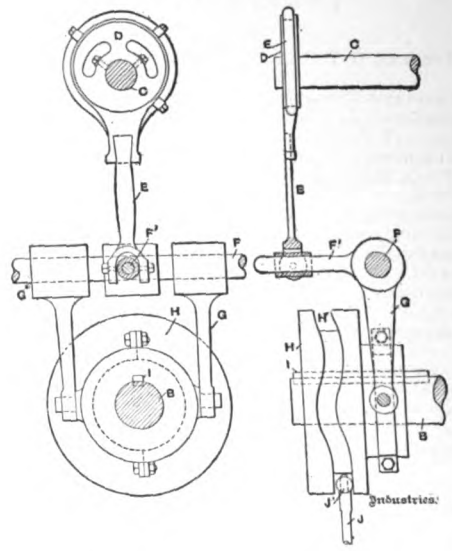


Fig. 1. Fig. 2.

shaft. This revolving part has also a reciprocating motion imparted to it, so that the "doctor," or thin steel blade, receives a compound vibrating motion. Fig. 1 represents an end view, and Fig. 2 a side view of the new connections. B is the bowl shaft, C the revolving back shaft, and D an eccentric connected by the rod E to an arm F¹ on the rocking shaft F. Two tappet levers G are fixed to the shaft F, and engage a groove in the boss of a grooved cam H. The latter is mounted, and free to slide on a feather key I; and a bowl J¹ on the end of the rod J lies in the cam groove H¹. The rod J is connected to one of the doctors. When the bowl shaft is driven the sliding cam H will impart a reciprocating motion to the doctor by means of the cam groove H¹ and the bowl J¹. The doctors also receive a second vibrating motion by the eccentric D revolving with the back shaft C, and through the parts E F¹ F H I. One claim is made.—No. 6192. April 28th, 1887. 8*d.*

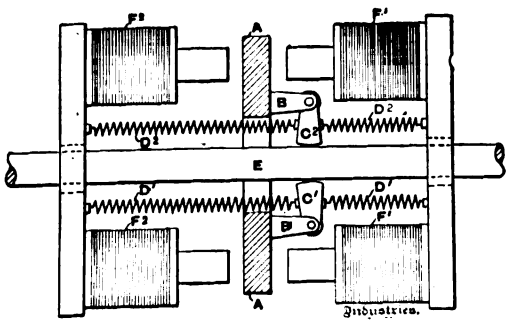
ELECTRICITY.

Incandescent Lamps.—*C. M. Dorman & R. A. Smith, Manchester.*—The object of this invention is to simplify the fittings of the porcelain shades of pendant incandescent lamps. The reflecting shade is formed of one solid piece of porcelain or glass ware, and has a central hole for the passage of the conducting wires. The lamp holder has projections on its metallic base, and is attached to the shade by means of screws passing through holes in the shade and the projections. Three claims are made.—No. 506. January 12th, 1887. 6d.

Electric Arc Lamps.—*A. Siemens, London.*—The two carbon holders are mounted on two vertical rods, one of which has a screw on its lower part and screws through the lower carbon holder, while the other has a screw on its upper part and screws through the upper carbon holder. The holders also have eyes through which the non-threaded parts of the rod pass, so that the rod that actuates one carbon holder acts as a guide to the other. The screw threads of the rods are both the same hand, but the threads of the rod for the upper holder are made double the pitch of the lower. The rods carry toothed wheels which gear into each other, so that contrary rotations are imparted to the rods. To obtain an automatic advance of the carbons, the wheel of the rod for the upper holder has a rim within which is a spring brake strap. The two ends of the strap are connected to one end of a lever in such a way that when the lever is moved in one direction it first causes the strap to bite on the wheel rim, and then carries the wheel with it by means of the brake and rotates the rods. When the lever is moved in the contrary direction it releases the brake strap, and the lever can move back to the original position, leaving the rods stationary. The lever is pivoted to a bar, one end of which is connected to an adjustable spring, while the other end is connected to the armature of an electromagnet, whose coils are in a shunt of the lamp circuit; and the coil connection between the coils and the shunt circuit is made by a contact spring on the armature when this is removed from the magnet. The spring connected to the bar that carries the brake lever is so adjusted that when the carbons of the lamp are at a normal distance apart the current passing through the shunt is too weak to cause the magnet to attract the armature in opposition to the spring, and consequently the bar and lever are held back when no feed is required. When the resistance of the arc has increased the shunt circuit is strong enough to attract the armature, and the rods are rotated. When this feed takes place the attraction of the armature causes the connection between the shunt and electromagnet to be broken, and the armature is not attracted any more. Thus a step by step automatic feed is imparted to the carbons. Three claims are made.—No. 6987. May 12th, 1887. 8*d.*

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REGULATION OF ELECTRIC CURRENTS.—*F. Ross & A. Franzen, Vienna.*—The grippers C¹ C² are pivoted to the projections B on the plate A, and the springs D¹ D² hold the grippers in the position shown in the figure. Between the grippers is a rod which forms part of the regulating devices, and which is arranged so as to be entirely free from the grippers when in their normal position. When the plate A moves in a direction parallel to the axis of the rod E the springs D¹ D² will tend to



hold the grippers in their original position, while the fulcrums B move along the plate A, causing the grippers to assume an inclined position, and to bear against the rod E and carry it along with them. When the plate returns to its former position the rod E will be released, but if the plate continues its movement in the opposite direction the rod will be moved along with it. The reciprocating movement of the plate is obtained by two electromagnets F¹ F². The rod E may be connected with a series of rubbing contacts, and its motion will thus throw a number of resistances in and out of circuit; or the rod may be coupled directly to the regulating devices of the motor engine. The inventors claim the method of producing a rectilinear reciprocating movement by the rod grippers and plate, as described.—No. 13148. September 28th, 1887. 6*d.*

CHEMISTRY.

COLOURING MATTERS.—*A. Kern, Basle.*—This invention relates to the preparation of the methylic ether of gallic acid, and of colouring matters which may be derived from it by the action of nitroso derivatives of secondary and tertiary aromatic monamines. In order to prepare the ether, twenty parts of crystallised gallic acid are dissolved while hot in fifty parts of methyl alcohol; dry hydrochloric acid gas is introduced into the solution until absorption ceases. On cooling, the new ether crystallises out. Another method of preparing this ether is to mix forty parts of tannin and eighty of methyl alcohol with twelve of concentrated sulphuric acid. In order to manufacture the purple colouring matter, ten parts of the methylic ether of gallic acid and twelve parts of hydrochloric nitroso-dimethylaniline are mixed with eighty of methyl alcohol; the mixture is boiled for four hours, and well agitated. The colouring matter forms gradually in small brown needles. Two claims are made for the process of manufacturing methylic ether of gallic acid, and for the colouring matter respectively.—No. 5953. April 23rd, 1887. 6*d.*

EXTRACTION OF COPPER FROM ORES.—*J. Perino, Charlottenburg, Germany.*—The novelty of this invention consists of the process of sulphating the sulphide of copper and iron by means of nitric iron salts. These iron salts readily give up their oxygen at a moderate heat, and decompose into gaseous oxides of nitrogen and ferric oxide. The disposable oxygen combines in the nascent state with the sulphides of copper and iron, and forms the corresponding sulphates. The resulting materials are lixiviated with warm water, and the copper in the vitriol lye is precipitated by a usual method. In carrying out this new method practically, a regenerative process is employed for the object of producing the nitric iron salt. The lye of green vitriol is mixed with a concentrated solution of nitrate of lime, with the result that gypsum and ferrous nitrate are formed. The latter salt is run off into the receivers of the sulphating apparatus. The nitric oxides produced in the sulphating process are conducted by a slowly passing air current into the receivers, and a further oxidation of ferrous salts takes place in consequence. The nitric oxide thus obtained is oxidised again by the oxygen in the air, and nitrous vapours are produced; these are absorbed by the carbonate of lime in the water. A gradual formation of nitrate of lime now takes place. The further conversion of ferrous into ferric nitrate is effected in the usual way. The inventor claims the process of disintegration of copper pyrites, after they have been partially roasted, by heating them in the presence of nitric iron salts.—No. 2019 February 10th, 1888. 4*d.*

COLOURING MATTER.—*R. Chadwick & J. W. C. Chadwick, Kidderminster.*—This colouring matter is produced for the object of applying it to dyeing, staining, and printing. In twelve quarts of water are dissolved 12oz. of atlas violet, 4oz. of 3 R aniline scarlet, 2lb. of nigrosine, 1lb. of Irish moss, 6lb. of indigo extract, and 1lb. of oil of vitriol. These ingredients, when incorporated, will produce about 34lb. of dye, and are ready for use after being strained through cloth. This colouring matter will dye blue, black, and other colours, according to the amount of the pigment and sulphuric acid used. The advantage of the process is that the dyeing is complete in one operation instead of two. One claim is made for this colouring mixture. —No. 3280. March 3rd, 1887. 6*d.*

ABSORPTION TOWERS.—*H. P. Weidig & R. C. Remmey, Philadelphia.*—The absorption towers used in the manufacture of hydrochloric and nitric acid are made of such a form in this invention that they may be used continually without being taken apart for re-filling. The tower is composed of cylindrical sections of earthenware, which are open at the top, and closed at the bottom. A channel runs round the top of each section, in order to form a support for the section immediately above. There is an opening in the bottom of each section, and a vertical partition disconnecting the opening from the rest of the interior of the section extends three-quarters of the height of the section; the sections are so disposed that these openings shall be alternately at opposite sides of the tower. An outside open pipe communicates with the bottom of each section, and extends to the same height as the corresponding internal pipe. When the interior of each section has been filled with water, the fumes of the acid are led into an opening in the roof of the tower. The vapours find their way through the alternate openings in the bottoms of the sections, and in their travel down the tower become absorbed by the water. During this process a hygrometer is placed in each exterior pipe, in order to test the degree of saturation of the solution, and after the water has absorbed all the acid that it can hold, it is drawn off through the exterior pipes by means of syphons. Two claims are made. —No. 1082. January 24th, 1888. 6*d.*

AMALGAMATOR.—*W. P. Thompson, Liverpool.* (*J. A. Sperry, New York.*)—This apparatus for extracting gold and silver from the ore by means of mercury, has no mechanical moving parts to effect the contact of the metals or the passage of the ore. A tray is mounted in a suitable frame, and a series of short pipes are inserted in its bottom; they extend a short distance below the tray and rise to a certain height above the bottom of the tray. The tray is partially filled with mercury to about the level of the mouths of the tubes. The water and ore is delivered through a hopper into the mercury, and the amalgam and water runs over through the tubes into a similar tray below. It is preferable to use a series of trays one under the other, with their discharge tubes arranged so as not to register with one another. In each tray the mercury rests upon a copper plate, and a carbon plate is sustained on rubber standards at a distance above the mercury. The upper plate allows the free passage of the water and pulp by being perforated with holes, which register with the tubes in the tray above. The carbon plates are connected to the cathode, and the copper plates to the anode, of an electric generator. Three claims are made.—No. 7370. May 20th, 1887. 8*d.*

ALUMINIUM ALLOYS.—*W. A. Baldwin, Chicago, U.S.A.*—In carrying out this process, the inventor mixes four parts of dry pulverised clay, one part of charcoal, and twelve parts of common salt, and brings the mixture to a state of fusion in a crucible. Into the fused mixture is poured some molten metal, such as iron, steel, copper, or zinc, with which it is required to make the alloy. After standing half an hour the molten alloy is run off and cast into pigs. Two claims are made.—No. 2584. February 21st, 1888. 4*d.*

COLOURING MATTER.—*C. D. Abel, London.* (*Meister, Lucius, und Brüning, Höchst am Main, Germany.*)—In producing the dialkyl-amido-benzophenones, the inventors make use of the halogen compounds of the anilides or naphthalides of benzoic acid. The anilides and naphthalides of benzoic acid are converted into the halogen compounds by means of chloro-phosphorus, these compounds are condensed by means of dimethyl-aniline or any other tertiary aromatic base, and the products of the condensat on are treated with diluted acids. To claims are made.—No. 5257. April 9th, 1887. 6*d.*

MISCELLANEOUS.

WATER METERS.—*S. A. de Normanville, London.*—This invention relates to that class of water meters in which a slotted piston has a combined rotary and sliding motion upon a pivot. Fig. 1 is a cross section and Fig. 2 is a plan of one form of the improved apparatus. The piston C is formed with an internal slot, in which the boss D slides; the boss is pivoted eccentrically within the chamber E upon the stud F. The shape of the chamber is such that the piston shall always remain in contact with the walls of the chamber at both its ends. An inlet port K and an outlet port L are provided at the bottom of the chamber E, and are in such a position that, when the piston is at right angles to the minor axis as in Fig. 2, they are covered by the piston. The water enters through the inlet port K, and

FIG. 1

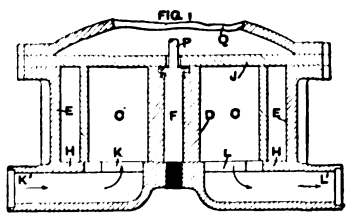
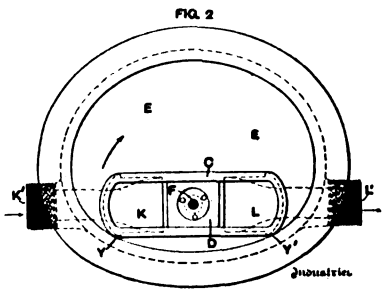


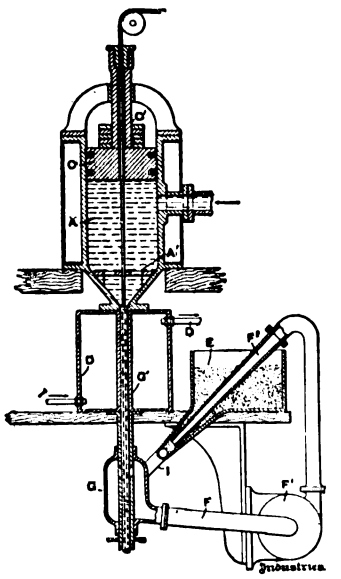
FIG. 2



communicates a sliding and rotary motion to the piston; it then enters between one side of the piston and the chamber wall, and assists in the rotary movement, while the water on the other side of the piston flows away through L. When the piston is in a position at right angles to that shown in Fig. 2, the ports are cut off from communication with the interior of the piston. The further oscillation of the piston is similar, but in reversed order to the first part of its motion. The inventor claims the combination of the slotted piston, having a combined rotary and sliding motion, with the chamber, whose walls are such that the ends of the piston always touch them, and that the flow of water from inlet to exhaust is prevented without the necessity of any fixed abutment.—No. 220. January 6th, 1887. 8*d.*

FLUES OF REGENERATIVE CHAMBERS.—*W. Tomlinson, West Hartlepool.*—The inventor has found that it entails a great defect to build the flues with straight sides from end to end, on account of the particles of dirt and scoria suspended in the current of air being intercepted by the sharp corners, and so forming an accretion on the brick work. The inventor proposes to overcome this defect by providing bell-mouthed flues, so that the force of the current will be enabled to carry the suspended matters to another part of the stove, from whence it can be more readily removed. Each side of the flue is caused to diverge at a suitable distance from the end. The inventor claims the employment of diverging or bell-mouthed ends for the flues for the purpose described.—No. 1959. February 9th, 1888. 6*d.*

INSULATING ELECTRICAL CONDUCTORS.—*D. Nicoll, London.*—The material used for insulating the wires is a mixture of gas pitch and cotton foots pitch in certain proportions. After this mixture has been heated it is introduced into a cylinder, where it is subjected to pressure by the piston, so as to force it through a tube of small diameter. At the same time the wire is passed in a tightly stretched condition through the same cylinder and tube. The accompanying figure illustrates the apparatus specially designed for this purpose. The wire is passed through the tubular rod C¹ of the weighted piston C, and through a guide in the jacketed cylinder A, so as to insure its entry into the tube



G¹, in a central position. The tube is enclosed by the refrigerating tank D, through which a current of cold water is caused to flow. In some cases the wire is given an outer coating of mica as it passes through the tube; for this purpose two or more conduits I are made to enter the chamber G. The hopper E contains the powdered mica, which is discharged in regulated quantities by means of a circulating current of air produced by the fan F¹, and passing through the pipes F, F², I, and chamber G. The tube G¹ has slits in it through which the mica can reach the surface of the coated wire. Three claims are made for this apparatus and for other details.—No. 6933. May 11th, 1887. 8*d.*

POLISHING TEXTILE FABRICS.—*W. Baxter, Bradford.*—This invention consists of an arrangement of revolving brushes, under which the piece of woven fabric is caused to travel. The shafts of several of these brushes are mounted on a frame, and underneath each brush are placed two rollers of wood or metal, whose spindles revolve in square movable bushes. It is necessary to raise these rollers in order to bring the surface of the fabric into contact with the revolving brushes. For this purpose the inventor employs two shafts, with heart-shaped cams fixed on them; the cams work against the square brass bushes, and the shafts are driven by bevel wheels, which receive their motion from a hand wheel. By these means the rollers can be raised to the required position after the piece has been placed in the machine. One claim is made.—No. 3662. March 10th, 1887. 8*d.*

INDICATORS FOR STEAM ENGINES.—*J. Buchanan, Glasgow.*—This invention comprises an improved ratchet spring detent device for preventing the rotation of the spring cylinder of the indicator while the card is being taken off and replaced by another. The usual spur ratchet wheel is mounted at the lower edge of the rotating spring barrel, in order to actuate it against the power of the internal spring. A ratchet pawl is mounted vertically on a joint at the lower front edge of the bracket supporting the barrel; the upper end, on which the gripping pawl is formed, is tilted in and out of gear with the teeth of the ratchet wheel by the action of a light curved spring lever, working in a groove in the back of the pawl. One end of the spring lever oscillates on a joint pin, secured by a washer and circular bearing on the front edge of the bracket, and a handle is fixed at the free end of the lever. The narrow slot is preferably cam-shaped in a vertical direction, and when the free end of the spring lever is pressed up in the groove beyond the fulcrum of the pawl, it retains the pawl in gear with the ratchet teeth, and yet allows the barrel to turn when actuated by the motive cord, and holds it there, preventing its return by the internal spring. When the spring lever is pressed down in the groove to the lower end below the fulcrum, it immediately takes the pawl out of gear, and allows the barrel to be turned in the backward direction by the internal spring, and leaves it free to oscillate. Two claims are made for the ratchet, pawl, and spring lever, for both moving it and retaining it in its engaged and disengaged positions.—No. 6773. May 9th, 1887. 8*d.*

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RAILWAY AND TRAMWAY SLEEPER.—*G. F. Redfern, London. (F. Coblyn, Seraing, Belgium.)*—The improved sleeper is made of rolled steel somewhat in the shape of a T in cross section; the horizontal top part of the sleeper is curved downwards at the outer edges, and is formed with a central gutter. This form is given to the sleeper in order to facilitate rolling, and at the same time to diminish the weight while giving additional sectional strength. The inventor makes two claims for this shape of sleeper.—No. 6030. April 25th, 1887. 4*d.*

REFRIGERATING APPARATUS.—*J. Dauber, Barmen, Germany.*—The ice machines hitherto in use require so great a supply of water that the cost of production of ice is increased when water is scarce. The methods pursued by the inventor, and described in this specification, are intended to reduce the cost under these circumstances. In one method the force pipe of the ammonia gases is placed in the bottom of the refrigerator without going through a condenser. In another method the use of the condenser is retained, and the cooling of the ammonia pipes and the condensation of the gases are effected by the salt liquid from the refrigerator being forced into and through the condenser, and back to the refrigerator, in a continuous circulating stream. The suction pipe leading from the refrigerator to the compressor is of serpentine form, in order to cool the water to the greatest possible extent. The other pipes leading from the refrigerator to the condenser and back again are also of serpentine form, for the same reason. Four claims are made.—No. 5600. April 18th, 1887. 11*d.*

WINDING YARN ON SPINDLES.—*I. C. Schofield, Elland, Yorkshire.*—The inventor dispenses with the clicks and springs usually employed on mules and twiners, and introduces a clutch motion instead. A disc is fixed to the tin roller shaft, and gears internally with a drum or pulley whose inner surface may be either smooth or indented. The pulley is loose upon the shaft, and has a flange which overlaps the disc. Another pulley with a side flange overlapping the disc prevents the clutch from operating until required; this pulley is made so that it may be slid along the shaft upon prongs on the boss of the disc, and revolve along with the shaft and the disc. The connection of the clutch motion may be made by the locking of the fallers, or by the revolution of the cam shaft. The inventor claims an internal wedge clutch overlapped by a pulley with a side flange, to prevent the gearing or "scotching" of the clutch during the "backing off" process.—No. 4156. March 19th, 1887. 8*d.*

PNEUMATIC SEPARATOR FOR GRANULATED MATERIALS.—*H. Dietz, Berlin.*—This apparatus is employed to procure the separation and sub-division of the particles of a granulated mass, according to their size and specific weight. Two frames are supported in a containing case; the upper frame is capable of vibration by means of a crank and links, and the lower frame is fixed, and has a number of holes in the bottom which are covered by a wire gauze. The two frames are joined by an elastic material; a number of bellows are fixed in the upper surface of the vibrating frame, and their flaps are worked automatically by a rod and crank. Valves are also placed in the side of the upper frame, which will allow only the entrance of air. The draught thus caused carries the lighter portions of the granulated mass through a shoot in the end of the apparatus, while the heavier portions fall through the sieves. Three claims are made.—No. 2123. February 11th, 1888. 8*d.*

ROLLED GLASS.—*J. Armstrong, London.*—The object of this invention is to insert wire work into the interior of sheets of glass while being rolled. The apparatus employed for this purpose consists of a roller of metal either flanged, grooved, or plain, which is made to travel in front of the ordinary large roller, behind the wire work, and at a distance above the surface of the table. The wire work is first fixed to one end of the table, and is then brought underneath the large roller, under the second roller, and carried above to a receptacle that contains a roll of wire. The receptacle travels along with the two rollers, and delivers the wire work before the first roller and against the incandescent glass. The action of the first roller is to press the wire work against the glass; the motion of the second roller and the tension of the wire causes a portion of the molten glass to be forced through the meshes of the wire work. This part of the glass is received by the heavy roller and is squeezed against the table, and the upper surface of the glass is thus made smooth. The first roller is mounted upon travelling gear, which is made to gradually approach the surface of the rolling table. This process is applicable to the rolling of very thin sheets of glass with wire in the interior. Two claims are made.—No. 5701. April 19th, 1887. 6*d.*

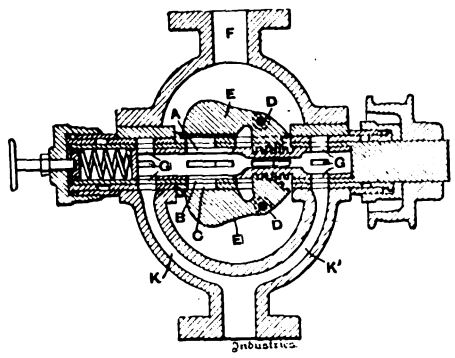
WOOL SCOURING MACHINE.—*C. H. Smith, South Geelong, Victoria.*—In the improved machine the wool is carried along through the liquor in the washing cistern by rakes or prongs, which are attached to two endless chain belts supported on hexagonal sheaves. The sheaves, which are situated at the same end as the squeezing rollers, have the necessary motion imparted to them. The prongs engage with the wool at one end of the cistern, and carry it down under the comb and immersion bars, and into the liquor. When the wool arrives at the end of the cistern, the prongs rise perpendicularly and deliver the wool through the squeezing rollers. When clear of the rollers, the prongs are canted over, and are carried horizontally along the top side of the chain belts until they arrive near the other end. They are then righted, and brought to a position at right angles to their supporting links, and are again in readiness to engage with the wool. The inventor makes four claims for the endless chains carrying the prongs, and for tail pieces on the prongs which engage against striking bars at the back of the sheaves for the purpose of raising and canting the prongs.—No. 1450. January 31st, 1888. 8*d.*

SUCTION BOXES FOR PAPER MAKING MACHINES.—*G. Bird, Leith, Midlothian.*—The object of this invention is to diminish the wear to which the endless wire gauze cloth is subjected whilst passing over the suction boxes. The wire is supported on two rollers whilst passing over each suction box; and these rollers are driven by gearing so as to have the same surface velocity as the wire. There is thus no friction between the rollers and the wire. The suction is arranged to take effect on the under side of the wire between the two rollers, and a space is there formed, having the wire for the top and parts of the rollers for its front and back sides, and adjustable pieces for its ends; its bottom is made of a horizontal piece of wood or metal, with its front and back concave edge surfaces bearing on the rollers. The bottom piece is made with a central opening communicating with the space beneath, which is connected at one of its ends with a pipe leading to the suction pumps. Troughs are formed round the under sides of the rollers, and are more or less filled with water when the apparatus is in action; beneath the bottom piece there is fixed a sheet of rubber cloth with loose ends extending some distance down and under the rollers, in such a way that if there is any leakage between the rollers and the bottom piece the loose ends of the rubber cloth will be drawn up to stop the leak. The end pieces fit tightly down on the bottom piece and on the rollers, and are provided with rubber strips to bear up against the wire; they are also adjustable by screw spindles so that they can be placed immediately under the deckles to suit the width of the paper. Three claims are made.—No. 6945. May 12th, 1887. 8*d.*

REFRIGERATING MACHINES.—*W. P. Thompson, Liverpool. (J. B. Craft, New York.)*—This invention relates to a device for preventing the boiling over of the liquid contents of the distilling retorts in absorption ice machines. The hot distilled gas is used on its passage from the retorts for the purpose of heating the incoming cold aqua ammonia that supplies the retorts. The aqua ammonia is heated in the distilling retorts by steam coils. The gas passes up into a gas receiver, and is thrown down to the bottom of it by means of diaphragms before it can pass up to the rectifier. All the liquid which has been carried bodily from the still is deposited at the bottom of the receiver, and a pipe carries it directly back to the still. The hot gas passing into the rectifier is brought into thermal contact with the descending supply of cold aqua ammonia without coming into actual physical contact with it. The gas gives up its heat to the liquid, and thus loses its watery vapour; the strong aqua ammonia takes up the heat, and is thus prepared for being heated in the retort. Sixteen claims are made.—No. 1419. January 31st, 1888. 8*d.*

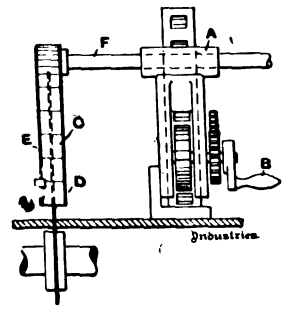
GERMAN PATENT ABSTRACTS.

GOVERNORS.—*G. Goepel, Merseburg.*—This apparatus consists of three hollow spindles A B C, which are revolved by means of a belt and pulley keyed to spindle B. The steam or compressed air enters through F into the chamber surrounding the governor, and from there through perforations G G in the spindles A B C



into the passages K K', and into the motor. If the speed of the motor exceeds a certain limit, the weights E E swing outwards round the pivots D, thereby forcing spindle A to the left, and diminishing the area of the perforations.—No. 42713. July 3rd, 1887.

CIRCULAR SAWS.—*J. B. Schmidt, Munich.*—This invention relates to an improvement in guards for circular saws. The guard consists of two semi-circular pieces D E and a flat bar C



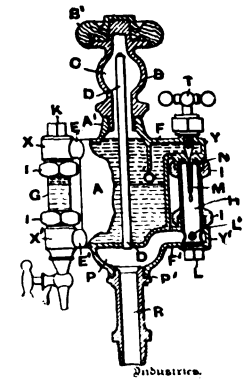
arranged so as to slide along the circumference of D and E. The guard is attached to a shaft F, which is adjustable in the boss A in a horizontal direction, while a vertical adjustment is effected by moving the boss A, and with it F and the guard, along the rack by means of the handle B and spur gearing.—No. 42712. June 30th, 1887.

UNITED STATES PATENT ABSTRACTS.

TANNING.—*A. Warter & H. C. Koegel, Newark, New Jersey.*—In the new process of tanning here described the skins are first depilated in any ordinary manner, and then subjected to the action of a neutral solution, which is formed by dissolving hydrated aluminium sesquioxide in an acid. A second solution is afterwards applied to the skin, consisting of a neutral solution of hydrated chromium sesquioxide in an acid. One claim is made.—No. 380708, dated 10th April, 1888.

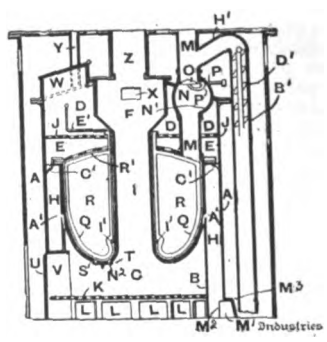
PRESERVING SUBMERGED TIMBER.—*H. L. Ricks, Eureka, California.*—This method of preserving timbers which are immersed in salt water consists in keeping the timbers continually soaked in fresh water. This is done by boring a central hole throughout the length of the piece of timber which is exposed to the action of the sea water. The upper ends of the holes in the timbers are connected by a pipe with one another and with a cistern of fresh water. The fresh water thus has a continual access to the interior of the timber, and the salt water is prevented from penetrating it. Three claims are made.—No. 380820, dated 10th April, 1888.

LUBRICATOR.—*J. Powell, Cincinnati.*—The tube R is screwed to the cylinder of the engine, and the steam enters through it into the distributing chamber P. The oil is contained inside the vessel A, which is provided with a gauge glass G and a sight feed H. The steam enters the tube D and becomes condensed inside the vessel A. The oil is thus raised in level in A, and in consequence gradually drops out of the nozzle M into the



chamber P. The screw T regulates the rate of dropping of the oil, and the top piece B C can be removed for the purpose of introducing the oil. A flange O is suspended opposite the entrance to the channel F, and the tap J allows the vessel A to be emptied. Four claims are made.—No. 379243, dated 6th March, 1888.

SEWAGE FURNACE.—*J. Vladyka & W. M. Mitchell, Newton, Iowa.*—The filth and sewage is placed in the retort R through the opening M. There are two furnace grates at J and K respectively. The retort is supported on the inner shell B, and between the inner shell and the outer shell A is a flue along which the



down draught travels from the upper to the lower furnace. The products of combustion pass up the central flue F. A counterbalanced valve is placed in the pipe M so as to allow the refuse to be poured into the retort, and at other times to keep shut. The perforated cover is placed over the retort, and any fumes emitted from the combustion will pass into the second furnace on the grate J. In the interior of the retort is placed a scraper Q, and a valve S in the bottom allows the ultimate remnants to be evacuated. Ten claims are made for this furnace.—No. 379189, dated 6th March, 1888.

INK.—*M. C. Lefferts, New York, and J. H. Stevens, Newark, New Jersey.*—This invention relates to the composition of an ink for printing upon celluloid or other pyroxyline compounds. An insoluble pigment in powdered form is mixed with a gum which holds the particles together, and a solvent for pyroxyline is added to this mixture. The gum which is preferably used is shellac, and the solvent consists essentially of oil of cassia. Five claims are made.—No. 380654, dated 3rd April, 1888.

LOOM FOR CROSS WEAVING.—*C. A. Littlefield, Fall River, Massachusetts.*—In addition to the ordinary harness, and a series of half heddles, the loom is provided with a stationary supplemental reed which has a series of needles pivoted to its top rail. The reed and needles can be deflected to the left or right by laterally inclined lugs on a pattern cylinder; and the warps which are raised by the ordinary harness are thus deflected to one side or other of the tie warps passing through the needles. The warp threads passed through the loops of the needles may be raised as desired by the half heddles. Four claims are made. —No. 380760, dated 10th April, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED RAG CUTTING MACHINE.

The accompanying illustration represents a duplex guillotine rag cutting machine patented by Mr. Nuttall, and constructed by Messrs. Bentley & Jackson, paper mill engineers, Bury, near Manchester. The machine consists of a strong frame and two heavy knives bolted to cast iron blocks and moving vertically up and down in slides. Both knives are actuated by cranks from a shaft carrying a heavy fly wheel, which is driven by means of a belt. The cutters are arranged at right angles to each other and at different levels. The material under operation is put on a travelling apron, from which it is drawn under the first cutter by means of feed rollers, and cut into pieces of suitable size. These pieces then slide down on a polished metal plate on to a second apron arranged at right angles to the first one, which supplies the feed roller which draws the cut material endways under the second cutter. By means of this the material is cut into nearly square pieces. Both travelling aprons have an intermittent motion, and by adjusting their speed, pieces from 1in. to 6in. square may be cut. When blunt, the knives may be taken off, ground, and re-set, the adjustment being effected by set screws. The makers claim that this machine will cut all kinds of rags, such as bagging, jute, sail cloth, rhea, Adansonia fibre, linen thread, thread waste, &c., at a rate of from 20 cwt. to 30 cwt. per hour.

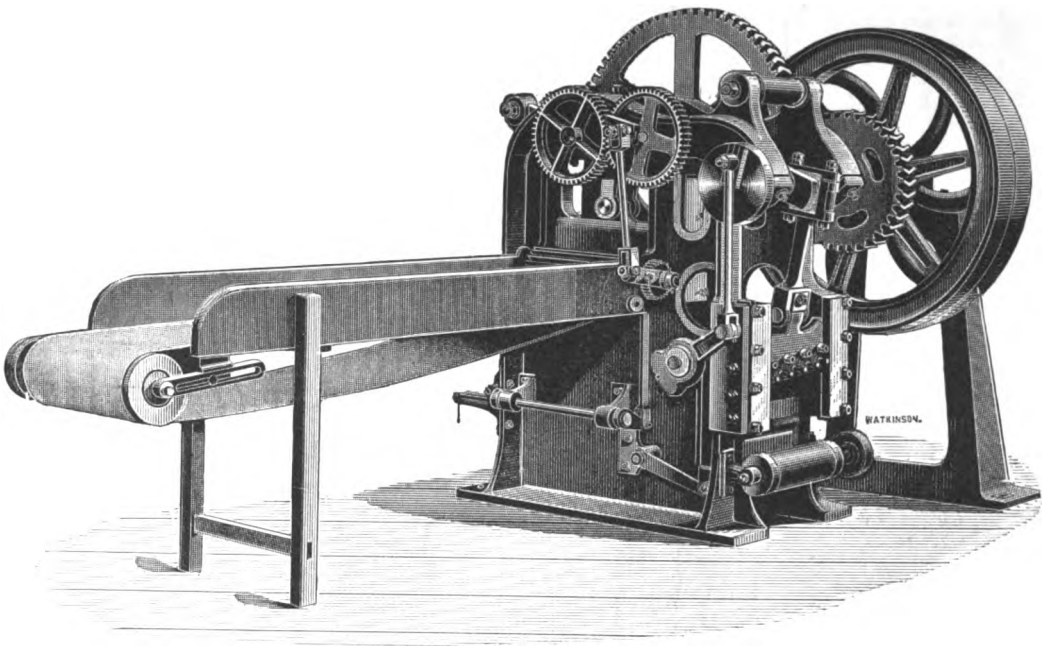
THE MANCHESTER ROYAL JUBILEE EXHIBITION.

Irish Section *(concluded from Vol. III., page 489)*.—An exhibit of original scientific apparatus was contributed by Professor G. F. Fitzgerald, of Trinity College, Dublin. The first instrument was a sine and tangent galvanometer, which combines both instruments, and has four interesting peculiarities: (1) The windings of the coils are visible through the plate glass sides, so as to be capable of easy measurement *in situ*; (2) the position of the needle is read by reflections of a cylindrical scale in two rectangular mirrors whose intersection is horizontal, and which are attached to the magnet. These mirrors reflect images of opposite sides of the scale to a fixed mirror which reflects them into a microscope, in which by means of a micrometer it is possible to read accurately the position of the line which is the same in the two images; (3) this cylindrical scale is affixed to the base of the instrument, and the coils can be rotated round it, so that when the instrument is used as a sine galvanometer, its position is read by reflection in the rectangular mirrors attached to the magnet of a pointer attached to the coils; (4) by a slight modification of the suspension, a beam of light can be reflected from a mirror connected to the magnet at 45° to its axis of rotation, and can emerge through the plate glass side of the instrument and fall on a horizontal scale, where it will measure the tangent of the deviation instead of the tangent of twice the deviation, as in ordinary reflecting galvanometers. The meldometer shown is an instrument for facilitating the identification of small quantities of minerals by comparative observations on their melting points, and for observing the phenomena of their fusion and ebullition. It consists of a strip of platinum arranged to traverse the stage of a microscope, and heated by a current derived from two Grove's cells. On this strip the fragments of the mineral, or if for comparative observation, of two or more minerals, are placed. The temperature of the platinum is then raised by gradually diminishing a resistance placed in circuit with the battery and meldometer, the behaviour of the substance being meanwhile observed through the microscope. To effect the elevation of a temperature automatically, a resistance, consisting of a rod of carbon fitted in a vertical glass tube, is employed. Professor Fitzgerald showed two sets of apparatus for measuring the densities of gases. Both methods depend on the determination of the amount by which a body is buoyed up when immersed in the gas.

A very interesting exhibit was the model for illustrating the electromagnetic and luminiferous properties of the ether, of which a detailed description is almost necessary. The model consists of a series of wheels, rotating on axes fixed perpendicularly in a plane board, and connected together by india-rubber bands The axes are fixed at the intersections of two systems of perpendicular lines, and each wheel is connected with each of its four neighbours by an india-rubber band. Thus all the wheels can rotate without any consequent straining of the system if they all rotate at the same rate. If, however, some of the wheels are rotated through a different angle from others, the india-rubber bands will be strained. If it be desired to represent a region in which conducting matter exists, it will be represented by removing the bands from a set of wheels. Suppose the bands are removed from the regions A and B, and from the connecting line A B, then we can represent the charging of these regions with opposite electricities by introducing some mechanism by

IMPROVED RAG CUTTING MACHINE.

Constructed by Messrs. Bentley & Jackson, Bury, near Manchester.



means of which the wheels on opposite sides of the line A B can be rotated in opposite directions. The model is not intended to illustrate in any way the connection between the ether and matter; indeed, one of the advantages claimed for the model is, that the study of it so distinctly emphasises the distinction between the phenomena depending on the general properties of the ether by itself, and those depending on its connection with matter. For instance, from the very case we have just considered, we get impressed upon us that it is by means of matter only that we can get a hold on the ether so as to strain it. As the object is not to illustrate the connection between matter and ether, any rough method of turning the wheels so as to create the proper strain will do well enough, as it is not the method of producing but the nature of the strain produced that is to be considered. Having once rotated these wheels, we may replace the bands along the line A B, and we have the state of the ether between two oppositely electrified bodies represented on the model. It will be observed that half the india-rubber bands are strained, and that in lines running round the bodies the tight side of a band is always away from one body and next the other. This represents the polarisation of the ether. The late Professor Clerk-Maxwell defined polarisation as a state in which the opposite sides of each element are in opposite states. Now, the opposite sides of each band are in opposite states—one side loose, the other tight; and so it can very well represent the polarised state of the ether. The displacement producing the polarisation is due to the different rotation of the wheels carrying the band causing more of the band to be at one side of the wheels than at the other—less at the tight and more at the loose side of the pair of wheels, and this represents the electric displacement producing the polarisation. The direction of this displacement is at right angles to the line of the bands that are strained, and is out from one body and in towards the other all round. Considering the other properties of the ether that are represented by the model, we observe in the first place that during the time polarisation is taking place the wheels are rotating, and that the rate of rotation of the wheels is proportional to the rate of increase of polarisation, and that the direction of the axis of rotation is perpendicular to the direction of the displacement. Hence it is seen that the magnetic force is properly represented by the rate of rotation of the wheels, and its direction by the axis of rotation. The model, although simple in construction, is very useful, and its careful study will greatly assist the student in obtaining definite physical conceptions of many of the more abstruse phenomena depending on the ether.

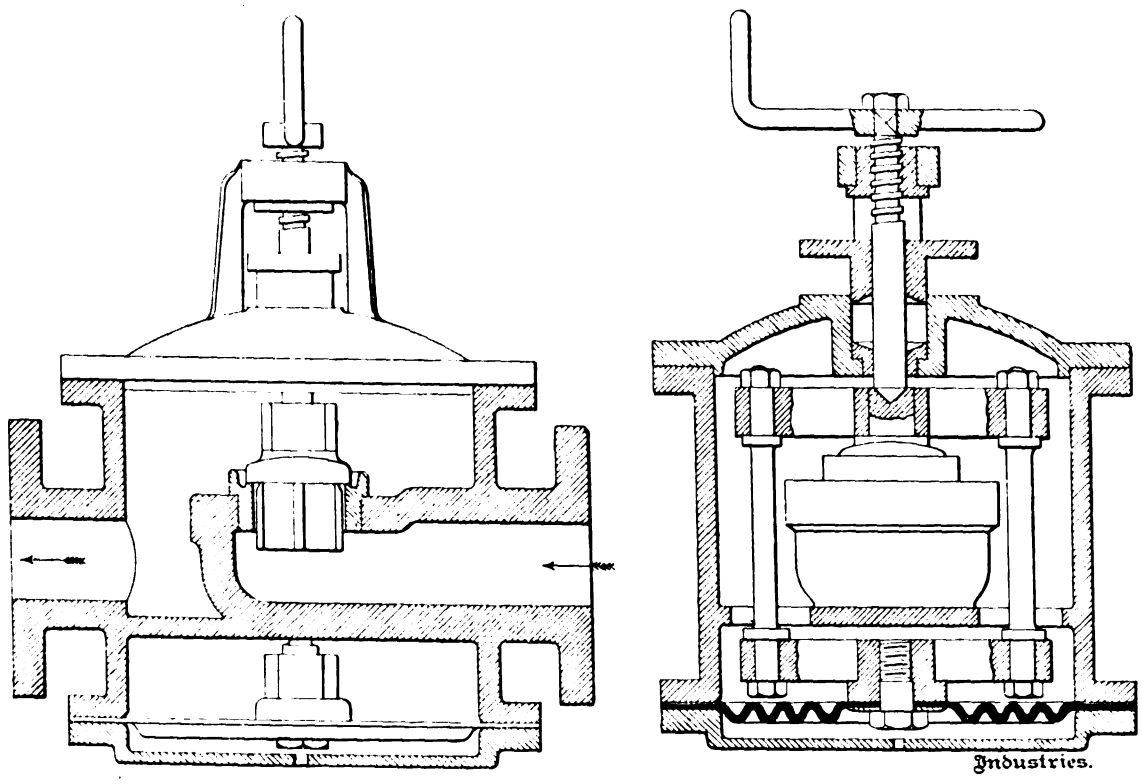
Another exhibit was a photometer made of solid paraffin, or any other translucent substance, invented by Mr. J. Joly, of the University of Dublin. The arrangement is at once simple and effective. The instrument depends upon the fact that if a prism be cut from a translucent body, and so exposed to a source of light that one only of its faces is illuminated, the light diffused through the substance and reflected out through the illuminated faces of the prism gives it an appearance as if lighted up internally. The effect is, in fact, as if the prism itself was a source of light. Two such prisms laid together on smooth faces, and receiving light from separate sources, if placed so as to be at opposite sides of the plane of division, appear as if each was emitting light proportional in intensity to the source of its supply. The double prism has the appearance of two luminous bodies laid side by side. When, however, the supply to each prism is brought to equality, they appear as if emitting equal quantities of light; and it is hard to detect any longer that two prisms are being observed, so completely does all trace of the plane of division disappear. An ingenious piece of apparatus invented by Mr. Joly was one for carrying out his method of determining the specific gravity of small quantities of dense or porous bodies. The method here shown enables the specific gravity to be determined whatever the density or state of aggregation of the substances, and in extremely minute quantities, with an accuracy limited only by the sensitiveness of the chemical balance. Another invention of Mr. Joly was his apparatus for obtaining telegraphically the readings of meteorological instruments placed at a distance from the observer. This apparatus may be attached or adapted to the various thermometers, the barometer, rain gauge, and to other instruments placed in a mountain station, thus enabling their readings to be taken from a conveniently placed observatory. Any number of instruments may be worked with perfect reliability and certainty by the use of three wires only; the only extra piece of apparatus needed being a disc, carrying insulated contact pieces arranged round its circumference, to which the wires of the different instruments are attached. Of these three wires, one serves to put one after the other of the contacts into circuit with the home station through the second wire. By this second wire the readings are taken and the re-adjustment of the instruments effected. The third wire is for the indication of the contacts, and is taken from all the instruments to the galvanometer in the home station.

Silk Section.—In this section sufficient evidence was afforded of the fact that this country has lost the lead in an important industry; but enough was shown to inspire hope and confidence for the future. Very much of the space devoted to this section was given up to the display of gorgeous brocades from Eastern looms; historical garments and fabrics; Oriental needlework; the life history of the various varieties of the wild and cultivated silk worms, and other matters which do not come within our province. For the rest, there were in great variety silk piece goods of German and French manufacture, and some remarkably satisfactory looking articles of home production. With regard to these latter, the fact that they were not exhibited by their manufacturers, but by merchants or middlemen, was greatly to be regretted, since this renders it difficult, if not impossible, to afford them a satisfactory notice, as no really trustworthy information could be obtained. Among the English firms who exhibited goods of their own manufacture or finish we can now only notice one or two.

Messrs. William Hammersley & Co., of Mill-street and Bridge End Works, Leek, showed two cases, the smaller

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WILSON'S PRESSURE REDUCING VALVE.



of which contained two patchwork quilts, which were interesting as illustrating a lost industry. The scraps of silk of which they were made consisted of "orris" bindings and figured silks, manufactured and dyed nearly forty years ago. These quilts attracted much attention, and it was clearly evident that the pristine brightness of the colours was scarcely impaired, and they were probably little worse than when first produced. "Orris" bindings and figured silks are no longer made at Leek, where formerly large quantities were produced. But, though the materials are no longer made, exactly the same process of dyeing is still carried on, and the same permanent results are produced in art and upholstery goods by this firm. In the larger case, the firm had a collection of the "Raven" silk, first introduced by them; schappe for filoselles; embroidery, gloving, and flannel silks; spun silk and shaded net. The sectional shaded silk, in which four or five distinct shades or colours, each graduated from light to dark in one skein, afforded an excellent example of the results of technical skill. The black dress piece goods were manufactured by an old Manchester firm, and dyed on the old system by Messrs. Hammersley, and are exceedingly fast and durable. Their "Desauge" blacks are intended to, and, in fact, do resist the action of sea water and sea air. Tussah, or Tussore, silk goods, manufactured by Messrs Yeomans & Co., of London, were dyed and exhibited by Messrs. Hammersley, who have given much care and attention to goods manufactured from this silk. In the trimmings, the light shades were particularly good; while a specially prepared design of trimming, manufactured by Messrs. Pitman, of London, deserved very great praise.

Mr. John Mason, of Macclesfield, had a small stand, which proved far more attractive to the expert than many of the more pretentious exhibits. As examples of skilful manufacture, some silk squares, in which a brocaded ground was varied by partial patterns in plush, were very interesting; and we have not seen anything more pleasing than the results attained. Mr. Mason showed also many styles of fancy weaves in ties and scarfs, trimming ribbons, and dress goods, which we had an opportunity of examining critically. In each case the manufacture was as near perfection as could be desired, although the difficulties to be encountered were by no means insignificant. Among them, taken at random, was a ribbon with gold selvedges; one side was a rich full shot effect of crimson ground, with a purplish bloom, while the other side was a very pretty plaid. The difficulty in weaving this is considerable, if broken effects are, as in this case, to be quite avoided. Reversible goods, in which the pattern is precisely the same on each side, also require skilful manufacture; but in all the examples no defect could be found in the weaving. The brocaded goods had their designs well brought out, and more than usual attention appeared to have been given to the floating of the warp and weft respectively in order to obtain the best reflections or light effects, and consequently the most pleasing and artistic results. We presume that all silk manufacturers are compelled to follow the behests of fashion in respect of colours and their combination and arrangement, and, therefore, will not say more in this regard than that while for the most part they were pure, chaste, and harmonious, there were one or two combinations which would probably look better by gaslight than by daylight. While viewing such examples of technical skill in manufacture and artistic excellence of design, it was hard to believe that the silk industry generally can suffer defeat all along the line, even if it may succumb in some instances.

Mr. Wardle, and those who have worked with him in collecting the illustrative exhibits, deserve great praise for the impetus they have undoubtedly imparted to the trade. They have shown what is being done here, what is done abroad, and what has been done in the past; from this what can and what has to be done in the future may be derived.

WILSON'S PRESSURE REDUCING VALVE.

Of the many reducing valves in the market it is difficult to find one which is quite reliable in practical working. They are usually so designed as to reduce the initial pressure a certain quantity, and any other reduced pressure is obtained by re-setting the gear in connection with the valve. Thus, if a valve is designed to reduce from 150lb. to 60lb. pressure, and the initial pressure falls to 100lb., the reduced pressure will fall to 10lb., which is, of course, generally useless. The adjusting gear is itself an objection, as it adds to the cost of the valve and to liability to derangement, and is open to be altered at will by an incompetent attendant to give any pressure up to the initial pressure. The reducing valve patented and introduced by Mr. M. Wilson, of 134, St. Vincent-street, Glasgow, and illustrated above, is designed to obviate these and other objections. It will be seen from the illustration that the distinctive features of the design are, the placing of the diaphragm on the low pressure side of the valve, and the absence of gear by which pressure can be put on the diaphragm from the outside. The valve is, in fact, entirely automatic in its action. A little consideration will show that the reduced pressure is a constant proportion of the initial pressure, the proportion being that of the area of the valve to the area of the diaphragm, so that if, as in the above example, the valve is proportioned to reduce from 150lb. to 60lb., and the initial pressure falls to 100lb., the reduced pressure falls only to 40lb. The valve obviously has the merit of simplicity, and should, we think, prove durable, as the diaphragm, which is a most likely thing to give out, is subjected only to low pressure and low temperature. In a test made a few days ago the ratio of reduction was 10 to 1. The test was a very severe one, the two pressure gauges being placed close up to the valve, one on each side, so that any irregularities could not be diminished, as they are very considerably in usual practice, by fluid elasticity and friction; but the experiments showed that, with great and sudden variations in the rate of flow of the steam, the reduced pressure varied very little. This is due, the maker claims, to the valve and diaphragm being, at the arranged reduced pressure, exactly in equilibrium in any position within the working limits, so that the slightest reduction of pressure on the low pressure side instantaneously increases the valve opening, and conversely the slightest increase of pressure reduces the valve opening, and re-establishes the arranged reduced pressure before any variation can be noticed. This automatic regularity is claimed to be the distinctive feature of the working of the valve. Even when the outlet was suddenly closed the reduced pressure rose only 4lb. We may point out that, as this valve is within itself a stop valve, the cost of a separate stop valve in conjunction with it is rendered unnecessary.

We understand that the Board of Trade has sanctioned the use of this valve on board passenger steamers, and that Mr. Wilson has already received several applications for its use in connection with certain special industries, in one of which great difficulty has been experienced for the want of a satisfactory reducing valve.

THE DISTRIBUTION OF HYDRAULIC POWER IN LONDON.

At the ordinary meeting of the Institution of Civil Engineers, held on the 24th of April, a paper on the above subject was read by Mr. Edward Bayzand Ellington, M.Inst.C.E. The author observed that water power was no new force, but that, as formerly understood, it was limited in its application to systems of mechanism suitable for the low pressures found in nature. The effects obtained by the use of high pressure were so different in degree from all previous experience, that a new name was needed, and had been found in the term "hydraulic power." Bramah's genius produced the hydraulic press, and he clearly foresaw the future development and great capabilities of his system; but it was reserved for Lord Armstrong to work out and superintend the intricate details that had to be developed, before the system could be made fully serviceable. The public supply of hydraulic power in London constituted the latest development of this system. The hydraulic power was supplied through mains charged by pumping at a pressure of 700lb. per square inch. The first and largest pumping station had been erected on a site known as Falcon Wharf, about 200 yards east of Blackfriars Bridge. The engine house at present contained four sets of pumping engines, each set being capable of exerting 200 i.h.p. The engines were vertical compound, of a type comprising the advantages of a three-throw pump with direct connection between the pump plungers and the steam pistons. Each set of engines would deliver 240 gallons of water per minute into the accumulators, at 750lb. pressure per square inch, at a piston speed of 200ft. per minute. This was the normal speed of working; but, when required, they could be worked at 250ft. per minute, the maximum delivery being 300 gallons per minute. The condensing water was obtained from storage tanks over the engine house, and was returned by circulating pumps to one or other of those tanks. The water delivered into the mains was maintained all the year round at temperatures of between 60° and 85°. The boilers were of the double flued Lancashire type, and were made of steel. All were fitted with Vicars' mechanical stokers. At the back of the boilers was a Green's economiser, consisting of ninety-six tubes. The economiser and the stoker gear and worm were driven by a Brotherhood three cylinder hydraulic engine. The reservoir of power consisted of accumulators. The accumulators at the pumping station were two in number, each having a ram 20in. in diameter and 23ft. stroke. The weight cases were of wrought iron, and were filled with iron slag. The total weight of the case and load on each ram was approximately 106 tons, corresponding to a pressure of 750lb. per square inch. The storage tanks formed the roofs for the engine and boiler houses. The water for the power supply was obtained from the river Thames, and was pumped into the tank over the engines. The water passed through the filtering apparatus by gravity into the filtered water tank over the boiler house, which was 7ft. below the level of the unfiltered water tank. The filters consisted of cast iron cylinders, and each contained a movable perforated piston and a perforated diaphragm, between which was introduced a quantity of broken sponge; the sponge was compressed by means of hydraulic pressure from the mains. The delivery of power water from the Falcon Wharf pumping station was through four 6in. mains. The most distant point of the mains from the accumulators was at the west end of Victoria-street, and was 5320 yards, or just over three miles. To provide for all frictional loss in the pipes and valves, the accumulators had been loaded to 750lb., the stated pressure supplied being 700lb. per square inch. The total length of the mains at present laid was nearly twenty-seven miles. The mains were laid in circuit, and there were stop valves at about every 400 yards, so that any such section of main could be isolated. The method employed for detecting leakage was based upon an automatic record of the number of gallons delivered into the mains, and in cases of abnormal increase during the night, if found to arise during the early hours of the morning, the mains were tested. The power water used was invariably registered through meters on the exhaust pipes from the machines, and from the meters passed to the drains. There was a sliding scale of charges from 8s. to 2s. per 1000 gallons at 700lb. pressure per square inch, designed to meet, as nearly as possible, the variable conditions and requirements of consumers. The more continuous the use the lower the charges. The scale was intended chiefly for intermittently acting machinery, and experience had fully proved that these rates were sufficiently low to effect a large saving to the consumer in almost all cases, whether for a large or a small plant. The author believed any idea of supplying power from a central source at rates much below these to be chimerical. The practical efficiency of the hydraulic system might be fixed at from 50 to 60 per cent. of the power developed at the central station. No other method of transmission would, he thought, show a better result; and the general convenience and

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simplicity of the hydraulic system were such that its use would hardly be affected, even if there were no direct economy in the cost of working.

In addition to the general supply of hydraulic power, in the City and adjoining districts, to the six hundred and fifty machines at present worked, a new departure had been taken by the application of hydraulic power to an estate at Kensington Court, the name given to an area of about seven acres opposite Kensington Gardens. Seventy houses and dwellings were to be built on this estate, of which thirty had been already erected. Each house was fitted with a hydraulic lift, taking the place of a back staircase, and the power supply was provided on the estate expressly for working these lifts. The driven machinery was of as great importance to an economical and satisfactory result as the distributing plant, but this obvious fact was not always understood. General regulations had been prepared by the author, defining the conditions to be observed by manufacturers in fitting up machinery for connection to the power mains. They were intended to secure safety, and an efficient registration of the quantity of power used; but they left the question of the economy and of the efficiency of the machines to be settled between the consumers and the makers. In London more lifts were working from the mains, and more power was used by them than by any other description of machinery. The number of all classes at present at work was over four hundred. The principal types in use were fully described. In some cases there had been, by adopting the public supply, a saving in the cost of working of about 30 per cent., as compared with the steam pumping plant previously in use. Lifts were now becoming so general, and the number of persons who used them was so great, that the author considered it necessary to urge the importance of securing the greatest possible safety in their construction, by the general adoption of the simple ram. Suspended lifts depended on the sound condition of the ropes or chains from which the cages hung. As they became worn and unreliable after a short period, it was usual to add safety appliances to stop the fall of the cage in case of breakage of the suspending ropes; but they could not be expected to act under all circumstances. As an indication of the important part which lifts occupied in a modern hotel, it might be mentioned that at the Hôtel Métropole there were, including the two passenger lifts and that for the passengers' luggage, no less than seventeen hydraulic lifts in use day and night, while the work done represented about 2000 tons lifted 40ft. in this time. The next largest use of the power was for working hydraulic cranes and hoists of various kinds along the river side, and in the city warehouses. It often happened that the pressure in the power mains was not sufficient for pressing purposes. The apparatus known as an intensifier was then used, by which any pressure required could be obtained. Hydraulic power was also used at Westminster Chambers, and elsewhere, for the purpose of pumping water from the chalk for domestic use. The pump was set going in the evening, and continued working till the tanks were full, or until it was stopped in the morning. For work of this kind, done exclusively at night, a discount was allowed from the usual rates. Mr. Greathead's injector hydrant, made at the Elswick Works, had been in use to a limited extent in London in connection with the power mains. A small jet of high pressure water, injected into a larger jet from the water works mains, intensified the pressure of the latter in the delivery hose, and also increased the quantity. By this means a jet of great power could be obtained at the top of the highest building without the intervention of fire engines. This apparatus enabled the hydraulic power supply to act as a continuous fire engine wherever the mains were laid, and was capable of rendering the greatest assistance in the extinction of fire; but there was an apathy on the subject of its use difficult to understand. In Hull, the Corporation had put down a number of these hydrants in High-street, where the hydraulic power mains were laid, and they had been used with great success at a fire in that street. The number of machines under contract to be supplied with power was sufficient, with a suitable reserve, to absorb the full capacity of the station at Falcon Wharf, and another station of about equal capacity was now in course of erection at Millbank-street, Westminster. The works had been carried out jointly by the author and Mr. Corbet Woodall, M.Inst.C.E.; Mr. G. Cochrane had been resident engineer and superintendent. The pumping engines, accumulators, valves, &c., and a considerable portion of the consumers' machinery, had been constructed at the Hydraulic Engineering Works, Chester. Sir James Allport, Assoc.Inst.C.E., who was the first to adopt hydraulic power for railway work, had been associated with the enterprise from the commencement of its operations in 1882. His wide influence and extended experience had greatly assisted the commercial development of the undertaking.

THE "UNIVERSAL" SCALING HAMMER.

Incrustation in marine and land boilers, although not so common now as it used to be, owing to the greater care exercised in the tending of boilers and the purifying of the feed water, is still sufficiently extensive to necessitate the periodical scaling of boilers. This process is often difficult of accomplishment, and entails a large expenditure for labour, owing to the confined spaces in which the scalers have to work. Hitherto, there have been few attempts to introduce suitable labour saving tools for this purpose, the ordinary slice which is used in places inaccessible to chipping hammers being an inefficient tool. The adoption of high steam pressures and smaller boilers, however, has increased the demand for improved scaling contrivances. Our illustrations show a new device for chipping the scale from tube plates, the necks of tubes and stays, and any flat or circular part of the boilers, which has been introduced by Mr. W. Cooper, Newcastle-on-Tyne. Fig. 1 shows a "universal" scaling hammer in two positions. On the left hand side it is fixed for removing the incrustation on the back of the combustion chamber of a marine boiler, and on the right hand side it is shown in position for performing the same operation on the necks of the tubes and stays. Fig. 3 shows a plan of the "universal" scaling hammer as arranged in the position shown in Fig. 1. In Fig. 2 we give an enlarged view of the apparatus and its immediate appendages. The apparatus consists of a universal joint B fixed to the slotted bar C by means of the bolt A and a

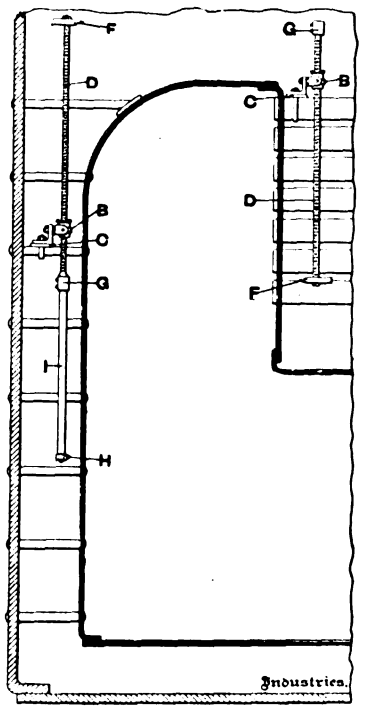


Fig. 1.

screwed bar D, which is provided with a hammer at one end and a socket at the other. When used in the combustion chamber, as shown in Fig. 3 and on the left hand side of Fig. 1, a lengthening bar with a hammer H is fitted in the socket G. The slotted bar is first fixed by two hooked bolts E to the stays (see Fig. 3). When the scaling hammer has been placed in

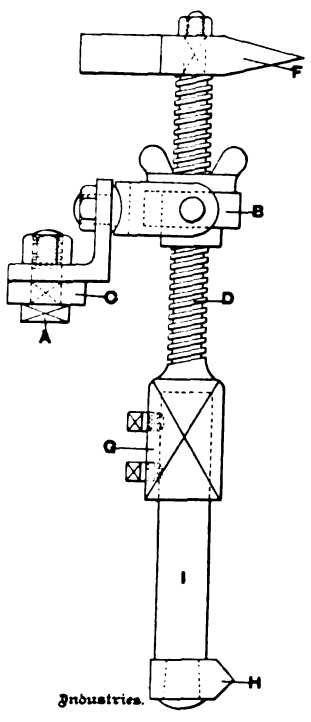


Fig. 2.

the desired position the T headed bolt A is passed through the slotted bar and fastened. The hammer H is actuated at the lower end of the bar D by moving the latter backwards and forwards at F, thereby striking the incrustation at right angles to the plate. As the work proceeds, the hammer is raised or lowered as required by means of the thumb screw shown on the universal joint B. In cleaning the tubes and tube plates of marine boilers the lengthening bar I is removed, and the screw bar fitted in a reverse position, as shown on the right hand side of Fig. 1. The slotted bar is fixed to the tubes by means of T bolts. By using the upper end of the screw G as a lever, the scaling may be accomplished both in the space between, and underneath and above the tubes, by means of the hammer F. In circular marine multitubular boilers of 6ft. 6in. diam., which have between the combustion chamber backs and

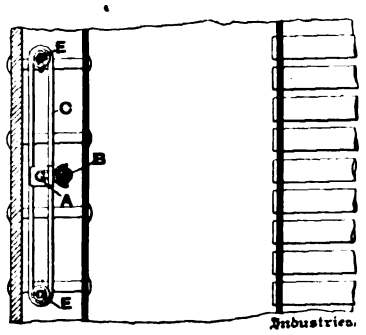


Fig. 3.

boiler shell a space of 3in. at the bottom and 4in. at the top, the plates were thoroughly cleansed of scale in a short time. It has also been successfully used in removing scale from the tube plates of the same class of boilers, and from the cross tubes of donkey boilers. It is claimed for this device that it may be efficiently used on any part of a boiler where scale is difficult to get at.

TASMANIAN RAILWAY CARRIAGES.

In a recent issue we published an article on the railways of Tasmania (see page 240), and we now supplement the information then given by an illustrated description of the passenger carriages in use on the Government lines in that colony.

Only two classes of carriages, viz., first and second, are employed; the first class are equal in comfort to those in use on English railways, whilst the Colonial second class are about on a par with the English third class. The fares charged are about 3d. per mile first class and 2d. per mile second class. In our illustrations, Figs. 1, 2, 6, and 7 represent a composite first and second class carriage. Fig. 1 is a half cross section of the first class and a half cross section of the second class portions, and Fig. 2 is an end elevation. This carriage consists of seven compartments, one second class at one end, with one first class smoking compartment adjoining, three first class compartments in the middle, and two second class compartments at the other end.

The carriage has an iron under frame carried on two four-wheeled bogies at 31ft. centres, the wheel base being flexible. There are fourteen india-rubber pads, 6in. by ¾in. by 1in. thick, fixed between the body and the iron under frames, to diminish shocks and vibration. The carriage is fitted with Clarke & Webb's continuous chain brake, the brake blocks being of cast iron and fitted to one side of each wheel. The bodies are 8ft. wide outside, and each first class compartment is 6ft. 6in. long between centres of partitions, each second class compartment being 5ft. 6in. long. The total length of the body of the carriage is 43ft. The height of body is 6ft. 3in. inside at the door, and a raised central roof is run from end to end, 4ft. wide outside, and 15in. high. The total height of the body from the floor to the top of the centre of the roof inside is 8ft. The compartments are all cross seated, with partitions from floor to roof. Each side of the first class compartment seats four persons, being divided by one arm and head rest in the middle of the seat.

All the frame work and panels which are visible are of Moulmein teak; the covered work is of Canadian oak, and the lining boards of St. Petersburg deals. The side lights, as well as the door lights, are arranged to slide up and down; they are supplied with louvre blinds, fitted with springs to hold them at any height. Each compartment is supplied with one roof lamp burning colza oil, with 1½in. wicks. The lamps were supplied by Messrs. Thomas Knight & Co., of Birmingham. The carriages have continuous footboards, as required by the Board of Trade. The wheels are 2ft. 7in. diam., 3ft. 6in. gauge, with Kirtley's spokes and Mansell rings; the axles are 4in diam. in centre, 4¾in. in the wheel seats, and the journals are 7in. long by 3½in. diam.

The under frames are made of channel and angle iron, connected by gusset plates and wrought iron knees riveted together at the joints.

Fig. 8 shows a longitudinal section, Fig. 3 a half section first class and half section second class, and Fig. 4 an end elevation of a special carriage used on the Parattah and Oatland Railway, a short line of light construction, the trains on which consist of a single engine and carriage. This carriage is of the American type, with a central passage 18in. wide, the doors being at each end, to which access is obtained by a flight of steps, so that passengers may enter and alight at any point. There are no regular

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TASMANIAN RAILWAY CARRIAGES.

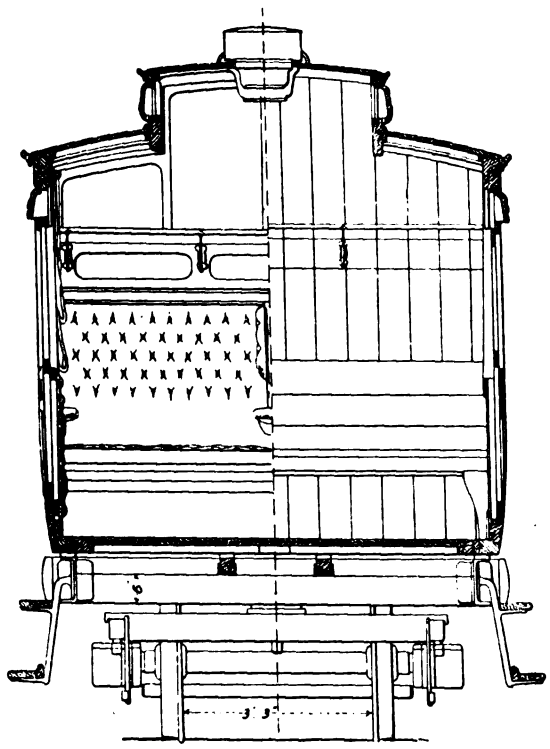


FIG. 1.

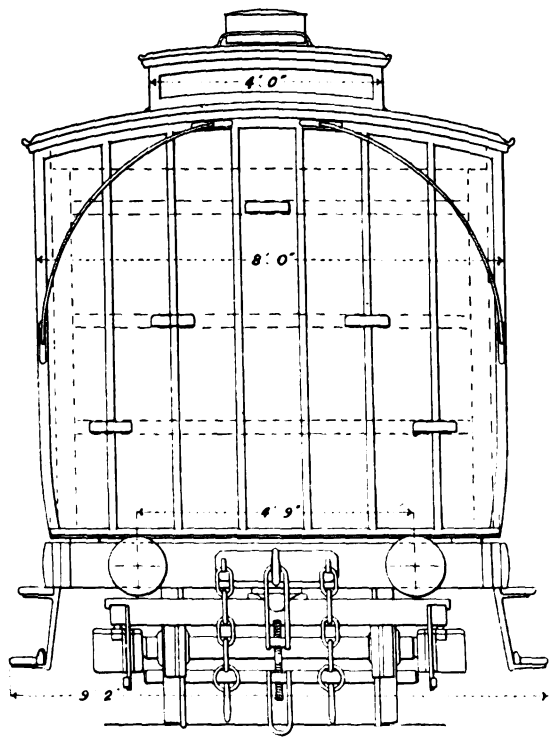


FIG. 2.

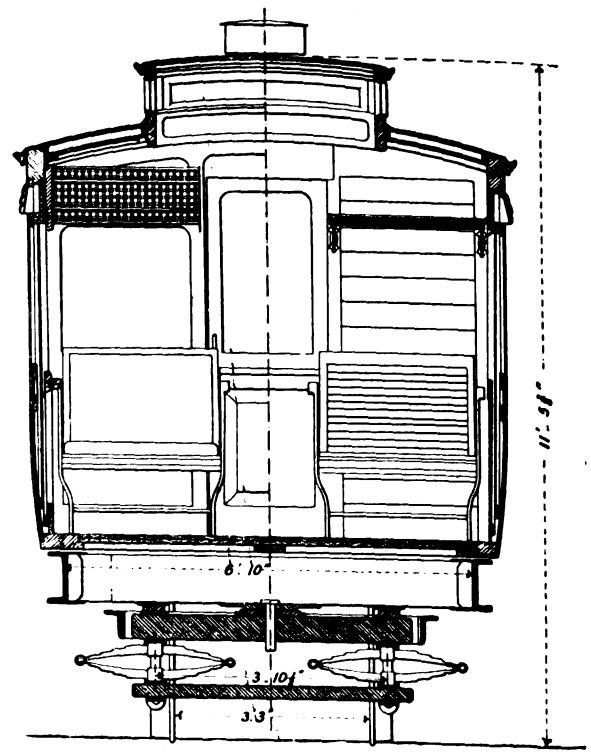


FIG. 3.

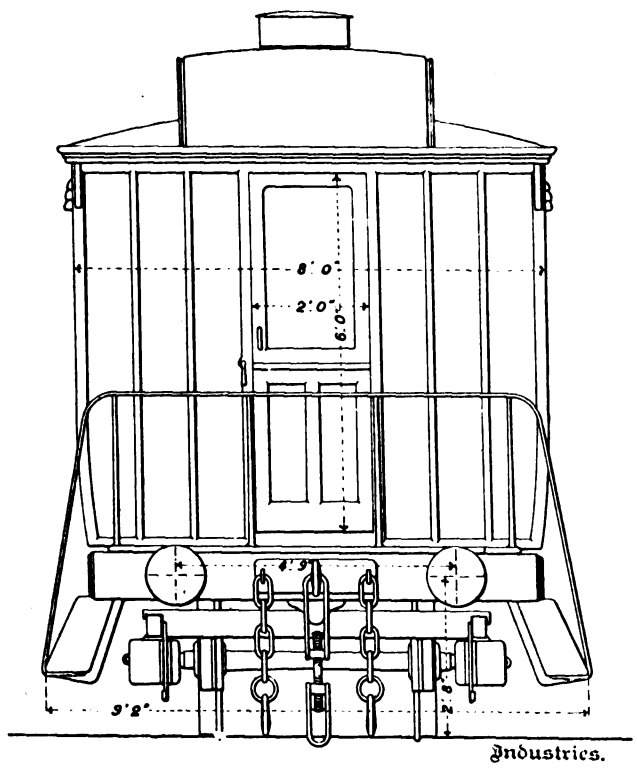


FIG. 4.

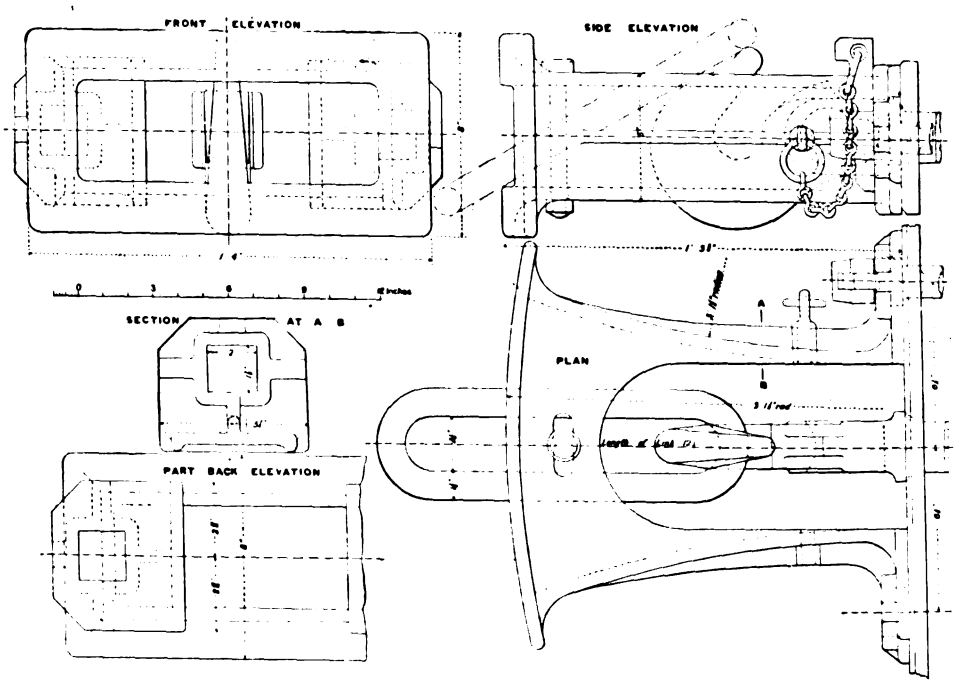


FIG. 5.

stations on this line, the train being stopped at the most convenient places to suit travellers. The general construction of the under frame is the same as for the composite carriage already described; the bogies are exactly alike, but in the present case are placed at 33ft. centres instead of 31ft. The carriage is 40ft. long over end pillars, with an additional length of 2ft. 9in. over each end platform. The seats are arranged crossways, with reversible backs, and the carriage is divided into two compartments by a partition in the centre, with a sliding door. The height and width are the same as in the ordinary carriages.

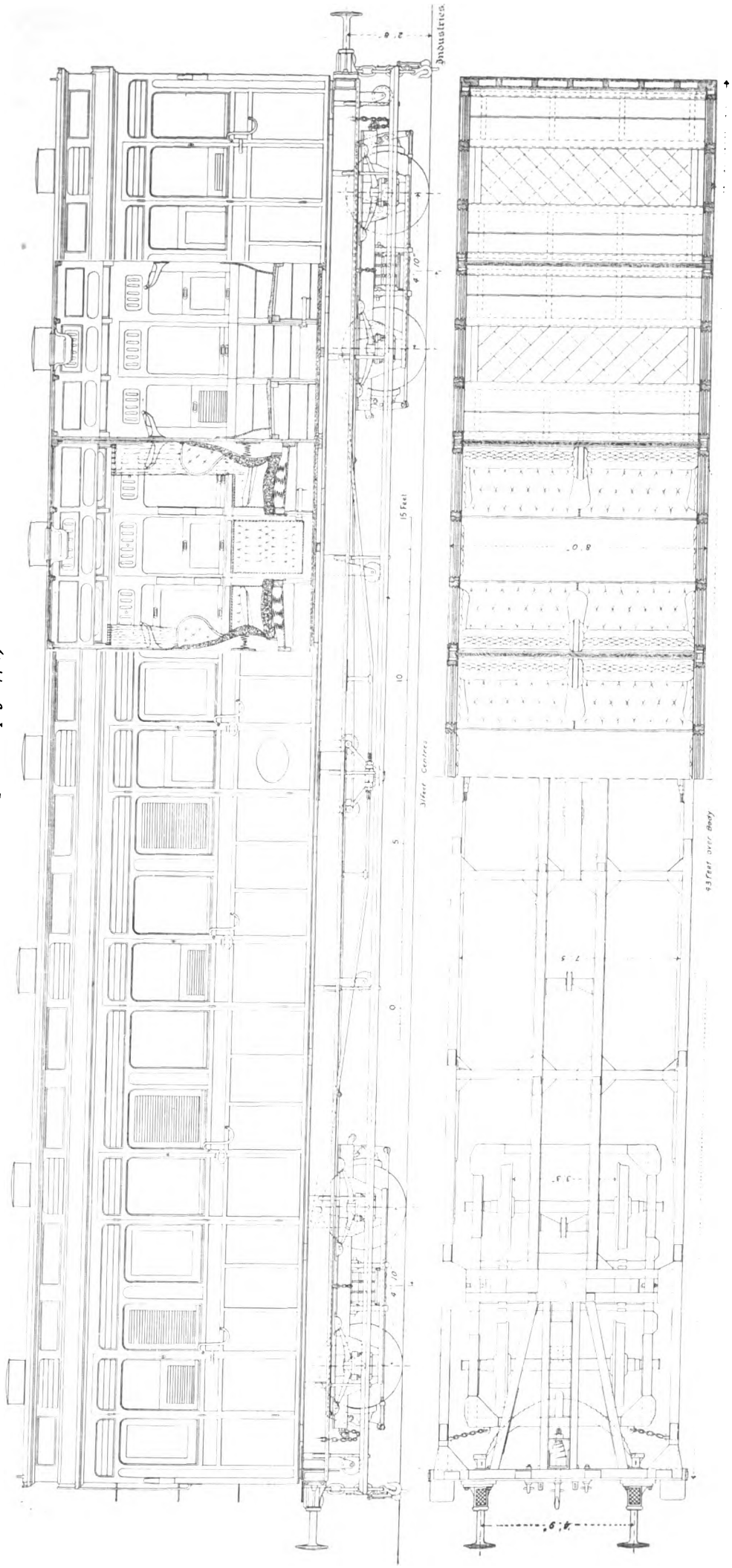
When the Government lines were made and the rolling stock ordered, a difference of opinion arose between the Government officials and the managers of the Tasmanian main line as to whether central buffers or side buffers should be used. The Government were in favour of side buffers; but the Tasmanian line strongly objected, as their stock was entirely fitted with central buffers. As there must be an interchange of rolling stock they contended that the new stock ought to be fitted with the same buffers, and that side buffers and central buffers could not work together in the same train. To overcome the difficulty Mr. Joseph Meilbek, Assoc.M.Inst.C.E., of 7, Westminster Chambers, Victoria-street, under whose supervision these carriages have been constructed, designed the neat form of removable central buffer shown in Fig. 5. At every station where there is a junction with the Tasmanian main line these special central buffers are kept in stock, and whenever any carriage passes from the Government lines on to the other line this buffer is slipped on to each end of the carriage, which is thus converted into a carriage on the central buffer system. This special buffer is complete in itself, and has two square holes through which buffer studs, fixed on the ends of every carriage, pass when the buffer is attached. These studs have cottar holes to fit a pair of cottars, which are chained to the buffer to prevent them being lost. The work of putting on or taking off the special buffer occupies no more time than the coupling of two carriages. All that has to be done is to pass the buffer over the studs, and drop in the two cottars. When a carriage comes off the Tasmanian Company's line, the action is reversed—the two cottars are withdrawn, and the buffer is free to be removed. The length of a side buffer is shorter than a pair of central buffers where they come together, so that there is plenty of clearance between the ends of a pair of side buffers and the end of a carriage without side buffers. The coupling arrangement with the special buffer is the same as with the ordinary central buffer.

The locomotives, carriages, and other rolling stock have been designed by Mr. W. E. Batchelor, the locomotive engineer. Messrs. Beyer & Peacock, of Manchester, are the locomotive builders; the Ashbury Carriage and Waggon Company, Manchester, the Bristol Waggon Works Company, the Birmingham Railway Carriage and Waggon Company, and Messrs. Brown-Marshall's, of Birmingham, are the makers of the carriages and waggons. The rails were manufactured by the Barrow Hematite Steel Company and the West Cumberland Iron Company.

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TASMANIAN RAILWAY CARRIAGES.

(For description see page 441.)



FIGS. 6 AND 7.

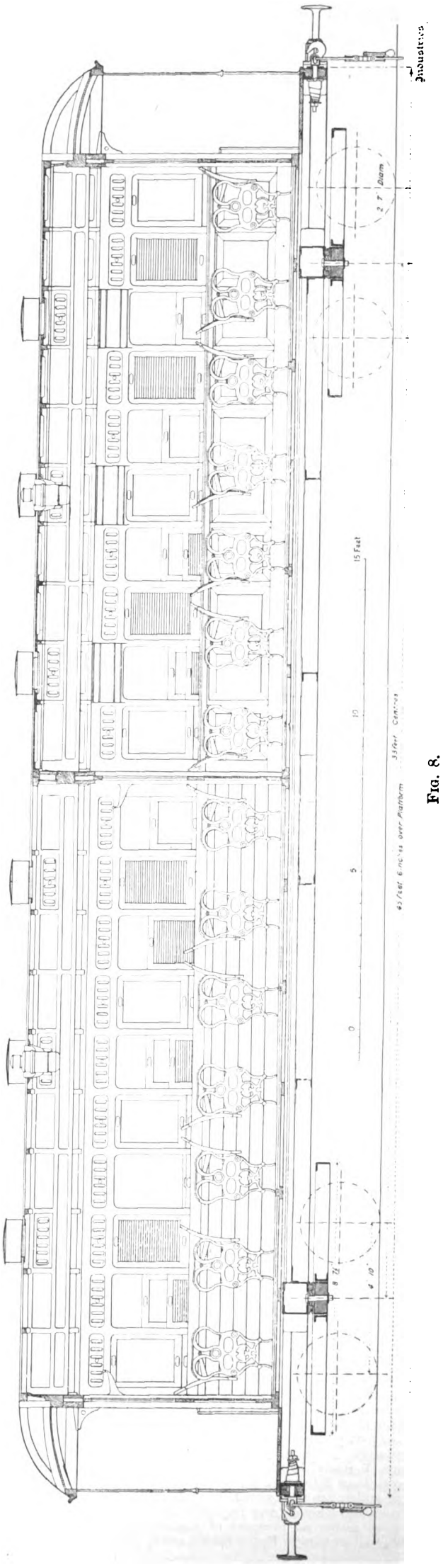


FIG. 8.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 1st May, 1888.

The Iron Market.—I am now in a position to give the particulars of the scheme which the manufacturers purpose to adopt to protect themselves against the merchants. It is proposed to establish a common agency at Paris under the control of one man, who will be accepted as the representative of all the manufacturers. It is argued that as one firm if existing alone could make its own prices, so when all are thus combined in one agency bound to act for the common good, the same result may be arrived at. The market is still somewhat weak here, and merchants continue to offer bars at £5. 12s. and joists at £5. 4s.; but elsewhere business is reviving. Orders come to hand pretty freely, and full prices are readily paid. The demand for wire and wire nails is very brisk, and is increasing. Galvanised wire is specially sought after. It now seems certain that, in the absence of political disturbances, trade will be fairly brisk throughout the early months of summer. The pig iron trade of the Meurthe-et-Moselle is in the best possible condition; the demand is steadily increasing, not only for France, but for Belgium, and prices move upward. The foreign trade in iron exhibits a tendency to shrink. In the first quarter of the year the imports of pig iron amounted to 31,169 (38,895) tons; those of finished iron to 5782 (8852) tons; and those of steel to 2428 (3848) tons, the quantities in brackets being those for the corresponding period of 1887. The exports of pig iron amounted to 8544 (10,358) tons; those of finished iron to 17,644 (17,418) tons; and those of steel to 5263 (13,188) tons. It is to be observed that the shrinkage in the exports is almost wholly in rails.

The Metal Market.—It is clear from the constant growth of the stocks in the hands of sellers that the consumption of copper is less than the production. Consumers, aware of this fact, defer the purchase of fresh material to the latest possible date, and then buy only for the wants of the moment. As a consequence the market is beginning to exhibit signs of weakness. Tin for prompt delivery has to be paid for at the prices which have been current for the last two weeks; but for future delivery large concessions may be obtained. Thus the tendency of the market is distinctly downward. Lead is active, and prices have further advanced 8s. a ton. Spelter is steadily declining.

Communication with the Continent.—The grounding of the "Invicta" on the Calais sands has directed public attention to the means of communication between London and the Continent, and particularly with Paris. It is interesting to trace, in connection with this subject, the progress of engineering science in the last fifty or sixty years. In 1828 the mail coach ran from London to Dover in 12 hours; 6 hours on an average were occupied in crossing the Channel to Calais by sailing boat; and the distance between Calais and Paris was covered by diligence in about 36 hours—a total of 54 hours from London to Paris. A few years later, a better built boat, the "Henry IV.," reduced the passage to 4 hours, and the diligence service was accelerated so as to save 6 hours on that portion of the journey. Twenty years later, in 1848, travelling on this route had been completely revolutionised. The time from London to Dover was by railway 3¼ hours, the steamboat "Courier" crossed the Channel in 2¾ hours, and the French railways conveyed the traveller from Calais to Paris by way of Lille in 8 hours, making a total of 14 hours for the whole journey. In 1868, the distance from London to Dover was traversed in 2½ hours; the "Samphire" did the passage in 1½ hours; and the journey from Calais to Paris was performed, *viâ* Boulogne, in 6½ hours—a total of 10½ hours. Another twenty years have brought further improvements. At the present time the London and Dover express is allowed only 1h. 45m.; boats like the "Victoria" and "Invicta" make the passage in very little over one hour; and the run from Calais to Paris, *viâ* Boulogne, occupies only 4h. 25m.; a total of 7h. 15m. actual travelling. A new steamer, the "Empress," is being built to make the passage in 50 minutes, and the Boulogne section of the line to Paris is being improved so as to reduce the time by 25 or 30 minutes. Thus visitors to the Great Exhibition will be able to perform the whole journey from London to Paris in about 6½ hours.

BERLIN, 30th April, 1888.

The Coal Market.—The condition of the coal market is only satisfactory as regards coking coal. Owing to the great demand for this variety the Königin Luise colliery has recently increased the price 3d. per ton, and this example has been followed by the colliery belonging to the Donnersmarckhütte; but for steam and household coal, colliery owners are obliged to make concessions, and a reduction in price of about 4d. per ton has taken place. The competition of collieries in Russian Poland is beginning to be more and more felt by Upper Silesian coal owners. The import of Polish coal is continually on the increase, and is partly due to the depreciation of Russian money, and partly to the reduction of freights on the Warsaw-Vienna Railway. Polish coal is from 1s. to 2s. a ton cheaper than Silesian coal, and consequently even those towns which are well situated for the Silesian trade, such as Posen and Gnesen, now import largely the cheaper coal. As there seems no prospect of Russian money rising in value, coal owners in Upper Silesia are agitating to induce the Prussian State Railway to make further concessions in their tariffs, so as to enable them to reach those towns at a cheaper rate.

The Iron Market.—During the past week a report has become current that the syndicate of rail makers has been dissolved, and this has caused a certain amount of uneasiness in the iron market. The firmness of the market depends to a great extent upon the existence of the various syndicates, and the dissolution of the rail makers' syndicate would endanger the condition of the others. Nothing definite is as yet known; but it is thought that the report has been circulated for stock jobbing purposes, since no confirmation of the fall of the syndicate has yet been received. Now that the inundations in Upper Silesia have ceased, business has resumed its normal aspect. The sales of crude iron have increased, and this branch has during the past week been more favourably situated. Common forge pig is still quoted at 50s., better qualities at 54s., and foundry pig at from 56s. to 60s. Engineering works continue well employed, and in some works more men have been engaged in consequence of the number of orders on hand. The output of the rolling mills is readily disposed of, this being especially the case with bars and girders, for which orders are numerous. Business in the crude iron trade of Upper Silesia continues satisfactory; but somewhat contradictory reports as regards future business are current. According to one of these reports the Donnersmarckhütte, anticipating some difficulty in disposing of about 6000 tons of forge pig, being part of their next year's probable output, has offered this quantity to the rolled iron syndicate at a reduction of 10s. per ton. On the other hand, the administrative council of the Tarnowitzer works have at their last meeting resolved not to make concessions in price for forward delivery, as they are confident that the demand will continue brisk, and prices remain firm. The Palatinate railway administration recently asked for tenders for the supply of various railway material. Messrs. de Wendel & Co., of Hagingen, obtained contracts for the supply of 7500 tons of ingot steel rails at 115s. 6d. per ton, and for 20,000 ingot steel fish plates at 113s. free at Ingbert. The Dortmund Union have obtained a contract for the supply of 7500 tons of steel rails, and 5600 tons of steel sleepers, at 110s.

Central Station Lighting.—In the electric light station at Lübeck, which is designed for 2000 lamps, but which will eventually be increased, a novel system of laying underground cables has been adopted. The method hitherto followed in Berlin and other towns consisted in the employment of either Edison tubes or Siemens lead covered cables, with an armature outside formed of spirally wound iron tape. To reduce the cost of the cables the iron armature has been omitted in the Lübeck cables, and the lead envelope is protected by a serving of jute heavily tarred. Since these cables are mechanically not so strong as those with an iron armature, they have been laid in flat channels of rolled iron with an iron lid. These channels are perforated at the bottom, so as to allow water which may find its way into them to pass out into the ground. Owing to the protection afforded by the iron channels, it has been found possible to lay the cables close under the paving stones. The junction, feeding, and distributing boxes are also smaller and less expensive than those used in Berlin. They are provided with short sockets, into which the iron channels fit. At the bottom of the boxes a plate of ebonite is fixed, to which are secured the various terminals and connections for the fusible plugs. Another departure has been made in the testing wires. These do not form part of the main cable as in Berlin, but are separate light cables brought back from the feeding centres to the station.

VIENNA, 30th April, 1888.

The Iron Market.—During the past week the iron market throughout Austria has continued firm, and business is very active. There is a good demand for agricultural machinery and implements, and this is bringing about an increase in the price of merchant iron. Considerable transactions are taking place in crude iron, and prices are as firm as in the winter months. Bar iron and black and tinned sheets are still in good request. Although the building trades are brisk the amount of business in building iron is not so great as was anticipated a few weeks ago. In Bohemia the condition of the iron trade has considerably improved, and the demand for girders and locksmiths' goods has especially increased. Large quantities of iron are being sold for agricultural and railway purposes, but bar iron and castings are neglected. Prices are generally well maintained, and a reduction has only taken place in galvanised sheets. In Hungary business is almost more favourable than in the western portion of the Empire.

Locomotives.—The Minister of Commerce has issued statistics showing the position of the locomotive trade in Austria, exclusive of Hungary. It appears that during the last year ninety-one new locomotives have come into service, of which number eighty-two were built by Austrian firms, while only nine were obtained from abroad, where three firms shared the orders. Locomotives before being allowed to be put in use must, according to a stringent police regulation, be submitted to an official test, and thus the tests are a reliable guide as to the number of new engines put on the road. The largest manufacturer of locomotives is the Austrian State Railway, which made last year twenty-four engines; a private company in Vienna made fourteen, and other railway works and private companies made smaller numbers.

Electric Lighting.—Considerable progress is being made in various Austrian towns with electric lighting. The total number of glow lamps now installed in Vienna may be estimated at eighteen thousand, and in addition there are about one thousand arc lamps in use. A small central station is projected for Neuhaus, in the south of Bohemia, where there will be a total of six hundred glow lamps installed, the motive power being supplied by turbines. Consumers will have to buy their own lamps, and pay for the current—not by meter, but at a fixed sum of 15 florins (about 24s.) per annum—for every 16 c.p. glow lamp fixed. In Pisek, also a town in Bohemia, a central station is in course of erection for twenty-two arc and one hundred glow lamps for street lighting; power will be supplied by a 45 h.p. water wheel. The station at Karolinenthal, near Prague, which I described some months ago, is in successful operation. There are now three hundred glow lamps in use, and the current is partly supplied direct from the dynamos and partly from Khotinski accumulators. One of the most complete installations in Bohemia is that on the Sophieninsel, in Prague, an island on which is a casino used for public entertainments. This installation has been erected by Herr Krizik, and consists of three Otto gas engines, each of 50 h.p., and a small gas engine for starting the big engines. There are four disc dynamos, each capable of supplying four hundred lamps. In the assembly rooms of the casino there are fixed five arc lamps, and nine hundred glow lamps; but as there is current to spare, some street lighting by arc lamps will be done from these dynamos. The whole of the plant for this installation, including the handsome electroliers, has been manufactured and supplied by Herr Krizik, who is also the contractor for the lighting. The light is paid for, not by the amount of current consumed, but by the amount of gas used in the engines, the charge varying from 20 kreuzer to 32 kreuzer per cubic metre, according to the number of lamps in use at a time. The gas for the engines costs 9½ kreuzer per cubic metre, or about 4s. 9d. per 1000 cub. ft., so that the contractor for the electric light receives a surplus of about 7s. on every 1000ft. of gas required, and this covers his profit, the payment of wages, lamp renewals, carbons, and other charges standing against the installation.

BRUSSELS, 1st May, 1888.

The Coal Market.—The situation continues favourable, and prices are very firm in all the districts. There is great activity on the State railways, 20,926 waggons of coal having been dispatched last week; and navigation on the Meuse to France having been resumed, numbers of boats are loading for the Ardennes district. The agitation still continues for lower railway rates, to enable our collieries to meet the German competition at home, which has been caused by the reduced tariff of the Grand Central. Owing to the brick making industry having been busy this year, there has been a good demand for inferior qualities of coal, which now show a tendency to rise. Stocks are very low in the Mons district, and coke is rising again. In the Liège district, steam coal and coal for metallurgical purposes are very firm; there is a slight falling off in the demand for household coal. During the first two months of the year the imports of coal and coke were as follow:—

From	Coal. Tons.	Coke. Tons.
Germany	59,975	2110
England	39,765	48
France	25,882	392
Holland	21,318	1270

Most of the imports entered as from Holland really come from Germany, which country shows a large increase at the expense of the other countries. During the same period our exports were:—

To	Coal. Tons.	Coke. Tons.
Germany	—	—
France	584,668	129,486
Luxemburg	15,823	30,316
Holland	21,730	—
Other countries	21,690	4,813

In addition to the above, we exported 45,954 tons of briquettes.

The Metal Market.—There is a falling off in the number of orders received, and in the export trade German and English competition is making itself severely felt. Steel is coming more and more into use for general purposes. Even in the construction of rolling mills it has nearly superseded every other variety of material. The Cockerill Company has obtained an order for 13,600 tons of steel rails for delivery at Venice, Ancona, and Brindisi, the prices quoted being respectively 111·75fr., 113·75fr., and 115fr. Delivery is to be made in June, July, and August. Tenders were also made for this contract by Bolckow-Vaughan, Ruhrort, and Terni. The Cockerill Company has also secured the supply of 2000 tons of steel rails to be delivered at Hamburg. The Société Franco-Belge furnishes two hundred waggons for the Roumanian railways. At the Belgian State railway contracts of last Tuesday Verhaegen obtained three mail vans at £304, Halot Frères forty-six waggon bodies at £64; Seneffe, thirteen at £50, and eight at £49; and Germain, forty-seven at £68. Trials of the Navez ores, made by several of our large establishments, have given excellent results. No buyer has yet been found for the blast furnaces of the old established firm of Dupret. There is some talk of a company being formed by English capitalists to purchase

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the rolling mill of the Société de Châtelet-Marchienne, the Lion Belge rolling mill, the Châtelet blast furnaces, and other establishments in the same district.

Our Foreign Iron Trade.—The following are the figures of our foreign iron trade during the first two months of the year, in tons:—

	Imports.	Exports.
Steel ingots	10	211
Rails	60	701
Rolled steel	386	772
Pig iron	11,954	1,944
Old iron	1,998	107
Iron wire	567	556
Iron rails	65	2,531
Sheets	135	6,573
Rolled iron (various)	1,000	32,575

The imports show a marked increase as regards pig iron, which has been contributed solely by England and France. The total exports show an increase of 2000 tons, compared with the same period of 1887.

The Exhibition.—It is doubtful when the Exhibition will be opened; the 19th of May is now spoken of, but the Exhibition will not be complete till June. The English section, however, is almost finished; it is of an elegant design, and the way in which it has been erected by the English workmen has called forth favourable criticism. Nothing more is heard of the competitions which were the original object of the enterprise. The magnificent programme for lighting, of which so much was heard at first, has given place to a far more modest scheme. The illumination of the grounds will, however, be on a fairly large scale. The electric railway has been abandoned; but a small electric train, on the overhead conductor system, will be installed, the plant being brought from England. A Lartigue railway, as illustrated in *Industries*, Vol. I., page 317, will also be laid down. There will be a captive balloon, constructed by Thoulet & Cie. The tobogganing slide and switchback railway, and other attractions for the general crowd, are more likely to be successful than the scientific and industrial exhibits. The management of the Exhibition is trying to obtain an additional subsidy from the Government.

DÜSSELDORF, 30th April, 1888.

The Iron Market.—A little more life has shown itself this week in the iron market, both in the business in crude and in finished materials. This change for the better has given rise to a feeling of greater confidence, resulting in a more buoyant tone. A better demand has sprung up for spiegel pig for the United States, and forge pig for home consumption is again being actively dealt in. The renewed animation of the market for forge is a consequence of a reviving demand for bars, and an upward movement in the prices of coke. There is a steady current of business in basic pig, tending to increase, and foundry pig is being more largely bought. The total production of pig iron in Germany, including Luxemburg, in the month of March, amounted to 359,772 tons, against 315,713 tons in the same month of last year. This total was made up of 176,618 tons of forge and spiegel, 104,592 tons of basic, 34,781 tons of Bessemer, and 43,781 tons of foundry pig. The total production for the first quarter of the year amounts to 1,045,575 tons, against 885,818 tons in the corresponding period of 1887, a difference of 159,757 tons, or 18 per cent. The trade in finished iron and steel is a little more brisk in some of its branches. Bars are in better demand for home consumption. Manufacturers complain of prices being unremunerative. What justification there is for this dissatisfaction with the existing rates may be learned from a comparison of the current rates with those which prevailed a year ago. At the end of the first quarter of 1887 Rhenish-Westphalian forge pig was quoted 48s., and basic steel pig 43s.; while bars were being sold for £5. 10s. and common plates for £6. 13s. a ton. Now forge pig sells at 52s. and basic steel pig at 45s., while bars are quoted £6. 5s. to £6. 7s. 6d. and common plates £7. 5s. The market is slightly flat for joists this week; plates are in stronger demand, except in the Siegen district, where this branch of the trade is dull, and sheets are not much inquired after. Founders are generally very busy; but prices, especially for gas and water pipes, are low, being scarcely above the cost of production. The Rhenish Steel Works at Ruhrort tendered £5. 1s. 6d. per ton for 13,600 tons of steel rails for the Italian railways. This offer was underbidden by the Belgian Cockerill Company, who tendered £4. 12s.

Coal Tar Pitch from England.—English coal tar pitch is being largely imported into this district for briquette making. Two English vessels, the "Excelsior" and the "Eastern Belle," are now lying in Hochfeld Harbour, each laden with a cargo of about 140 tons of pitch from London. As return cargo, one will carry back to London empty bottles from Düsseldorf, the other mineral water from Remagen. Similar shipments each way will follow at short intervals.

LILLE, 1st May, 1888.

Textile Manufactures.—Business in textile goods has improved in some respects within the last few days. There is less distrust of the situation manifested, and the retail dealers seem disposed to buy more freely. In linen goods there is a steady current of business, but the weekly turnover is less than that of the corresponding season of last year. If this business follows its usual course, there will be greater activity after the middle of this month. In woollen goods there is a little more life, and manufacturers at Roubaix are beginning to regard the situation more hopefully; but there are no indications of anything like general activity. The demand has increased for fancy goods, striped fabrics being chiefly inquired after. Stock patterns of cloth are neglected. There is nothing new to report in the cotton goods trade, which remains dull, and there is no sign in the silk trade at Lyons. The Customs returns for the first quarter of the year show the foreign trade in textile goods relatively to the corresponding period of 1887. The declared values of the imports are: For linen goods, £56,080 (£54,080); for cotton goods, £480,000 (£639,280); for woollen goods, £576,360 (£578,040); for silk goods, £645,720 (£555,640). Of the exports the declared values are: For linen goods, £94,800 (£87,880); for cotton goods, £1,060,280 (£1,153,320); for woollen goods, £3,939,320 (£3,382,720); for silk goods, £2,396,920 (£2,454,040).

Flax and Yarn Markets.—The conditions of the flax markets have not changed since my last report. Business in home grown flax has been limited to a few unimportant transactions; but though the demand is light, offers are not pressed, and prices are maintained. There is scarcely more business doing in Russian produce, for which the quotations are the same as those of last week. The Ghent market is firmer, the demand being now fairly strong for home grown flax, and the quantity on offer small. Business in tows is dull. Yarns have been dealt in less briskly. The finer numbers are in good demand, at full prices; but the heavier sorts are somewhat flat, and concessions have to be made to buyers to induce them to deal in considerable quantities. Jute yarns are also quieter.

The Iron Market.—There is a steady and fairly abundant current of business in iron in this locality. Consumers, convinced now that lower prices are not to be expected, are giving out their orders more freely. Prices are very firm all round. Bars are quoted £5. 8s. to £5. 12s., and common plates £6. 12s. to £6. 16s. a ton. There is some talk of a further advance in these goods shortly; but it is not likely that manufacturers will push their advantage so rapidly, after the experience of the last few months. If the scheme for regulating the Paris market be carried into effect, a source of weakness will have been removed, and then higher prices may be expected.

The Export Butter Trade.—I directed attention some months ago to the efforts which were being made to extend the butter export trade of this district. Recent statistics show that considerable progress has been made, the trade with England having increased in a marked manner within the last three months. The total exports of fresh butter to England in 1887 amounted to 3,952,500lb., against 3,775,000lb. in the previous year. The quantity of salt butter sold to English consumers in the same time was 44,825,000lb., against 43,655lb. in 1886.

WINTERTHUR, 30th April, 1888.

Water Supply.—Herr Ritter, of Neuchâtel, has made a proposal to the municipality of Paris to supply that town with water from the Lake of Neuchâtel, the level of which is nearly 1000ft. above that of Paris. The distance is about three hundred miles. The quantity to be supplied is 20 tons per second, and the estimated pressure at Paris, after deducting loss by friction in the supply main, is 50lb. per square inch. The total energy therefore brought by water to the town of Paris would thus amount to over 8000 h.p. in falling water, or say 6000 actual h.p. obtainable from water engines.

Textiles.—According to figures which have been published by the union of Swiss silk spinners, there were last year in Switzerland 61 silk spinning mills, employing 5765 hands in the works, in addition to 2289 persons who were engaged in their own houses. The total wages paid during the year were rather less than was the case in 1885, although 300 more persons were engaged in the industry. The value of the exports from Switzerland in 1887 of cotton embroidered goods amounted in round figures to £3,600,000, whilst the exports of silk and linen embroidered goods in the same year were of the value of £400,000.

Extension of the St. Gothard Railway.—The second line of the St. Gothard railway has already been commenced, and active operations will shortly begin on the Faido-Rodi-Fiesso portion. This part of the line offers the greatest difficulties. It will involve the construction of two curved tunnels 15,000 metres long, and four straight tunnels of about 1000 metres, and two iron bridges of considerable span. The Faido-Airolo portion is to be completed by the year 1890; the Faido-Biaska portion by 1892; and the Erstfeld-Göschenen section by 1896. The total estimated cost is £650,000.

NEW YORK, 21st April, 1888.

The Coal Market.—In the anthracite coal trade it was hoped that the spring season would bring with it the usual activity; but this has not been the case. On the contrary, there is a disposition on the part of buyers to purchase only for immediate wants. Consumers are almost universally of opinion that lower prices will prevail. In the East, where navigation is just opening, there is a scarcity of coal; but the orders are only enough to supply present necessities, and this indicates the state of the trade everywhere. Production goes on at a great rate, and coal is being stored in large quantities. There has been no formal understanding about the output, but some steps in that direction are necessary, owing to the tendency of prices. The leading companies profess the most earnest desire to do all that is proper to maintain the trade on a profitable basis.

The Iron and Steel Markets.—The second quarter of the year has not opened very favourably for iron dealers. While there is probably a good amount of business in prospect, it will be at terms which cannot possibly leave much, if any, margin to manufacturers. Prices have been cut down far more rapidly than the cost of production has been reduced. There is a moderate degree of activity in pig iron. Standard brands, which are still scarce, are steady; but there is an increasing supply of "outside brands," the quality of which is generally uncertain. They are offered at lower figures than regular irons, but have not found much favour so far, and are not bought to any extent, except at extremely low prices, or in sample lots subject to approval. In this way options for thousands of tons have been bought; but whether they will result in actual sales remains to be seen, and will depend on how the iron turns out and how the market looks a little later on. It cannot be said that the position is any more settled than it has been for some time past, although the market is now so low that there can hardly be any further concessions; and when consumers realise this, purchases will be on a more liberal scale. The Thomas Iron Company have booked orders for over 30,000 tons since announcing the $20 rate for the year. Last year, after announcing their rate, the company had orders booked for 100,000 tons in less than a week. There has been a slight recovery from the rapid decline of blast furnace output which has been going on steadily since the beginning of the year; although there are fewer furnaces in blast now than there were a month ago, the output has increased, owing to some of the smaller furnaces blowing out and some of the larger ones starting again. On the 1st of April there were in blast 95 anthracite furnaces out of 198; 128 bituminous and coke furnaces out of 212, and 52 charcoal furnaces out of 175, having a total output of 110,769 tons. At present $20 to $21 per ton is the quotation for No. 1 foundry, and other grades in proportion. Southern and Western irons are more irregular, and are offered at from 50 cents to a dollar less than the quotations for local brands. There is a pretty fair demand for manufactured iron, and the business is improving slightly from week to week. Prices are somewhat irregular, and vary considerably with the size of the order. Plates have sold at 2 cents per lb., although in most cases 2·1 cents are asked; angles are quoted at 2·15 cents, and refined bars from 1·85 cents to 1·95 cents, but competition is very close. Business in steel rails is very quiet, and prices are steady at $31·50 per ton at mill as an inside price with large lots, and $32 for smaller orders.

The Metal Markets.—The copper market has been fairly active and steady during the past week. Most of the sales have been to consumers or for exportation, which partly accounts for the slight increase in price. There has been but little speculative buying, legitimate business alone being sufficient to strengthen the market. The stock in dealers' and consumers' hands is very small, so that the market is likely to remain firm for some time. Quotations are 16·85 cents to 16·95 cents per lb. for present delivery. Trading in tin has been very light, with declining prices. Prices for May delivery have fallen from 29·20 cents to 27·40 cents per lb. Plates are still dull, but prices remain unchanged. Stocks are small and very much broken, so that dealers have considerable trouble in filling large orders for one brand. Spelter is weak with a downward tendency, and little business doing.

PHILADELPHIA, 21st April, 1888.

Underground Cables.—The Town Council of this city have control of all electrical work, and some time ago they determined that all overhead wires should be undergrounded, which has been done. The engineer to the Council, Mr. D. R. Walker, has just sent in his annual report to the Mayor, describing the behaviour of these underground cables, which are used for telephonic, telegraphic, and electric light service. There are four companies in Philadelphia now using Waring underground cables, viz., the Brush Company, the Keystone Company, the United States Company, and the Underground Electric Light and Power Company. The Brush Company are using sixty arc lamps in one of their circuits, which is five miles long, and is worked at a pressure of 2800 volts, or about 45 volts per lamp. The lamps are generally placed at intersections of streets, and at a distance of about 500ft. apart. The cable for the Brush lamps consists of a seven strand 14 B.W.G., with insulation of from $\frac{1}{16}$in. to $\frac{4}{32}$in., and protected with a lead covering $\frac{1}{8}$in. thick. The same cable is used by the Keystone Company in a fifteen mile circuit at 2000 volts, and no difficulty has been found in working it. Along Chestnut-street the electric light cables are laid side by side with telephone and telegraph cables in a cast iron duct 20in. by 30in. In Broad-street the cables are laid in a wooden trough, covered with a plank and close under the pavement. According to the report, nine-tenths of the difficulties experienced with underground work were not in the cables themselves, but in the connections with the overhead portions. Mr. Walker also mentions an interesting case where lightning struck an overhead connection on an underground circuit, ran through three miles of cable, and burned the dynamo; the cable itself, however, was not injured.

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FORMAL INVESTIGATION UNDER THE BOILER EXPLOSIONS ACT, 1882.

The report of the first formal investigation held under the Boiler Explosions Act, 1882, on the 11th, 12th, and 13th January, 1888, has just been issued, Messrs. H. R. Mansel-Jones and Druitt Halpin being the commissioners. The boiler explosion investigated occurred on the evening of the 11th October, 1887, at Leys Iron Works, Brockmoor, Staffordshire, belonging to Messrs. Brown & Freer. It was of the Rastrick type, heated by the waste gases from two puddling furnaces, seated and flued as shown by the accompanying illustration, in which Fig. 1 is a sectional elevation and Fig. 2 a plan. The boiler was 9ft. 3in. diam. and 17ft. 6in. high. The cylindrical part was made in two rings, each formed of nine plates. The top and bottom, which were hemispherical, were formed of sixteen and eighteen plates respectively. The vertical tube of the flue was 9ft. high, made originally in two rings of plating—the upper ring 3ft. 6in. diam. in four plates, the lower

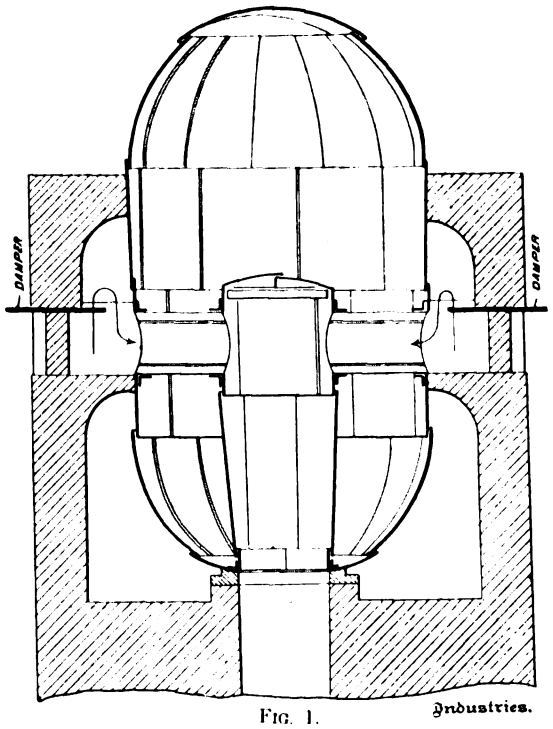


Fig. 1. Industries.

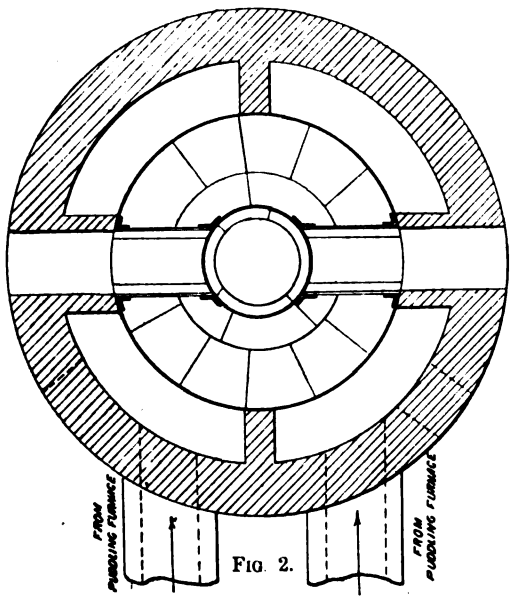


Fig. 2.

ring in six plates tapering to 2ft. 6in. diam. at the lower end; this ring had been cropped, and an additional ring 9in. broad fitted. The crown of the vertical tube was formed of two plates, and the cross tubes of four plates secured to the vertical tube, cross tubes, and shell by L rings 3in. by 3in. by ½in. All the plates appear to have been originally $\frac{7}{16}$in. thick, single riveted with lap joints, rivets $\frac{3}{4}$in. diam. and $1\frac{3}{16}$in. pitch. There was an internal manhole 15in. by 12in., with strengthening ring. The mountings consisted of one safety valve 5in. diam., with a counterbalanced lever with weights at each end loaded to about 30lb. per square inch; one stop valve; two floats with wheel standards to indicate the height of the water; one blow-off cock; one non-return feed valve, the feed valve and blow-off having only one pipe common to both, which is a most objectionable arrangement and liable to cause accident. There was no pressure gauge to the boiler which, from the evidence, appears to have been made by Messrs. Westwood & Wright, Brierley Hill, about 1853. The boiler was inspected about once a month by the engineer of the works, and, as might be expected from its age—thirty-seven years—had been extensively repaired from time to time; twice re-bottomed—once in 1863, and again in 1883. A report of these inspections had been kept by the engineer since 1870, of which the Commissioners somewhat suspiciously remark that "the entries are undoubtedly genuine, and made at the time they purport to have been made." The whole of these reports up to May, 1883, are appended to the report. Since 28th May, 1883, the engineer had inspected the boiler regularly, and with slight exceptions had reported it in good condition. In addition to this inspection, the boiler had been under the inspection of the Midland Steam Boiler Inspection and Assurance Company from the year 1863 to 1882, and from the latter date till the time of the explosion under its inspection and assurance for the sum of £500. A copy of the prospectus, names of directors, officials, rates of assurance, copy of proposal, copy of the policy and all its conditions, and also copy-reports of the insurance company upon the boiler are appended to the Commissioners' report, from which it may be inferred that this report is, at least, not wanting in the way of bulk.

Since the year 1863 the boiler appears to have been regularly inspected by the officers of the insurance company, and the reports clearly show that it had been in an exceedingly unsatisfactory condition for many years, as appear from the continuous leakage, caulking, chipping of seams, renewals of rivets, and patching alluded to therein. The last inspection was made by the senior inspector of the Midland Steam Boiler Inspection and Assurance Company, Mr. J. T. Short, the day before the explosion. The mill started about six p.m., and the boiler was worked as usual during the evening; three heats had been taken out of the furnaces, and the men were preparing for the fourth heat, when the boiler exploded, killing seven persons, and injuring nine others. The boiler gave way in the right flue, at one of the vertical seams of the lower belt of plating of the cylindrical part of the shell. The plates were blown violently outwards, the secondary rips following the line of rivet holes at the top, and the line of rivet holes of the curved end plates at the bottom, then vertically through the solid plates at each side within a few inches of the vertical seams of the next plate in the belt, and the plates were blown one to the right and the other to the left of the boiler site, scattering the surrounding brick work. The reactions of the outflowing steam and water through the opening thus made projected the boiler in the opposite direction, and it fell 34 yards from its original position, demolishing the shed in which the puddling furnaces stood. The plate that first gave way was cracked between the rivet holes of the joints. Most of the flaws have the appearance of having been of long standing, and were hidden by the inside overlap of the plates. The ring seam connecting the upper and lower belts of plates was also cracked for about 2ft. in length. The boiler does not appear to have been ever wholly stripped of brick work or subjected to a hydraulic test. The feed water by which the boiler was fed was taken from the hot wells of the condensing engines of the works, supplied from the adjoining canal, which is contaminated with sewage. From a report upon specimens of plates submitted to test by Professor W. C. Unwin, which is appended to the report along with his observations thereon, it appears that the mean breaking load of seven strips cut from the exploded boiler was 18·33 tons, with a minimum of 13·79 tons, the mean extension being 5·42 per cent., with a minimum of 1·5 per cent. Comparing these results with some tests of similar plates made by a Glasgow firm some years ago, which gave a breaking load of 22·42 tons, and a minimum of 20·20 tons, with a mean elongation of 8·72 per cent., and a minimum of 4 per cent., it would appear that the plates from the exploded boiler had only one half the combined resistance and ductility of similar plates from the same district. With regard to the cause of the explosion, the Commissioners say: "The remains of the boiler itself, together with the other evidence given before us, conclusively proves to our minds that the explosion was not due to over-pressure or shortness of water, but solely to the age of the major portion of it, an age which, having regard to the severe and alternating strains to which this class of boiler is subjected, must be considered very great. The plates and the rivet heads were very extensively reduced by wear from their original size, the seams had suffered severely from repeated chipping and heavy caulking, and the tests which we considered necessary to have carried out upon the original plates conclusively show that their quality had most seriously deteriorated, owing to their long exposure to intense and varying heat resulting in seam rips and edge cracks, which eventually caused the explosion, and it is impossible for us to explain how the inevitable calamity was so long deferred, particularly in view of the extensive seam rips existing in the boiler." . . . . . "No application was made as to costs." The last sentence is very disappointing, as it robs the whole report of the formal investigation of its distinctive value in a legal and moral sense, and reduces it to a mere report of preliminary inquiry. The report is, as we have stated, more diffuse and voluminous than usual, but that is of no real importance. This question of costs has apparently imparted a want of definiteness to the report, and prevented the Commissioners from plainly and clearly putting the blame, if any, where it is deserved, which is much to be regretted. Here is a boiler stated to be of a risky type, although it worked safely thirty-four years (from the evidence it would appear night and day), exploding in the usual course of work, apparently because it was thoroughly worn out, and no longer fit to withstand steam pressure. It does not appear that the actual remaining thickness of plate was ever ascertained, the boiler had not for the last twenty-four years at least been entirely stripped of brick work, nor even tested by hydraulic pressure. The insurance company do not appear to have recommended its replacement, nor does the possibility of a new boiler being required ever appear to have presented itself to the owners; and yet the Commissioners, deputed by the Board of Trade to make a formal investigation into the cause of its explosion, in framing an elaborate report of great length, formulate no conclusion as to where the responsibility should fall.

THE EFFECT OF OIL ON WAVES.

We have on several occasions mentioned the effect of oil on troubled waves, and stated a few of the experiments, both ancient and modern. The matter is now passing from the region of story to that of science, and is being discussed in papers and reports of Government departments and scientific societies, and a short time ago it was brought up in Parliament as deserving of attention. The Hydrographic Office of the United States has done the most effective service in bringing it into prominence and forcing it on the attention of the public. In 1886 the British Admiralty issued a memorandum on the subject, to which we directed attention at the time, and which was largely founded on the results published by the American Office. An interesting pamphlet has been published in Paris by Gauthier-Villars, the author being Vice-Admiral Cloné, and which contains a most admirable digest of the American results, supplemented by some striking examples which have occurred during the past year or two, and which further suggest some improvements in the methods of using oil for the purpose of stilling the waves.

The ordinary method of application is to hang canvas bags pierced with small holes, and containing a gallon or two of oil, over the side of the vessel. The oil slowly exudes through the holes, and spreads over the surface of the water with great rapidity and transforms a violent wave into a gentle swell, which lifts the ship without shock. Admiral Cloné has calculated that a film of oil, not thicker than one hundred-thousandth of a millimetre, is sufficient to produce this effect. In fact, it is shown that a small quantity of oil is more efficacious than a large quantity, as the thin film seems to spread more quickly, less than half a gallon per hour being sufficient to protect the largest ship. The oils most suitable for the purpose are those of the seal and the porpoise. Mineral oils have been used, although they are found to be too light, while the heavy vegetable oils congeal too quickly in cold seas.

Within the past few months various remarkable cases of the effect of oil on the waves have been published which are deserving of notice. Captain Kuhlmann, of the North German Lloyd steamer "Main," recently reported some experiments which he says were successful beyond conception. His words are as follow: "We were in 50°N. and 23°W., in stormy weather, with a high sea from the west. We steered west, and thus had the sea right in front of us, so that the vessel pitched and rolled badly, taking the heavy seas at the bows. The passengers could not remain on deck for the seas which rolled from the fore part and flooded the deck; and, moreover, the boats hanging in the davits threatened to be washed away in the shifting of the vessel. I resolved in this emergency to experiment with oil, and two pipes opening on the sides of the ship were stopped with tow and then filled with oil, which flowed slowly through the tow. I soon observed the effect, for from the foreshrouds to the stern no water came over. The sea had lost its power by reason of the oiling. We opened the doors and approaches, and the passengers could stay on deck at will. The oiling was continued seven hours, and the small quantity of 5lb. was used." A short time ago the steamer "Baumwall," of Hamburg (1050 tons), arrived at Leith with a cargo of wheat from Montreal. During the voyage heavy weather was experienced, and most of the deck fittings were washed away by heavy seas, which damaged the bridge. To prevent further damage being done, oil bags were hung over the side, and this had the effect of reducing the force of the waves. One of the most striking

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cases is that of the "Stockholm City," which, on its passage from Boston to London, encountered a terrible gale, which raised waves to a very great height. The deck of the vessel was encumbered with two hundred head of horned cattle, which made the management of the ship all the more difficult. The captain caused bags of oil to be suspended from the stern, two amidship, and others at the bows. The effect was said to be instantaneous, and large breakers were converted into harmless swells, and not a sea was shipped during the remainder of the storm. These examples are sufficient to show that the subject deserves the attention of all who are interested in shipping, and to such we commend a careful perusal of Admiral Cloné's pamphlet, which we have mentioned.

THE "BAR-LOCK" TYPE WRITER.

A NEW type writer with this designation has just been introduced from America, and placed on the English market by Messrs. W. J. Richardson, of 12 and 14, Queen Victoria-street. The instrument may be described as a modified form of the well known Remington machine. The arrangement of the key board, and of the levers by which the type bars are actuated, is similar to that of the Remington; but, instead of placing a capital and small letter or two different signs on the same type bar, and effecting the change from one to the other by keeping a special key depressed while striking the printing key, and thus shifting the paper carriage, as in the Remington, each type bar carries only one type, so that seventy-two keys are used instead of thirty-six. This had already been done in the "calligraph," an earlier modification of the Remington; but in that machine the keys for capitals and figures were placed at each end of the key board, while in the present instrument the keys are arranged in six lines, sloping slightly upwards away from the operator. The small letters and stops are assigned to the three rows nearest the operator, and the capitals and figures to the other three rows, so that the change from a small letter to a capital is made by moving the finger three rows forwards. This appears a more convenient arrangement than that of the calligraph, but whether it is preferable to that of the Remington machine is a question which would probably be answered differently by different operators. The type bars strike downwards on the paper, instead of upwards, as in the Remington, and this allows the last line printed to be seen without lifting the carriage—a decided improvement. The depression of the keys is shorter and lighter than in the Remington, which is in favour of rapidity. Expert operators with the Remington can work the machine up to its extreme limit of about ninety to one hundred words a minute. Beyond this it is impossible to go, as the type bars then interlock. In the new machine, the distance through which the type bar has to rebound after printing a letter, in order to clear the next one struck, is considerably less than in the Remington, so that the mechanical limit to rapidity is higher. We do not, however, attach very great importance to this, as no operator could maintain a speed of much over ninety words for any length of time.

The bar-lock, from which the machine derives its name, appears to be an important improvement. A series of conical pegs are arranged in a small semicircle, having its centre at the printing point, and each type bar when printing a letter is locked between two of these pegs, which prevents the alignment becoming defective when the type bar sockets become loose through wear. The use of this device also enables the steel type bars to be made elastic instead of being rigid, as in the Remington machine, which obviates any possibility of injuring the type bars by striking two keys at once, or in too rapid succession. The pegs are made of phosphor bronze, to avoid wearing the type bars, and when they become worn they can be replaced at an insignificant cost. The paper carriage is lighter than in the Remington machine, and on completing a line the carriage is shifted, and the spacing for the next line simultaneously effected by a simpler movement of the hand, and with less exertion. As far as it is possible to judge from mere inspection, without the test of time, the machine appears to be well made, and to give every promise of durability.

GERMAN NICKEL WORKS.—A share company, with a working capital of £31,000, has been formed to establish works at Schwerte, on the Ruhr, for the production of nickel. The new company will be known as the Westphalian Nickel Rolling Works Company.

LIVERPOOL ENGINEERING SOCIETY.—The eighth meeting of the current session was held on the 25th ult. at the Royal Institution, Colquitt-street, Mr. Charles H. Darbishire, president, in the chair. The discussion of Mr. Webster's paper, entitled "Steam Boiler Explosions," was resumed and taken part in by members and visitors. After Mr. Webster had replied upon the discussion, Mr. C. F. Bamford read a paper entitled "Air Brakes." This paper was illustrated by numerous diagrams with the aid of an oxyhydrogen lamp, and dealt exhaustively with the question of continuous brakes for railway trains.

Notices of Meetings.

THIS WEEK.

GEOLOGISTS' ASSOCIATION.—Friday, 4th May, 8 p.m. Papers to be read on "Palæozoic Arcidæ," by Mr. J. Logan Lobley, F.G.S., and on "Pterodactyls," by Mr. E. T. Newton, F.G.S., F.Z.S., &c.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 4th May, 3 p.m. Paper to be read on "Horse Artillery," by Captain M. Robertson, R.H.A.

NEXT WEEK.

SOCIETY OF ARTS.—Monday, 7th May, 8 p.m. Cantor lecture on "Decoration," by Mr. G. Aitchison, A.R.A.—Tuesday, 8th May, 8 p.m. Applied Art Section. Paper to be read on "The Decorative Use of Colour," by Mr. J. D. Crace.—Wednesday, 9th May, 8 p.m. Paper to be read on "Locks and Safes," by Mr. Samuel Chatwood.

ROYAL INSTITUTION OF GREAT BRITAIN.—Monday, 7th May, 5 p.m. General monthly meeting.—Tuesday, 8th May, 3 p.m. Lecture on "The Plant in the War of Nature."—Thursday, 10th May, 3 p.m. Lecture on "The Chemical Arts," by Professor Dewar.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday, 7th May. Annual general meeting. Discussion of the annual report, election of officers, &c.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, 7th May, 8 p.m. Paper to be read on "Standards of Light," by Mr. W. J. Dibdin.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 8th May, 8 p.m. Ordinary meeting. Paper to be further discussed, "The Distribution of Hydraulic Power in London," by Mr. E. B. Ellington, M Inst.C.E. Papers to be read with a view to discussion, "The Tay Viaduct, Dundee," by Mr. Crawford Barlow, M.Inst.C.E., and "The Construction of the Tay Viaduct, Dundee," by Mr. W. Inglis, Assoc.M.Inst.C.E.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, 9th May. General meeting for the presentation of report and election of Council, &c.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Wednesday, 9th May. Closing meeting.

INSTITUTE OF PATENT AGENTS.—Wednesday, 9th May, 7 p.m. Ordinary meeting. Discussion of Mr. Hardingham's paper on "The Proposed Patent Law in Switzerland." Paper to be read on "Patent Claims," by Mr. J. Imray, Fel.Inst.P.A.

IRON AND STEEL INSTITUTE.—Wednesday, 9th, and Thursday, 10th May, 10-30 a.m., and on Friday, 11th May, if necessary. Papers to be read as far as time will permit. Adjourned papers (1) "On the Mutual Action of Sulphur and Silicon in Iron at High Temperatures," by Mr. T. Turner; (2) "On the Use of Water Gas for Metallurgical Purposes," by Mr. A. Wilson; (3) "On an Imperfection in Mild Steel Plates, considered Chemically," by Mr. H. Eccles; (4) "On the Mechanical Apparatus for Continuous Moulding at the Works of M. Godin, Guise," by Mr. Jas. Johnston; (5) "On the Effect of Arsenic on Mild Steel," by Messrs. F. W. Harbord and A. E. Tucker; (6) "On the Manufacture of Ordnance at Trubia," by Major Cubillo. New Papers: (7) "On the Melting of Wrought Iron or Steel Scrap mixed with Ferro-Silicon in Cupola Furnaces," by M. F. Gautier; (8) "On the Behaviour of Arsenic in Ores and Metals during Smelting and Purification Processes," by Messrs. John Pattinson and J. E. Stead; (9) "On a New Instrument for the Measurement of Colour, more especially as applied to the Estimation of Carbon in Steel," by Mr. H. Le Neve Foster.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, 10th May, 8 p.m. Paper to be read on "The Risk of Fire Incidental to Electric Lighting," by Mr. W. H. Preece, F.R.S.

PRICES CURRENT, 3RD MAY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3	31/3½	Cash
Scotch Warrants, m/n	38/4½	"
Hematite Warrants, m/n	41/4	"
Stocks in Stores. Scotch	976,068—Inc. for week,	2239 Tons
Middlesbro'	308,016—Dec. "	2517 "
Hematite	208,586—Dec. "	500 "

Exclusive of stocks in makers' yards.
Market weak with no new feature.

	No. 1.	No. 3.		
Coltness	47/6	42/6	f.o.b.	Glasgow.
Gartsherrie	44/3	41/3	"	"
Dalmellington	39/6	38/-	"	Ardrossan
Eglinton	38/6	37/-	"	"
Glengarnock	43/6	39/6	"	"
*Derbyshire	—	35/-	f.o.t.	Works.
*Lincolnshire	—	32/-	"	"
*Lancashire	—	37/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com.	Best.	
Middlesbro' Bars	£ 4 17 6	£ 5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	4 17 6	5 7 6	"
Staffordshire Bars	5 0 0	6 0 0	Manch'r.
" Angles	5 10 0	6 10 0	"
Crown Sheets	6 10 0	6 15 0	"
" Hoops	5 7 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		8 0 0	"
" Ship and Girder		7 15 0	"

METALS.

Spelter: Ordinary	£18	0	0	to	18	5	0
Copper: British Cakes and Ingots	81	0	0	"			
" Chili Bars	80	0	0	"	80	10	0
" Manufactured (strong)	88	0	0	"	90	0	0
Lead: Common Pig	14	10	0	"			
" English Sheet	15	10	0	"			
Tin: Straits	89	0	0	"	90	0	0
" Australian				"			
" English Ingots	100	0	0	"	105	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER has remained without much change since our last, to-day's price being £80 to £80. 10s. There are sellers for delivery in three months at about £5 per ton less, the rapid fall in tin having weakened the market for copper. It is reported that M. Secrétan has given it out that the copper syndicate, of which he is the head, are not affected by the collapse of tin.

TIN.—The great speculation by which this metal was forced up from £106 to £166, collapsed at the end of April. The price was kept up by steady buying, so as to exact the heavy differences upon sales made some time ago for April delivery, at low prices. The moment it became known that the syndicate had ceased buying, the price fell at a bound £60 per ton. It seems likely that prices will recede still further, as stocks are heavy and the production of tin has largely increased. To-day Straits tin, spot, is quoted £89 to £90; English, nominal.

LEAD.—Quiet and rather easier.

SPELTER improving. The fall in price has been considerable, and the present position of this metal is attracting attention. Warrants are quoted £17. 12s. 6d. to £17. 15s. per ton—a very low price.

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/-	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.
Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	0	0
" Ceylon	"	24	0	0
Cottonseed	"	21	0	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	18	10	0
Palm, Lagos	"	21	0	0
Rapeseed: English	"	24	5	0
Seal: Pale	"	23	0	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	10	0
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	6
" Spirit	"	0	0	8½

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	6¾	—	0	1	7
" Oxalic	"	0	0	3½	—	0	0	4
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6⅛	—	0	1	6½
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	12	2	6	—	12	5	0
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	12	6	—	7	15	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	31	0	0	—	31	10	0
Benzole (90%)	gal.	0	3	4	—	0	3	6
" (50/90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	23	10	0
" White Sugar	"	27	10	0	—	29	0	0
" Brown "	"	23	0	0	—	24	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	0	0	5⅞
" Prussiate (Yellow)	"	0	0	7	—	0	0	7½
" Sulphate (Basis 90%)	ton	8	15	0	—	9	0	0
Precipitate: Red	lb.	0	4	1	—	0	4	2
" White	"	0	4	0	—	.....		
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	9	0	0	—	9	10	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	7	0	0	—	.....		
" " (" 60%)	"	6	0	0	—	.....		
" " (Cream, 60%)	"	5	18	9	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1½	—	0	1	2½
Tartar, Cream of	cwt.	6	7	6	—	7	10	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

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HOME INDUSTRIES.

MANCHESTER, 3rd May, 1888.

The Engineering Trades.—Engineers continue to be fully employed. There is still a brisk demand from India and the Continent, but very little new work is being received from home consumers. Mill gearing is in good request, and most millwrights are fully occupied, especially in the East and North-East Lancashire districts. The extension of weaving sheds still continues, and there is consequently a demand for shafting and gearing. As we have before noted, it is now becoming almost the universal practice to use steel instead of iron for this purpose, and fully 75 per cent. of all the work in hand is being carried out in that material. Boiler makers are well supplied with orders, and there appears to be no prospect of any diminution. Prices, however, are not so good as formerly, as the extensive use of special tools in this department tends to keep them low. Locomotive engineers are finding work a little easier to obtain. The condition of tool makers is also improving, but there is still plenty of room for improvement. Machinists have in many cases sufficient work to keep them employed for several months. Some good orders on Indian and Russian account have been recently placed, and Japan is also becoming a very good customer. The orders coming from India are mostly for ring spinning machinery, and it is also worthy of notice that weaving is being rapidly extended in that country. In miscellaneous engineering there is a quiet tone prevailing. Hydraulic engineers especially are doing badly, and copper smiths and brass founders are poorly employed. The phenomenal fall in tin from £166 to £103 per ton will enable makers to reduce the price of brass, and will permit of its use in larger quantities. Constructional iron work is not much sought after, and the prices which are being accepted are very low. Cast iron pipes for water and gas purposes have been taken at a rate of £3. 10s. per ton, a price which can leave very little if any margin of profit.

Technical Education.—A discussion on this subject was concluded at the last meeting of the Manchester Association of Engineers. There was a general agreement that some movement in this direction was necessary, but it was pointed out that there was a danger of exaggerating the importance of the subject. It was practically confessed that no system of technological instruction conducted in schools would be satisfactory as a sole means of education, and could only be recommended as an accessory to workshop practice. Eventually a committee was formed to draw up a syllabus of subjects which it was desirable should be studied by youths employed in the workshops. In this connection it may be mentioned that the designs for the new technical school at Blackburn have been considered, and those of Messrs. Smith, Woodhouse, and Willoughby, of Manchester, have been placed first in order of merit. The foundation stone is to be laid by the Prince of Wales on the 9th inst., and the estimated cost of the building is to be £25,000.

The Ribble Navigation Works.—The Bill empowering the Preston Corporation to spend more than £500,000 on the completion of this scheme has been before a House of Lords Committee for some days past, and has resulted in the limitation of the sum to be expended to £200,000. This, it is calculated, will allow for the completion of works at present undertaken, and for the payment of present liabilities.

A New Industrial Movement.—A movement is on foot in North-East Lancashire for the establishment of "self help weaving companies." Each weaver is expected to take at least one share of £5 value, which is to be paid up by instalments out of the wages earned, and the profits made after full allowance for depreciation, &c., are to be divided amongst the whole body of shareholders *pro rata*. This is a new development of the system of industrial partnerships, and it will be interesting to watch the working of the scheme.

LONDON, 3rd May, 1888.

The Money Market.—The general tone of the money market has become firmer, and rates will remain so to the end of the week in consequence of requirements for a couple of loans, one for India and the other for New South Wales. There have been considerable withdrawals of bullion, chiefly for the Cape and South America; and as further exports are anticipated, lenders have been keeping up the charges for loans for longer periods than a few days. Business on the Stock Exchange has been somewhat restricted this week owing to the May Day holiday. Prices have shown an inclination to rise all round. Foreign stock has advanced on account of the favourable reports of the Emperor Frederick's condition, and on account of the absence of disturbing news from Paris. Though some disquieting intelligence comes from South-Eastern Europe, Turkish stock has improved; Egyptian issues have resumed the upward tendency, which was checked by reports of the intended conversion of the preference loan. Home railway stocks are steady; the approach of summer weather is telling well upon the Southern lines, whose stocks should prove good purchases at present. The unfortunate Hull and Barnsley ordinary has now receded to the price which ruled before its revival, which was caused by the report of the negotiations with the Midland Railway. All hope of an arrangement of the kind is now abandoned. American railway stocks have begun to rise upon better traffic prospects, and in sympathy with the improved feeling in all the markets. The collapse in the tin market makes copper shares rather insecure, the same persons being interested in the "rig" in both metals. While so many new companies are being floated, the disappearance of one recently brought out may almost pass unnoticed; but as *Industries* was the first journal in the Kingdom to warn the public about the machine made bottle companies, we may note that the European and American company set on foot to exploit the much vaunted and hitherto unproved invention of Mr. Ashley has gone into voluntary liquidation. The directors have been generous enough to bear the whole of a very considerable loss.

Companies.—There is no falling off in the number of companies which are being promoted, as may be seen from the following long list of those which, among others, have been registered since our last report: Hadfield's Steel Foundry Company, Limited, with a capital of £110,000, to take over the business carried on at the Hecla Steel Foundry, Attercliffe, Sheffield; the Stanley Fire Proof Lathing Company, Limited, with a capital of £65,000; Anti-Friction Conveyor and Grinding Machinery Company, Limited, with a capital of £10,000, to carry on the business of general millwrights and mechanical engineers, and to acquire the business of Mr. Julius Schlesinger, 16, Mark Lane, E.C. (the Anti-Friction Conveyor was described and illustrated in *Industries*, Vol. II., page 212); Crypto Cycle Company, Limited, with a capital of £20,000; Electric Date and Time Stamp Company, Limited, with a capital of £100,000; Anglo-American Self Opening Square Paper Bag Machine and Manufacturing Company, Limited, with a capital of £100,000; Honduras Railway Company, Limited, with a capital of £8,000,000; Reynold, Limited, with a capital of £10,000, to manufacture earthenware goods, asbestos fuel, &c.; the Bostwick Gate and Shutter Company, Limited, with a capital of £25,000, to purchase the patent rights for inventions respecting folding steel gates and shutters, and to carry on business as engineers and ironmongers; South Down Metal, Chemical, and Brick Company, Limited, with a capital of £40,000; the Hele Cross Pottery and Terra Cotta Company, Limited, with a capital of £10,000, to purchase the pottery business now carried on by the Torquay Terra Cotta Company, Limited; Patent Lath, Splint, and Match Syndicate, Limited, with a capital of £10,000, to acquire inventions in machines for rending laths and cutting veneers; Guion Steamship Company, Limited, with a capital of £300,000; Thornebury Light Company, Limited, with a capital of £20,000, to carry on the business of light and lamp manufacturers; the Auxiliary Railways Company, Limited, with a capital of £1,000,000, to promote railways, tramways, and auxiliary railways in the United Kingdom, India, or foreign countries; the Colorado Gold and Silver Extraction Company, Limited, with a capital of £100,000; Normal Manure Company, Limited, with a capital of £10,000, to carry on the business of manufacturers of chemicals, artificial manures of all kinds, and guano from sewage; C. W. Boot & Co., Limited, with a capital of £10,000, to carry on the business of worsted spinners, &c., at Ponsanooth, Cornwall; Driffield Pure Linseed, Cotton, and "Union" Cake Company, Limited, with a capital of £54,000; Ashworth Brothers & Co., Limited, with a capital of £10,000, to carry on the business of an electric light company in Manchester and elsewhere in Lancashire; the Iron and Land Company of Minnesota, Limited, with a capital of £1,000,000; the Divisidero Gold and Silver Mining Company, Limited (Salvador), with a capital of £200,000; the New Drws-y-Coed Copper and Silver Lead Mines, Limited (Wales), with a capital of £50,000; Gwin and Singer United Tin Mines, Limited (Cornwall), with a capital of £45,000; the Bangor, Carnarvon, and Henddol United Slate Quarries, Limited, with a capital of £100,000; Mexican Coal and Iron Company, Limited, with a capital of £80,000; the Namaqua Copper Company, Limited, with a capital of £200,000; Jay Hawk Mining Company, Limited (Montana), with a capital of £175,000; Moodie's Golden Hill Gold Mining Company, Limited (Transvaal), with a capital of £33,000; the Dalmatia Mine, Limited (California), with a capital of £60,000; Havelock Gold Mining and Exploration Company, Limited (South Africa), with a capital of £120,000; London and Brazilian Exploration, Land, and Public Works Syndicate, Limited, with a capital of £20,000; Standard Mining Company, Limited, with a capital of £250,000, to acquire mines in Great Britain and Ireland; Cae Coch Pyrites Mine, Limited (Wales), with a capital of £20,000; and Silver King Mining Company, Limited (California), with a capital of £400,000.—Mr. W. H. Smith has stated in the House of Commons that the nominal capital of companies registered between the 1st of January and 17th of April of this year amounted to £100,206,857, as compared with £40,525,266 in the same period of last year.

Metals.—Messrs. Merton gave the stocks of copper in England and France on the 30th April at 57,449 tons, or with the quantities advised for Chili and Australia, 64,349 tons, as compared with 51,797 tons and 58,747 tons on 31st March of this year, and 48,722 tons and 56,172 tons on 30th April, 1887. In tin there has been a sudden collapse, the cash price of "Straits" having fallen £60 in two days.

Shipbuilding.—Returns have been compiled by Lloyd's Register of Shipping which show that on the 31st March there were 302 steamers and 78 sailing vessels building in the United Kingdom, against 247 and 80 respectively at the same date last year. The gross tonnages of the two classes of ship were 538,944 tons against 374,037 tons, and 55,482 tons against 66,542 tons respectively. Of the steamers all but about 20,000 tons were of steel, and of the sailing vessels nearly 34,000 tons were steel.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 22nd April, amounted to £1,210,029 on 15,850½ miles, as compared with £1,175,077 in the corresponding period of 1887, when the mileage was 15,724 miles. An increase is thus shown in the mileage of 126½ miles or 0·8 per cent., and in the receipts of £34,952 or 2·9 per cent.

GLASGOW, 3rd May, 1888.

General Business.—The stock markets began the week with a tone of considerable liveliness, and a large amount of stock changed hands. In some securities, especially Americans, prices rose sharply from the closing figures of last week. In metals the attention of speculators has been turned to tin, which has dropped from some unexplained reason. It is not believed that there has been much buying in Glasgow for some time. Steel and iron manufacturers still continue to be fairly employed. It is rumoured that a very large contract has been placed with Messrs. Beardmore for steel boiler plates and crank shafts for two cruisers now being built at Barcelona for the Spanish navy. Local boiler makers are well employed, and there is a considerable amount of work of moderate dimensions on hand. Shipbuilding and marine engineering are both at the moment suffering from a lull, although the contracts booked at the close of the year are, of course, not yet out of hand. Mechanical engineering generally is moderately active, though there is very little prospect of any fresh work. Joiners, show case makers, and decorators have been very busy over the Exhibition, and over three thousand persons are being employed within the walls. It is understood that a large number of tradesmen have come to town from the country districts, and have during the past year found employment at the Exhibition buildings. Many of these are, it is said, intending to emigrate whenever they are paid off.

Trial of an Asphalt Boiler.—The Municipal Appliances Company, Liverpool, invited the Corporation of Glasgow to make an experimental trial of their new asphalt boiler on Monday last. The feature of the boiler is that the fumes are led from the smoking mixture into the flue, and melted bitumen and tar are drawn off by a tap, instead of being ladled out from an open boiler as is customary.

Mineral Shipments.—The coal shipments for the month of April show a serious falling off, when compared with the corresponding figures for April, 1887. Coal shipments in April, 1887, aggregated upwards of 82,000 tons; in April, 1888, they were only 43,000 tons. The decrease for the year, so far as it has gone, is 118,600 tons, a decrease of almost 50 per cent.

The Glasgow Subway Bill.—The Glasgow and Suburban Subways Bill is now before a Select Committee of the House of Lords. In order to secure the consent of the Corporation of Glasgow to the scheme, the company has offered to pay a sum of £65,000 to the Corporation as wayleave. A number of new features are embodied in the proposal. It is proposed that the tunnel should have an outer skin of iron, then a shell of concrete, then an inner skin of iron. At the point where the Kelvin bridge crosses the river, in immediate proximity to the proposed line of the subway, the promoters propose to co-operate with the authorities in building a new structure, which should comprise a subway and bridge combined. The trains will be drawn by ropes actuated at a central station. The speed of the rope will be eleven miles per hour. The evidence of the engineer, Mr. Alexander Simpson, was taken on Tuesday, and that of other parties to the Bill followed.

The Exhibition.—During the past week rapid progress has been made in placing the exhibits. The exigencies of the case have compelled the Executive to extend the time for receiving exhibits, and now to-morrow, Friday, is announced as positively the last day. The progress of every day makes it more possible to estimate the educational and industrial value of the Exhibition, and there is now no doubt that with due allowance for deficiency in certain departments, for example, in marine and locomotive engineering, the Exhibition is one of the most diversified and instructive of world shows. The improvement in the condition of the Emperor of Germany now removes almost all doubt as to the presence of the Prince of Wales. The Indian artisans who are to work at their respective handicrafts in a row of workshops in the Indian section, have arrived in Glasgow. A range of buildings has been erected in the Exhibition grounds for their accommodation. The trades represented by the Indian artisans are jewellery, pottery, wood carving, and confectionery.

(From our own Correspondents.)

LIVERPOOL, 2nd May, 1888.

Liverpool Overhead Railway.—The Mersey Docks and Harbour Board obtained Parliamentary powers in 1882 for the construction of an overhead railway along the line of docks; they took no further action in the matter until last year, when they applied to Parliament and obtained an extension of time and powers to make certain deviations at the Stanley Dock, the George's Dock, and the Queen's Dock, and also to lease the undertaking to a private company. The Board were of opinion that as a public trust they ought not to burden themselves with

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the administration and management of such a railway; at the same time they felt that they ought to be the legal owners of the line, that those who worked it should be under their control, and that the Dock Board should have it in their power to settle what the lessees might and might not do. Application has been made to the present Parliament for power to promote a company on the above conditions. The only opposition to the Bill was from the Bootle Corporation. The Bill, after consideration by a Select Committee of the House of Lords, was passed on Monday last with certain amendments, by which the Bootle Corporation will have reasonable access to the quays and to the proposed ferry. The principal promoters are Sir William B. Forwood, Mr. Robert Alexander, and Mr. Arthur Earle, and the proposed capital is £450,000 in shares and £150,000 in borrowing powers.

SHEFFIELD, 2ND MAY, 1888.

THE HEAVY TRADES.—There is not much change in the price of iron, though quotations for some sorts are slightly easier. Angles are quoted at from £5 to £5. 10s., and up to £6. 10s. for best kinds. Rods can be obtained in quantities at £5. 5s., though the superior makes are fetching £6. 10s. and £7. Hoops and plates are in better request, and the tendency is perhaps a little firmer. The demand for Bessemer steel continues to be extensive, and the crucible houses are very busy. But everywhere there are complaints of the increasing keenness of competition; a great bulk of billets has been sent out during the past month at exceedingly narrow profits. The struggle for orders for steel rails on foreign account becomes more accentuated year by year, and the tendency of the buyer is more and more to look at the lower quotations rather than to consider the wearing power of the rails. In order to quote with any chance of success in large contracts, English makers are doing much to reduce the cost of production; but they are still under-quoted by Belgian and other foreign houses. There is a steady inquiry for shipbuilding material, such as plates, engines, propellers, and one or two Sheffield concerns are very busy in these departments. Hadfield's Steel Foundry Company is doing a large trade not only in heavy machinery and steel castings, but in steel shells. The latter branch of manufacture is one which the company has recently taken up with much success, their projectiles having stood very severe tests. There has been a keen competition for shares in this concern. At the armour plate works there is a little more being done; and Messrs. T. Firth & Sons are well engaged on war material. Messrs Davy Brothers have recently received additional orders for heavy machinery, and other engineering firms in the town are tolerably well employed.

LEEDS, 2ND MAY, 1888.

IRON AND STEEL.—Operations are rather quiet in best Yorkshire iron, though the trade is not in such an unfavourable condition as some people believe. Several weeks ago Messrs. Cooper & Co., of the Leeds Iron Works, gave their men notice to leave, and have now practically relinquished the manufacture of Yorkshire iron. But the decision has come as no surprise to the manufacturing community, for orders in best Yorkshire iron have been decreasing ever since Bessemer steel came into common use. Yorkshire iron, though used very extensively, is, after all, being driven out of the market by Bessemer steel, and this firm have consequently thought it best to discontinue operations. Still there are other concerns in and around Leeds who have adopted the manufacture of Bessemer, and converters are becoming gradually more numerous in the district. At the forges and foundries the men are well employed, and there is more railway work on hand than at the beginning of the year. The locomotive builders are busier, and for traction, pumping, and other engines the demand is more encouraging. Leeds makers of railway material are well supplied with work, and tyres, axles, and rails are selling with greater ease. Agricultural implements are on better call for the Colonies, though there is an unusually slow sale for them in the home markets. Cut nails, which have had such a prosperous market for months, are now rather a drug; but prices are on the whole maintained.

TEXTILES.—In spring goods there is a satisfactory demand, and most of the ready made clothing factories are busy. Attention is being turned to the sweating system in Leeds as well as in London; but it is contended, that however great the outcry, customers will go to the cheapest market, and that the public are really to blame.

NORTH STAFFORDSHIRE, 2ND MAY, 1888.

ENGINEERING.—There is no improvement noticeable in the general condition of the local engineering industry, and founders express themselves as very dissatisfied with current prices, which are, however, necessary to secure orders, owing to the keen competition which prevails.

THE IRON TRADE.—There are no additional demands forthcoming, and the mills and forges are working irregularly, making about four turns per week. The outlook is not an encouraging one, and there seems no probability of any improvement in price for the next few months. Deliveries of pig iron are being made on contracts entered into on quarter day, but in consequence of the inactivity at the forges a considerable quantity of pig iron is being put into stock. Of the thirty-nine furnaces in existence in this district, there are twenty-one now in blast. The Shelton Iron and Steel Company's new plant for steel making is approaching completion, and operations will probably be commenced next week.

SOUTH WALES, 2ND MAY, 1888.

TIN PLATES.—Notwithstanding that the recent extraordinary rise in the price of tin did not materially enhance that of plates, now that the tin ring has collapsed, and the metal is down at its normal figure, common sorts of tin plates can only find buyers at a reduction, viz., 12s. 9d. The nominal figure for Siemens quality with coke tinning is 13s., but orders are being freely booked at the lower figure. The value of "wasters" is a noticeable feature of the trade, fetching as they do in many cases the full price of the perfects. A company, with £50,000 capital, has been formed to take over the Gwendraeth Tin Plate Works, and Mr. Harries, of Pontymister, has been appointed manager. It is stated that the works are not to be started until the company can see their way to a profit of 1½d. per box. It is hoped that a return of the price of tin to its former value will shortly enable the company to commence operations, as the immediate district has greatly suffered since the closing of these works. Progress is being made with the building of the Victoria Tin Plate Works at Briton Ferry, a neighbourhood which has also suffered much since the iron works were closed.

NEW IMPORTS.—The first cargo of petroleum imported into South Wales has just been received by Messrs. Bird & Son, of Cardiff, who are arranging for the delivery of further cargoes periodically at that port. This firm also brought into Cardiff not long ago the first cargo of seal oil ever shipped direct to South Wales from Newfoundland.

BARROW-IN-FURNESS, 2ND MAY, 1888.

REVIVAL IN SHIPBUILDING AND ENGINEERING.—The anticipations of a permanent revival in the shipbuilding and engineering industries of this district are at length about to be fulfilled. In a few days the fact of large orders having been placed with the Naval Construction and Armaments Company, Limited, will be officially announced. In the meantime it is interesting to note that the preliminaries of work of very considerable magnitude have been arranged. It is certain that the local yard acquired by this new company will soon be very briskly employed, and that all the facilities at command for the building and engining of large steamers will be fully utilised. Further extensions of premises on a large scale have been decided on.

IRON AND STEEL.—There is a weaker tone to note in the iron and steel trade. The demand is much less active for iron, but makers are very busy, and are likely to remain so; indeed, they are fully sold forward for some months to come. The action of the holders of warrants in quoting less figures, in order to clear the stocks, has brought down prices, and 42s. 6d. per ton is now the quotation for parcels of Bessemer iron in mixed numbers. Makers, however, are not doing much business at this price, but are waiting until better prices can be obtained. Steel makers are very busy in all departments. Rails are largely sold forward, the mills are busily employed, and the output is well maintained. Prices have, however, gone down to £3. 17s. 6d. per ton net f.o.b. for heavy sections, and £4. 2s. 6d. for light sorts. In steel for shipbuilding purposes the demand is exceptionally strong, and very heavy contracts have been placed. In the iron ore trade business is steady but quiet, at from 8s. 6d. to 11s. 6d. per ton at mines.

MIDDLESBROUGH, 2ND MAY, 1888.

PIG IRON.—Stocks are decreasing and shipments are increasing, but prices continue to fall. It appears that the Glasgow speculators have the market under their control to such an extent that the ordinary economic law is powerless. No. 3 G.M.B. is now offered for 31s. 6d. per ton for prompt delivery. Makers, of course, hold to their price; but they cannot get it.

EXPORTS OF PIG IRON.—The exports of pig iron from the port of Middlesbrough for the month of April are greater than for some time past. They amounted to 90,641 tons, being 12,432 tons more than those of April, 1887, which had the highest record of the year. At this season the record is expected to be high, but this is certainly higher than was anticipated.

FINISHED IRON AND STEEL.—In manufactured iron there is hardly the same briskness that there was, and prices have, as a rule, dropped 2s. 6d. per ton. The works are busy, but there are few new orders to go on with when the present orders are completed. In finished steel prices are also easier, especially in plates, as there is not the same demand from the ship yards. The same trades union difficulty which troubled the N.E. Steel Works Company is affecting the Darlington Steel Company in exactly the same way. The manager has interfered with the right of the men to associate by dismissing the unionists, and the men have struck against this action.

SUNDERLAND, 2ND MAY, 1888.

SHIPPING TRADE.—The general condition of the market is satisfactory. Fixtures for Cronstadt are higher than those of last year, and a large amount of tonnage is engaged in very profitable employment in the Black Sea trade. During the last week the trade of the port was fairly satisfactory; 79,853 tons of coal were shipped, as against 75,925 tons in the previous week, an increase of 3928 tons, 30,031 tons being exported, and 49,882 tons sent coastwise. Other shipments comprised 1160 tons of patent fuel, as compared with 1946 tons in the previous seven days; 930 tons of lime, and 47,000 dozen bottles. Foreign imports included 29,205 sacks of wheat, 2298 bales of esparto grass, 2650 tons of iron ore, 483 tons of silver sand, besides a quantity of timber, block ice, and hay.

RIVER WEAR COMMISSIONERS.—The return for the month of March is scarcely so encouraging as it was for the early months of 1888, as in comparison with March 1887 there is a decrease in the total income of £391. 10s. 9d. The falling off in the river shipments of coal and goods traffic are answerable for the deficiency. The river shipments of coal show a falling off of 30,693 tons, but there is an increase of 13,103 tons in the coals shipped in the South Dock. Rapid progress is now being made with the new Roker Pier, and also with the new gates at the Gladstone Bridge. The depth of water at both entrances is satisfactory.

NEWCASTLE, 2ND MAY, 1888.

SHIPBUILDING.—The tonnage now building in the various yards on Tyneside may be approximately stated at 140,000 tons. Most of the shipbuilding firms have orders in reserve, but very few new orders are now being booked, and there is a probability that the present briskness in the yards will not be continued for a very lengthened period. The first wages dispute of any consequence which has arisen in this industry since business began to improve, commenced a week ago at Jarrow. About 400 platers struck work for an advance of 3s. per week on the present rate of 25s. Up to the time of writing no settlement has been effected. Work in this great establishment is now practically at a standstill, as progress in the other departments is prevented by the stoppage of the plating work. Messrs. Armstrong, Mitchell, & Co. have seven large vessels on the stocks at their Low Walker yard, and material is being received for several vessels that have not yet been laid down. Messrs. W. Dobson & Co. have received an order from Messrs. Milburn, of Newcastle, for a steamer of the largest class, and the frame work of this vessel has already been commenced. Messrs. Hawthorn, Leslie, & Co. have a large steamer, which has been built to the order of a local firm, nearly ready for launching. Messrs. Swan & Hunter will very shortly put a twin screw steamer off the stocks.

ENGINEERING.—Business at the marine engineering establishments could not well be more active, and in every instance night work is resorted to as the most effectual means of expediting contracts. The North-Eastern Engineering Company, Wallsend, are now engining the steamer "Rapel," which has just been launched by the Blyth Shipbuilding Company, and is owned by a firm at Valparaiso. Messrs. Palmer are also engining a vessel, and have another waiting its turn. Messrs. Clark, Chapman, & Parsons, Victoria Works, Gateshead, have just now a large amount of work in their steam winch, windlass, and steering gear departments; and some other firms that are engaged in the same lines are also doing well. Foundries are generally busy, and the manufacturers of ship and engine forgings have, in most cases, work enough to keep their furnaces and machinery fully employed.

BELFAST, 2ND MAY, 1888.

SHIPBUILDING AND ENGINEERING.—The ship yards still continue to be fully employed, and several orders for vessels of large tonnage have been placed during the past fortnight. There is at present a larger number of hands engaged in shipbuilding than there has ever been before. Wages are steady, with a slight upward tendency. It is rumoured that the Cork Harbour and Docks Company at Passage has been disposed of to a wealthy firm of shipbuilders; there is every facility, with the dry dock and convenient launching ground, for doing a large business. Most of the shipbuilding firms have forwarded handsome models of vessels, built by them, to the Glasgow Exhibition, and are preparing others for the forthcoming Irish Exhibition in London. Marine engineers and boiler makers are fully employed on both new work and repairs. Millwrights and iron founders are fairly busy, and some of the latter hold large orders. Messrs. Musgrave & Co., in consequence of their largely increasing business, have made arrangements for the erection of a large foundry at Bloomfield, near Belfast, for the manufacture of their patent stoves and stable fittings.

LINEN TRADE.—On the 27th April, Mr. Wm. Montgomery sold by auction the premises of the late Northern Spinning Company, Belfast. The entire mill and weaving factory was disposed of to Messrs. Ewart for the sum of £30,500. Trade still continues to be fairly good, but quiet, without any change in prices. The better numbers of yarns have had a slight upward movement, and find a good market. Tow yarns are somewhat easier. All the looms are fully employed. The general trade in hollands, canvas, &c., is up to the average, and prices remain as before. Damasks are in good demand, with prices slightly higher. In consequence of the fine quality of damasks now being turned out by power looms, the hand loom industry is rapidly declining. The manufacturers of fancy and hemstitched handkerchiefs, shirts, cuffs, &c., are doing a large and rapidly increasing trade.

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THE "CYCLONE" DUST COLLECTOR.

Last week we had an opportunity of inspecting a "Cyclone" dust collector, as applied to wood working machinery, at the works of Messrs. A. Ransome & Co., Chelsea. The collector is an American invention, for the prevention of the escape of fine dust, which is often so troublesome in saw mills and other wood converting establishments. The efficient collection of chips and dust has also the great advantage of minimising the risk of fire. The principle of the collector which we are about

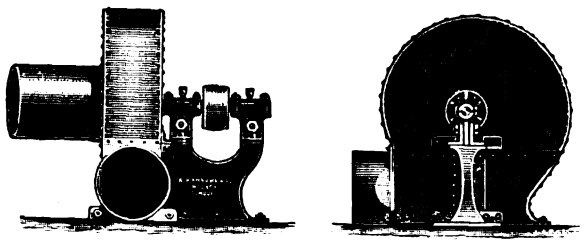


Fig. 1.

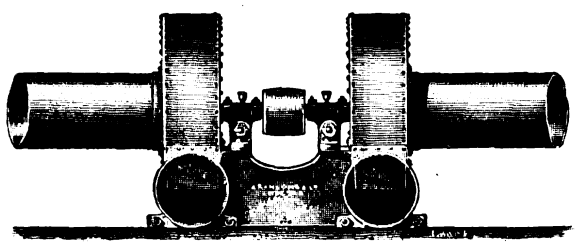


Fig. 2.

to describe as applied to wood working machinery, is also applicable to flour mills and other works where dust of all kinds has to be removed. At Messrs. Ransome's works the collector is established in conjunction with the well known pneumatic conductor system. We illustrate herewith the fans by which the light shavings and sawdust are drawn away from the wood working machines, and passed on to the collector. Fig. 1 shows a single, and Fig. 2 a double fan; while Fig. 3 is a part section of the collector. The sawdust and other particles of wood, after passing through the fan, are

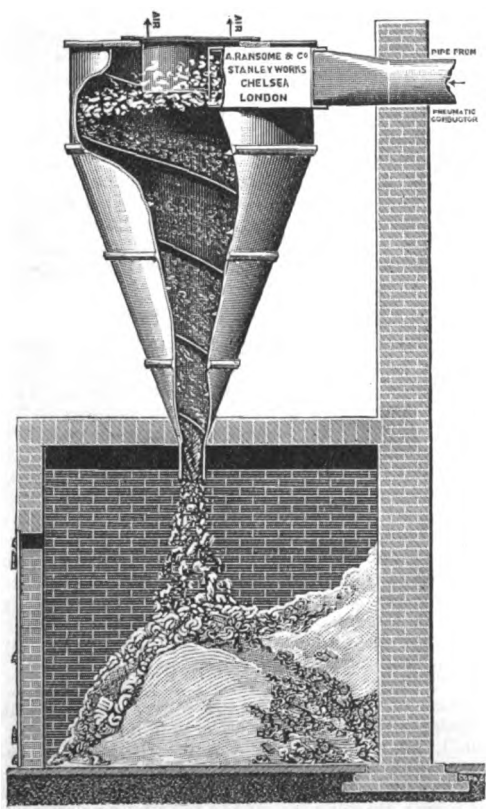


Fig. 3.

carried along the pneumatic conductor and enter the collector at its upper part, tangentially. The collector consists of a short cylindrical drum of galvanised iron, terminating in a cone, the point of which enters a chamber where the material is deposited. The drum is covered at the top by a plate with a central opening, through which projects a short pipe forming an outlet for the air. The interior surface of the cone is provided with a spiral shelf. The particles, as they are projected with great speed tangentially into the collector, are by this action of centrifugal force carried round the inner surface and acquire a spiral motion, and by the assistance of the shelf already mentioned are passed downwards into the chamber, the air escaping through the large central opening at the top. In cases where the sawdust and shavings are used as fuel for the boilers, the chamber can be dispensed with, and the material can be discharged directly into the stoke hole.

DIAGRAMS RELATING TO THE PROPERTIES OF WATER AND SATURATED STEAM.

II.

By Professor R. H. Smith.

(Concluded from page 426.)

Diagram II. gives expansion curves for gas and steam. There are three sets of curves, in each of which sets there are five curves, and in each of which the horizontal ordinate is the ratio of expansion. The first set of curves gives the ratio of the final or terminal pressures at the end of the expansion to the initial pressure for each grade up to 20. These ratios are given as percentages, the initial pressure being marked 100. These curves can be used either to find the terminal pressure for a given ratio of expansion, or to find the ratio of expansion required to reduce the pressure to a given terminal amount. The reason that they are carried out to so large a grade of expansion is to enable them to be used to find the volumes of the exhaust steam from an engine from the known ratio of back pressure to initial pressure. These curves are all marked with an F, the first letter of the word final; thus F(.....).

The next set of five curves is marked M (.....). These give the mean pressures for any given ratio of expansion, also in percentages of the initial pressure. This mean is, of course, reckoned from zero, there being no subtraction of back pressure. The mean effective pressure of an indicator diagram is different from this also because of the clearance volumes. The reckoning of the difference is shown below. It must be clearly understood that the mean pressure here tabulated is not that of the area under the expansion curve alone, but that of this area added to the area under the horizontal line showing the initial volume and pressure. In both these sets of curves the first portions lie so close together, and cut through the vertical lines so obliquely, that it is difficult to read them accurately. They are therefore plotted out again to a horizontal scale ten times more open. This more open scale is figured along the line marked A A. Throughout their range these curves should be used in preference to the others. The vertical scale of pressures for both these two sets is the same, and is marked F M at each end of the diagram.

The third set of five curves is marked W (.....). This gives the area referred to above, including that under the horizontal line; or rather it gives the ratio of this area to the area under the horizontal line alone, this latter being the value of the area without any expansion. The vertical scale for this set is different from that of the others, and is marked W at the two ends of the diagram. The ratio given here is the ratio of mechanical advantage obtained by the use of expansion without either clearance or back pressure.

To find the area of the effective indicator diagram, or the mean effective pressure for given clearance and given back pressure; let

c=ratio of clearance volume at one end to volume swept through by piston in one stroke;

$\frac{1}{r}$=cut-off, *i.e.*, ratio of volume swept by piston up to point of cut-off to whole volume swept through;

b=ratio of mean back pressure to initial absolute pressure.

Then real ratio of expansion is

$$r\frac{1+c}{1+rc}=\text{say } e.$$

On the proper curve W find the ratio corresponding to e, and call it w_e. Then the ratio of the area of the effective diagram to the rectangular area between the admission line and the line of zero pressure is

$$\left\{w_e(1+rc)-r(b+c)\right\};$$

and the ratio of mean effective pressure to initial absolute pressure is this divided by r, or

$$\left\{w_e\left(\frac{1}{r}+c\right)-(b+c)\right\}.$$

This latter is expressed rather more simply by

$$\left\{m_e(1+c)-(b+c)\right\},$$

where m_e is the mean pressure for real ratio of expansion e obtained from the proper curve M, divided by 100 so as to give it as an ordinary fractional ratio and not as a percentage.

Each of the expansion curves is drawn out to the formula:—

Final press. = Initial press. $\div n^{th}$ power of ratio of expansion where n is different for each of the five kinds of expansion.

If f represent the ratio of final to initial pressure and e the ratio of expansion, this formula is

$$f=e^{-n}.$$

If m represent the ratio of mean to initial pressure we have for the curves M ( )

$$m=\frac{1+\log_e e}{e} \text{ when } n=1$$

and $m=\frac{1}{n-1}\left(\frac{n}{e}-f\right)$ when n is different from 1.

If w represent the ratio of the area of the diagram up to ratio of expansion e to the area when $e=1$ (*i.e.*, area under initial horizontal line), we have for curves W ( )

$$w=m\,e=\frac{1}{n-1}\left(n-fe\right).$$

The following are the five cases of expansion tabulated with their values of n.

1. Hyperbolic or isothermal expansion of a perfect gas, marked H ..... $n=1$
2. Expansion of initially dry saturated steam with conduction of heat during expansion just sufficient to prevent condensation, marked S ... $n=1{\cdot}064$ =nearly $\frac{100}{94}$
3. Expansion of initially dry saturated steam without conduction of heat to or from the expanding steam, *i.e.*, adiabatic expansion, marked A S... $n=1{\cdot}135$ =nearly $\frac{100}{88}$
4. Adiabatic expansion of initially superheated steam, or steam gas, marked A S G..... $n=1{\cdot}304$ =nearly $\frac{100}{77}$
5. Adiabatic expansion of perfect gas, marked A G..... $n=1{\cdot}409$ =nearly $\frac{100}{71}$

THE PROSPECTS OF SOUTH STAFFORDSHIRE.

South Staffordshire has with other localities, though with greater severity, felt the extreme depression of the iron trade. Many causes have been assigned to explain why the district should feel more acutely than others the bad times of the past few years. For many years it has been declared to be "behind the times" in respect of scientific methods, and canal and railway companies have been abused, and perhaps with some show of reason, for the continued and severe depression. While very little has been done so far to remedy the excessive canal and railway rates under which the district suffers, it may be interesting to notice what manufacturers and managers have done to remove the dense commercial cloud under which they have so long existed. In its palmy days, before the discovery and development of the immense masses of ironstone in Cleveland, the West Coast, Northamptonshire, and Lincolnshire, South Staffordshire was probably considered the highest example of metallurgical industry. Men possessed of great energy, foresight, and perseverance were found ready to guide and improve its industries. From 1830 to 1860 considerable strides were made in the improvement of its manufactures. The substitution of round for square blast furnace hearths, increased dimensions in height and diameter of furnaces, together with the introduction of the hot blast, and the utilisation of furnace gases for heating purposes, all greatly augumented the prosperity of the district. These improvements resulted in a larger make of pig iron, economy of fuel, and diminished cost of production. When blast furnaces began to be built in Cleveland, South Staffordshire practice was considered so far perfect as to form the model upon which Cleveland furnaces were to be operated. Furnaces of 48ft. and 50ft. high, the type then generally employed in Staffordshire, were erected. Before many years elapsed Cleveland iron masters became aware, through the agency of the late Mr. John Vaughan and others, that to increase the height and capacity of their furnaces, to further increase the temperature of the blast employed, and to improve the methods of collecting and utilising the waste gases, gave them greater economy and increased production. However, the influence of progress is felt at last; and let us hope in time to save the iron industry of this famed district from extinction. It would seem that nothing short of an outlook of ruin has been sufficient to stir up some of the manufacturers

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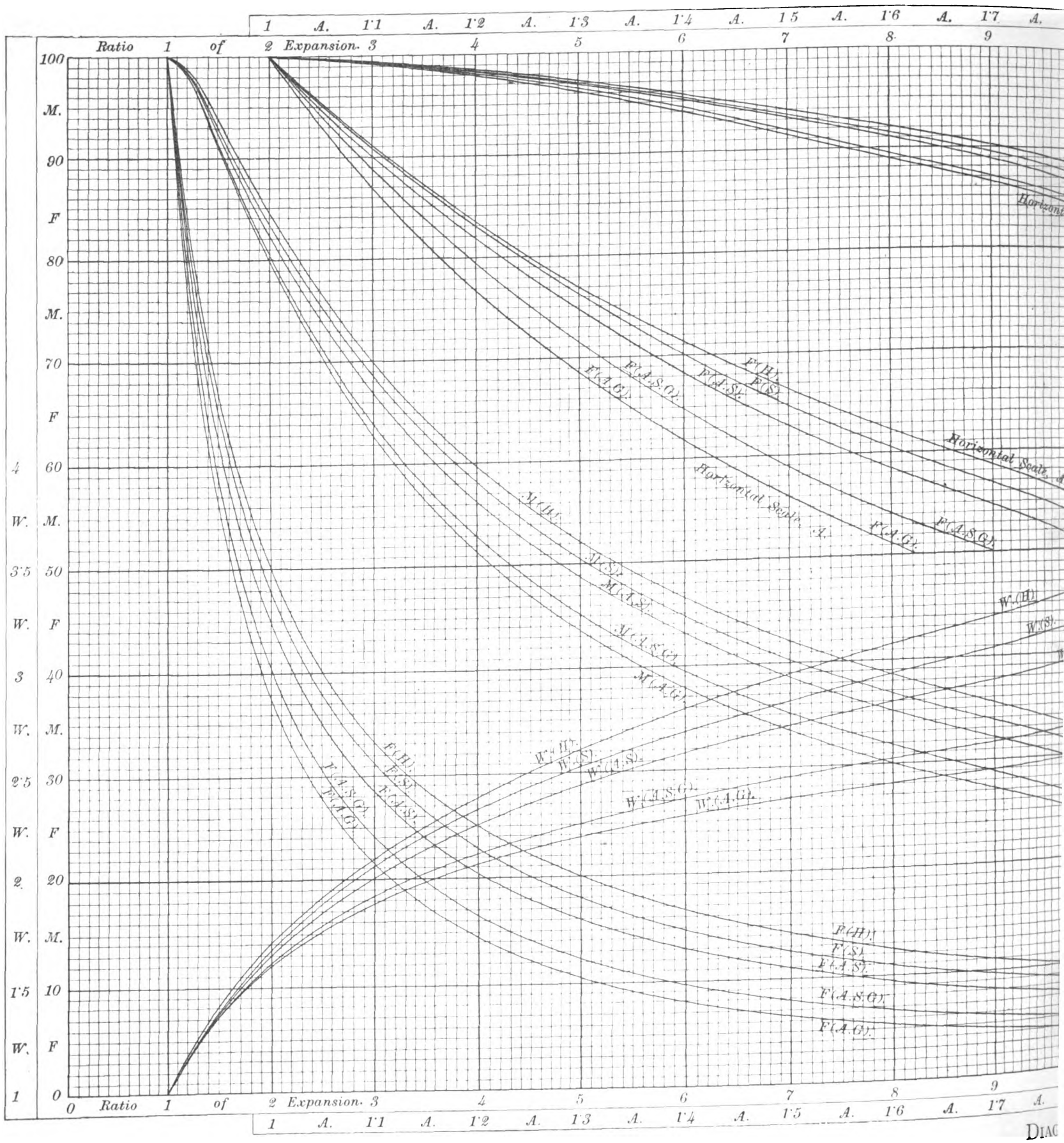
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DIAGRAM RELATING TO THE PROPERTI

BY PROFESSOR

(For descripti



N.B.—The vertical scale marked **F M** *indicates absolute pressure, the initial pressure being taken 100.*

The vertical scale marked **W** *used for the five curves marked* **W**, *indicates ratios of whole work with expansion to work done without expansion.*

F=Final Pressures.
M=Mean Pressures.
W=Work Done, or Mean Pressure × Ratio of Expansion.

STEAM AND GAS

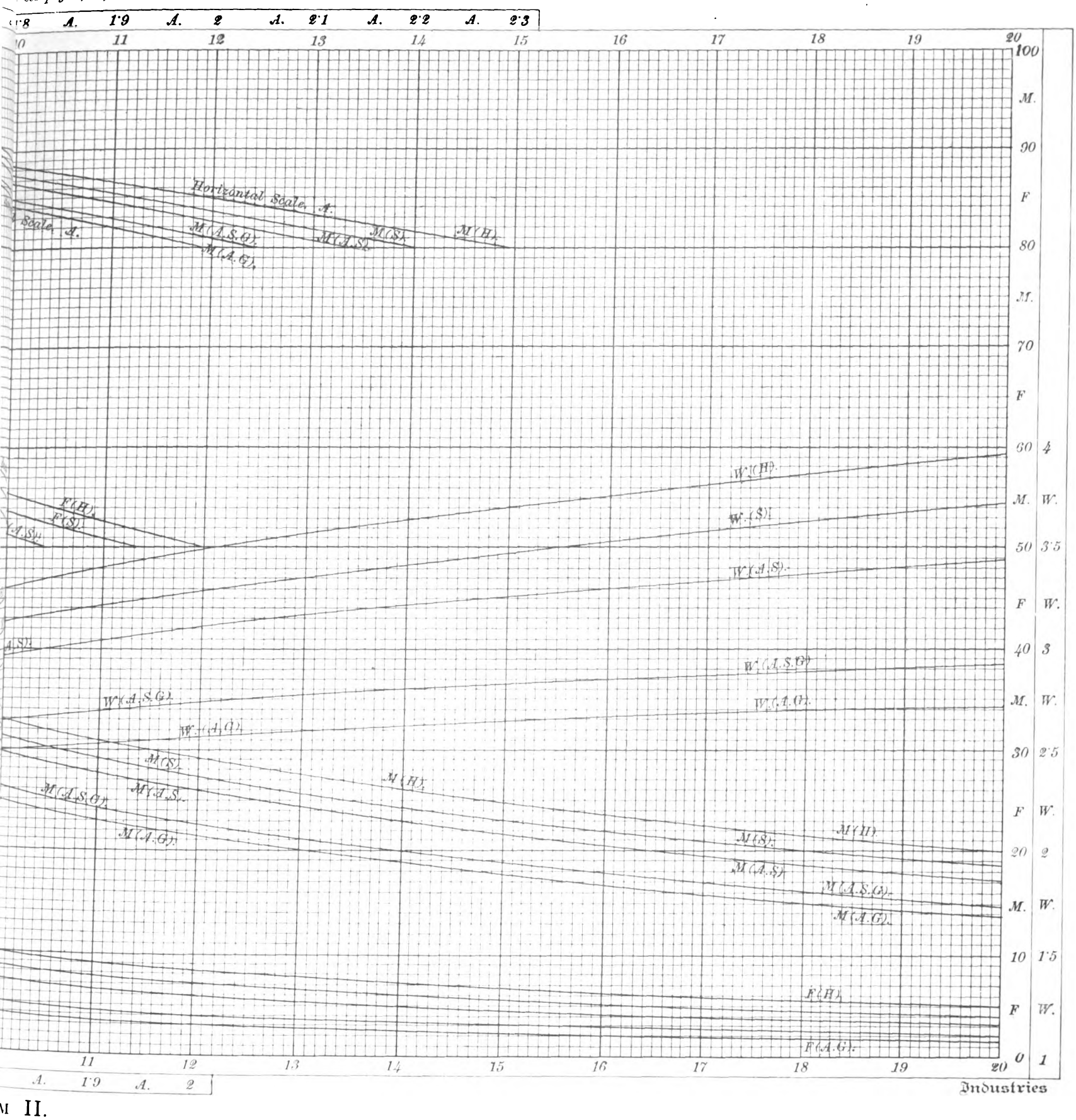
H=Hyperbolic or Isothermal Expans
S=Saturated Steam, heat being supp
to prevent condensation.

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...ES OF WATER AND SATURATED STEAM.

...S R. H. SMITH.

(... see page 450.)



N.B.—The vertical scale marked **F M** *indicates absolute pressure, the initial pressure being taken 100.*

The vertical scale marked **W** *used for the five curves marked* **W**, *indicates ratios of whole work with expansion to work done without expansion.*

M II.

...PANSION CURVES:—

...of Gas.

... during expansion just sufficient

A S=Adiabatic Steam Expansion, the steam being initially saturated.
A S G=Adiabatic Steam Gas, or Superheated Steam Expansion.
A G=Adiabatic Gas Expansion.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
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Telephone number: 684, MANCHESTER.
,, ,, 2785, LONDON.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," *either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.*

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 4TH MAY, 1888.

INDUSTRIAL COMPETITION AND FREE TRADE.

AT the National Liberal Club last week, Sir Lyon Playfair opened a discussion on "Industrial Competition and Free Trade," in which he enlarged on some of the topics alluded to in our recent article (see *Industries*, page 401) founded on a paper by him on "The Progress of Applied Science, and its Effect upon Trade." He insisted on the point we have already mentioned, that the real cause of our depression could be summed up in a single sentence—that the world had not yet accommodated itself to the wonderful changes which science had produced in the modes of production and in the exchanges of commerce. If that be so, it strengthens the position we have all along taken in the matter of technical education, and proves that we require to train the rising generation, not only in the principles and applications of physical science, but also in those of political economy, combined with a thorough knowledge of what may be called the political geography of the part of the globe with which trade is being carried on. Too exclusive a devotion to science may end in industrial degradation and national disaster. As Professor Huxley put it some time ago, unless beneath all our scientific and technical education there is the strong moral fibre of healthy manhood, these will simply afford swifter methods of going to ruin. If Sir Lyon Playfair's opinions be correct, this is true not only individually, but also nationally; unless we study the improvements necessary for the distribution of the products of industry, improved industrial education will only add to the existing disorganisation.

Sir Lyon began his address by insisting that our long continued depression of trade had nothing to do with the fiscal policy of Free Trade; and he pointed out that in the United States, with a Protective policy, the unemployed had been more numerous and the labour disturbances greater than in England under Free Trade, and that the present depression was universal and synchronous in all machine using countries. Such periods of depression had been frequent; but the peculiarity of the present one was that it had lasted fifteen years, while the former depressions of the century had passed away in two or three years. The marked periods of depression in the United Kingdom have been in 1803, 1810, 1815, 1818, 1826, 1830, 1837, 1847, 1857, 1866, 1873, 1883, from which it will be observed that from the year 1837 to 1873 they were at tolerably regular distances of ten years. Since the latter date, with a short cessation for special industries in 1879-82, prices have maintained an abnormally low level; and this, in the opinion of Sir Lyon Playfair, as we pointed out in the article already alluded to, arises from the improvements which have been made in machinery, and by new inventions, which have produced great changes in the quickness and economy of distribution of commodities, and have profoundly altered the whole system of commerce. He maintained that since 1873 a great change has taken place both in commerce and manufacturing industry all over the world by scientific discoveries, as seen in the more economical use of steam, and the electric telegraph. The whole system of markets had been altered; to a great extent local markets had been destroyed, and the world itself had become the one market for all nations. The increased economy of transit had necessarily lowered prices, every ton of coal now carrying a much greater weight of cargo than it did a few years ago; while the improvements of machinery have increased the supply of commodities beyond the immediate demands of the world, and have too rapidly displaced the old forms of labour. The application of machinery demanded higher intelligence among the leaders of industry; but it was the essence of invention to displace unskilled labour, and its effect upon industry was, that while the labour of quantity, which was little more than brute force, was constantly decreasing in value as a factor of production, the labour of quality, or the labour carried on and directed by skilled intelligence, was as constantly increasing in value. All machinery and all invention tended to progress from simplicity to complexity, and therefore the workmen required a superior and versatile intelligence to be able to adapt themselves to the changes which constantly arose. Sir Lyon stated that in their last report the Inspectors of Factories mourned the fact that the labour of children in factories was decreasing; but this he looked upon as a happy sign, indicating an advance in the social condition of the people, for it proved that the labour now required more skill and intelligence than mere children could give to it, and as a consequence the labourers of low intelligence went to the wall, and flocked to large cities, and became familiar as the unemployed. Not only was this true of manufactures, but also of agriculture, the oldest and the most important of our industries. Agriculture was one of the few industries of a domestic character remaining in Great Britain, and our farmers had to meet in their isolation the competition of land cultivators in other countries, who carried on their industries through enlarged combinations, and with the use of machinery of the newest character. It was neither the climate nor the soil of England which stood in the way of our successful competition in food products; but the age of domestic manufacture was past, and English agriculture had now come under the common law of production. The conditions under which its products could be manufactured by combination and machinery had been established, and were in themselves of easy application. While willing to admit this, we must point out that people are beginning to see that there is still a very considerable field both for domestic manufactures and for the operations connected with farming. If things are made for use and not for sale, the workers are largely independent of foreign competition, and in agriculture, poultry, vegetables, and fruit might be raised to a much greater extent than at present; while many domestic industries might be cultivated by those who spend a great part of their time in idleness. Still, in the main, Sir Lyon Playfair's opinions are correct, and the world has become as one market for all nations.

The Fair Trade party would remedy matters by taxing imported goods which entered into competition with those produced at home, which, as Sir Lyon remarks, is much the same operation as when a person, dissatisfied with the working of a machine, adds a new cog, then a spring, then a lever, forgetting that, with every new addition, he is increasing friction and lessening power; and he is strongly of opinion that no fact in political economy is more clear than that taxation on foreign commodities must ultimately be paid by the consumers, and not by the producers. All taxation is a deduction

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from the fruits of labour and from the fertility of the soil of the country imposing it. No political economist has ever been able to show how prices to consumers can be lowered by increasing the cost of production. He believes that the great industrial machine of this country is good enough in itself, but it needs proper oiling to make the parts work smoothly, and he is of opinion that the technical education of working men is the lubricant which we require. As we have very often pointed out, too much stress is laid on the education of the working men. While that is necessary, it is still more necessary that the leaders of the working men should be educated, or, at least, that every opportunity should be given for passing from the ranks to the position of commissioned officers. Sir Lyon seems to prove a little too much. The tendency of all labour is to become more mechanical, and while intelligence is necessary among the *hands*, the highest scientific knowledge is required for the *heads*. He, in fact, admits this when he says that Englishmen must prepare to keep the position of England in the increasing struggle of nations. They must give more of a trained intelligence to their producers, intelligence to the rank and file, and high technical education to the leaders of their industrial armies. He further insists, as we have always done, on the study of political economy, so that the workers may realise with tolerable certainty the conditions which regulate wages, and that both masters and men may be led to see that the interests of capital and labour are identical, and that the industrial prosperity of Britain is as much due to commercial freedom as the social condition of her people is due to political liberty.

TRANSFORMERS OR ACCUMULATORS?

The comparative merits of different systems of distributing electrical energy from a central station have been the subject of discussion amongst electrical engineers, and especially amongst the members of the Society of Telegraph Engineers and Electricians, for some months past. So far as the Society is concerned, the subject will now be laid aside; but individual electricians who may be called upon to decide for one particular system of distribution will not be much assisted by the lengthy discussions which have taken place at the Society. The subject in its present phase was first started by us in an article on the cost of central station lighting, which appeared in our pages on the 2nd December last. We there compared the installation cost, exclusive of building and land, for three different systems of distribution—one by storage batteries, the second by rotary transformers, and the third by alternating current transformers. The conditions of supply were in all cases assumed to be the same, viz., the same distance from the generating station, continuous service, and a maximum pressure of 100 volts in the houses; and under these conditions the first two systems came out almost equally costly, while the third system was found to be considerably cheaper than either. The question was further discussed in our correspondence columns, and in those of our contemporaries, until the matter was taken up by the Society of Telegraph Engineers and Electricians, to whom Messrs. Kapp and Mackenzie presented papers, the one on the construction of transformers, and the other on electric lighting by means of transformers. In the discussion on these two papers the relative merits of the rival systems were brought forward by their respective advocates; but the subject was by no means exhausted, for shortly afterwards Mr. Crompton contributed to *Industries* an article on the cost of central station lighting, which we published in our issue of the 16th March, and in which he endeavoured to show that the battery system was not more expensive, but far more efficient than the alternating current transformer system. This article was followed by a paper which Mr. Crompton read at the Society of Telegraph Engineers and Electricians on the 12th of April, and which led to a discussion lasting over three nights. It would be difficult to find a subject in applied science upon which so much has been written and spoken within the short space of four or five months; but we fear that, notwithstanding this vast amount of writing and talking, the practical question of central station lighting has been left very much where it was previously. It is certainly a significant fact that the small group of men who have in this country by far the greatest practical experience in distribution by transformers—viz., the engineers of the Grosvenor Gallery installation—have completely abstained from taking part in the discussion, and that in the face of a very determined attack on the part of Mr. Crompton, which was intended to prove that their system must be inefficient. Mr. Crompton, in fact, spoke of the consumption of coal at the Grosvenor Gallery installation as being so many tons per lamp in the daytime, and although this was obviously an exaggeration, the indictment was still sufficiently severe to induce the engineers in charge to refute it had they thought it worth their while to cross swords with Mr. Crompton on purely theoretical, not to say hypothetical, grounds. The engineers at the Grosvenor Gallery did, however, not think it worth their while to discuss the question; and whatever may be the theoretical objections of the advocates of the battery system to the low efficiency of the transformer system when the number of lamps is small, the broad fact remains that the Grosvenor Gallery station is doing an excellent business in selling electricity at 7¼d. per unit. The total number of lamps supplied from this station is at present about 28,000 10 c.p. lamps, and from an inspection of the plans of the circuits, we find that the area of lighting now extends southwards to the Thames Embankment, northwards to Marylebone Road, eastwards to Arundel-street, and westwards nearly to Hyde Park Gardens. At Deptford, machinery for the supply of 50,000 lights is now being erected; but this installation will eventually be very much enlarged, and it is intended chiefly for serving the City. These facts should be sufficient to convince even the most sceptical that the transformer system, whatever may be its theoretical disadvantages, is a great practical success.

The method of distribution advocated by Mr. Crompton is a combination of a five-wire direct supply system, with four local batteries. Its chief merit lies in the fact that the machinery need not be kept going during the hours of small consumption; but the limited pressure of 500 volts does not enable it to compete in point of distance with the alternate current system, where pressures of from 2000 volts to 2500 volts are employed, whilst it also violates the Board of Trade regulations, under which the maximum pressure on any conductor entering a house is limited to 300 volts. The last difficulty is to a certain extent overcome by the ingenious device of an earth connection midway between the extreme positive and negative ends of the circuit, and by the employment of lamps having one internal contact, which is always brought into connection with that wire on which the potential differs most from that of the earth. Mr. Crompton's system is, however, strictly speaking, not a storage system, because the supply in the busy hours of the evening must, as a rule, be simultaneously from the batteries and from the dynamos. It is true that the batteries are intended to give on an emergency the full output, but this is only for short periods. Now, the other battery system which we described in our article of the 2nd December, is strictly speaking a storage system, because each of the two batteries installed at the sub-centres is able to supply the whole of the demand whilst the other battery is being charged. This arrangement would of course be very much more expensive than the system advocated by Mr. Crompton, but it has the advantage of greater storage capacity. The merit of a high pressure system, say of about 2000 volts, is twofold. In the first place it enables us to locate the generating station on property of comparatively low value, without necessitating costly mains; and in the second place, as was pointed out by Mr. Preece, it makes it impossible for the local authority of the district lighted to exercise harshly the provisions of the Electric Lighting Act as regards compulsory purchase after the lapse of a certain number of years. It is obvious that no local authority would take over a central station if they could not work it profitably, and to do this they would have to secure not only the plant installed within their district, but also the distant generating station, and the right of way for the main leads. But as the generating station and a portion of the mains would be situated outside of their district, the purchase of the whole would have to be carried out on fair and equitable principles, so that the use of high tension currents is the very best possible guarantee to the investing public that their interests will not be set aside under a harsh Act of Parliament.

A great deal has been said during the recent discussions about the low efficiency of tranformers when working lightly loaded, and to overcome this difficulty Mr. Kapp proposes to switch off certain transformers during the hours of minimum demand, so that the remaining transformers may be used with a fairly large output, and may therefore work with high efficiency. It is, however, necessary to bear in mind that the switching out of transformers could not conveniently be done from the central station. It is necessary to switch off, not only the primary current, but also to interrupt the connection of the transformer with the secondary or distributing network, and this could only be done from the central station if some more or less complicated device were adopted by which the secondary current is automatically switched off as soon as the primary feeder has been switched off at the station. Such automatic appliances are in themselves objectionable, and it would probably be necessary to switch off both currents at the transformers themselves, for which purpose an employé of the company would have to visit the sub-centres at stated hours in the day. It is very doubtful whether the gain thus obtainable is sufficient to pay for the complication of the service thereby entailed. The experiments of Professor Ayrton in England and of Professor Forbes in America have shown that the efficiency of a transformer at full output is about 95 per cent. The loss of five out of every hundred horse power given off by the transformer may be roughly divided into 3 h.p. lost in heating the iron, and 2 h.p. lost in heating the copper. The loss in the iron is constant, so that, even if a 100 h.p. transformer is doing only 3 h.p., another 3 h.p. would have to be wasted in heating its core. The loss in copper heat at this low output may be neglected, so that the efficiency would be 50 per cent. In a station arranged for a maximum supply of 10,000 lamps the power required at the time of heavy lighting would, according to American practice, be about 1000 h.p., giving ten lamps per horse power. Supposing that only 3 per cent. of the lamps were lighted during the daytime, the power required at the station would be 60 h.p., or five lamps per horse power. Now, it will readily be conceded that the difference between 30 h.p. and 60 h.p., that is, the loss of 30 h.p., which is due to the low efficiency of transformers when these are very lightly loaded, is but a small matter in a station which at times develops 1000 h.p., and the annual coal bill would, therefore, not be materially affected by a falling off in efficiency during the daytime. It must also be remembered that as the efficiency of transformers becomes lower, that of the distributing plant increases. It is on account of these various reasons that transformer lighting, although theoretically not perfect, is yet a great practical success.

THE EDISON GLOW LAMP PATENTS.

We now continue our report of this important case from page 428 of our last week's issue. Sir Horace Davey, in his opening speech for the defendants, which occupied almost the whole of one day, pointed out that Lane-Fox's patent, taken out in October, 1878, contained a statement of the principles which lie at the bottom of a successful incandescent lamp to be used in a system of parallel distribution. It was there stated that the lamp must have a high resistance, and that the electromotive force must be considerable, say about 100 volts. A subsequent specification of Lane-Fox's was also referred to, which came very near to Edison's, except that Lane-Fox, instead of saying "I make use of carbon," had stated that he used certain metals "or other suitable material." Sir Horace Davey then passed on to the consideration of Swan's anticipations, and said that he hoped to be able to prove, that from as early a date as 1877, but certainly from 1878, Mr. Swan was engaged at Newcastle, with the assistance of Mr. Stearn, at Rockferry, near Birkenhead, in making incandescent lamps, and that he succeeded in making not only lamps with straight conductors, which had been called "stick" lamps, but also lamps with more or less filamentous conductors, in some cases made from carbonised paper. Speaking of the "stick" lamp which was produced in Court by the Edison Company, the one frequently exhibited by Swan at lectures before the date of Edison's patent, Sir Horace said: "It cannot be denied, and I think it never has been denied, that this lamp is identical with Edison's specification, unless you can distinguish it on the ground that this carbon conductor does not come within the description of what Edison meant by a filament." It had been said by the plaintiffs that it was a lamp of low resistance, 3 to 5 ohms, and no doubt it was so, although its exact resistance could not now be ascertained, for after a "litigious" life of ten years, the carbon had become damaged. The lamp was composed of a straight stick of carbon about 1¼in. long and $\frac{1}{25}$in. diam., mounted between two platinum wires in a glass globe, from which the air had been exhausted. The globe of the lamp was considerably dimmed in the inside by deposited carbon. The occluded gases had not been removed by Mr. Swan when he constructed the lamp in 1879. Sir Horace Davey then proceeded to point out the main lines of attack which he proposed to make on Edison's specification. He said that Mr. Edison had not on his specification added anything to the stock of knowledge possessed by the public in 1879; that Edison had not given sufficiently clear and definite instructions to enable a skilled working man to make a lamp without a considerable amount of experimenting; that he had in fact done nothing more than make a series of suggestions which he had not worked out in his own mind, but which he had left to be worked out by subsequent experimenters; that the mere statement that a combination of a carbon filament

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within a receiver entirely of glass through which the leading wires pass, and from which receiver the air is exhausted (Edison's second claim), was nothing more than a statement of a desirable object which electricians had in view. Sir Horace then went on to discuss the meaning of the word "filament," and pointed out that the witnesses who had been called for the plaintiffs had been unable to give anything like an accurate definition of a filament, and would not commit themselves by stating where a filament ended and a pencil began, and he should argue that Edison had deliberately abstained from making his meaning clear, and that a patentee was rigorously bound in law to put up such a fence that everyone coming within that fence would be coming upon forbidden ground, and Edison had erected no such fence. Sir Horace then dwelt on the fact that, with the exception of a few lamps made for use in the former action against Messrs. Woodhouse & Rawson, and for use in this action, the plaintiffs had not been able to produce a single lamp made according to the directions given in Edison's specification without the addition of any other processes or improvements, although the counsel for the plaintiffs and their scientific witnesses had spoken of the world wide Edison lamp which had created a revolution in electric lighting. Edison himself had taken out several subsequent patents, in two, at least, of which he had given further instructions in the processes of manufacture. In one of these he had stated that purely structural carbon was the only carbon which would answer; which, said Sir Horace, is the greatest possible condemnation of that portion of the specification in question which described and claimed filaments made by carbonising lamp black and tar. He then proceeded to cite certain decided cases, which, he contended, showed that Edison's specification was invalid. Sir Horace Davey then went to the other patent upon which this action has been brought, viz., Cheesbrough's, which is a patent for an invention made by Messrs. Sawyer and Mann, in America, and communicated by them to Mr. Cheesbrough in this country. The invention consists in placing the filament in a vapour of some hydrocarbon, and then passing the electric current through it, so as to raise the conductor to a yellow heat. At that temperature the hydrocarbon is decomposed, and carbon is thrown down in a very beautiful manner upon the filament, the deposition taking place most rapidly at those points on the filament where the temperature is highest, which are the places where the filament is thinnest. By this means a filament of uniform electrical section is rapidly obtained. Sir Horace Davey stated that the anticipation upon which he intended to rely chiefly was a paper published by the eminent French chemist, M. Despretz, many years ago. M. Despretz had been anxious to ascertain whether he could fuse or volatilise carbon. He had placed carbon in the electric arc, and he had also passed a current of electricity through the carbon, and in the course of his experiments he had surrounded the carbon with nitrogen; but he found that some chemical action took place between the carbon and the nitrogen, and he then hit upon the idea of placing the carbon in a hydrocarbon atmosphere. To his astonishment the hydrocarbon was decomposed, and carbon was deposited not only on the piece of carbon operated upon, but also on the clamps in which it was held, and on the glass vessel containing them. Sir Horace also stated that he intended to rely upon that passage in Cheesbrough's specification in which he stated that his invention was not confined to carbon alone, but included many other substances which are infusible non-conductors, as for example lime.

Mr. Robert Percy Sellon, the chief electrician of the Anglo-American Brush Company, was the first witness called for the defendants. He was examined by Mr. Finlay, and described at full length the process by which the Brush Company had made the lamps complained of. That process, which is to some extent covered by patents, consists in taking cellulose in a pure condition and dissolving it in chloride of zinc, producing a jelly-like substance, which is forced through a small circular aperture into alcohol. The effect of the alcohol is to cause the cellulose to deposit in long fine homogeneous threads, which are very carefully dried on velvet, and then wound upon moulds the shape of the filament when finished, and the whole placed in carbonising crucibles, packed with charcoal, and raised to a high temperature, care being taken to exclude the atmosphere, and to allow for the contraction of the filaments during the process of carbonisation. The filaments are then mounted in clips and flashed for a few seconds only, so as to bring them all to the required resistance, or, as it is termed, to standardise them. The filaments are next mounted on to the platinum wires, by again flashing the surfaces where the carbon and platinum touch, and are then ready for mounting in the lamp and for having the globes exhausted and the occluded gases taken out, the vacuum which is obtained being a very perfect one. Mr. Sellon was examined at some length as to the insufficiency of the directions contained in Edison's specification, and more especially as to the carbonising, and the injurious effect alleged to be produced on the platinum leads by putting them into the carbonising chamber in those cases where the filaments are mounted to the platinum before carbonising. Mr. Sellon was then cross-examined by Mr. Aston, and admitted that in one or two of the papers in evidence in the case there were directions given for putting powdered charcoal into the crucible when carbonising carbons to be used for arc lighting, especially in a description of the process adopted by the well known French maker, M. Carré.

The next witness was Professor Crookes, who was examined by Mr. Graham. He described very minutely a large number of experiments which he had made upon the directions contained in Edison's specification, and which he had found the greatest difficulty in following, having failed to produce a lamp of any commercial value by any of them. Professor Crookes also described some very remarkable experiments which he had made upon that portion of Edison's specification where it is stated that the filament may be coated with some non-conducting non-carbonising body. Professor Crookes coated the filament with asbestos, fire clay, and other similar substances, and found that at temperatures below those which are usual in a lamp, a chemical reaction takes place between the carbon and the oxygen in those substances, the carbon burning off as carbonic acid. Professor Crookes had also made similar experiments with respect to the passage above referred to in Cheesbrough's specification. He took a small pencil of carbon, and surrounded it with lime, and passed the current through the carbon, while it, with its lime envelope, was surrounded by a hydrocarbon gas. Carbon was deposited throughout the pores of the lime. The witness then cut a small pencil out of the lime, impregnated with carbon, and mounted it in a lamp, which was then exhausted. When the vacuum was as good as that usually obtained in lamps, Professor Crookes passed the current through, and before the usual lamp temperature was reached a reaction commenced. The filament began to scintillate, and broke down immediately. Experiments of a similar character were made with magnesia and other bodies with similar results.

Professor Crookes was cross-examined at great length by the Attorney-General, and admitted that many of the references in Despretz's experiments were made with the arc phenomena and not with incandescent carbon.

We shall report the further progress of the case in our next issue.

THE SOCIETY OF TELEGRAPH ENGINEERS AND THE LATE MR. T. R. CRAMPTON.

At the meeting of this Society, held on the 26th inst., the President (Mr. Graves) announced the death of Mr. T. R. Crampton, member, and called on Sir Douglas Galton, as an intimate friend of the deceased, to move a resolution to the effect that an address should be presented to his widow and family expressing the sympathy and condolence of the Society with them in their bereavement. In moving the resolution, Sir Douglas Galton referred to Mr. Crampton's work in the early days of railway enterprise, and his invention of the "Crampton engine," which is still in use in France on the Chemin de fer du Nord. He reminded the younger members of the Society that the first successful submarine cable laid between Dover and Calais was due to Mr. Crampton. Earlier attempts had been made with cables consisting simply of a wire covered with insulating material, but they had not been successful. It was Mr. Crampton who devised the cable of 1851, which formed the model for all subsequent successful cables. He retired somewhat early from active engineering enterprise to undertake contract work, and this was shortly followed by his retirement into private life. He did not, however, abandon his interest in engineering works; and among other things he devised hydraulic machinery intended to be used in excavating a Channel tunnel, and he actually employed the method in excavating a tunnel near Sevenoaks, making use of the waste water in removing the excavated materials. Professor G. Forbes seconded the resolution, which was unanimously agreed to.

Letters to the Editor.

PROPOSED EXTENSION OF TEXTILE MANUFACTURES IN IRELAND.

To the Editor of "Industries."

Sir,—Although cotton spinning about fifty years ago formed one of the chief manufactures in Ireland, it has, unfortunately, from various causes, now become almost entirely extinct. The great prosperity attendant on the introduction of machinery into the flax manufacture while the cotton trade was passing through a season of depression, was the means of enticing many producers to discard the latter and adopt the former manufacture; while other concerns, which were endeavouring with worn and antiquated machinery to compete with the well equipped factories of Lancashire, were, as a consequence, forced out of existence. In this way, each year saw a diminished production of cotton yarns in Ireland, until, at the present time, the trade is represented by only two concerns of any magnitude, one of which is engaged in the fine trade. In the official returns to the Home Office, the extent of the cotton industry in Ireland is given as follows: No. of spinning spindles, 68,604; No. of looms, 2501.

That the position and climate of Ireland is of the most favourable character for cotton spinning is generally admitted; and, but for the disturbed condition of the country, we may conclude that English and Scotch capitalists who are on the look out for new fields of enterprise would, ere this, have made use of the advantages thus offered for the re-introduction of this dying manufacture on a large modern scale. In the North of Ireland, however, if our capitalists would only realise the fact, there is little to stand in the way of successfully establishing one branch of cotton spinning, and it is with the idea of showing them that such is the case that I now take up this important subject. Before, however, proceeding to that part of it which deals directly with this point, it may be well for me to give here the following explanatory remarks on the two systems of spinning now adopted in English mills, viz., ring and mule spinning.

In the United Kingdom at the present time there are estimated to be 40,000,000 spindles distributed throughout our cotton spinning concerns, of which about 36,000,000 are known as mule spindles, the remaining 4,000,000 being made up of throstle and ring frame spindles. The reason or cause of the disparity in numbers between the latter and the former is due to the fact that the ring frame, although not a new invention, has only been recently introduced to the trade, while the self acting mule has been in general use for nearly a half century. The great distinctive feature about the two machines is that the ring frame is continuous, while the mule is intermittent in its action of spinning; consequently the production is much greater by the former than by the latter machine. To explain this more clearly, I may state that the self acting mule is constructed of two distinct parts, viz., a stationary beam and head stock, and a traversing carriage. The material as it leaves the rollers passes to the revolving spindles fixed in the carriage, as it recedes from the beam, and after the length of its traverse has been reached the twisting and the delivery ceases, and the winding on of the threads begins, during which the carriage is drawn up to its original starting place. In the throstle and ring frame, delivering, twisting, and winding are effected simultaneously. In the throstle frame, however, owing to the spindle being weighted with a flyer, the number of revolutions at which it can be driven is limited, so that the production is little in advance of the mule, and accordingly machines of this class are not now being made. It is only during the past few years that the subject of ring as against mule spinning has been energetically taken up and practically tested; but the result has so far been in favour of the former system, at least for the spinning of the lower numbers of yarns. This fact may be, and is, disputed by some; but there need be little difference of opinion on the subject, as in numerous concerns where both ring frames and mules were in operation, the latter have given place entirely to the former machines. The advantages claimed for the ring frames over mule machinery may be briefly summarised as follows: (1) A ring spindle will easily produce 25 per cent. more than a mule spindle. (2) The yarn produced from rings is more regular, and very much stronger than that spun upon mules. (3) There is no cop bottom waste made with ring frame yarn. (4) Young persons can learn to work the ring frame with greater facility than the mule. (5) The ring frames are worked by females, while mules require the attendance of men. The attendants' wages, therefore, are much lower. (6) There is less danger from fire, as there is less friction. (7) The cost of repairs with ring frames is about 75 per cent. less than with mules. (8) There is greater economy in oil. (9) There is also economy in space, as fifteen ring frame spindles only occupy the same area as eight mule spindles. (10) There is less shafting and gearing required.

Against these advantages, however, must be taken into consideration the fact that the cost of the two machines, spindle for spindle, is greater in the ring frame than in the mule, and also that the yarn on a ring frame requires to be spun on a bobbin or tube, while the mule yarn is built up on the bare spindle. Probably a mule spinning mill in Lancashire can be built at the present time for about 21s. per spindle, while a ring mill will cost from 24s. to 25s. per spindle. This greater first cost is, however, of small moment when compared with the greater production and less working cost of the ring frame. As I have just stated, it is also against the ring frame that the yarn requires to be wound on a bobbin or tube, which, of course, increases the cost of production, and carriage or freightage of the yarn. These drawbacks are, however, more than accounted for by the greater advantages which a ring pirn possesses over a mule cop, and which may be enumerated as follows: (1) All the yarn made upon a ring frame can be utilised. A mule cop has always more or less yarn wasted in the cop bottom. (2) With a ring pirn there is no "readying" or "clearing" of the cop nose required, as all the yarn is built straight and regular, and will leave the pirn from beginning to end without waste, and very seldom breaking from the commencement to the finish of the unwinding operations. On the other hand, in mule cop yarn there is always a certain amount of "readying" or "clearing" necessary when the cop is fixed on the winding frame skewers or the shuttle peg, and in addition mule yarn is more liable to break than ring yarn in weaving. (3) Sometimes mule cops are "stabbed" by the winders and weavers, but in a ring frame pirn this cannot possibly happen.

For some time past at the quarterly meetings of Lancashire shareholders the subject of discarding the mules and replacing them with ring frames has been often discussed. This is owing to the fact that the few ring frame spinning concerns which have been floated within the past year or two, have succeeded in declaring dividends ranging from 8 per cent. to 10 per cent., while mule mills, built at the same time on the most productive and economic principles, can scarcely show dividends of half the above value. In Scotland, France, Germany, and America the ring system of cotton spinning is also proving remunerative, and consequently making rapid progress, so that taking into consideration the facts that the Belfast district possesses the

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very highest commercial advantages, that the climate is specially suitable for the cotton manufacture, and that there is an abundant supply of unemployed labour, the subject of ring spinning mills is one well worthy of consideration.

To erect a ring spinning concern in Belfast, say of 40,000 spindles, and preparation machinery, with all the necessary engines, boilers, shafting, and gearing, a share capital of £60,000 would be necessary, augmented by a loan fund of £20,000, which could be raised at say 4 per cent. If this were accomplished, then of a share capital of say 12,000 £5 shares, or 6000 £10 shares, it would only be necessary to call up about £2. 10s. or £3 per share, equal to about £30,000 or £36,000. As a considerable portion of the capital would, no doubt, be raised in England and Scotland, the division into £5 shares would be the most popular, and receive greater favour at the hands of intending investors. Of course this would be a matter entirely for future consideration. The cost of erecting a mill of this size in Belfast I estimate at £56,000, which would include the building, driving power, preparatory and finishing machinery of every kind, all on the most modern, productive, and economic principles of construction. The production would, of course, depend on the counts or numbers of the yarn; but to take an average, say 30's, 42,000lb. would express approximately the net weight of yarn turned off weekly. The necessary cotton supply could be obtained from Liverpool at a slightly cheaper rate than from Liverpool to Oldham or Bolton, so that therefore, in this respect even, Belfast would be better placed than the great centres of the Lancashire cotton trade. A mill of this size in Belfast, under proper management, could not possibly fail to be a great financial success, and pay a return on the invested capital of from 12 to 15 per cent., and possibly even higher, as will be explained from the following tabular statement, contrasting the wages in a Lancashire mule mill of say 50,000 spindles (equal in production to 40,000 ring spindles) to a Belfast ring spinning concern of the capacity already stated:—

Comparison of the Weekly Wages in a Lancashire Mule Mill having 50,000 spindles, and a Belfast Ring Mill having 40,000 spindles.

	Lancashire. £ s.	Belfast. £ s.
In mixing room—		
Three attendants required...combined wages	1 15 ...	1 6
In scutching room—		
Six attendants required..... „	5 0 ...	4 0
In carding room—		
Carder, £2. 10s.; under carder, £1. 10s.; and a grinder, £1. 2s... „	5 2 ...	5 2
Seven other grinders ..... „	7 7 ...	5 12
Four card tenters ..... „	2 12 ...	1 12
Ten drawing frame tenters ..... „	9 0 ...	5 10
Seven slubbing frame tenters ..... „	6 6 ...	3 17
Six intermediate tenters..... „	5 8 ...	3 6
One intermediate tenter.....	0 14 ...	0 8
Four back tenters ..... „	1 8 ...	1 4
Sixteen rove frame tenters ..... „	14 8 ...	8 16
Eight back frame tenters ..... „	2 16 ...	2 8
In spinning rooms—		
Twenty-five spinners for mules (men)	50 0 ...	—
Fifty piecers for mules, at 12s. 6d. each on average	31 10 ...	—
Eighty ring frame tenters (women).....	— ...	44 0
Eight back tenters.....	— ...	2 8
For working engine, boilers, packing, &c., cost at Belfast would, at very lowest estimate, be £4. 11s. under that of Lancashire	4 3 ...	—
Totals	147 9 ...	89 9
	89 9	
Weekly balance in favour of a Belfast ring mill.....	58 0	

From the above statement, then, it will be seen that in wages alone there would be a saving of £58 per week, equal to £3,016—or say £3,000 per annum—a sum which would in itself be sufficient to pay the loan interest of 4 per cent (£800), and a dividend of 7½ per cent. on a called up share capital of £30,000. To this estimate must be added that of a Lancashire ring spinning concern, which, if I take at 8 per cent., after making allowance for depreciation, &c., will give a total dividend available for distribution of 15½ per cent.

As regards the greater productive capacity of the ring frame, the following statement, obtained from the working of machines erected within the past three years, may be interesting:—

Counts or Nos. of yarn.	Production of mule in hanks, per spindle.	Production of ring frame in hanks, per spindle.
20's	32½	44
24's	31	41
28's	29	39
30's	28½	38½
32's	28	37½
36's	27	35
40's	26	33
42's	25½	32

Before concluding this already long letter I would like to refer to another very important advantage which a ring frame concern in Belfast would possess. At the present time there is a large quantity of cotton yarn being consumed in Belfast and the neighbouring manufacturing towns, both in cotton and linen weaving factories. The numbers of these yarns, I find, range from 150's down to 10's; but as the different kinds are not specified in our import returns (the gross weight in tons merely being given), it is difficult to arrive at a decision of how much of this comes within the range of ring spinning. The counts or numbers which a ring frame is economically adapted to spin is limited to 50's, but 45's, or even lower counts, is considered more satisfactory. From extensive inquiries I have made, I have been led to believe that about two-thirds of the total import of cotton yarns would come under the ring frame capacity; but allowing that only half were of this description, then the requirements of our northern manufacturers alone could not be supplied by the total production of a ring mill of the size I have now been considering. For during the year 1885 there was imported into Belfast 5,022,080lb., or an average of 96,578lb. weekly; and during the year 1887 the import has been 5,800,000lb., or an average of about 111,000lb. weekly. If, then, I take 50 per cent. of these quantities as representing yarns which might be produced by a Belfast ring concern, I find that it would require about 56,000lb. weekly to supply the demand. As a mill of 40,000 spindles could only turn off say 40,000lb. of yarn weekly, there would therefore be ample scope for its encouragement and development. The cost of transit of yarns from Manchester, Oldham, and Bolton to Belfast being almost ¼d. per lb., there would therefore, from this item alone, be a saving to a local concern of about £42 weekly, or over £2,100 per annum, which in itself would be sufficient to pay about 7 per cent. on the share capital, or an aggregate dividend equal to about 22 per cent. This estimate can be formed on another basis, so that one will form a check upon the other. In Lancashire mule mills at the present time the margin of profit realised on the spinning of say 26's twist yarns, after paying every item of expense, and making allowance for depreciation, &c., averages from 1/16d. to ⅛d. per lb. In ring mills this margin varies from 1/16d. to ⅜d. per lb. To test, therefore, whether the results already given would be borne out by this statement, I give the following calculation: I will take the difference in wages between a Belfast ring concern and a Lancashire one as £45 per week, and I have thus a saving of £2,340 per annum. To this I must add the profit on the production of 40,000lb. weekly, which, if I take at the lowest figure, *i.e.*, 1/16d., would amount to £52 weekly, or £2,704 per annum, making a total of £5,044, or say £5,000. If from this sum I deduct the interest on the loan capital, viz., £800, I have then a disposable balance of £4,200, which would be sufficient to pay a dividend on the share capital of 14 per cent. Adding to this the percentage made up by the saving in carriage, viz., 7 per cent., and I get a total return of 21 per cent. Of course there would necessarily be greater expenses in connection with the directorate and the management of a concern in Belfast than in Lancashire; but I may safely assume that a well and economically conducted ring spinning factory should be able to pay at least 14 to 15 per cent. As I have already stated, workpeople are plentiful in the Belfast district, and there is one great advantage which would be derived by a ring spinning concern, viz., that flax spinning mill hands could, almost in a day's time, be initiated into the working of the cotton ring frame.

The task I have had before me for some time is now completed, and I shall be pleased if this letter is the means of interesting Lancashire capitalists in the question. That all the statements I have made are thoroughly reliable I can fully prove, and I may say that I shall at any time be happy to give any further information on the subject that may be required.

Yours, &c.,

Belfast, 28th April, 1888. HUGH MONIE.

SHIPBUILDING NOTES.

ON the 14th ult. a steel sailing barque named the "Lorton" was launched by Messrs. Workman, Clark, & Co., Limited, Belfast, for Messrs. P. Iredale & Son, Liverpool. Her dimensions are: Length, 241ft. 8in.; breadth, 27ft. 4in.; tonnage registered, 1360 tons.

On the 19th ult. there was launched from the Low Walker Shipbuilding Yard of Sir W. G. Armstrong, Mitchell, & Co., a steel twin screw steamer, for service on the Caspian Sea. The vessel, which is named the "Yang," is of 500 tons burthen and 180ft. long, and on her arrival at St. Petersburg will be divided so as to pass the canal locks. A portion of the holds of the "Yang" are fitted up for carriage of petroleum in bulk, and her bunkers are also arranged for carrying liquid fuel, with which object the main boiler and donkey boiler will also be fitted with a special apparatus for burning petroleum refuse or astatki, which is practically the only fuel now used on the Caspian Sea.

On the 23rd ult., Messrs. Edward Withy & Co. launched from their yard at Hartlepool a steel screw steamer, named the "Grenville," built to the order of Messrs. J. Holman and Sons, London. She is 260ft. by 35ft. by 18ft., and built throughout of Siemens-Martin steel; has a long raised quarter deck, long bridge house, and a topgallant forecastle main, bridge, quarter, and topgallant decks, skylights, bulwarks, rails, bulkheads, cargo battens, &c., being built of steel and iron; is constructed with a cellular double bottom (Withy & Sivewright's patent), all fore and aft, and is fitted with four steam winches, two donkey boilers, and patent windlass fitted on forecastle, hand and steam steering gear amidships, and patent screw stand-by gear aft. The accommodation for officers and passengers is under the poop aft, and is fitted up in hardwood. The panels in the sides of the saloon are handsomely painted in oils by the lady decorative staff of the firm, and considerable taste has been shown in the selection of the different subjects painted. The accommodation for the engineers is fitted up in a neat and comfortable style in the bridge, and the crew and firemen are berthed under the topgallant forecastle. The steamer is rigged as a two-masted fore and aft schooner, with iron lower masts, and is built to the 100 A1 class at Lloyd's, under the personal superintendence of Captain Holman. She will be fitted with triple expansion engines by Messrs. Blair & Co., Stockton-on-Tees, under the superintendence of Mr. E. J. Caiger.

On the 24th ult., the steel screw steamer "Zeta" was launched from the shipbuilding yard of Messrs. Jos. L. Thompson & Sons, North Sands, Sunderland. The vessel has been built to the order of Messrs. Turner, Brightman, and Co., of London. She is 3400 tons dead weight capacity, and of the "well deck" type, having raised quarter deck, hurricane house, and topgallant forecastle. She is to be classed 100 A1 at Lloyd's. The "Zeta" is now being fitted with engines of the triple expansion type and 200 n.h.p., and with boilers by Messrs. Blair & Co., Limited, Stockton-on-Tees.

On Wednesday, the 25th ult., Messrs. Russell & Co. successfully launched from their Greenock yard a large steel screw steamer, built to the order of a Liverpool firm. Her dimensions are: Length, 320ft.; breadth, 40ft.; depth of hold, 27ft. 6in. The vessel is classed 100 A1 at Lloyd's, and is built to the Admiralty requirements of a troopship. She has a dead weight capacity of nearly 4200 tons. The engines will be supplied by Messrs. Dunsmuir & Jackson, of Glasgow, and have cylinders 24in., 39in., and 64in. diam., by 45in. stroke. There are two double ended boilers of large size, each having six Brown's patent furnaces. The construction of the vessel and her machinery has been superintended by Messrs. Flannery & Blakiston, of Liverpool.

On the 26th ult., there was successfully launched from the shipbuilding yard of Messrs. William Simons & Co., Renfrew, a handsomely modelled screw steamer for passenger service on the Adriatic. Its dimensions are: Length, 157ft.; breadth, 21ft.; depth, 11½ft. The vessel is built of Siemens-Martin steel, under the superintendence of Lloyd's special survey. Saloon accommodation is provided at the after end for first class passengers, having ladies' cabin, lavatories, &c., and the panelling is of well selected birdseye-maple, pilasters and mouldings of mahogany, and cushions of Utrecht velvet. A second class saloon is placed under the main deck forward, and has sleeping accommodation for twenty passengers. Deck shelter for third class passengers is provided under the turtle back forecastle. Electric light is fitted in the various cabins, engine room, &c., and also for side lights. The engines are on the triple expansion principle, and are expected to propel the vessel at a high rate of speed. The boilers are constructed of steel for a working pressure of 150lb. per square inch. As the vessel left the ways, she was named the "Trieste C."

Messrs. Cochran & Co., steam yacht builders, of Birkenhead, launched from their Bidston wharf, on Thursday, the 26th ult., a steam yacht of the following dimensions: Length over all, 117ft.; length on water line, 106ft.; beam, 17ft.; depth, 10ft. 8in. She has been built to the order of Mr. Frederick Platt, Barnby Manor, Newark, and was designed by Mr. St. Clare J. Byrne, of Liverpool. She is fitted with triple expansion engines, having cylinders 11in., 17in., and 28in. diam. respectively, and 20in. stroke.

Messrs. Scott & Co., of Greenock, launched on the 27th ult., the twin screw steel steamer, "Sung Kiang," 1650 tons net register. The vessel has been built to the order of the China Navigation Company, and will be fitted with engines of triple expansion type, indicating 1000 h.p.

On Saturday afternoon, the 28th ult., there was successfully launched from the yard of Messrs. Wm. Doxford and Sons, Pallion, a handsome new screw steamer, "Brenner," built to the order of Messrs. Cag, Hall, & Co., of South Shields. The vessel is intended for the general trades, and is entirely built of steel to Lloyd's 100 A1 class. The principal dimensions are: Length between perpendiculars, 265ft.; breadth, 37ft.; depth moulded, 18ft. 6in.; with cellular bottom fore and aft. The vessel carries 2600 tons on 18ft. The engines are of the triple expansion type, and are supplied with all Messrs. Doxford's latest improvements; the cylinders are 20in., 33in., and 54in. diam. respectively, and the stroke 36in. She is fitted with Bow-McLachlan's patent steam steering gear, Hastie's screw gear aft, four steam winches, by Messrs. Welford Brothers, of Pallion, patent multitubular donkey boiler, by Messrs. Cochran, of Birkenhead, and all the most recent improvements for cargo purposes. The cabins are most tastefully constructed in teak, oak, and mahogany, in the poop aft.

A new screw steamer, the "Quito," built to the order of the Pacific Steam Navigation Company for their West Coast trade, was launched from the yard of Messrs. Laird Brothers, Birkenhead, on Saturday, the 28th ult. Her principal dimensions are: Length over all, 225ft.; beam, 35ft.; depth to upper deck, 22ft. 6in.; builders' measurement, 1270 tons. She is built of steel, with steel lower deck, and is designed to carry a large cargo, with space on deck for cattle and deck cargo. There will be accommodation on deck for sixty first class passengers. The saloon and state rooms are sumptuously fitted, and the former has a Mosaic floor of artistic design, which will be fully appreciated in the hot climate. The ship is fitted throughout with the electric light, and is provided with steam steering gear, and all modern appliances. The engines will be triple expansion, indicating 800 h.p.

On the 28th ult., there was launched from the shipbuilding yard of Messrs. Short Brothers, Pallion, a steel screw steamer, built to the order of Mr. J. S. Barwick, Sunderland. The following are the chief dimensions: Length over all, 325ft.; breadth, 39ft.; depth, 22ft.; and dead weight capacity, 4000 tons. The engines and boilers have been constructed by Mr. George Clark, of the Southwick Engine Works.

On the 30th ult., the steel screw steamer "Rapel," built for the Compania Sud Americana de Vapores, of Valparaiso, was launched from the yard of the Blyth Shipbuilding Company, Limited, Sunderland. The vessel has been specially designed for the South American trade, and will be equipped with four powerful steam cranes, &c., by Messrs. Robert Roger & Company, of Stockton-on-Tees. The engines and boilers have been constructed by the North-Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne, and the donkey boiler by the Tyne Boiler Works Company, Walker-on-Tyne.

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IMPROVED JAW CHUCK.

THE type of chuck which we herewith illustrate is an American design now being introduced into this country by Messrs. Clark & Wellington, of 73, Queen Victoria-street, London. Each jaw consists of two pieces, the lower, as usual, in one with the nut C (Fig. 2), which works over a screw for shifting the jaw, and the upper piece, which may be set farther in or out or reversed according to the size and shape of the job. The body of the chuck consists of a front and back shell arranged to screw on to the face plate of the lathe, and containing the gear for the universal or independent movement of the jaws as may be desired. The construction of this gear will be understood from Figs. 2 and 3, which show sections through a three-jawed chuck, whilst Fig. 1 is an outside view of a four-jawed chuck with independent jaws. The bevel pinions B can be brought simultaneously into gear with

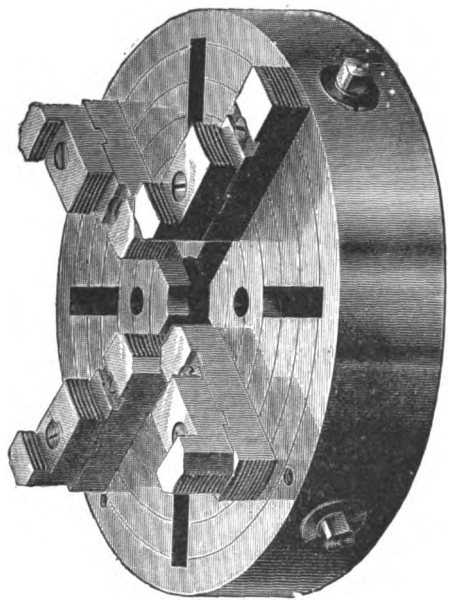


FIG. 1.

the toothed ring D, when the latter is lifted and backed up against the pinions by the ring H. In this position the turning of one pinion causes the ring D to revolve, and so to transmit an equal rotary motion to the other two pinions. At the bottom of the shell and opposite each pinion are projections G, and similar projections with tapering ends are fitted to the ring H, so that when the latter is turned by the thumb screw in one direction the projections are brought over each other, causing the toothed ring to come into gear with the pinions; whilst if the thumb screw is pushed in the other direction the smooth part of the ring H is brought over the projections G, and the toothed ring comes out of gear. The ring H is locked in either position by the thumb nut shown, and a plate covers the slot in the shell through which the thumb screw passes, so as to prevent turnings or filings getting into the gear.

IMPROVED JAW CHUCK.

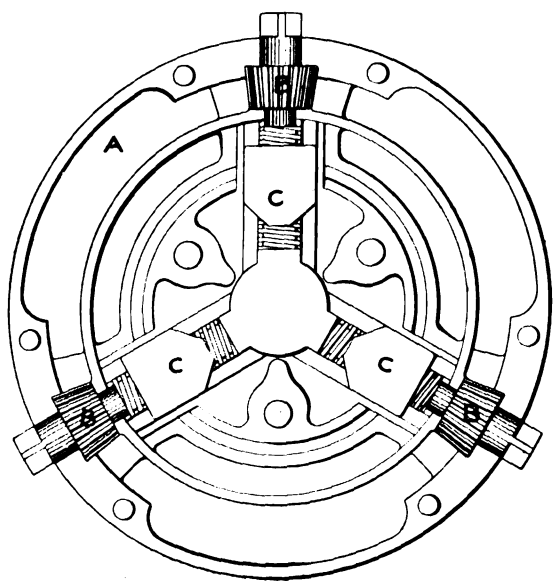


FIG. 2.

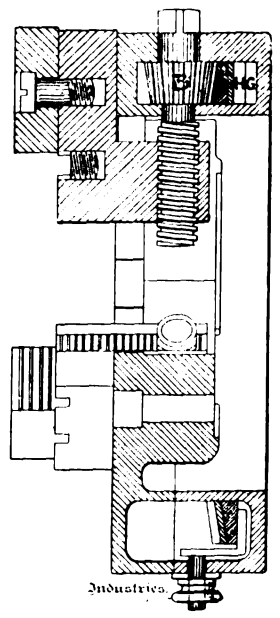


FIG. 3.

CENTRAL STATION LIGHTING.

(TRANSFORMERS V. ACCUMULATORS.)

IN our last issue (see page 432) we reported the second night's discussion on this paper, by Mr. R. E. Crompton, read at the Society of Telegraph Engineers and Electricians. The discussion was resumed on the 26th ult., and concluded.

The first speaker was Mr. W. B. Esson, who considered that the numerical results of the author's own experience were of great value, and regretted that he had not confined himself to these, excluding merely hypothetical calculations. It was generally agreed that accumulators charged with a current at 2·5 volts would give a discharge current of 2 volts, giving a maximum possible efficiency of 80 per cent. In actual practice probably even 70 per cent. would very seldom be attained, and the results obtained at Vienna, viz., an efficiency of 60 or 61 per cent., might be considered the general average. Mr. Crompton's estimate of £8,000 for the generating station, on the B.T. system, was too small; but he agreed with the author that his estimate for the cost of the alternating machines was below the mark, as at present their cost is much higher than that of continuous current dynamos. With regard to working expenses, he did not think there would be much difference between the two systems. He thought the reliability of either system would be about the same, for though there is an objection *per se* of moving machinery, there would be very little danger to a breakdown if a spare set of machinery were kept ready for use. On the A.T. system the alternative methods of distribution were: Large transformers feeding a network at 100 volts; or small transformers in every house, with a primary current at 2000 volts in a distributing network. He considered that our present experience would tend to induce distrust of the permanent reliability of an underground network carrying a current at 2000 volts. If the former system were used, the cost of the mains would be about the same as if accumulators were employed, except that the charging main in the transformer system would carry a current at 2000 volts, as opposed to one at 500 volts in the accumulator system, giving a considerable economy in favour of the transformers. He considered that, except in the matter of the charging mains, there would be very little difference in cost between the two systems.

Professor Forbes observed that the paper was of a character not often read before the Society, dealing, as it did, mainly with hypothetical results. He considered that the discussion was of much greater value than the paper itself. He would have liked a paper from Mr. Crompton describing the actual results obtained in Vienna and at Kensington Court, and giving precise details as to the efficiency of the accumulators. It was all very well for Mr. Crompton to say that anyone could go and inspect the Howell accumulators at the Kensington Court central station; but he, at any rate, was unaware of any method of testing the efficiency of an accumulator by merely looking at it when in use. The object of the paper, as set out by the author, was to show that distribution by means of transformers had no advantages over other methods. He had then selected an example as disadvantageous as possible to the former, viz., a small 10,000-light central station supplying a closely contiguous district. Therefore, even if he made out his case in the example selected, it would not prove his assertion. He might have considered numerous other systems, and there was no doubt that the least costly would have been the system recently carried out by Mr. Stanley in America, and referred to in Mr. Mackenzie's recent paper on transformers. The speaker had formerly obtained details of the cost of electrically lighting the club district of Pall Mall and St. James' from the secretaries of the clubs, and his calculations, based on these figures, and carried out with the assistance of Mr. W. H. Snell, showed that the cost per candle power per annum of the different systems was as follows:—

System.	Cost per candle power per annum. s. d.
Simple parallel system	2 0
Three-wire system	1 10½
Multiple series system	1 10
Multiple series system carried out in compliance with Board of Trade regulations as regards pressure at the house terminals	2 0
Simple series (Bernstein's) system	1 10¾
Transformers	1 11½
Storage batteries	2 4

The most important of Mr. Crompton's tables were those relating to the cost of installations and maintenance. He compared Table III. (see Vol. IV., page 406)—giving the cost of a plant for an output of 600 kilo.-watts—with the results obtained in America. With the Westinghouse transformer system in use there, 600 watts were obtained in the lamps per i.h.p. Mr. Crompton demanded 1450 h.p. instead of 1000, which would be sufficient according to American practice—that is to say, he added nearly 50 per cent. to the maximum, a reserve enormously exceeding what was requisite. This would reduce all the details of his estimate. The cost of dynamos and exciters per kilo.-watt given in the paper was correct according to the American estimate, but this would also include the cost of all adjuncts.

The cost of transformers Mr. Crompton estimates at £7,500, while it should have been £4,000. His chief error, however, was with respect to the mains, and arose from his not appreciating the advantages of the transformer system. His allowance of 22,000 yards of mains for 10,000 lights was too high. In a case like this no one would think of taking up the pavement and laying down culverts, because overhead wires were more suitable for a small installation of this kind. The pressure of 480 volts assumed by the author exceeded that allowed by law. His wires would carry a current of about 1500 ampères at this pressure, and for this he assumed that a wire of 2·55in. sectional area would be required, which could not be carried overhead. Still more would this be the case if the Board of Trade regulations were complied with. He would, therefore, reduce the estimate for the mains from £20,430 to £6,000, and the total cost of the station on the A.T. system should be £34,140, instead of £57,440, and it was the former figure which should be compared with Mr. Crompton's own estimate of £59,762 for the cost on the B.T. system. Mr. Crompton's calculations for the accumulator system also contained serious errors with regard to the efficiency. This he assumed to be 80 per cent. for the whole system—that is, for the conductors and accumulators combined—and he admitted a loss of 10 per cent. in the charging and 4 per cent. in the discharging mains. Professor Forbes found that the loss on the charging mains would be 12 per cent., making a total loss in the mains of 16 per cent., and therefore leaving only 4 per cent. for the loss in the accumulators, which would, therefore, have to give an efficiency of 96 per cent. Again, he gave 416 ampères as the rate of discharge of each cell for five hours, or 2080 ampère hours, and stated that they were capable of a rapid discharge of 1352 ampères. With this rate of discharge he only allowed 15 per cent. for depreciation. Professor Forbes did not know of any company that would agree to maintain storage batteries at this price. Mr. Preece, whose cells were being carefully attended to, had stated that they lost 1lb. in 16lb. during the first year. Mr. Crompton then assumed that he could get such cells as these at £40 each. This estimate of price he had only based on hearsay, as was also the case with his figures for the alternating system, which were to a great extent based on articles in *Industries*. If he had confined himself to his own experience, the results would probably have been very different. Mr. Crompton had stated that American experience was of no assistance; but the speaker, on the contrary, found that during the few months in which he had recently been studying the A.T. system in America, he had obtained more practical information than he could have gathered by reading everything that had ever been written by English authors on the subject.

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Mr. Crompton had characterised as nonsense the statement that the cost of laying down conductors was approximately proportional to the cost of the copper. This would not be the case for small sections, but for these overhead conductors should be employed. For large installations requiring heavy mains it was necessary to put them underground, and for such installations—say of 100,000 lights—the cost of mains would be very nearly proportional to that of the copper. Mr. Crompton had offered to carry out an accumulator installation at his own estimate, it was true; but then he would not be allowed by the Board of Trade regulations to carry it out. On the other hand, the transformer system was allowed, and the speaker knew plenty of contractors who would be very pleased to carry it out on the alternating system at Mr. Crompton's estimate of £57,000.

Professor Forbes, at the request of Mr. Preece, next gave a short account of his experience of the transformer system in America, and stated that he had been specially impressed by the small number of men attending on the stations. As an example, he stated that at Denver, where coal was the fuel used, the staff for a 7000-light installation consisted of one manager at $150 a month, one secretary at $80, one office boy, two dynamo attendants at $70, two engine attendants, five firemen, two line inspectors, and one man for repairs. At Pittsburgh and Alleghany natural gas was used instead of coal, and the supply was regulated automatically, so that the boilers for a 10,000-light station were looked after by one man only. The Westinghouse engines were in very general use for alternate current lighting. They were not the most economical, but were very suitable; and the Westinghouse governor, which ran in an oil bath, was extremely sensitive. The dynamos differed greatly from the types used in this country. The field magnets consisted of an iron ring, with sixteen poles turned inwards. The armature was formed of thin iron plates bolted together, and wound with sixteen coils separated by wooden laths. The construction of these machines was excellent, both mechanically and electrically, and the heating was much less than would be expected. The power used in exciting was 2 per cent. of the total output. The weight of a 2000-light machine was 18,000lb., and the speed 1000 revolutions. The space taken up by the laths ought really to be occupied by useful material. If iron were put in the cost would be very largely increased, owing to the mechanical difficulties. He had suggested that the laths should be removed and replaced by a separate circuit lagging behind a quarter of a period. This would increase the output by 25 or 30 per cent. He had tested the converters at the Westinghouse Works at Pittsburgh by the same calorimetric method which Professors Ayrton and Perry had recently employed. He found that the 30-light converter, when working at half its maximum load, gave an efficiency of 95 per cent. Only three types of dynamos and five types of converters were constructed at the Westinghouse works; this restriction to a limited number of types enabled the machines to be manufactured on a large scale, and supplied at a much lower cost than would be possible if each machine were constructed to a separate specification, as was the custom in this country. It also had the advantage that if any part of a machine gave way, it could be supplied immediately from the works in answer to a telegraphic order. The switch boards in use at the American central stations were remarkably small and simple in comparison with those in use here for non-transformer systems. Some of the switches and other fittings used by the Westinghouse Company were exhibited.

Mr. J. E. H. Gordon pointed out with reference to the load diagrams exhibited, that while the London diagram showed a maximum demand at 7 p.m., that for Brooklyn was at 5-30, that for Cincinnati at 5-45, and that this exactly corresponded with the difference in the dinner hour in London and in the United States. Mr. Crompton had been put at a disadvantage by his desire to abstain from advertising his own wares. He himself had concluded a contract with Mr. Crompton for the supply and maintenance of Howell accumulators for the installation which he was carrying out at Whitehall. There were to be eight batteries of sixty cells each, and ten spare cells, at a cost of £6. 15s. per cell. The nominal rate of discharge was to be 105 ampères, with a capacity of 525 ampère-hours. At a discharge rate of 200 ampères the capacity was to be 375 ampère-hours. At 105 ampères discharge rate a minimum efficiency of 75 per cent. was guaranteed, 85 per cent. at 75 ampères, and 90 per cent. at 45 ampères. If these conditions were not attained, Mr. Crompton undertook to supply extra batteries at his own cost to bring the capacity and efficiency up to the required standard, by reducing the rate of discharge of each cell. The batteries were to be kept in a condition equal to new at a yearly rate of 12½ per cent. on the original cost.

Mr. Sellon thought that overhead mains will not be allowed in England as they are in the United States.

ELECTROLYTIC BLEACHING.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
		Theory.		Found.							Efficiency.			
——	Copper deposited.	Hydrogen.	Oxygen.	Hydrogen.	Oxygen.	Oxygen retained.	Chlorine=0 retained.	Available chlorine found.	Total chlorine found.	Total chlorine theory.	Available chlorine.	Total chlorine.	Per cent. of total chlorine available.	Time: minutes.
1st period.....	0·3125	110·5	55·2	108·7	7·8	47·4	0·3014	1·085	1·333	0·3500	72·8	89·4	81·4	45
2nd „	0·3760	133·0	66·5	130·9	5·6	60·9	0·3873			0·4211				48
3rd „	0·3170	112·1	56·0	111·4	5·6	50·4	0·3205			0·3550				45
4th „	0·3255	115·1	57·6	117·1	6·8	50·8	0·3231			0·3645				39
Totals.....	1·3310	470·7	235·3	468·1	25·8	209·5	1·3323			1·4906				177

Strength of solution after electrolysis, 3·5 grammes chlorine per litre. Density of current 0·023 A. per square centimetre.

Most of the advocates of the transformer system admitted that distribution by accumulators was the ideal system, and that the other was only a stopgap. Accumulators had been discredited because they can go wrong without its being immediately evident, as in the case of dynamos. This objection would not apply to the system of distribution from local stations, where the accumulators would be under competent care. He considered that the ideal method would be the combination of continuous current transformers and accumulators. During the period of maximum demand the supply would be obtained from both sources; during the period of medium demand, or about half the time, the whole plant would be at work, and the surplus current would be used to charge the accumulators; during the period of minimum demand the supply would be from the accumulators alone.

Mr. B. Drake thought the public preferred the accumulator system, even if they had to pay more for the light. He advocated the same mode of working as the author, viz., running the dynamo continuously through the battery, and using the latter as a source of additional supply during the period of maximum demand, and also to guard against a breakdown of the machinery. The lighting during the day to be from the batteries only.

Mr. F. King thought Mr. Crompton might have used a higher pressure for charging. At Colchester they had used 1250 volts for two and a half years without a breakdown, and when the cables were taken up they were as perfect as when laid down, the good condition being due to their having been cased in lead. The speaker proposed to use a current of 2750 volts for charging. Mr. Crompton proposed only four subsidiary stations, and therefore the pressure would vary considerably; to avoid this, ten subsidiary stations would be necessary. He advocated the use of a complete storage system, as he did not think reliance could be placed on the continuous running of any dynamo, and he thought that accumulators could be constructed which could not be run down by any internal action. If the peroxide plate only lasted for three years, the accumulators could be maintained at a rate of 10 per cent. Storage batteries should never be charged in parallel, as very small differences in the counter electromotive force would produce large differences in the charging. He had made batteries which gave an output at the rate of 150 watts for seven hours, with a fall of only 4 per cent. in the pressure.

Mr. Stewart Russell thought that most of the failures in underground electric lighting cables, especially a few years back, arose from the use of inferior cables with light insulation, and with no mechanical protection. He gave instances of American cables laid underground for arc lighting from Thomson-Houston machines, which subjected them to a much greater strain than the A.T. system. Among other instances of successful underground cables he mentioned cables at Milan carrying a continuous current at 1500 volts, or an alternating current at 2000 volts; and a cable at Brussels, five miles long, carrying a continuous current at 1400 volts. At Silvertown, cables for arc lighting had now been underground for five years without requiring any repairs, and the two cables supplying fourteen or fifteen lamps had been laid side by side in the same trench.

Mr. Fleetwood observed that it would be quite impossible to put culverts such as Mr. Crompton described under most of the London streets, as the space was already so fully occupied that it was often impossible even to find room for 3in. pipes. He considered the use of iron pipes to be the best means of protecting permanent underground cables.

Production of Silver in Germany.—A report just issued on the present situation of the mining and blast furnace industries of the Cologne district, directs attention to the increase of the silver production of Germany since the year 1880. In that year the production amounted to 406,267lb., from which quantity it has gradually increased to 717,845lb. in 1887. The increase has chiefly taken place in the Cologne district.

ELECTROLYTIC BLEACHING.

At a recent meeting of the Society of Chemical Industry, a paper by Messrs. C. F. Cross and E. J. Bevan was read, upon the Hermite electrolytic bleaching process. The authors said that at the Liverpool section of the Society Dr. Hurter had severely criticised their first memoir on the subject, and spoken of it as unworthy of serious notice, because the results claimed to have been obtained were contrary to known chemical laws, for "if bleaching were oxidation" such results were impossible. They, however, responded that bleaching is not oxidation in the limited sense meant by him, and is not comparable with the conversion of FeO into Fe_2O_3. Certain conditions may modify the bleaching of cellulose: for instance, a solution prepared by passing chlorine into milk of lime has a totally different bleaching effect from a solution of bleaching powder of identically the same strength. In the experiments they had recently made, electricity was passed through a copper plate voltameter containing slightly acidulated copper sulphate, and then through a cell containing a 2½ per cent. solution of magnesium chloride. The plates were of such a size that the copper deposited was bright and coherent, and the voltameter was proved to accurately measure the electricity passing. The gases obtained from the chloride were collected in the nitrometer and analysed, and the total amount of oxidising chlorine determined with the results given in the above table, obtained from a typical experiment comparable with many others. The electrolysis was conducted in four stages, the gases were analysed each time, but the solution was analysed only at the end of the fourth period.

Platinum electrodes were used in the decomposition cell. They thought it might be worth while to thus compare Dr. Hurter's results with their own, and analysis of the solution proved that no perchlorate was present:—

Strength of Solution grms. Chlorine per litre.	Current Efficiency. Available.	Total.	Percentage of Total Chlorine available.
Dr. Hurter..... 3·19	... 21·8	... 47·5	... 45·9
Cross & Bevan 3·50	... 72·8	... 89·4	... 81·4

By using a stronger solution of chloride of magnesium greater current efficiency is obtained; but, for certain economical reasons having reference to the amount of $MgCl_2$ that would have to be wasted, a weaker solution than 14 per cent. of the crystallised salt is preferred, notwithstanding the lesser yield. In view of Dr. Hurter's assertion that potassium chlorate is converted into potassium perchlorate by electrolysis, they had tried it experimentally, and obtained no perchlorate at all. They found that the obtaining of it is simply a question of current density, governed by the size of the electrodes relatively to the current passing. An exhaustive series of trials had been made at Belfast as to the relative efficiency of the Hermite and the bleaching powder process, resulting as 4s. 8d. for the Hermite process, against 14s. 4d. for bleaching powder; the time by the Hermite process was 15min., as against 47min. when bleaching powder was used. They had made a careless mistake in their previous paper in saying that hydrogen peroxide was present. Dr. Hurter had not stirred his solution as the Hermite process demanded, and that had made a large difference in the bleaching efficiency indicated by his results. In conclusion, Mr. Cross mentioned that the process had been started in an American paper mill in January, and those using it now said that all the promises made about it had been fulfilled. In this statement the author was corroborated by Mr. Christie, who said that a friend of his, who was working the process on a large scale in America, was entirely satisfied.

Professor Dewar had no doubt that it was one of those cases explicable by the difficulties of electrolytic methods, although contrary to Dr. Hurter's knowledge and antecedent views. Messrs. Cross and Bevan had now established their position, in his opinion.

M. Hermite said that the process would bleach some valuable classes of fibre which other methods destroyed,

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and that one firm of paper makers was bleaching 4½ tons of pulp per day with an excessively weak solution of chloride of magnesium; the results could not be accounted for on a theory of the bleaching efficiency of hypochlorite of magnesium. The bleaching compound is used in its nascent state, and an old solution does not work so efficiently. Dr. Hurter must have been using solutions at nearly the boiling temperature.

THE MANUFACTURE OF CHLORINE.

At the last meeting of the Society of Chemical Industry, Mr. C. T. Kingzett read a paper on the manufacture of chlorine, in which he described experiments made by him to ascertain if the Leblanc soda makers could utilise their spare hydrochloric acid by means of a permanent quantity of magnesia to be alternately converted into chloride by hydrochloric acid, and decomposition of the product by air at a high temperature, indefinitely, or by means of a nominal amount of magnesia to effect the interaction of air and hydrochloric acid vapour. In his first experiment he slowly passed dry air and dry hydrochloric acid gas for one hour through a red hot combustion tube containing a small quantity of magnesia and much asbestos, and obtained a certain amount of chlorine. Next he passed dry hydrochloric acid gas and common air through a combustion tube at a bright red heat, containing asbestos only, and obtained a smaller proportion of chlorine than before. In another experiment, he passed dry air for five hours over dry chloride of magnesium at a bright red heat, and obtained chlorine. In his fourth experiment, air was sent through fuming commercial hydrochloric acid, and afterwards for six hours over red hot pumice stone impregnated with a small quantity of magnesia, chlorine being obtained; and $MgCl_2$ being then present in the tube containing the pumice stone. He thought, therefore, that not alone chlorine but bleaching powder was economically made by the process. He mentioned that Henry Larkin and William White had, in 1870, received provisional protection for obtaining chlorine by the reaction of oxygen upon certain metallic chlorides at a high temperature. Mr. Ludwig Mond said that the paper did not go sufficiently into detail as to temperatures, and the proportions of oxygen and hydrochloric acid, consequently the value of the suggestions in it could not be estimated; the method had all the disadvantages of Deacon's process, whatever advantages it might have. Professor Dewar, president of the Society, did not doubt the results obtained in the few laboratory experiments described; but they could not be brought forward as novelties in advance of the Weldon-Pechiney process, which is now proving very useful in the manufacture of chlorates. That process depended largely upon good chemical engineering, and Mr. Kingzett should work with quantities of a ton at a time.

Notes.

JAPANESE IMPORTS.

A Foreign Office report on the exports and imports of Japan in 1887 gives the total value of the foreign trade at £17,500,000, an increase of £3,000,000. About three-fourths of this increase is in the imports. Cotton yarn was imported to the value of over £1,500,000, an advance of over £400,000 on the previous year. Brown sugar was taken to the amount of £470,000, an advance of over £90,000; but there was a falling off in refined sugar. Over 28,000,000 yards of grey shirtings and other cotton fabrics were imported, as against 20,000,000 yards in 1886, the increase in value being about £60,000.

PROGRESS AT THE FORTH BRIDGE.

The advent of spring has given a very notable impetus to the erection of the Forth Bridge, and the work of the last few weeks has been marked by important progress all over the structure. On the Fife cantilever the south bottom members now project over the estuary a distance of 280ft., and the north members are almost equally advanced. Tie I. is completed on both the north and south ends, and the internal viaduct is carried over the trestle at the end of Bay I. into Bay II. The top members are within 30ft. of the end of Bay I., and the first struts are built almost to their permanent junctions with them, while the second struts now extend 40ft. beyond their junctions with the bottom members. The positions of the Queensferry pier and cantilevers are almost the same as those of Fife, while the central ones at Inchgarvie are now only about ten weeks behind the others. Comparison between the progress reports for March and April strikingly illustrate the influence of the weather on the erection of the bridge. In March, when the work was very seriously retarded by this cause, the weight of steel placed in permanent position was 650 tons, while during April, the first three weeks of which have been most favourable to the work, and only the last unfavourable, the weight of steel erected has been 1700 tons. If the mild weather had continued during the last week the monthly return would have exceeded 2000 tons. This rate of progress is highly satisfactory to the engineers and contractors.

THE AUSTRALIAN RABBIT PEST.

At a recent meeting of the Académie des Sciences, in Paris, a sealed packet, deposited by M. Boné on 12th January of this year, was opened, containing a description of a method for dealing with the rabbit pest in Australia. The author suggests that a poisonous or asphyxiating gas should be introduced into the burrows in those districts which are infested with this vermin. Carbonic oxide, vapour of carbon bisulphide, and carbonic acid gas are proposed as those which would be the most effectual and cheapest to apply. Details of the proposed method and the means to be employed for simultaneously using this process of destruction over a large area have not yet been disclosed, but the author is confident that it would be found more economical than that suggested by M. Pasteur, or the present methods of extermination adopted by the Australian Government.

TECHNICAL EDUCATION IN INDIA.

Mr. Alfred Chatterton, B.Sc., has been appointed professor of engineering to the college at Madras. The selection was entrusted to a committee, appointed by the Secretary of State for India, which consisted of Sir Alexander Taylor, principal of Cooper's Hill College, Professor Unwin, of the City and Guilds of London College, South Kensington, and Sir Philip Magnus, secretary and director of the City and Guilds of London. The committee recommended two gentlemen, and of these Mr. Chatterton was selected. Mr. Chatterton received his preliminary education at St. Mary's College, Peckham; he subsequently studied at Finsbury Technical College, where, amongst other distinctions, he gained the Cloth Workers' exhibition and numerous medals. Mr. Chatterton's practical knowledge has been obtained at the locomotive works of the London and South-Western Railway at Nine Elms, where he has also been engaged in teaching the apprentices' evening science classes.

SHIPBUILDING IN GERMANY.

It is interesting to note that the output from the Vulcan Ship Yard, at Stettin, for the current year promises to be very large. In addition to being actively employed with repairing work on several ships, the company have in course of construction two large twin screw steamers, 460ft. in length, for the Hamburg and Bremen Lloyd's; two large paddle steamers; and two twin screw passenger steamers of about 270ft. in length. Altogether, there are upwards of 5000 men employed in this establishment at present. At Kiel, the various departments in connection with the Germania Schiffswerft are pretty busy. The firm has a fair amount of work in hand, and prospects are anything but cloudy. The torpedo boats already launched are being vigorously pushed forward towards completion, and the work in connection with the cruiser recently booked is well advanced The cruiser "Prince Wilhelm," which is supplied with triple expansion engines of 8000 i.h.p., will be ready for her preliminary trials on the measured mile in a few days, when it is expected that the stipulated speed will be exceeded.

THE WAR OFFICE AND METROPOLITAN HORSE OWNERS.

The *Times* states that the War Office have issued a circular inviting owners of twenty horses and upwards within the metropolitan area to register such a number of horses as they would be prepared to sell to the Government on the occasion of a great national emergency. Ten shillings per horse registered will be paid annually as retaining fee. Only serviceable horses of from five to ten years of age, and from 15 hands to 16 hands 2in. high, will be registered. Officers appointed by the Secretary of State will inspect the class of horse owners propose to register, on their premises, at least once a year, after which the final agreement will be made as to prices with the proprietors. The Government are prepared to agree to pay in case of taking the animals a price which would represent: (*a*) What it would cost to replace them; (*b*) the estimated loss which might accrue pending their being replaced. As it is evident that the amount of (*a*) and (*b*) above would vary in proportion to the number of horses required by the Government, the prices to be agreed upon should, it is considered, be based on a sliding scale. The following particulars should be given by owners of horses: (1) The number of horses of the description defined they are prepared to hold at the disposal of the Government in the event of their being required under an emergency; (2) the price per horse they consider should be given by the Government in the event of their horses being impressed—(*a*) if a quarter of the registered number be taken; (*b*) if one-half be taken; (*c*) if three-quarters be taken; (*d*) if the whole be taken. Varying rates can be named where owners have more than one class in possession. Forms of application can be obtained from Major-General F. G. Ravenhill, Inspector-General, Remounts, 69, Spring Gardens, S.W.

JAPANESE RAILWAYS.

The first railway constructed in Japan, which connects Tokio and Yokohama, was opened in June, 1872, and is the only double line of railway in the country. There are now open 245 miles of Government lines, 254 miles are in progress, and 52 miles more are in contemplation. There is also a line of 56½ miles in the island of Yezo. The Japan Railway Company, on whose paid up capital the Government guarantees 8 per cent. interest, has 289 miles of line open, and contemplates a new railway from Sendai to Awomori, a distance of 240 miles. The construction of a number of private railways has also been sanctioned by the Government.

NEEDLES IN CHINA.

The Chinese Commissioner of Customs at Wênchow reports that foreign needles find no market there, but samples of the native article have been sent through the Foreign Office to the Needle Manufacturers' Association, Redditch. The price is 5 cents or say 2d. per hundred. It is the only kind, as to make and size, fit for silk embroidery. The importance of the market may be measured by the fact that every well-to-do woman embroiders her own shoes (of which each pair lasts at the most two months), and her own head gear, besides fans, screens, and the like. The smallest foreign needles hitherto imported at Wênchow have been No. 12 "betweens," at a price of 9 or 10 cents per hundred, wholesale, and these are considered to be only fit for tailor work.

PRICE OF WHEAT.

In view of the present low price of wheat, the opinion expressed by Mr. Edward Atkinson, the well known American economist, in a recent letter to the editor of *Bradstreet's*, deserves attention. Mr. Atkinson not only re-affirms his position that the American farmer can sell wheat at London at 34s. per quarter with as much profit as when wheat sold at 50s., but after re-examination of the subject, concludes that America can compete as favourably to-day with wheat at 28s. as fifteen years ago at 30s. This is not a very encouraging prospect for either the British farmer or landlord. In connection with this subject it may be interesting to note that the fall of prices of ocean transit from New York to Liverpool has been as follows:—

	1880.		1886.
Grain, per bushel	9½d.		1d.
Flour, per ton	25s.		7s. 6d.
Cheese	50s.		15s.
Cotton, per pound	⅝d.		5/16d.
Bacon and lard, per ton	45s.		7s. 6d.

BULL'S METAL.

We have this week seen samples and test pieces made from a new alloy containing copper, zinc, and some other metals, which at present are the secret of the inventor, Mr. John Bull, of 18, Adolphus Road, Finsbury Park. The metal is at present prepared in two varieties. One is a soft variety which is more adapted for cold working, and which has a tensile resistance of slightly over 30 tons; the other is a strong variety, with a tensile resistance of nearly 35 tons; but this alloy is not so well adapted for cold working. Both varieties can, however, be forged and stamped at a dull red heat, the same as wrought iron. In the diagrams which have been prepared from tests made by Messrs. J. Buckton & Co., of Leeds, and which we have had an opportunity of inspecting, the strong metal exhibits a very peculiar property. Shortly after the elastic limit has been passed, which happens with a load of 24 tons, there is a sudden drop in the curve; but on further straining the metal it seems to recover itself, and there is as sudden a rise, so that finally the curve passes on as if this period of unstable equilibrium had not existed. Certain qualities of mild steel exhibit a similar property; but we have never seen it so marked as in this metal. At the tests referred to, the hot rolled sample bar of the strong metal broke at 34·76 tons, with an elongation of 19·3 per cent.; whilst the soft metal showed 30·46 tons tensile resistance, with an elongation of 30 per cent. We have seen test pieces of Bull's metal made from a round bar at a dark red heat, which in finish leave nothing to be desired. The inventor states that the metal can be cast like gun metal, in dry moulds. The chief precautions to be observed are to use a large head, stir up and skim well, and pour quickly.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

20th April, 1888.

5872. Theermann, W. P. ..... Gas engines.
5880. Kelso & Hill ..... Indicating and recording speed of engines.
5882. Stanley & Vicarman... Automatic letting off and taking up motion for looms.
5883. Merrall, E. R..... Machinery for twisting or doubling yarns or threads.
5887. Poyser, J..... Sewing machines.
5890. Hawkins, F. P..... Steam engines.
5892. Müller, F. W..... Sewing machines.
5896. Mouradian, M..... Apparatus for drawing a thread from woven cloth for the purpose of testing it.
5911. Smith, M. H..... Railway rolling stock and arrangement of switches.
5914. Lake, H. H. ..... Hydrocarbon engines (*Spiel*).
5915. Pitt, W. A..... Steam engines.
5919. Cotton, J..... Steam boilers.
5927. Preston & Cornish ..... Apparatus for establishing communication with pipes containing fluid under pressure.

21st April, 1888.

5929. Eddington & Steevenson ..... Brick moulding machines.
5930. Merrall, E. R..... Faller operating mechanisms of gill boxes used in the preparation of wool.
5939. Elliott, G. W..... Grinding and pulping machines.
5940. Dack & Barlow ..... Transferring vessels from one canal to another.
5941. Hetherington, J. M.... Carding engines.
5942. Butterfield, F. ..... Wheel and rack cutting and dividing machines.
5945. Hill & Hill..... Cold iron sawing machine.
5948. Scott, W. ..... Rolling machines for stripping cloth off cropping machines.
5954. Crawford, M. ..... Machines for removing the lint from cotton seed.
5956. Newman, T. W. ..... Machinery for drying at a high temperature.
5957. Cook & Buchanan ..... Manufacture of paper boxes.
5958. Parker, H. ..... Manufacture of paper.
5960. Stubbs & Heaton ..... Reeling yarns.
5961. Skinner, G. J. C. d'U... Slide valves.
5963. Schoder, E. ..... Production of metal paper.
5965. Delhaye, H..... Apparatus for elevating grain.
5966. Barraclough, T. C. ... Machinery for dressing ramie (*De Landtsheer*).
5972. Rayner, T. J. ..... Steam generation for distilling purposes.
5973. Simpson, W. S..... Fire arms and ordnance.
5980. Gibbs, W. A..... For the production of hot air for drying.
5982. Fricker, G. C..... Cleaning the surfaces of metallic bodies.

23rd April, 1888.

5989. Buxton, J. H., & others Newspaper printing machinery.
5997. Turner, C. ..... Loose reed looms.
5998. McCallum & MacCllum Hand printing presses.
5999. Kirk & Lee ..... Apparatus for finishing woven fabrics.
6028. Malvez, M. ..... Polishing and grinding plateglass.
6031. O'Neill & O'Neill..... Compressed air engines.
6032. Hallatt, B. ..... Twist lace machines.
6034. Mayos, T. T..... Apparatus for compressing hay.
6036. Gaze, E. H. ..... Gas engines.
6040. Poyser, J. ..... Sewing machines.

24th April, 1888.

6054. Emmens, S. H. ..... Ordnance and small arms.
6058. Robinson, C. H. ..... Tube expanders.
6060. Marjerison, J..... Spinning or twisting machinery.
6061. Dewees, J. W. ..... Sewing machines.
6065. Taylor, E. ..... Steam engines.
6066. Farrer, J. W., & others. Signal apparatus for tramways.
6069. Vickerman, J. ..... Sizing, warping, and beaming machines.
6071. Serjent, G. E..... Bearings for machinery.
6074. Whitwam, H. ..... Looms.
6078. Pullan & Spence ..... Type writing machines.
6080. Larsen J. D. ..... Tramways and railways.
6081. Burdon, L. L. ..... Manufacture of compound ingots
6083. Burdon, L. L. ..... Straightening metallic tubes.
6084. Whitney, A..... Machine for milling twist drills.
6088. Thompson, W. P..... Gas engines (*Durand*).
6094. Bryce-Douglas, A. D... Marine boilers.
6095. Russell, J. ..... Portable ramps for railways.
6096. Brisay, J. D..... Valve gear.
6097. Lake, H. H. ..... Apparatus for facilitating the repair of ships' propellers (*Kirkham*).
6098. Fletcher, G. ..... Sugar cane mills.
6101. Lindheimer, F. O. ..... Crushing and grinding mills.
6106. Austin, H. K. ..... Axle boxes and bearings.
6108. Wells & Pickburn..... Hot air motors.
6109. Wells, C. ..... Obtaining power from the heat contained in waste steam.

25th April, 1888.

6118. Bellhouse, E. L..... Hydraulic packing apparatus.
6124. Smith, W. ..... Machines for agitating substances.
6128. Thompson, W. P..... Fluid pressure motors (*Lemonon*).
6147. Hodgkinson, J., and others ..... Mules.
6153. Armstrong, J..... Apparatus for blowing & moulding glass.
6154. Schenkenwald and Osborn..... Manufacture of paper.
6156. Jagger & Priestman... Manufacture of cloth.
6159. Vismes, Count A. V. de Drilling machine.
6163. Daniels, F. H..... Reeling apparatus for rolling mills.

26th April, 1888.

6165. Jardine, J. ..... Carriages employed in lace machines (*Sival*).
6166. Gaunt & Stansfield ... Looms.
6168. Simpson, H. C. ..... Water wheels and paddle wheels.
6179. Linkleter & Linkleter Deck seats self convertible into lifeboats.
6181. Hollingworth, E..... Shedding and taking up motions of looms (*Hutchins*).
6187. Hacking, W. H..... Drop box looms.
6201. Comings, W. R..... Machinery for cutting blanks (*Knowlton*).
6203. Margetson & Hek..... Waggons and vans.
6208. Reynolds, C. L., and others ..... Sewing machines.
6209. Cowburn & Peck..... Looms.
6210. Hovell-Thurlow-Cumming-Bruce, T. J. ... Fire engines.
6211. Witthoffft, L. ..... Circular saws.
6219. Goodwin, A..... Hydraulic meter or motor.
6224. Ford, T. P. ..... Valve operating apparatus for hydraulic lifts.

ELECTRICITY.

20th April, 1888.

5870. Rauschke, R..... Electric batteries.
5898-99-900. Chadburn, W... Telegraph apparatus for communicating between one part of a navigable vessel and another.
5913. Heaviside, A. W..... Electric telegraph, telephone, and electric light insulators.
5922. Stuart, G..... Joining electric conductors.

21st April, 1888.

5937. Collingridge, A..... Galvanic salts.

23rd April, 1888.

6046. Fischer-Treuenfeld, R. von..... Coupling for electrical conductors

24th April, 1888.

6075. Ries, E. E. ..... Heating by means of electricity.
6076. Gross, A. ..... Electrical appliances for a mariner's compass to give alarm upon deviation from the ship's course.
6093. Jacob, F. ..... "Morse inker" apparatus for telegraphic purposes.
6100. Todman, J. T. ..... Locking electrical indicator.

25th April, 1888.

6133. Boardman & Teague ... Electric arc lamps.
6157. Keen, R. E. ..... Electric arc lamps.

26th April, 1888.

6184. Ruddle, M. ..... Telephones.
6191. Schroeder, C. A. J. H. Carbons for electric lighting.
6214. Farquhar, C. W..... Laying underground electric conductors.

CHEMISTRY.

20th April, 1888.

5909. Abel, C. D..... Blue colouring matters (*Actien Gesellschaft für Anilin Fabrikation of Berlin*).
5910. Abel, C. D..... Azo colouring matters (*Actien Gesellschaft für Anilin Fabrikation of Berlin*).

21st April, 1888.

5949. Kuhnt & Deissler..... Explosive compounds.
5953. Daudenart, L. G. G. ... Extracting magnesia from sea water.
5971. Haddan, H. J. ..... Extraction of oil by the naphtha process (*Evans*).
5981. Saunders, T. S. ..... Soap.
5985. Lewkowitsch, J..... Obtaining fatty acids and glycerine from fats and oils.

23rd April, 1888.

6026. Hucks, W..... Treatment of brewers' worts.

24th April, 1888.

6102. Jensen, P..... Extracting metals from ores (*Russell*).
6104. Weirich, J. ..... Treating auriferous ores.

25th April, 1888.

6151. Chatfield, R. E..... Ammonia carbonate.
6152. Chatfield, R. E..... Manufacture of ammonia and its sesquicarbonate.

26th April, 1888.

6175. Parnell & Simpson ... Production of sulphur from sulphuretted hydrogen.

MISCELLANEOUS.

20th April, 1888.

5865. Gye, P..... Landing nets for fishing.
5866. Payne, S. J..... Powder for cleaning and polishing plate.
5875. Cochrane, J. G..... Sectional revolving brush.
5876. Hugel, J. ..... Tools for preparing dowel and tenon sockets.
5877. Oates, W. ..... Apparatus for forming gullies and traps.
5881. McAra, A..... Cement.
5886. Morawetz, G. V..... Lamp chimneys.
5889. Travers, W..... Pedals for velocipedes.
5893. Paris, R. J. ..... Composition for protecting ships' bottoms.
5902. Fairfax, J. S. ..... Velocipedes.
5903. Nicol, A. ..... Handles for writing instruments.
5905. Lawrie, T..... Protections for cellar openings.
5908. Hill & Mayfield..... Drying apparatus for developing aniline dyes.
5912. Smith, W..... Filling paraffin lamps.
5917. Spence & Spence..... Fire resisting materials.
5921. Kreysler & Mohr..... Ornamentation of glass and ceramic ware.
5923. Austin, H. K. ..... Lubricating axles.
5924. Burton, E..... Apparatus for screening.
5928. Winterros, C. E..... Driving belts.

21st April, 1888.

5934. Roberts & Elliott ..... Coke forks.
5935. Benson, W. A. S., and others..... Artificial lighting.
5944. Whitehead & Ball ..... Holders for gas burners.
5946. Skinner, C. E. ..... Velocipede pedals.
5950. Rawlings & Rawlings. Blow pipe apparatus.
5951. Wigzell & Pollit ..... Trip gear for valves.
5962. Charles & Wells ..... Safety lamps.
5969. Barfoot, H. ..... Chimney pots.
5970. Burrow, W. B., & others Apparatus for bottling liquids.
5976. Utter, H..... Barbed fencing.
5977. Vavasour, Sir W. ..... Valves.
5984. Player, J. E. ..... Railway lamps.

23rd April, 1888.

5990. Sainty, J. ..... Fencing.
5993. Hoop, J. F. H. van der. A secret lock.
5994. Lindon, H. ..... Hoop fastenings.
6005. Tanner & Howe..... Taps and cocks.
6007. Coulson & Mulholland Lubricating journals.
6010. Sutcliffe, R. ..... Hinge.
6012. Wailes & Dove ..... Preservation of metal structures from corrosion.
6015. Fehlen, A..... Apparatus for warming rooms.
6016. Lee, W. ..... Manufacture of ears for buckets.
6019. Thornelor, J..... Fire lighters.
6020. Grandjean, E. F. L. ... Watches.
6022. Bickle, J. ..... Metallic packings for pistons.
6029. Gross, H. ..... Dyeing cotton.
6030. Harvey, R. ..... Eliminators for saccharine liquids (*Cornish*).
6035. Woodward & Foster... Utilising scrap leather.
6039. Dando, I. T. ..... Ventilators.
6044. Johnson, J. Y..... Oil lamps (*Upton*).
6045. Gooch, W. D., & others. Lamps.
6047. Imray, O. ..... Heating liquids (*Aries*).
6050. Davies, A..... Automatic ball and nut lock.

24th April, 1888.

6051. Welsh, S. ..... Destroying sewer gas.
6053. Schumann, C. B. ..... Extension ladder and hose carriage.
6062. Buckley, W..... Metallic packings.
6070. Schott, G. A. J. ..... Purifying sewage (*Lortzing*).
6072. Neilson, A., & others... Gas lamps.
6073. Turner, W. ..... Joining driving straps.
6077. Wallwork, R..... Instrument for screwing and unscrewing pipes.
6087. Wild, A. J. T. ..... Manufacture of bottles.
6089. Butzke, F..... Regenerative gas lamps.
6090. Shaw, H. ..... Cisterns.
6092. Thompson, G. H..... Fire escapes.
6099. Paling, F..... Securing corks in bottles for containing aerated liquids.
6103. Brothers, C. ..... Ventilator.
6105. Chinnock, A. S., & ors. Preparing china clay.
6107. McEvoy, C. A. ..... Ammunition.

25th April, 1888.

6112. Taylor, G. B. ..... Key stopper bottle.
6114. Kemp, J. R., & others... Shuttle boxes.
6115. Tye & Ancil..... Slides of gasaliers.
6121. Turner, T. H..... Wire grain screens.
6123. Helliwell, R. B. ..... Fire lighters.
6125. Boulay, D. de la M. du. Horseshoes.
6126. Kilner, T. ..... Forming glass bottle necks.
6127. Merryweather and Jakeman ..... Pipe connections.
6129. Hart, A. ..... Oil lamps.
6132. Minto & Smith ..... Ports for the discharge of water from ships' decks.
6134. James, S. H..... Sounding apparatus.
6135. Mitchell, W. ..... Ladders and fire escapes.
6136. Woolley, T..... Coating the bottom of iron ships.
6143. Davies, E. A. ..... Galvanised cisterns.
6144. Sharples, T., & others. Stoppering bottles.
6146. Delton, A. ..... Valves.
6148. Hughes, G. ..... Rapid engraving with immediate stereotyping (*Motteroz*).
6150. Heenan, R. H..... Stirring and mixing substances.
6160. Hall & Hall ..... Fire extincteurs.

26th April, 1888.

6169. Hoblyn, W. P..... Smoke consuming arrangement.
6171. Lawton, J. E. ..... Lubricator.
6172. Kirk, A. S. ..... Metallic fence.
6174. Hughes, T. ..... Sliding gas chandeliers.

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6183. Burgess, J. T. M. ..... Taps.
6185. Rochester & Dejean... Horseshoes.
6186. Blakeney, W. H..... Pneumatic carrying apparatus.
6188. Fourness, W. A. ..... Regenerative gas lamps.
6189. Jones, W. ..... Gas light reflectors.
6193. Brooks, H. ..... Bottle stoppers.
6196. Royle, J. J ..... Connecting hose pipes to water fittings.
6197. Mayall, E. ..... Filling cartridges.
6199. Brown, R. ..... Securing covers of ships' hatches.
6202. Jenkins, T. ..... Revolving gas lights.
6205. Barkley, W. M. ..... Stop for gates.
6206. Palmer, C. A. E. T..... Velocipedes.
6207. Arnold, G. E. ..... Pipe joints.
6212. Tellier, C. ..... Producing cold by means of waste heat.
6213. Engert, A. C. ..... Reflectors.
6215. Lawton & Blackman... Packing cases.
6222. Palmer, W. ..... Eaves gutters.
6225. Pullin, A. R. ..... Signals.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

28th April, 1888.

5957. Greth, J. ..... Colour printing.
6143. Beckwith, H. J. F. ..... Sight feed lubricators.
6389. Martin & Martin ..... Selecting and punching patterns in jacquard cards.
7036. Trier, F. ..... Stone working machines.
7080. Helliwell & Helliwell ..... Manufacture of loom pickers.
7211. Capewell, G. J. ..... Nail making machines.
7249. Wise, W. L. ..... Stopping and starting vehicles (*Nordmann*).
7417. Wilke & Schott..... Cut pile fabrics.
7437. Bischoff, J. G. G. E.... Lubricators.
7513. Tschieret, T. ..... Felting woollen yarn.
7886. Barthel, A. E..... Gasometers.
8043. Davis, E..... Machines for making screws (*Heyne & Heyne*).
8048. Penning, G. A. de ..... Rotary steam engine.
8057. McCulloch, J. McG. ... Link motion for steam engines.
8104. Lightowler, E. ..... Retaining tidal waters.
8178. Tremsal & Dicktus..... Apparatus for scouring wool.
8256. Craig & Craig..... Cropping machines for clipping the loose fibres off the surfaces of linen woven fabrics.
8258. Billeter, H..... Automatic lubricators.
8317. Nordenfelt, T. ..... Breech loading guns.
8347. Patrick & Hunter..... Bending and straightening iron or steel plates.
8355. Picking & Hopkins..... Direct acting steam pumps.
8361. Belcher, H..... Machine for pressing bricks.
8375. Stanley, R. ..... Tunnelling machines.
8416. Babbage, H. P..... Type writer.
8418. Fisk, T..... Pillar pumps.
8466. Wastfield, E. G..... Low pressure or vacuum motors.
8545. Pooley & Chater ..... Weight printing steelyards.
8657. Wilson, J. M. ..... Apparatus for planing wood.
8721. Ambler & Blackburn. Machinery for washing wool.
8737. Willans & McCulloch Motor for working by steam, gas, water, or compressed air.
8777. Briggs & Eastwood ... Preparation and combing of flax, wool, silk, woollen, or other textile material.
8815. Simpson, J. H., & ors... Manufacture of lint and wood wool.
8891. Price, W. S..... Screw propeller.
8933. Bosshardt, F ..... Reels for bolting, sifting, and dressing flour (*Outrequin*).
8946. Fletcher, H. ..... Capstans.
8964. Jones, W..... Sewing machines.
8974. Gledhill, R. ..... Machines for sizing warps.
8979. Chapman & Masker ... Saddles for supporting fallers in preparing boxes.
8992. Heath, W. E. ..... Laying tramway rails.
9006. Snow, H. W..... Sewing machines (*Kanbery*).
9007. Paton, T. ..... Steering gear for vessels.
9008. Wardlaw, T. ..... Turnip thinning machines.
9029. Riley, W. J..... Leno weaving.
9043. Dick, R..... Manufacture of driving belts.
9053. Timmis, I. A..... Wheels of tramway locomotives.
9087. Matthew, P. M. ..... Manufacture of india-rubber water proof textile fabrics.
9095. Turnbull, A. ..... Boiler feed regulating apparatus.
9102. Dick & McMurtrie ... Compressing fluids.
9111. Haddan, R. ..... Gas engines (*Archat*).
9114. Partridge, E..... Butterfly wings for the flaps of plain solid welded axles.
9121. Oriolle, P. ..... Steam boilers.
9824. Croft & Trenbath..... Permanent way of railways.
9935. Bell, J. R. ..... Grab dredger fittings.
10992. Stead, W. H. ..... Treatment of cotton seed.
11680. Jones, E. ..... Coupling railway carriages.
11700. Montrichard, G. de ... Pump.
12293. Thompson, W. P..... Centrifugal machines for filtering liquids (*Jäger*).
12394. Johnson, S. A..... Steam vessels.
13945. Barrow, J..... Plate bending machines.
14477. Boyd, T. A. ..... Fancy yarns.
16196. Rossiter, T. R. ..... Sewing machine.
2234. Wheatley, W. H. ..... Car axle lubricators (*Faas*).
2418. Williams, H. A. ..... Rolling metal rods.
2716. Hipkins, H. ..... Sleepers.
3153. Binns, L. ..... Cap spinning and twisting frames.
3175. Sallandrouze, T., and others ..... Looms for weaving figured pile carpets.
3216. Oldroyd, J. W. ..... Steam boilers.
3287. Fairclough, G. ..... Lubricator.
3452. Catchpole, A. ..... Generating steam.
3813. Sudheim, S. ..... Side couplings for railway rolling stock.
3839. Jacobs, J. ..... Railway sleepers.
3863. Hannay & Doxford..... Burning liquid fuel in steam boiler furnaces.
3910. Hoopes, C. R. ..... Liquid fuel in steam boiler furnaces.
3972. Bellotti, S. ..... Grinding & polishing machines.
4259. Hawley, C. P. ..... Permanent way of railways.
4305. Mugnier, J. ..... Ornamentation of open work fabrics.
4363. Thien, K. ..... Preparing moulds for the casting of pipes.
4364. Haddan, H. J. ..... Safety raft (*Millet*).
4464. Fear, E. J. C. ..... Ships' anchors (*Munn*).
4480. Linnenbrügge, A. W. F. G. ..... Propelling and steering ships.
4596. Besserer, G. L. von .... Preventing oscillation on board ship.
4681. Eames, H. H..... Machinery for pulverising ore.
4707. Lake, H. H. ..... Apparatus for generating steam for utilising the heat of slag from blast furnaces (*Adams*).
4708-9-10. Lake, H. H..... Apparatus for generating steam for utilising the heat of slag from blast furnaces (*Peck*).

ELECTRICITY.

28th April, 1888.

6682. Swinburne, J. ..... Electrical distribution.
6993. Slater & Newman..... Signalling by electricity.
7078. Williams & Powles..... Electrical indicators for showing the rise and fall of gas holders.
7618. Mordey & Webber..... Electric transformers.
7857. Tudor, H..... Registering meter for electric currents.
8068. Bayley, H..... Incandescent electric lamps.
8380. Lineff & Jones ..... Operating tramcars by electricity.
8433. Neale, F. W..... Telephone apparatus.
9011. Jones, E. ..... Electric generators and motors.
14542. Sandwell, W. D..... Electric motors.
14622. Vaughton, E. E. ..... Electric accumulator.
3678. Olpherts, W. G..... Electrical signalling on railways.
4561. Brown, C. A..... Battery jar.

CHEMISTRY.

28th April, 1888.

7426. Henderson, A. C..... Aluminium and alloys (*Héroult*).
8284. Thompson, S. P. ..... Electro-deposition of the heavy metals.
8289. Bramley, W..... Hydrochloric acid.
8427. Thompson & White..... Aluminium and alloys.
8437. Paul, L..... Mono and diamidoazobenzidines.
9543. Bull, H. C., & others ... Sulphate of ammonia.
3949. Justice, P. M. ..... Hydrochlorate of quinine (*Weld*).
4284. Wood, M. R..... Monocarbonate and bicarbonate of soda.

MISCELLANEOUS.

28th April, 1888.

1333. Webster, W..... Decomposing sewage.
5968. Neave, J. H..... Manufacture of hats.
6256. Kneen, W..... Latches for doors.
6349. Cowell, Sir J. C..... Regulating the supply of fluids.
6820. Gwinett, W..... Eaves plate for use with corrugated roof.
7245. Jones, G. H..... Stoppering bottles.
7306. Thomson, D. E..... Machine for mixing dough.
7613. Sepulchre, L. ..... Lighting and heating by mineral oils.
7648. Starley, J. K. ..... Wrenches.
7778. Newcome, H. J..... Fire escape.
7879. Wallis, W. G..... Reels adapted for holding needles.
8149. Kohn, I..... Automatically extinguishing lamps.
8357. Rimmer, H..... Purifying and filtering water, saccharine, and alcoholic fluids.
8756. Harris, J. T..... Taps.
8762. Taylor, E..... Lock.
8787. Mason & Hodkinson ... Union socket.
8810. Wise, W. L. ..... Flooring (*Petersen*).
8849. Bastow, S..... Door cramp.
8942. Shelton & Cutlan..... Manufacture of boots.
9223. Wilson, J. H. ..... Bobbins.
9411. Henley, W. ..... Safety lamps.
9549. Judge, T ..... Bottle stopper.
9976. Wilkes & Wilkes ..... Locks.
10086. Dungey, J. ..... Cup and ball joints for gas fittings.
11569. McIntyre, L..... Ventilating stoke holes.
11937. Homan, J. ..... Fire proof floors.
12572. Pegg, C., & others ..... Air tight valve.
15865. Hogg & Robinson ..... Spindles.
15999. Lake, W. R. ..... Vapour burners (*Ford*).
17480. Porri, L. ..... Wheels.
326. Blanchard, M. H. ..... Terra cotta fire proof construction.
2470. Bulpitt, W. H. ..... Lamps.
2927. Bornstein, H. ..... Wrenches.
2998. Harrison, W. S. ..... Clocks.
3143. Stone, J. H. ..... Hose directors.
3225. Shearme & Morris..... Measuring liquids.
3319. Héroux, J..... Automatic gas extinguisher.
3394. Harrison, W. M..... Hand fire extinguishers.
3469. Lugrin, H. A. ..... Stop watches.
4269. Grundig, C. R., & ors... Spiral dust collector.
5333. Lodge, T. H..... Portland cement.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 21st January, 1888, inclusive.)

Year 1884.

1438, 1439, 1440, 1442, 1444, 1450, 1452, 1453, 1454, 1455, 1456, 1457, 1460, 1461, 1463, 1465, 1466, 1468, 1469, 1470, 1471, 1472, 1476, 1480, 1482, 1484, 1485, 1486, 1487, 1488, 1493, 1496, 1498, 1501, 1502, 1504, 1506, 1512, 1514, 1515, 1516, 1518, 1519, 1520, 1522, 1523, 1524, 1525, 1526, 1527, 1528, 1529, 1530, 1538, 1539, 1543, 1545, 1548, 1550, 1552, 1558, 1560, 1563, 1567, 1571, 1573, 1575, 1578, 1579, 1581, 1582, 1583, 1584, 1585, 1586, 1588, 1591, 1592, 1593, 1595, 1597, 1599, 1600, 1602, 1603, 1604, 1606, 1609, 1612, 1614, 1616, 1620, 1625, 1627, 1630, 1631, 1634, 1635, 1636, 1641, 1642, 1649, 1650, 1652, 1655, 1657, 1661, 1663, 1665, 1667, 1669, 1671, 1675, 1677, 1679, 1682, 1683, 1685, 1686, 1687, 1691, 1692, 1695, 1696, 1699, 1703, 1707, 1709, 1710, 1712, 1713, 1715, 1721, 1722, 1725, 1732, 1737, 1738, 1741, 1743, 1748, 1760, 1763, 1764, 1765, 1767, 1770, 1773, 1775, 1776, 1777, 1779, 1781, 1783, 1784, 1785, 1786, 1789, 1790, 1791, 1795, 1797, 1799, 1800, 1803, 1809, 1810, 1812, 1814, 1816, 1818, 1819, 1821, 1823, 1826, 1827, 1828, 1835, 1842, 1843, 1846, 1852, 1853, 1854, 1856, 1857, 1858.

Year 1883.

223, 315, 329, 335, 347.

Year 1882.

239, 287, 317.

Year 1881.

199, 242, 266, 268.

Year 1880.

263.

Year 1878.

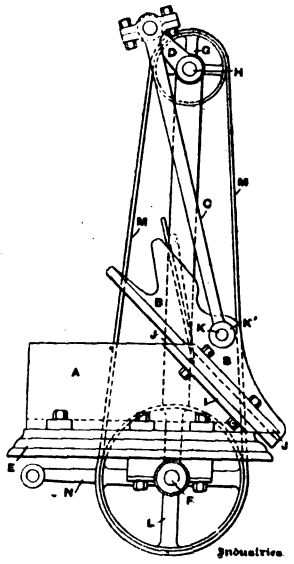
264.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Mitre Planing Machine.—*G. T. Webster, Drypool, Hull.*—The object of this invention is to construct a mitreing machine which shall be simple in its parts. One end of the iron case A is cut at an angle of 45°, and two slides J are bolted to it. The plane B works in these slides, and is centrally pivoted by



the pin K to the connecting rod C. The shafts F and H turn in suitable journals, which are supported by the frame work, and the band M passes round the wheels G and L. On the wheel L being turned by hand or by power, the band M, wheel G, pin D, and connecting rod C transmit the motion to the plane B. The wood is inserted in the case A, and is pressed against the end I; the incline of the mitre which is obtained is constant. Three claims are made for the inclined end, which is provided with guides, and for the employment of the plane to run in these guides, as described.—No. 793. January 18th, 1888. 6*d.*

Hardening Steel.—*R. A. Hadfield, Sheffield.*—The stee article to be tempered is made partially hollow, and a continuous stream of cold water is fed through its interior, when it is placed in position in the furnace. The running water keeps the interior of the steel cool, while the outer portion is heated to any degree, according to the temper required. After being heated, the steel is removed and immersed in the usual bath. Instead of water, the inventor sometimes charges the hollow portion with some metal which has a low melting point, such as lead, and by this means the temperature of the interior can be more perfectly regulated, and injury from expansion prevented. By these two processes, a gradually varying condition from hardness to softness is obtained in the steel. Two claims are made, one for each process.—No. 6173. April 27th, 1887. 6*d.*

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MACHINE FOR DRYING FABRICS.—*G. Tolson, Dewsbury.*—A chamber is mounted upon central trunnions, upon which it is made to rotate or oscillate. The materials to be dried are placed inside the chamber, and a current of hot air is forced in through a tube in one of the trunnions. Valves and dampers are employed to regulate the supply of air. In another form of apparatus the chamber is made stationary, while the fabrics are agitated by a number of oscillating or rotating forks. Two claims are made, one for each form.—No. 6254. April 29th, 1887. 8*d.*

STEAM BOILERS.—*J. P. Bordone, Paris.*—The improved form of boiler described in this invention is illustrated in the two accompanying figures. Fig. 1 represents a longitudinal section of a locomotive boiler, and Fig. 2 a transverse section of a modified form. A is the steam collecting cylinder, and B the feed water heating cylinder; C is the mouth of the furnace, and D D^1 D^2 the furnace bars, counterweight, and lever of the

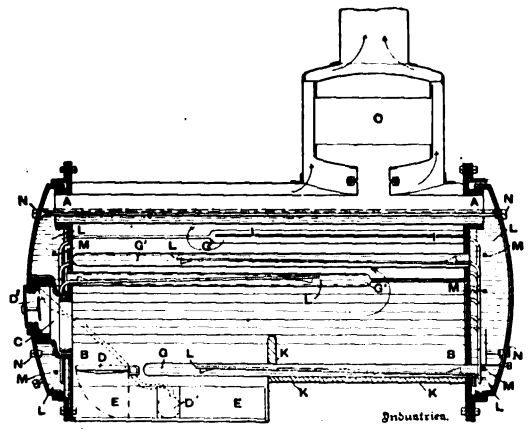


FIG. 1.

fire bars respectively. E is the door of the ash box, G are the grate tubes, G^1 the heating tubes, and I the obstructing bars. L are the small circulating tubes, and M the rods for maintaining the circulating tubes in place. N is a movable plate, and O O^1 are the domes for drying the steam. In Fig. 2 is shown the adjunct P to the chimney, forming a steam drying device. The series of tubes Q form a passage for the water and steam accumulated in the collector, and the tube R returns the water to the lower part of the boiler. The movable sheet metal plate S closes the upper flue round the cylinder which supports the engine T, while the flue serves as a steam dome. The water grate is shown at V, and X are nozzles forming intermediate

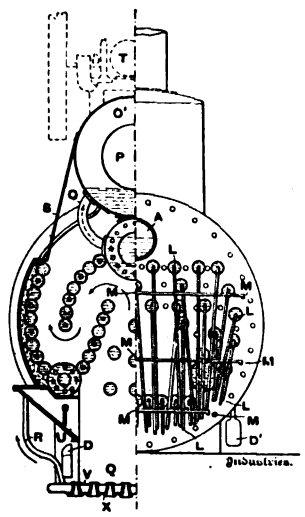


FIG. 2.

stays. The tube A serves as a steam collector, and carries the steam to the dome O. The steam is here superheated by the gases, which pass in the direction of the arrows. The pipes B are arranged symmetrically in the lower part, and serve as heaters for the feed water. The tubes are arranged as shown, and act as baffle plates to cause the most advantageous circulation of the products of combustion. Another advantage of this arrangement is that a rapid circulation is insured between the coldest and hottest parts of the boiler. The feed water is retained in a state of repose in the heating cylinders B, and the water in other parts of the boiler is efficiently circulated, so that all impurities of the water are deposited at once. Five claims are made for these arrangements of the tubes of the boiler.—No. 15326. November 9th, 1887. 8*d.*

BOILER FURNACES.—*J. Lyle, Paisley.*—This invention relates to the application of petroleum as fuel in ordinary boiler furnaces. The ordinary furnace bars are removed, and the charging doors are securely closed; a new close plate is fixed over the entrance to the ash pit, and to it are secured the new fittings which are required by this invention. When compressed air is used for forcing in the oil spray, a small auxiliary engine is employed. The air pipes are led through stuffing glands in the lower central part of air supply boxes which are secured to the closing-in plate; the boxes are also provided near the centre with two cocks and knee branches, which lead into a spray jet burner on each side. A corresponding general oil supply pipe is led along and below the front of the furnaces, and is fitted with vertical branches and screw couplings leading up to the centre of each furnace; a knee and coupling is led through the lower spray furnace plate into a T branch in the inside of the plate and furnace, and the oil is heated during its passage through it. The T tubes are each to be led out at their extreme ends through coupling knee branches on the outside of the plate, and on the opposite side of the spray apparatus, to those of the air branches. These branches are here similarly coupled on the opposite side to the air branches, so that each spray apparatus can be swivelled up on these double sets of couplings, for cleaning their nozzles and orifices. Each spray apparatus consists of an internal central tube, with a conical jet nozzle in front, and with a lateral oil supply branch on the outside. The compressed air is supplied to the burner through an outer annular tube close to the hinder end, and is led forward to a conical nozzle in front of the internal tubular nozzle. Screws regulate the distance apart of the two nozzles. The apparatus is fitted with a short widening-out entrance part of a combustion chamber, projecting a little beyond the nozzles so as to rest on a large checked widening-out main combustion and air supply chamber, with small air inlet ducts, secured by a flange to the front plate of the boiler. By turning the flange, any desired amount of air may be made to enter the furnace. An angular platform of fire clay is supported on brackets, and extends across the whole furnace. The flame is by means of this platform deflected upwards, and caused to fill the whole flue. Five claims are made.—No. 6774. May 9th, 1887. 8*d.*

BRICK MAKING MACHINES.—*W. Barker, Birtley, and R. F. Boyd, Houghton-le-Spring, Durham.*—The inventors discontinue the use of the vertical rollers which served the purpose of collecting the clay, and substitute for them a pair of curved guides. Two of the sides of the die are parallel to each other, and the top and bottom only are tapered. By this arrangement the bad effects of the retardation of the clay against the sides of the die are, to a large extent, avoided, and the lateral and middle portions of the clay are delivered uniformly to the cutters. There are five claims.—No. 4458. March 25th, 1887. 8*d.*

STEAM ENGINES.—*J. Maynes & C. L. Watchurst, London.*—By these improvements the mean effort on the crank can be varied in exact proportion to the work to be done, without interfering with the ratio of expansion, the steam pressure, or the speed of the crank. The object is accomplished by increasing or decreasing the stroke while the length of the crank remains the same. In carrying out this idea the inventors interpose a curved link and sliding block between the piston rod and the connecting rod. Six claims are made for the mechanism employed by this method.—No. 4659. March 29th, 1887. 1*s.* 1*d.*

LOADING SHIPS.—*A. B. Brown, Edinburgh.*—A pair of horizontal girders can be moved in guides, so as to project from the side of the vessel just below an upper deck. A small truck runs on the pair of girders and carries two pulleys, between which hangs the loop of a chain and a tackle pulley for carrying the load. One end of the chain is fixed to the outer end of the girders, and the other end is led round pulleys which are worked by hydraulic power. The same means is employed for moving the girders and the truck. Three claims are made.—No. 6810. May 10th, 1887. 8*d.*

COTTON WASTE MACHINES.—*J. D. Tomlinson, Rochdale.*—This invention relates to the toothed coverings of the cylinders, doffers, and rollers of machines used for treating engine cleaning waste. Hitherto such coverings have consisted of iron or wooden lags, or of strips of leather, into which the teeth are inserted. When the teeth had been inserted, they were bent to the requisite angle. This arrangement necessitated the use of soft steel, and, as a consequence, the teeth were easily broken. According to the present invention, each tooth is made singly and bent to the proper angle; the teeth are then hardened before their insertion in the lag. The foot of the tooth is formed with a head, and is squared at the neck; the iron lag is bored to receive the teeth, and may be countersunk on the lower side to receive the head. The lags are bored of such a size that the teeth must be driven forcibly in. The inventor claims the provision of the rollers with steel teeth, which are formed with a head, and with a squared neck, and finished, bent, and tempered before insertion on the lags.—No. 8729. June 17th, 1887. 8*d.*

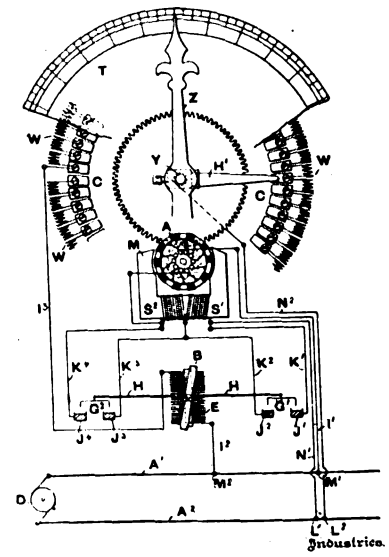
NAIL MAKING MACHINES.—*C. March & W. Dick, Glasgow.*—In the machines to which these improvements are applicable, the nails are cut transversely from strips of iron or steel, and the taper is imparted to them by presenting them at a slight angle to the cutters and whilst being turned half round between each cut. The strip is raised a little between each cut to allow of its being turned over, and in order to effect this motion the present inventors make use of a cam, a spring, and a fixed surface on which the cam bears. The cam is fixed on and encircles the holder, through which the strip is fed, and by means of which it is turned over. The cam is made with flat surfaces on opposite sides, and each flat surface extends equally on both sides of the point which is directly under the middle of the horizontal position of the strip. The fixed bearing surface is made of equal extent with the flat surface of the cam, so that there is no tendency to rock; and the holder is made to bring the cam quickly to its bearing after each turn over. Another part of this invention relates to the dies which form the head. When the blank is severed, it is held by a gripper which bears upwards on the under side of the nail, and holds it against a lip on the inner face of the stationary piece. When the heading operation is completed, the gripper travels backwards and removes the dies. The motions of the gripper are obtained by cams on the main shaft, and by springs and levers. Two claims are made, one for each improvement.—No. 7538. May 25th, 1887. 8*d.*

DANDY ROLLS FOR PAPER MAKING MACHINES.—*R. Brown, Penicuick, Midlothian.*—In constructing the dandy rolls which are used for making the water lines in paper, the inventor first covers a cylindrical frame with coarse wire cloth. A "laid" wire is then wound spirally over the woven cover, and soldered at each end, and on top of this wire are soldered a series of longitudinal line mark wires. The laid is thus made to run along the machine, instead of across it as heretofore; it is claimed that this arrangement produces a better "laid mark," and also permits of a higher speed. One claim is made.—No. 6563. May 4th, 1887. 8*d.*

ELECTRICITY.

DYNAMOS.—*R. E. B. Crompton & J. Swinburne, Chelmsford.*—The present practice of the makers of dynamos of the drum armature type is to wind the armature with little wire and with few ampère turns. The inventors reverse this method, and make the ampère turns comparatively large. For small machines, in which this method of winding is adopted, it is preferable to use single horseshoe magnets. The pole pieces are made to offer as little magnetic resistance as possible to the induction of the field magnets, but to oppose as great resistance as possible to the cross induction. The section of the iron connecting one horseshoe with another is made small; it is allowable to let the horseshoes be absolutely separated; but it is preferable to make the internal surface of the pole pieces practically continuous in order to avoid the heating of the armature bars. The armature is made up of thin discs of soft iron, and the spindle on which they are strung is made of manganese or other steel. In large armatures, the inventors employ the usual end connections, arranged in two layers, but of an improved form. The path of the conductor is first inwards towards the axle, and then away from the armature head in a direction parallel to the axis. Afterwards the path curves toward the other conductor in a plane at right angles to the axis. The connectors thus form two layers. The inner parts of the connectors are made radial, and the outer parts are curved as much as possible. The connectors are made so that they can be disjointed at their central part; the object of this construction is to allow the radial part to be withdrawn whilst the other part is not disturbed. At one end of the armature the commutator sections may form part of the connectors; but it is preferable to connect them separately, so as to admit of ventilation. The inventors make twelve claims.—No. 6754. May 9th, 1887. 11*d.*

ELECTRICAL MEASURING AND INDICATING APPARATUS.—*C. D. Abel, London.* (*Siemens & Halske, Berlin.*)—The apparatus here described is adapted to obtain reliable indications without requiring the attendance of experts. Two parallel circuits, the regulating and measuring circuits respectively, are employed, and are supplied from one source of electricity. Apparatus in the regulating circuit maintains the strength of the current in the second circuit constant. The application of this invention to the measurement of the difference of potential is illustrated in the accompanying figure. Two main conductors A^1 A^2, whose difference of potential is to be measured, lead from the current producer D to the outer circuit; from them branch the regulating circuit, in which are included the coils S^1 S^2 of the field magnets and the coils A of the armature of the motor M. The measuring circuit also branches from the main conductors, starting from the point M^2 and passing through the coils of a solenoid E, through the



resistance coils W of the measuring apparatus, and through a contact lever H^1. The solenoid E is surrounded by a pivoted frame B, with the axis of which is connected a two-armed lever H of insulating material; to each end of the lever are fastened the forks G^1 G^2 of conducting material. Under the prongs of these forks are two pairs of mercury cups J^1 J^2 J^3 J^4. The cups J^1 J^2 are in connection through the leads K^1 K^2 with the ends of the coil S^1, and the cups J^3 J^4 with the coil S^2, so that by the inclination of the rod H in one direction or the other, the coils S^1 or S^2 are short circuited. With the normal current tension at the terminals of the generator D, the frame B of the solenoid is so placed that the forked lever is horizontal and the coils of both limbs of the field magnets of the motor are in series in its circuit. As soon as the tension increases or decreases, the frame of the solenoid is turned, and the coil of one or other of the magnets of the motor is short circuited, and the rotation of the armature of the motor ensues. The axis of the armature is connected with the axis Y of the measuring apparatus. The pointer Z and lever H^1 are made to move, and the lever H^1 travels over the contact plates C and introduces more resistance into the circuit of the solenoid, until the proportion of total resistance between the points of connection of the measuring circuit with the main circuit to the current tension between these points again becomes a normal one. The forked lever H then resumes its horizontal position, and the movement of the armature ceases. Four claims are made for this arrangement and for other adaptations to special cases.—No. 4545. March 26th, 1887. 8*d.*

ELECTROMOTORS.—*G. Scarlett, Liverpool.*—The object of this invention is to construct an electromotor which will work without field magnets. A revolving ring or rings of soft iron are employed, which are cut at one or more points, and the gaps thus formed are filled with a connecting piece of non-magnetic material such as brass. On the circumference of each ring is a

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groove suited to carry a gut band or driving strap. The rings are supported and held in position by flanged rollers. Surrounding the rings are a series of solenoids; the ends of these coils are carried to commutators, which are arranged so that when the ring rotates, one or more of the coils are connected to the actuating battery circuit, and the other coils to the secondary circuit. It is so arranged that the battery current is set up in the coils nearest the ends of the soft iron portions of the annular bar, and the current will therefore cause their magnetisation. As these coils are at the ends of the magnet only, the magnet is propelled forward so as to bring the centre of the magnet into the field of the lines of force. The moment, however, that the magnet goes beyond a coil and enters another the battery current is cut off by the commutator, and is admitted to the one which the magnet is just entering. There is, therefore, a constant struggle on the part of the magnet to get into equilibrium, and a continuous rotary motion is accordingly set up. In the meantime, secondary currents have been set up in the remaining coils, especially in the two immediately following the one through which the battery current is passing. When the battery current is cut off from the actuating coil, a secondary current is generated in it. The secondary currents are picked up and conveyed away to secondary batteries for storage, or may be utilised for driving another ring. If not collected they would soon cause the overheating of the machine. One of the advantages claimed for this machine is that the secondary currents are utilised instead of their being left to neutralise the action of the apparatus. There are three claims.—No. 7021. May 13th, 1887. 8*d*.

Dynamos.—*W. M. Mordey, London.*—In alternate current machines the inventor proposes to employ a field magnet which with a single exciting coil supplies the whole inductive effect; in some cases two such magnets may be used. When applied to armatures of the Siemens type, the whole periphery of the armature is surrounded with iron. Inside this iron ring is placed a magnetising coil, whose convolutions also entirely surround the periphery of the armature; or the coil may be at the side of the armature near its circumference. From the outer iron ring, iron pole pieces project towards the axis; a number of similar magnetic poles are thus produced on one side

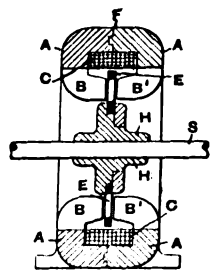


Fig. 1.

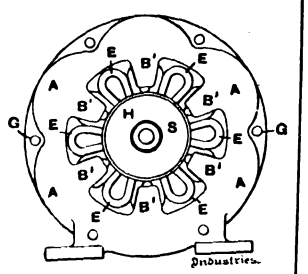
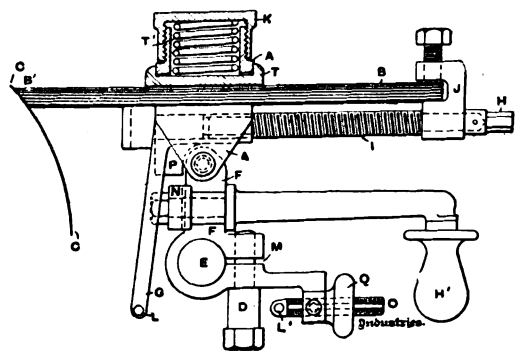


Fig. 2.

of the armature, faced by a number of poles of the opposite sign on the other side. The accompanying figures illustrate a dynamo constructed according to this method. The armature consists of a number of coils E carried by the hub H. The whole circumference is surrounded by the iron ring A, and inside is placed the magnetising coil C. From the outer iron ring the pole pieces B B¹ project. These pole pieces are magnetised by the peripheral winding C. In the case of an ordinary alternate current machine, the number of polar projections on each side of the armature is made exactly half of the coils E, and the enclosing iron E is divided as shown in Fig. 1. The two portions are machined true on the inside faces F, and then bolted together at G after the armature and coil E has been inserted. Several other applications of this principle are described in this patent. Eleven claims are made.—No. 8262. June 8th, 1887. 11*d*.

Brush Holders for Dynamos.—*A. P. Trotter & W. T. Goolden, London.*—These holders allow the brush to be traversed in a direction perpendicular to the axis of rotation of the commutator, or at any desired degree of obliquity to the axis. The



curved lines C C denote part of the circumference of the commutator on which the brush B B¹ bears. The fixed part F of the holder is clamped to the insulated arm of the usual brush carrier by means of the shouldered stud D. The movable part of the holder A is secured to the fixed part by the pin N, about which it is free to rock. The lower end L of the arm G, forming part of the movable portion, is connected to the end L¹ of the regulating screw O by a spiral spring, and thus tends to draw the brush on to the commutator, the tension of the spring being regulated by the thumb nut Q. The feed or traverse of the brush is effected by the handle H, which is pinned to the outer extremity of the unthreaded portion of the screw I; the threaded portion engages in a corresponding threaded opening in the movable part of the holder. The backward or forward motion of the screw I imparts a similar motion to the sleeve clamp J. The upper portion of the movable part A is formed as a box for the strong spiral spring T¹, which is held in compression by the threaded lid K. The lower end of the spring T¹ presses on the thickness piece T, and serves to steady the movement of the brush during the traverse, and aids in maintaining a uniform pressure and flexibility of contact on the commutator. When it is desired to lift the brush off the commutator, the handle H¹ is given a quarter turn. By this means the cam piece N is brought to bear against the projection P, and the whole of the movable part A is thereby rocked about its pin, so throwing the end B¹ up and off the commutator. The inventors make one claim for this method of constructing the brush holders.—No. 5186. April 7th, 1887. 8*d*.

CHEMISTRY.

Manufacture of Hypophosphites.—*P. G. W. Typke, New Malden, Surrey.*—Hitherto the phosphoretted hydrogen given off in the manufacture of hypophosphites has been either wasted or converted into the comparatively valueless chemical phosphoric acid. According to this invention, the gases and steam, resulting from the treatment of alkaline earths with water and phosphorus, are first cooled, so as to deposit the greater proportion of water. The gases are afterwards conducted through a tube, which is heated by a furnace, and filled with pieces of unslaked lime. The result of this action is the production of phosphide of calcium. This chemical is converted into hypophosphite and phosphoretted hydrogen by the action of water, and the phosphoretted hydrogen is used again in the same way as before. Two claims are made for this utilisation of the phosphoretted hydrogen as described.—No. 7504. May 23rd, 1887. 6*d*.

Treating Ores.—*J. S. MacArthur, R. W. Forrest, & W. Forrest, Glasgow.*—The ores to be treated by this process may contain lead, zinc, iron, gold, or silver in the form of the sulphides. The ore is first finely powdered and treated with a solution of per-salts of iron at their boiling temperature. Certain of the metals are dissolved as per-salts, and are separated by washing. If lead is present, it is preferable to use hot water to wash out its salts; and if silver is present, a hot solution of common salt is used for the same object. The per-salt of iron becomes partly or wholly reduced to the proto-salt, having given up the rest of the acid to the copper, zinc, lead, and silver. The precipitation of the salts of these metals is effected by running the solutions through a series of tanks. Most of the lead and silver will settle in the first two tanks, and the copper can be precipitated by means of metallic iron. The zinc falls to the bottom on the addition of oxide of zinc or sulphide of sodium. The proto-salt of iron is regenerated for further use by any of the ordinary oxidising or chlorinating processes. In the second stage of treatment the ores are mixed with a halogen per-salt and other salts of iron; the gold is thus converted into a soluble salt, while the compounds of the base metals are prevented from dissolving. Three claims are made.—No. 7278. May 19th, 1887. 6*d*.

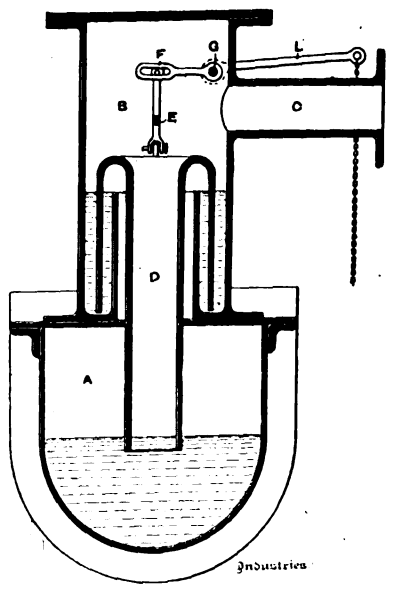
Colouring Matters.—*J. Y. Johnson, London.* (*Badische Anilin und Soda Fabrik, Ludwigshafen am Rhein, Germany.*)—In order to prepare a soluble naphthazarine, the inventors take one hundred parts of a paste containing 20 per cent. of dry naphthazarine powder, and intimately mix it with thirty-five parts of a solution of bisulphite of soda of 38°Bé. to 40°Bé. This mixture is then digested in closed vessels at a temperature of 50°C. to 70°C. for a period of eight days, at the end of which time the desired soluble colouring matter is obtained. This invention also relates to an improved mordant for use in dyeing with naphthazarine, viz., the new chromium compounds of naphthazarine. If these chrome lakes are produced within the textile fibre they give rise to shades of colour varying from an intense black to the most delicate grey or slate; they can thus be used in conjunction with other colouring matters for the purpose of toning down the colour. As an example of their action the inventors describe the application of them to woollen goods. One hundred parts of well washed wool are taken and boiled for an hour and a half in water to which has been added about three parts in weight of bichromate of potash and two and a half parts of bitartrate of potash. The wool which has thus fixed the chromium mordant is then well washed and placed in a dye bath. In the bath are contained forty parts of naphthazarine paste of 10 per cent. strength, dissolved in cold water. In order to neutralise the carbonate of lime usually suspended in the water, about one part of acetic acid is added for every thousand parts of water. The temperature of the dye bath is then raised to the boiling point, and there maintained for two or three hours. This process of mordanting may be varied by the application of other mordants, such as chrome alum, or bichromates of potash and soda in combination with sulphuric, tartaric, or oxalic acid; but the above described method is preferable. In preparing the soluble naphthazarine in the commercial form of dry powder, its aqueous solution is either evaporated to dryness, or it is saturated with common salt; in the latter case a precipitate is formed which is collected upon a filter and dried. An analogous result is obtained if the bisulphites of ammonia or potash are employed instead of the bisulphite of soda. The powder of soluble naphthazarine has the appearance of a dark brown powder, and its aqueous solutions possess a brown colour and exhibit a strong bluish green fluorescence. Two claims are made, one for the mordanting process, and one for the production of the soluble naphthazarine.—No. 7833. May 28th, 1887. 6*d*.

Explosives.—*H. H. Lake, London.* (*Wohanka & Co., Vienna.*)—When the nitro derivatives of the hydrocarbons of the aromatic phenol series are dissolved in concentrated nitric acid they yield exceedingly powerful explosives. The disadvantage of these explosives is that they are liquid. The object of the present invention is to transform these liquids into a gelatinous or plastic compound. This is accomplished by the addition of cellulose in the form of fine wood wool, cotton, or other fibrous substances. The cellulose swells up by its contact with the nitric acid, and forms with the explosive a plastic mass like gelatine. Sometimes the cellulose is nitrated before its mixture with the explosive. Two claims are made.—No. 7608. May 25th, 1887. 4*d*.

Printing Ink and Dyes.—*L. A. Groth, London.* (*C. Collin and L. Errani, Paris.*)—The object of this invention is to prepare a black liquid, which shall be antiseptic and insoluble in water, for use as the base of several compositions for dyeing, printing, and varnishing. The different kinds of black known as black aniline, blue black, compound black, and unitarian black, are dissolved in either aniline, nitrobenzine, or phenol. When these colouring matters are dissolved, quantities of rosin, bitumen, or fatty substances are added to the mixture in proportions varying with the purpose for which the compound is used. One claim is made.—No. 17925. December 30th, 1887. 6*d*.

MISCELLANEOUS.

Relieving Gas Retorts from Pressure.—*T. Settle, Huddersfield.*—The accompanying illustration shows a transverse section of the hydraulic main, dip pipe, and bridge pipe. The apparatus consists of the hydraulic main A, upon the top of which is bolted the chamber B; the lower part of the chamber B is annular, and capable of containing liquid. To this chamber is cast the bridge pipe C, which connects the chamber B with the ascension pipe. Within the chamber there is an annular dip pipe D; the outer annulus of this pipe descends and enters the liquid contained in the cup of the chamber B, while the main part of the pipe enters



the liquid in the hydraulic main. The dip pipe is suspended by a strap E, which is connected to a slotted lever F turning on an axis G. The lever L is fixed to the axis G, and a chain hangs down from its free extremity. The liquid is supplied to the cup, and the retort charged; the chain is then drawn down, causing the dip pipe to be withdrawn from the liquid in the hydraulic main so as to afford an unimpeded course to the gas. The pipe may be allowed to dip into the water slightly if a seal is desired. The annular cup will always be supplied with liquid from the condensation of the gas. By this apparatus the retort may be partly or entirely freed from pressure. Three claims are made for the dip pipe, chamber B, and manner of suspending the pipes.—No. 1274. January 27th, 1888. 6*d*.

Jointing Sheets of Metal.—*W. Orr & P. S. Brown, Glasgow.*—The object of this invention is to provide a simple means of securing the sections of sheet metal together, without the necessity of overlapping the edges. The edges, which have hitherto been riveted together, are bent upwards or downwards, and are butted together. Over the downwardly or upwardly projecting parts there is slipped a circular or oval tube, which has a longitudinal slot along the whole of its length. When the edges are so placed, the joint is made tight by the insertion of wedges between the edges of the plate, or by curving the edges of the slot inwards to grip the sheet. The fastening of the sheets, if used for roofing, is preferably in the direction at right angles to the eaves; and the tubes are secured to the purlin bars by bolts and brackets, or they may be carried in slots made in the bars. Several modifications of the tube are described in the specification. Three claims are made.—No. 7280. May 19th, 1887. 8*d*.

Manufacture of Tin Plates.—*A. J. Maskrey, Nant-y-glo, and P. S. Phillips, Crumlin, Monmouthshire.*—The apparatus here described is arranged so that the coating of successive plates is effected in a continuous manner by the aid of two operators, who feed the plates into the bath and remove them from the delivery rollers respectively. The bath is in the form of a rectangular basin with a curved bottom, and is divided by a partition which extends some distance down into the metal. The partition is made hollow, and its internal space is open at the top, so that it can be charged with molten metal. The heat is applied at the feeding side of the partition, and passes through the partition to the other part of the metal, which is covered with grease; if no metal is in the hollow of the partition, the metal on the other side will be cooler. Within the bath there are two or more sets of guide bars of circular curvature sweeping round under the partition; and below these are guide pulleys for an endless chain, which also passes over a chain driving wheel at the top of the bath. Some of the links have studs projecting from them. As each stud presents itself over the top of the bath, the operator places a plate in front of it, and introduces the front edge of the plate between the curved guide bars. The plate then travels through the bath of metal and grease, and is delivered through rollers at the other end in a finished state. One claim is made for this apparatus.—No. 6109. April 26th, 1887. 8*d*.

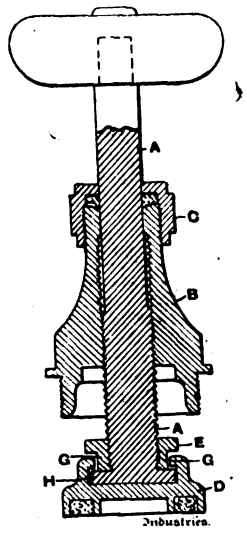
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CAGE FOR CARRYING FIBRE.—*H. M. Girdwood, Manchester.*—This invention relates more particularly to Patent No. 9270 of 1887, in which is described a method of treating fibres. The cage in which the fibres are packed is made of metal rods, and is preferably in three pieces, consisting of the main portion, the lid, and the dividing portion. The parts are unfolded while the fibre is packed in, and when the movable pieces are fastened down on the main portion, the cage becomes divided into six compartments. The interior divisions are made by a series of metal rods, which are fixed in the main portion and in the lid. Two claims are made for the cage, which is divided into separate sections.—No. 1675. February 4th, 1888. 6*d.*

DISTRIBUTING OIL UPON WOOL.—*P. Bairstow & J. Bairstow, Halifax.*—The object of this invention is to distribute oil and soap suds upon wool whilst it is being fed to the drawing frames or combing machinery. An oil trough is kept supplied in any suitable manner, and inside it is placed a series of cranked tubes; these tubes revolve, and take up the oil and pass it along a second stationary tube above the wool. The stationary tube is perforated, and a circular revolving brush, coming in contact with it, takes off the oil, and throws it in a fine spray among the fibres. The amount of oil distributed can be regulated by driving the feed tubes at a different speed. The inventors claim the combination of the revolving tubes and brush.—No. 6726. May 7th, 1887. 8*d.*

SHUTTLES.—*H. Burgess & T. Burgess, Congleton, and C. Clay, Manchester.*—In looms employed for weaving smallwares, such as ribbons, the axis of the bobbin which carries the weft yarn usually runs parallel to the longitudinal axis of the shuttles; this arrangement requires the use of a shallow horizontal bobbin which carries only a comparatively short length of the weft yarn. In overcoming this disadvantage the inventors place the axis of the bobbin transversely to the axis of the shuttle, so that when in use it will assume a perpendicular position; the bracket which carries the axis and the controlling spring is arranged so as to allow of the free movement of the bobbin, and the bridle is so placed as to take up the slack from the top to the bottom of the shuttle. Five claims are made.—No. 387. January 10th, 1888. 8*d.*

STOP VALVES.—*W. P. Thompson, Liverpool. (The Barnett Brass Company, Mansfield, Ohio, U.S.A.)*—The spindles and valves are attached to each other in such a way that the valve proper can have a rotary motion round the spindle, and can be easily separated for repairs or renewal. The figure represents a section of a stop valve constructed according to this invention. B is the hub of a valve having the usual stuffing box C, and an internal screw thread to receive the corresponding thread on the valve spindle A. The valve spindle has an annular collar F at its lower end, and above the collar is placed a nut E, which can be screwed closely against the upper side of the collar. The valve proper D is constructed with the usual annular groove containing the packing H. An annular chamber is formed in the top of the valve D, and at one side of the chamber is a lateral opening wide enough to allow the collar F to pass into the chamber. The nut E is screwed down in position as shown in the figure, so that neither the nut nor the spindle can pass laterally between

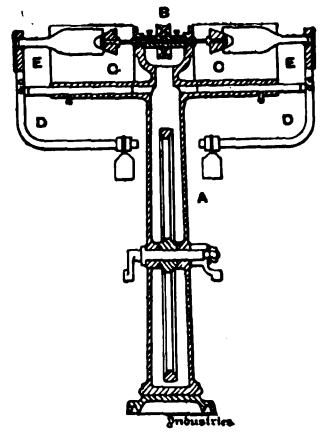


the sides of the passage, and hence the valve and the spindle are securely attached to each other. The desired freedom of movement between the parts is still allowed for, but the possibility of an accidental detachment is reduced to a minimum. The slight rotation of the valve spindle, when the valve comes to a bearing on the seat of the stop valve, causes a like movement of the nut E, and as the nut is so fitted into the opening in the top of the valve that it does not come into contact with the upper projecting rim of the valve D, there is no danger of the nut coming loose. The inventor claims the combination of the collar, nut, annular chamber, and the overhanging rim, as described.—No. 1061. January 24th, 1888. 6*d.*

COTTON GINS.—*A. M. Clark, London. (A. G. Jennings, Brooklyn, U.S.A.)*—In order to increase the efficiency of the ginning process, the inventor makes use of a current of air to force the fibre from the carrier on to the receiving roller. The carrier band is made of wire cloth, and passes over a series of rollers in succession. Two ginning or receiving rollers are caused to revolve in close proximity to the carrier, and are separated from it by a fixed longitudinal grating. The extremities of two air pipes come close up to the carrier, just opposite to the ginning rollers, and the blast of air issuing from them carries the fibre through the grating on to the rollers, from which it is stripped by doffers. The husks and foreign matters are prevented from passing through the grating. Four claims are made for the application of the blast of air for the purpose described.—No. 2592. February 21st, 1888. 6*d.*

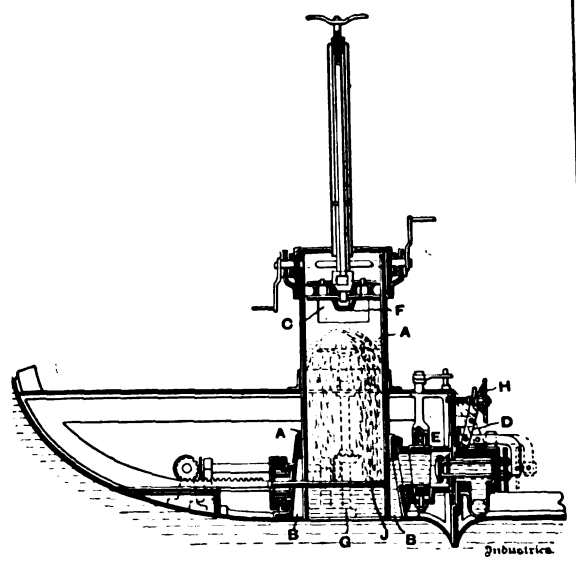
GERMAN PATENT ABSTRACTS.

BOTTLE WASHING MACHINE.—*W. A. Zemsch, Worms.*—The bottles are held between elastic cushions C and weighted levers D, fitted with suitably shaped ends E. The cushions are



attached to a spindle which is actuated by means of a belt and the pulleys A and B, thereby revolving the bottles. The inside of the bottles is cleaned by brushes made to the shape of the bottles under operation. These brushes are inserted through a hole in E. The apparatus is arranged to take different sizes of bottles.—No. 42363. May 24th, 1887.

ASH REMOVER.—*Franz Liebler, Kiel.*—This apparatus is intended for removing the ashes from parts of a ship which are below the water line. The ashes are introduced through the door F into the cylinder A, and after shutting F and drawing back



the plate J they are discharged by the piston C. The sea water enters the openings B. The valve E is in communication with a Kingston valve, which is adjusted by means of a lever D and a hand wheel H.—No. 42828. August 3rd, 1887.

UNITED STATES PATENT ABSTRACTS.

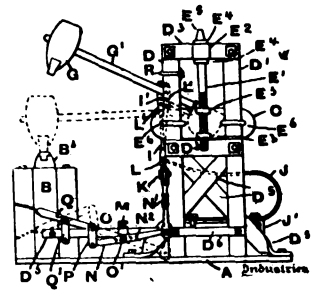
PYROXYLINE VARNISH.—*W. D. Field, Short Hills, New Jersey.*—In making lacquer or varnish of pyroxyline, the pyroxyline is first dissolved in naphtha, and then a menstruum is added consisting of the acetic acid derivatives of the lighter alchohols contained in fusel oil. It is found that this preparation does not dry so rapidly, and the brush marks will thus have time to disappear from the lacquered surface. Three claims are made for the admixture of these acetic acid derivatives with the pyroxyline.—No. 381354, dated 17th April, 1888.

STEAM ENGINE.—*E. A. Moon, Chicago.*—This invention relates to the transformation of the reciprocating motion of the piston rod into the rotary motion of the crank. Two spiral shafts in the form of helicoidal blades revolve in bearings, which are aligned in a parallel direction with the piston rod; two clutches are carried by the piston rod, and gear with the spiral shafts. The blades on the spiral shaft are opposite handed, and the clutches are so arranged that one of them operates during the forward stroke, and the other during the return stroke of the piston. At the other end of the spiral shafts are toothed wheels which gear with a common pinion, and in this way the alternating motions of the spiral shafts are transformed into the continuous motion of the shaft on which their common pinion is fixed. One claim is made.—No. 381160, dated 17th April, 1888.

SCOURING FIBRES AND FABRICS.—*G. Toppan, Salem, Massachusetts.*—The present invention relates to the composition of the bath used for scouring yarns and fabrics. A mixture is made of benzine, mustard seed oil, and an alkali, preferably caustic soda, and the whole is well diluted with water. This bath may be used for any kind of fibre without the fear of any deleterious action on the part of the chemicals. Three claims are made for the composition and for its application.—No. 381444, dated 17th April, 1888.

ORNAMENTING SHEET TIN.—*J. Koebel, Milwaukee, Wisconsin.*—This invention relates to the production of a coloured crystalline surface on sheet tin. The sheet is first heated until the tin begins to melt, and the surface is then cooled by sprinkling cold water upon it or by blowing a blast of cold air over it. The cooled surface is treated with a mixture of nitric acid, muriatic acid, and bichromate of potash. Afterwards cold water and muriatic acid are successively poured over the metal, and after these have been drained off, the same process is performed with a solution of hyposulphite of soda. The object of the invention is then attained. Two claims are made.—No. 381390, dated 17th April, 1888.

FOOT POWER HAMMER.—*C. J. Rundquist, Opheim, Illinois.*—The accompanying illustration shows an elevation of a hammer, and the mechanism employed in actuating it by means of foot power. The handle G^1 of the hammer G is mounted on a rocking shaft, which is carried by vertically adjustable bars and a clamp plate. The anvil is shown at B, and the lever Q is adapted to be moved by the foot of the operator. The levers P N K transmit the motion to the rock shaft, and cause the

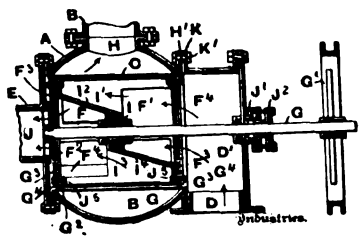


hammer to rise; the weight of the hammer causes it to fall. The handle is adjustable, and the rock shaft may be adjusted vertically by means of the screw E^1 and plate C. The plate C slides up and down the standards D D^1, and carries the rock shaft and clamp plates with it when the screw E^1 is turned. The length of the foot leverage may also be varied by means of the fulcrum O^1 being inserted through the several holes N^2 in the lever N. Thirteen claims are made.—No. 379818, dated 20th March, 1888.

THREAD GUIDE FOR LOOM SHUTTLES.—*T. J. Mayall, Reading, Massachusetts.*—The thread passage in the shuttle is formed by bending a piece of sheet metal strip back upon itself, and fixing it on the shuttle so as to form the walls of the thread space. These two parallel walls have slots in them, through which a spring piece passes. The spring holds the thread down, and a button resting upon the spring affords the means of retracting the spring so as to allow the entrance of the thread. There are three claims.—No. 381402, dated 17th April, 1888.

CARDING ENGINES.—*E. Wright, North Andover, Massachusetts.*—Certain improvements are here introduced into the construction of the mechanism for operating the doffer combs of carding engines. The driving shaft has its inner end enlarged and provided with two or more holes at different distances from the centre. The purpose of the holes is the reception of a shank, to which is attached a sleeve. The sleeve receives the end of an arm, which forms part of a hub on the comb shaft. The amount of motion communicated to the comb is thus made to depend upon the hole into which the shank is inserted. There are two claims.—No. 381516, dated 17th April, 1888.

HYDRAULIC VALVE GEAR.—*R. L. Teed, Chicago.*—The accompanying illustration shows a section through the rotary water valve. The water supply enters at D, and the water may be made to leave either at E or B. Inside the casing A is placed an inner casing C, in which are two ports communicating with H. The rotary valve F is mounted on the spindle G, and is



made to fit tightly against the inner casing. The central partition I divides the interior into the two spaces F^1 F^2, and the passages I^1 I^3 allow the water to travel through. The rotation of the wheel G^1 causes the valve to either close the ports or to place either of the spaces H or J in communication with the supply. The arrows indicate the course of the water. Six claims are made for this valve.—No. 379617, dated 20th March, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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AN IMPROVED LOOM.

THE accompanying illustration represents a loom fitted with Simpson's patent selvedge motion, the object of which is to provide a ready means whereby two pieces of cloth can be easily woven on the same loom. From the fact that each piece is connected by the weft, and can be easily separated, they are technically known as "splits." There are several prior inventions for this purpose, all of which are defective in one or more points, and it is claimed for the motion we are now describing that many of the defects of its predecessors are remedied. The objects of such a motion are to so manipulate the leno threads —that is, those in the warp which form the selvedge— that they may be securely fastened, and fraying out be completely avoided. These leno threads are usually doubled, and they can either be wound on the beam in the ordinary manner, or, as in this case, special provision can be made by winding them on to separate bobbins placed in some convenient position. The latter is the preferable course, as it permits of the change from a narrow to a broad piece to be more readily effected. Two of the leno threads are passed through eyes formed in a vertical lever which oscillates laterally, and which derives this movement from an eccentric fixed on the tappet shaft. The eccentric being adjustable, any amount of throw can be given to the lever as desired. A similar eccentric is fixed on the crank shaft, and drives two vertical rods with eyes at their upper extremities, known as reed hooks. These hooks have a vertical motion only, and are employed to form the shed, which can be varied by adjusting the eccentric. The space left between each piece is one dent only, so that it will be seen that this mechanism occupies very little room, the splitting of the warp being effected by the rod carrying the reed hooks. Thus one pair of ends have the necessary sideward movement, and the other the vertical movement, to permit of the locking of the weft; and the general effect is that the weft is completely wrapped round each pair of leno ends, which are thus securely fastened. This movement really requires diagrammatic representation to make it quite clear, but the effect is as stated. It may be noted that it is not necessary to cut down the healds, which can be left in their ordinary form, and by the simple removal of a bracket the loom can be weaving broad cloth in less than five minutes. Among the advantages which are claimed for this loom is one which we think will be generally admitted, viz., its adaptability. By the use of some such motion a manufacturer is not limited in the class of cloth he can weave, but can take orders for such broad or narrow widths as may be required. The extra first cost of a broad loom is very slight, and would not seriously militate against its adoption, while in many ways it would be decidedly advantageous to use wider looms. Indeed, if this freedom of choice were left to manufacturers, there is little doubt that they would readily accept the wider loom, as in that way space, wear and tear, and rent would be saved. We may add that the motion in this case is positive, and does not depend on any springs for its efficiency. The makers of this loom are the "Simpson" Patent Selvedge Motion Company, Springfield Bridge Works, Manchester.

THE INSTITUTION OF MECHANICAL ENGINEERS.

AN ordinary general meeting of this Institution was held at the Institution of Civil Engineers on Thursday evening, the 3rd inst., and on Friday afternoon, the 4th inst., the time having been fixed at half-past two for the second day, on account of the annual dinner, which was held in the evening.

The president, Mr. E. H. Carbutt, in opening the meeting referred briefly to the Architects' Registration Bill, and expressed the thanks of the Council to those members who had taken an active part in opposing this Bill, either personally in Parliament, or by writing to their members of Parliament. The Bill was most mischievous and totally unnecessary, and the President hoped the gallant member who had introduced the Bill would profit by the experience of its sudden collapse, and not interfere with the engineering profession in future. The President next referred to the accession of thirty-six new members, among whom he was pleased to see the names of Dr. Werner Siemens and Mr. Frederick Siemens. He also drew the attention of the meeting to the Paris Exhibition of next year, and regretted that the Government, who on the last occasion had spent about £67,000 in organising an adequate representation of British industry, refused on this occasion to take any official part in this great undertaking. Mr. Carbutt pointed out that it would be a grievous mistake for our engineers and manufacturers to abstain from exhibiting at Paris, especially as many persons from South American countries will visit that exhibition. Those countries are capable of great development, and the Paris Exhibition will be an excellent opportunity for initiating business relations with them. The President, in calling upon the secretary to read the third report of the Research Committee which dealt with experiments on the friction of a collar bearing, stated that Sir Henry Bessemer had promised to put his experience on the friction of high speed vertical shafts at the disposal of the committee, if they should continue their experiments. As we give this paper *in extenso* in another part of our present issue, a very brief abstract of it will suffice in this place. The experiments were made with a friction apparatus specially designed by the committee, and consisting of a steel ring of 13in. mean diameter, held stationary between two revolving rings of gun metal. The surfaces were oiled at the minimum rate of lubrication with which the bearing could work safely, but were not running in an oil bath. The pressure between the surfaces was produced by a spiral spring, and measured by the axial length of this spring, which could be increased or reduced at will by means of a screw and nut. The steel ring was prevented from revolving by a lever on which the twisting moment due to friction was measured, and this twisting moment, the speed, and the pressure between the surfaces were the experimental data. The general conclusions arrived at by the committee were: First, that this kind of bearing is very inferior to a cylindrical journal in its power of carrying weight; secondly, that the co-efficient of friction is much higher than for cylindrical bearings, and that the friction follows more nearly the law of the friction of solids than that of liquids; thirdly, that the co-efficient of friction is independent of the speed, but diminishes somewhat as the load is increased.

A letter from Mr. Alexander Turnbull, of Glasgow, was then read by the Secretary, in which the writer drew attention to the fact that the result as given in Tables XIV. and XV. are not very satisfactory, on account of their irregularity. He attributed this to the complication of the apparatus used in the experiments, which had too many moving parts, and about one dozen points or surfaces which must be in contact before an accurate measurement can be taken. The writer had himself designed a more simple machine, which is intended to obviate these difficulties.

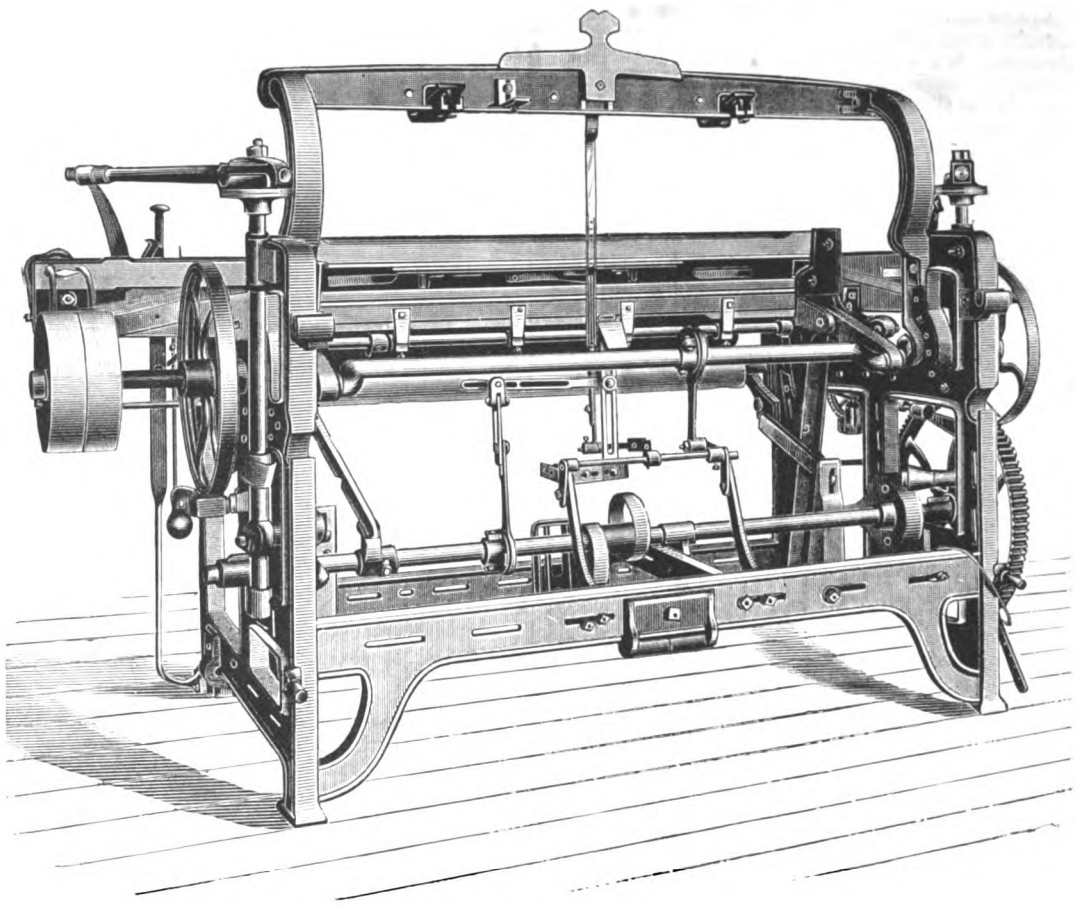
Mr. Tomlinson, the chairman of the committee, defended the design of the apparatus used. The irregularities mentioned by Mr. Turnbull were simply due to differences in lubrication. It would have been very easy to so adjust the lubrication for each experiment that the curve Fig. 11 should not contain the kink in the middle; but he thought the members would not thank the committee if they had adjusted the conditions of their experiments with a view to get a pre-conceived result. The committee are now designing a machine for testing the friction of pivot bearings.

Mr. F. Smith, of Manchester, called attention to the fact that one most important point had not been touched in the paper, viz., the quality of the metal used for shafts and bearings. He had found that with soft steel the danger of seizing and tearing of surfaces is exceedingly great, and the difficulty could only be overcome by a large increase of surface; and failing this, by using hardened steel, working on a surface of dense cast iron, or, better still, by using hardened steel working on hardened steel. He mentioned one case where a vertical shaft of 2¼in. diam. and 40ft. long was working satisfactorily on a pivot bearing of only 2¼in. diam. This pivot had to support the weight of the whole shaft, three couplings, and several heavy wheels, and the speaker attributed the success to the employment of several hardened steel washers interposed between the ends of the shaft and the bottom of the bearing. A central channel was drilled through these washers with oil channels radiating outwards on the face of each washer, and the whole was working in an oil bath. The object of employing several washers was to allow them to rotate at different velocities, and thus divide the speed between them. A similar arrangement is also used in drilling machines, where the pressure per square inch is exceedingly great.

Professor Unwin thought the reason why a collar bearing would carry more weight at low speeds than at high speeds was on account of the temperature. It is evident that heat must be accumulated in every bearing, and the latter can only work safely as long as the rate at which the heat is carried off at a moderate temperature is equal to the rate at which that heat is generated. Now, where the speed is fast, the energy transformed into heat must be greater than where the speed is low, and, therefore, the load per square inch cannot be so high in fast running shafts. He thought it remarkable that the friction was independent of the speed, but not of the pressure. It would generally be supposed that the rate of lubrication must in some way be connected with the speed.

Mr. Schönheyder thought the method of using water for cooling bearings a barbarous one, and he objected to its having been adopted in these experiments, as it altered the conditions under which collar bearings should work in practice. He also objected to the journal being stinted of oil. A thrust bearing in a ship would run

AN IMPROVED LOOM.



GENERAL VIEW.

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in an oil bath, and yet the lubrication was very economical, because the oil could be used over and over again. It was remarkable to find that whereas a cylindrical journal could carry from 400lb. to 600lb. per square inch, this collar bearing carried only about one-tenth of this pressure safely.

Professor Barr explained the difference between the two kinds of bearing by referring to Professor Reynolds' theory that in the case of brasses and a cylindrical shaft where the radius of the former was larger than that of the latter, the oil was carried by the shaft from the free space at the side until it was jammed between the brass and shaft, where they came into contact with one another. He suggested an analogous arrangement for collar bearings and pivots consisting of a groove tapering to nothing in the face of the collar or bearing, so as to jam the oil between the surfaces. In the machine which had been used no provision was made for altering the pressure during a run, and the speaker suggested the employment of a water pressure diaphragm such as was used in the Emery testing machine. It was desirable to know where the oil appeared, and whether it ran from the inner to the outer circumference or *vice versâ*.

Mr. Greig contended that bearings should have a surface proportional to the speed, and that it was of great importance that air should be admitted, in order to keep the bearings cool and to circulate the oil. He considered some of the theories which had been enunciated as quite fallacious, and caused considerable amusement by stating that, "in fact, there was no theory about a bearing."

Mr. Wickstead further illustrated Professor Reynolds' theory as to the carrying forward of the oil into the space between the cylindrical journal and the brass, by pointing out that the journal will only carry 100lb. per square inch when the lubricant is applied on the pressure side, whereas it will carry 600lb. when the lubricant is applied on the other side. Allowing for the reduction of area of contact due to the difference in the radius of journal and brass, the actual pressure would probably be 1200lb. per square inch. The collar bearing tested by the committee failed at 80lb., but in practice collar bearings were loaded to about four times this amount. In a drilling machine, for instance, the shoulder of the spindle had about 2 sq. in. area, and the pressure on the drill might be 6 cwt., or about 336lb., per square inch. Yet it worked with hardly any attention, and with no special lubrication. This was due to the low speed of about 20ft. per minute, and to the interposition of a hardened steel washer, revolving at half the speed of the drill. In another case, that of a screw displacer on a testing machine, the pressure at the end of the operation amounted sometimes to as much as half a ton per square inch; but here the work was intermittent, and a considerable amount of heat was generated. He suggested that the committee should continue their experiments with a collar bearing more nearly resembling that of a screw propeller shaft bathed in oil.

Mr. Scott Moncrieff complained that the report was not at all explicit as regarded the question of lubrication, and considered that details should be given as to the amount of lubrication required to produce certain results. He and the late Mr. R. D. Napier had gone into the question of friction at the time that the latter was working out his differential clutch, and they found that there was a great difference in the effects of lubrication with vegetable and with mineral oils.

Mr. Holroyd Smith had used washers for turbine shafts, and these had proved successful in one case, but not in another. His theory had been that they caused a reduction of speed, but this proved not to be always the case, and he thought that possibly the pile of washers acted as a kind of self adjusting apparatus like the onion bearing described by Mr. Davey at their last meeting. To facilitate lubrication, he suggested that the collars, instead of being rounded off in the corner, should be undercut; he had also found it advantageous to use collars which, instead of having their working surfaces at right angles to the shaft, had them in the shape of very flat truncated cones. This arrangement facilitated the circulation of the oil and compensated for cross strains.

Mr. D. Adamson regretted that the paper contained no practical advice. The lubricant should be chosen with reference to the speed at which the shaft worked. For light spindles, running at 10,000 revolutions per minute, thin mineral oils were best suited; but for heavy, slow-running shafts, the thick vegetable oils or animal fats were preferable. He knew of a case where a weight of 10 tons was carried on a 5in. shaft, the area of the bearing being only 20 sq. in. To facilitate the carrying of the oil between the surfaces in cylindrical journals, he had found it useful to file a flat on the journal, the flat being $\frac{1}{4}$in. wide for every inch in diameter.

Mr. Paget drew attention to the fact that this and the previous investigations of the committee had considerably altered our views of friction, and he looked upon the experiments as showing a result which was half way between the friction of fluids and the friction of solids. It was most desirable that bearings should be so constructed as to come entirely within fluid friction. What was wanted in a collar bearing was that it should float on oil.

Mr. Mair, in reply to Professor Barr, pointed out that the ring did not revolve and was very narrow, in consequence of which it was difficult to get the oil from the inside to the outside, as there was little centrifugal force. The ring was of mild Landor-Siemens steel. If the committee had set themselves the task of investigating the behaviour of different materials in this bearing their labours would have been indefinitely prolonged, as the choice of materials was practically unlimited.

Mr. B. Tower, in replying to the discussion, said that the diagrams obtained by the committee were on the whole more regular and satisfactory than many of the diagrams usually obtained in experiments on friction. He considered it as quite certain that the readings of the pressure were practically correct. The compression of the spring was ascertained by dead weights, and always found to agree within 2lb. for the same reading of the micrometer. He had no doubt that the heat developed is the determinant factor in the load which can be put on to a bearing, and he did not think that 80lb. per square inch was so small a safe load as some speakers had stated. He might mention that Mr. Thorneycroft loaded the thrust bearing of his torpedo boats with only 50lb. per square inch. With regard to Professor Barr's suggestion that the load should be varied during the run, he might state that the committee had already considered this matter, and determined in their future experiments to use an arrangement not unlike that suggested.

The next contribution read referred to a

Description of the Emery Testing Machine.

By Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A.

We shall in a future issue reprint this paper with illustrations; but to enable our readers to follow the discussion, we give herewith a short abstract.

This machine differs from all its predecessors in two important points, the first being an arrangement of hydraulic chambers and diaphragms capable of receiving without injury pressures and shocks of great intensity, and transmitting the pressures without loss to a convenient point for measuring and recording; whilst the second point consists of a new method of suspending or supporting a vibrating lever either on a fixed abutment or on another lever in the same system in such a manner as to eliminate friction. The machine consists of the usual hydraulic cylinder, but has improved grip boxes. The stress is put on the specimen in the ordinary way by hydraulic power; but instead of directly measuring it by levers, it is made to cause a hydraulic pressure within a chamber provided with a diaphragm, and the pressure is transmitted to a second smaller chamber and diaphragm, which form part of the weighing apparatus, and may be situated in the office or at any other convenient point. The large hydraulic chamber is technically termed the "support," and the smaller hydraulic chamber the "reducer." The acting area of the liquid in the reducer is less than in the support in the proportion in which the load on the specimen is desired to be reduced before it is received upon the beams in the scale case where it is weighed. In the machine described the reduction is as thirty to one, and the maximum load on the large support is 300,000lb. The diaphragms are of very thin sheet brass, and the motion of the piston of the support is less than ·001in., whilst the free motion of the diaphragm is ·1in. The film of liquid in the support and reducer is exceedingly thin, being only about ·015in. in thickness. In the scale case, which contains the weighing mechanism, the pressure transmitted from the reducer is received at one end of a system of levers, and is measured by weights. These weights are applied from the outside by means of two handles in a most ingenious way; but without illustrations it would not be possible to give a clear description of this part of the machine. There are three levers. The first lever taking the load has a ratio of twenty to one, the second lever has a ratio of twenty-five to one, and is connected to a third lever or indicator bar, the arms of which have a ratio of forty to one. The multiplication of motion is, therefore, 20,000 times that of the reducer piston, and 600,000 times that of the piston in the main support. A movement of one six-millionth of an inch at the specimen produces a motion at the indicator point of $\frac{1}{10}$in., which is easily visible. The levers, instead of being supported on knife edges, are connected by thin plates of tempered steel. These fulcrum plates are used in tension where the load is small, as in the indicator lever; but in compression where it is great, as in the first lever. When in tension, the thickness of the fulcrum plates varies from ·004in. to ·006in., and when in compression it varies from ·01in. upwards. The fulcrum plates, when in compression, are forced into grooves planed in the levers, which they unite; when used in tension, they are changed in position, and the maximum working load on the fulcrum plates is limited to 50,000lb. per square inch. Each fulcrum plate offers a slight elastic resistance to bending, but this resistance is balanced by certain poise weights. The machine is arranged for testing specimens for extension, compression, and transverse strains.

The meeting was adjourned after the reading of this paper.

At the meeting on the following day Mr. Wickstead explained the diagrams of the Emery testing machine, and some conversation ensued on the proposal of Mr. Martin to postpone the discussion of the paper until the members should have had an opportunity of seeing the machine at work, which is now being erected, and will be on exhibition next month, at 30, Kirby-street, Hatton Garden. The President, however, with the concurrence of the majority, decided that the discussion should be taken, and if desired the subject might be re-opened at the autumn meeting this year in London.

Mr. Walker did not think that the Emery machine was superior in point of accuracy to the better kind of testing machines now in use; but he admitted that for very great stresses, such as 400 tons to 500 tons, there might be an advantage in the adoption of the hydraulic support and reducer. All testing machines gave comparative results, and a skilful operator could very materially modify the indications of the machine, and this objection would apply equally and perhaps more so to the Emery machine.

Mr. D. Adamson did not think that hydraulic gauging was compatible with a high degree of accuracy. He himself had a machine in which there were two gauges, but as one was accidentally broken he sent it back to the maker, and when it was returned its indications did not agree with the other gauge. He sent it again to the maker to be re-calibrated, and yet the indications did not agree, whereupon the maker asked him to send him both gauges together and he would make them agree. This evidently proved that hydraulic gauges were not absolutely reliable. The speaker thought the Emery machine a good testing machine for comparative work, and he approved specially of the grip boxes, which were a valuable feature of the design. Levers with short fulcrums were objectionable, and it was preferable to employ multiple levers, the shortest fulcrum of any lever not to be less than 6in. With such a system, when the registering lever has moved $\frac{1}{10}$th of an inch, an extension of $\frac{1}{1300000}$th of an inch of the test piece can be accurately ascertained. The speaker did not think knife edges applicable to very great forces, and he suggested that it was high time we had a national testing machine of sufficient power that a 5in. or 6in. bar could be pulled asunder. It was a different thing to test a specimen of half a square inch section and one of 10 or 20 square inches, as in the latter case, especially if the metal is ductile, the outer skin is stretched before the strain reaches the inner portion of the specimen.

Mr. Stanger, of the Chemical Laboratory and Testing Works, in Broadway, Westminster, considered the Emery machine a splendid device to overcome what did not exist, viz., the friction of knife edges. In a 50-ton Wickstead machine which he has at his laboratory there is practically no friction in the knife edges, and he had as yet detected no alteration in the machine. When the short end of the lever is loaded with 50 tons, and is balanced by the moving weight, he could move the lever by applying pressure with one finger only at its short end.

Professor Barr, although admitting that the details in the Emery machine were admirably designed, pointed out that it had the radical defect of too great a multiplying power. For a dead weight weighing machine such multiplication was not objectionable; but the testing of specimens is not an operation involving merely static strains, it is a dynamical process. For commercial purposes tests must be made with reasonable speed, and assuming that a sample having 3in. extension is broken asunder in a quarter of an hour, the rate is 1in. in three hundred seconds. To prevent the levers acquiring too high a velocity, it is necessary to continually adjust the poise weights whilst the test proceeds, and if the operator were to neglect this adjustment only for one second, the indicating point—provided the system were free from inertia—would acquire a very considerable speed. As, however, the system has inertia, the point does not acquire this speed, but the strain due to the extension remains unrecorded. He also pointed out that the connecting pipe between the support and the reducer, which is only one-tenth of an inch in diameter, is too small to allow of the ready flow of liquid which, for the example just given, should take place at a velocity of 62in. per second. He commended the design of the fulcrum plates, but did not think that knife edges were so bad as made out by the author of the paper. An ordinary chemical balance will usually weigh with an accuracy amounting to the $\frac{1}{100000}$th part of the weight applied, and, in his opinion, the Wickstead machine should be equally accurate. In one of these machines he had inserted a specimen 9ft. long and loaded it to 43 tons, and when in this condition he applied a weight of 1lb. to the short end of the lever, he could make the latter move. The advantage of the Wickstead machine was that the weight could be

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kept sliding along the lever during the time the tests proceeded, whilst the lever was kept floating freely. The defect of the Emery machine, due to the inertia of the multiple levers, is, however, not apparent when the machine is used for testing ductile materials, because near the breaking point the stress curve is nearly flat, and only slight variations of strains occur. He regretted that Mr. Emery had not designed his machine with an autographic recorder.

Mr. Paget thought that the diaphragm of the Emery machine was not an objectionable feature. As a matter of fact, in aneroid barometers, which remain in perfect working order for many years, the same device was employed. The introduction of a liquid to transmit the stresses was a good feature. In ordinary testing machines, at the moment of rupture of the specimen, there is always a great jerk; but with water or other almost non-elastic liquids, no shock or jerk would be felt.

Mr. Wickstead hoped that the discussion would be adjourned, and that thereby time would be given to the author to answer certain questions which he should like to put to him. One was whether the machine had been rated for different temperatures, also whether the rating had been done with dead weights. He noticed that in the paper it was mentioned that a special rating machine was employed, which itself had been rated with dead weights; but it was possible that from various causes the condition of the rating machine became altered, and thus the indications of the large machine might be inaccurate. He did not think that the ordinary testing machines in use in this country were so inaccurate as some speakers seemed to imply. When steel makers were dependent upon accurate tests for getting their material accepted, it was clearly of the highest importance that the machines they employed should be as accurate as possible. At the Consett Iron Works, one of his machines had been in use five years. It is possible to test with this machine at the rate of thirty specimens per hour, and this machine has actually broken 250,000 specimens since it was erected. The machine is rated once a year with dead weights, and no alteration has yet been observed in it. With the large multiplication adopted in the Emery machine, great skill is required on the part of the operator so as to obtain an exact record of the load, and a clever operator could catch up the varying loads, and thereby make the machine record almost any result. He did not think the machine stiff enough for compression tests. The stress in this case would pull the two standards out of line.

Professor Unwin, who had specially gone over to Paris last year to see an Emery machine, spoke highly in favour of its accuracy. He had at the Central Institution two Wickstead machines which were very accurate; but the Emery machine surpassed them, as a chemical balance surpassed a pair of grocers' scales. When he saw the machine at work in Paris, the pressure was applied by an ordinary Worthington pump, and the indicating lever, which was kept floating during the whole time of the test—which might have lasted about ten minutes—never reached the top or bottom stop. The reason of the lower accuracy of the Wickstead machine was, in the speaker's opinion, the arrangement of the movable weight, which rolls on a path, which in a scientific instrument must be described as rough, although as a piece of practical engineering it was perfect. The Emery machine can be fitted with an autographic recording apparatus.

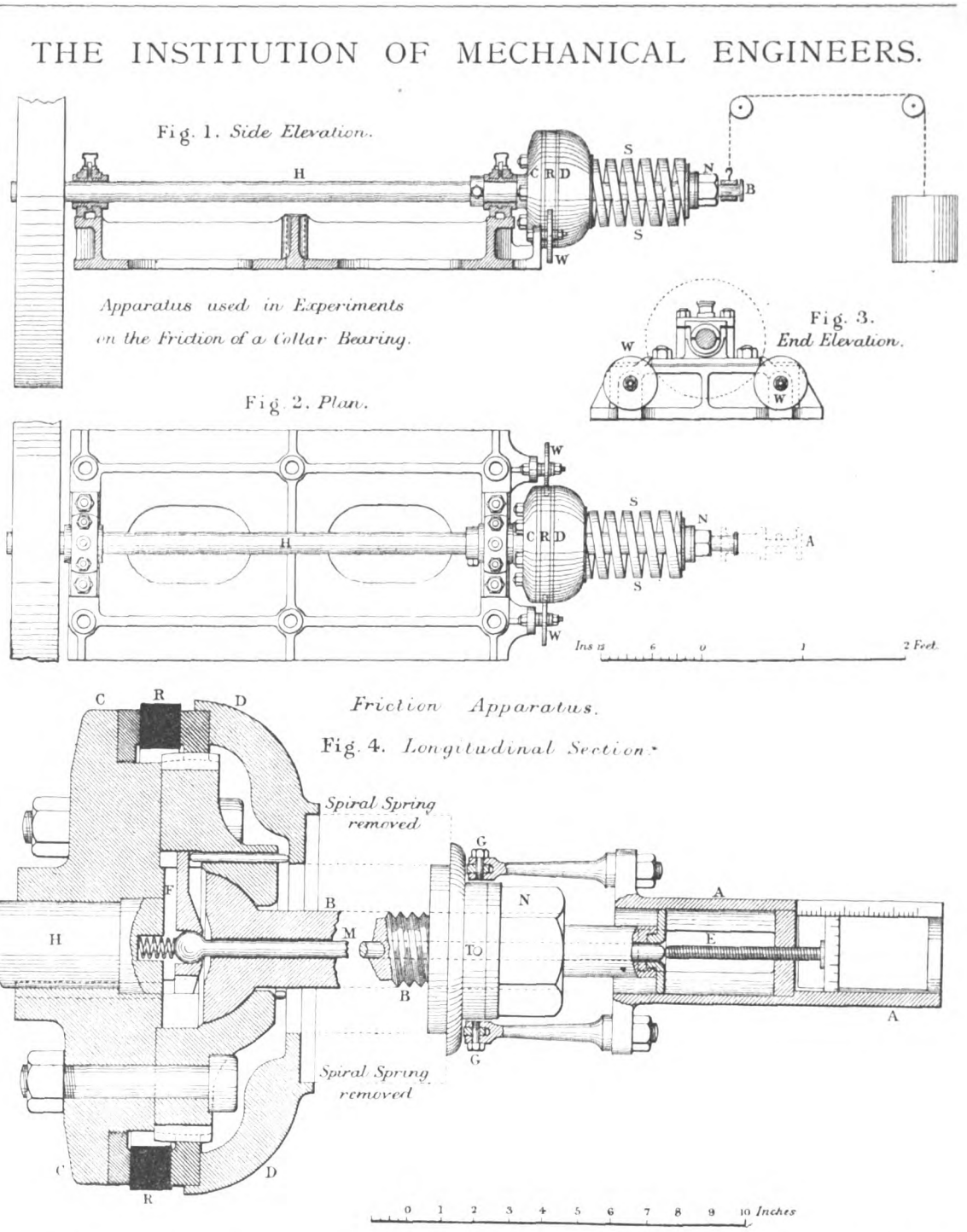
The next subject on the list was a supplementary paper on "The Use of Petroleum Refuse as Fuel in Locomotive Engines," by Mr. Thomas Urquhart, the reading of which was, however, adjourned till the next meeting of the Institution.

THIRD REPORT OF THE RESEARCH COMMITTEE ON FRICTION.*

Experiments on the Friction of a Collar Bearing.

Description of the Apparatus.—As shown in the accompanying illustrations, the machine with which these experiments were tried consisted of a steel ring R (Figs. 4 and 5), of rectangular section, which was pressed between two cast iron discs C D. The annular bearing surfaces of the discs were covered with gun metal, and were 12in. inside diameter and 14in. outside, giving on each disc an area of exactly 40 sq. in., after deducting the oil channels. The pressure was applied by a large spiral steel spring S, one end of which abutted against the front disc D, while the other end pressed against a nut N on a central bolt B connected with the back disc C. Screwing up the nut N compressed the spring S, and tended to pull the two discs together, causing them to press the ring R between them. The bolt B was connected with the back disc C by a ball and socket joint, so as to insure the pressure being distributed uniformly all round the ring. The back disc C was keyed on the end of a horizontal rotating shaft H, and drove the front disc D by means of four feathers engaging in four notches, in such a way that the front disc D, though compelled to rotate with its fellow C, was free to move in any other way relatively to it. The two discs rotating together, and pressing on the steel ring R, tended by friction to carry it with them, but were prevented from doing so by a horizontal lever L (Fig. 5) attached to the ring. The holding force on the end of the lever being measured by a spring balance, showed the amount of friction between the ring and the discs. The ring was held concentric with the discs by resting on two friction wheels W (Figs. 3 and 5), because any shoulder on the discs for this purpose was inadmissible, as introducing another kind of friction. The overhanging weight of the spring S and bolt B, which would have tended to relieve the pressure on the top of the ring R and increase it on the bottom, was taken off by a counterbalance weight, on the end of a rope that passed over two pulleys and was attached to a brass collar (Fig. 1), in which the end of the bolt B ran as in a bearing. This arrangement, while carrying the overhanging weight of the spring and bolt, allowed them to run a little out of truth if the spring required it. The true measurement of the length of the spring S, for the purpose of ascertaining the pressure exerted by it, was a point which required special attention. The bolt B had a hole drilled up its centre, along which passed a freely fitting measuring rod M (Fig. 4). The outer end of this measuring rod was flush, or nearly so, with the end of the bolt; the inner end was ball and socket jointed to a three-toe foot F; the point of each toe pressed on one end of a small steel rod, which passed freely through a guiding hole, its other end abutting against the back of the front disc D, immediately behind the seat of the spring S. Thus the three steel rods touched the back of the seat of the spring at three points, and the average of their measurements was delivered to the measuring rod M by the three-toe foot F. All the points of this system were kept in contact by a small spiral spring (Fig. 4) pressing with a definite force behind the ball of the measuring rod M. The position of the outer end of the main spring S was defined by two studs T (Fig. 4) projecting diametrically opposite each other from the washer, which was between the nut N and the end of the spring S. These two studs were touched by two notches in a gimbal ring G, by which their position was averaged, and were connected with a frame A, containing a micrometer screw E. The true length of the spring S was obtained by screwing up the micrometer screw E until its point just touched the point of the measuring rod M. The frame A, containing the micrometer screw, being rather delicate, was removed while an experiment was being made, and was applied only when an alteration or adjustment of the force of the spring S was required. It will be observed that this measuring system was entirely free from any strain applied to the spring, and also from any alteration of zero caused by the wear of the working surfaces. The scale of the spring S was found by putting the apparatus in a vertical position, and hanging weights on the driving shaft H (Fig. 1), and then reading off the micrometer. The weights corresponding with the arbitrary divisions of the micrometer were thus ascertained. The scale of the spring was about 7000lb. per inch. The micrometer screw had thirty-five threads per inch, and its head was divided into tenths and hundredths of its circumference; thus 100th of a turn of the screw was equal to about 2lb., and in testing the spring it was found that on repeating a test the reading of the micrometer could be depended on repeating itself within about that amount.

Lubrication.—The method of lubrication adopted was one which is in practical use for collar bearings, and which seemed by the light of our previous experiments to be a good one. It consisted of four grooves cut in each face of the ring R (Fig. 5), $\frac{1}{4}$in. wide and $\frac{3}{4}$in. long, arranged in a diametrical direction and so that each end of the groove was $\frac{1}{4}$in. inside the edge of the bearing surface. From each of these grooves there extended in the direction of motion of the surfaces a shallow groove about $\frac{1}{10}$in. wide and of a serpentine form, tapering away to nothing in about $3\frac{1}{2}$in. length. These grooves were each supplied by a pipe P, into the mouth of which oil was dropped from a small cock connected with an oil tank K, so that the rate of supply to each set of grooves was easily seen and regulated, and uniformity of supply was secured. As we were led to expect by our previous experience, the magnitude of the friction depended considerably on the rate of lubrication; but we soon found a minimum rate of lubrication with which the bearing would work safely, such that, if the lubrication was less, the bearing would show signs of seizing by rapid variations of friction and



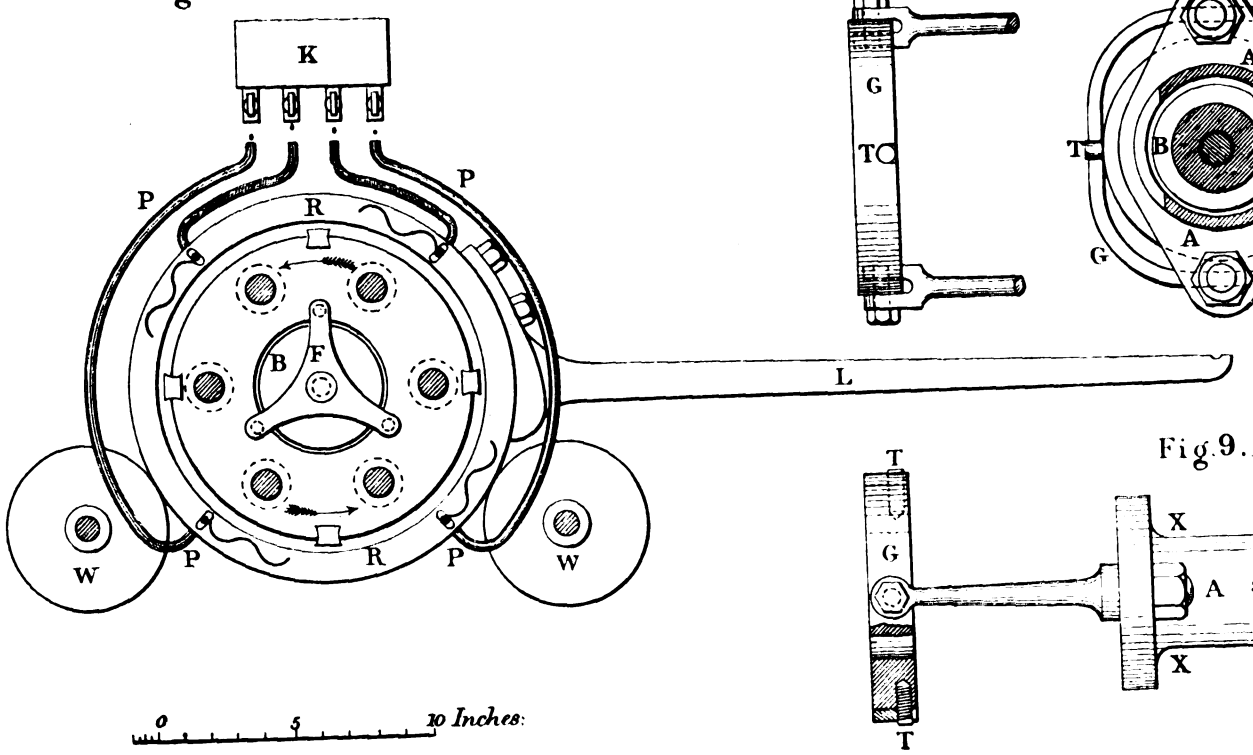
* Read at the Institution of Mechanical Engineers, on the 3rd inst.

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THE INSTITUTION OF MECHANICAL ENGINEERS.

Friction Apparatus

Fig 5. *Transverse Section.*



Measuring Apparatus.

Fig.6. *Elevation.*

Fig. 7. *Transverse Section at* XX.

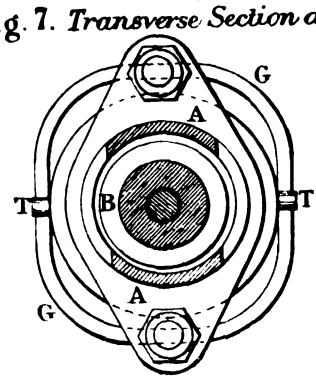


Fig. 8. *Transverse Section at* YY.

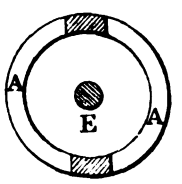
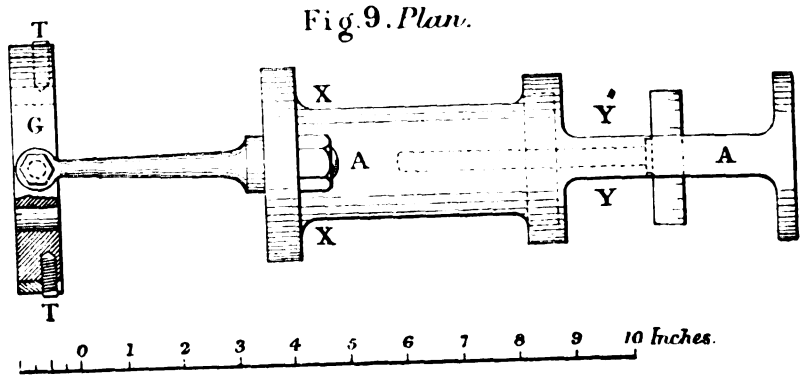


Fig.9. *Plan.*



by a jerking of the lever; and if it was much more, the friction, though less, was not reduced in proportion to the increase of the oil supply, and consequently it might be assumed that the oil was being wasted. This minimum safe rate of oil supply, with which the friction recorded in the tables corresponds, varied from 60 to 120 drops per minute for both faces, the quantity varying with the speed and load. The oil used throughout was a mineral lubricating oil.

Results of the Experiments.—The machine was run for a week with varying loads, in order to bring the surfaces into a proper working condition before the experiments recorded in the tables were begun. The experiments were tried in the order shown in Table I., the variations of load being run through with the lowest speed first, then with the next, and so on till the highest speed was reached. Except with the lowest loads, it was found impossible to keep the bearing cool without a little water running over it. The friction given in the tables is that of one face of the annular bearing surfaces, at the mean radius of the face, viz., 6½in. It will be seen from Table I. that the revolutions per minute were not very constant, owing to the varying speed of the shafting by which the machine was driven. The variation in speed, however, was but small in each individual experiment, not amounting to more than 1 per cent. above or below the speeds given in Table I. In order that the results might be plotted on a diagram, it has been necessary to reduce the results to regular speeds at regular intervals by interpolation. The speeds taken were 50, 70, 90, 110, and 130 revolutions per minute; and the results so reduced are given in Table II., from which is plotted the diagram shown in Fig. 10. When examining this diagram, it must be remembered that the friction varies somewhat with the rate of lubrication, and that the minimum safe rate of lubrication is not very exactly defined: this must explain one or two slight irregularities in the diagram. For instance, with loads of 1200lb. and 2400lb. there can be no doubt that at fifty revolutions the rate of lubrication was too great, and the friction consequently somewhat too small; and that, if the experiments were repeated, there would be no difficulty, by reducing the oil supply, in bringing the friction more nearly to agree with that of other speeds. But in these experiments all such adjustments were carefully avoided, as tending to deprive the experiments of value. Nevertheless, in the majority of instances the results are extremely well defined, and point to the fact that the friction is independent of the speed. For instance, with a load of 1200lb. four different speeds—viz., 90, 110, 70, and 130 revolutions per minute—give the same friction so nearly that the greatest variation from the mean is only 2·19 per cent. With a load of 1800lb. four different speeds—viz., 130, 90, 50, and 110 revolutions—give the same friction so nearly that the greatest variation from the mean is only 2·57 per cent. With a load of 2400lb. and three different speeds—viz., 70, 110, and 90 revolutions—there is a variation of only 2·29 per cent. from the mean friction. Again, with a load of 3000lb. the greatest variation from the mean with five speeds—viz., 130, 110, 90, 50, and 70 revolutions per minute—is only 2·12 per cent. The above speeds are given in the order of the magnitude of the friction; and in these small variations it does not appear that there is any well defined connection between the speed and the friction. For instance, with 1200lb. the highest speed gave the lowest friction, while the reverse was the case with the higher loads. Thus out of twenty experiments the results of sixteen agree with one another so nearly that the greatest variation from the mean is only 2·57 per cent.; an agreement so close that we think we may with confidence accept their testimony, and reject the remaining four. The diagram shown in Fig. 11 is plotted in this way, and may be considered to sum up generally the results of the experiments.

General Conclusions.—This kind of bearing is evidently very inferior to a cylindrical journal in its power of carrying weight; 3000lb. on 40 sq. in., or 75lb. per square inch, was as much as it would bear at the highest speed, though it carried 90lb. per square inch at the lowest. The co-efficient of friction is also much higher than for a cylindrical bearing, and the friction follows the law of the friction of solids much more nearly than that of liquids. All this is doubtless due to the much less perfect lubrication applicable to this form of bearing compared with a cylindrical one. The co-efficient of friction appears to be about the same with the same load at all speeds, or in other words, to be independent of the speed; but it seems to diminish somewhat as the load is increased, and may be stated approximately as 1-20th at 15lb. per square inch, diminishing to 1-30th at 75lb. per square inch.

TABLE I.

Experiments on the Friction of a Collar Bearing. Results obtained from the machine.

The friction given is that of one face of the annular bearing surfaces, at the mean radius of the face, viz., 6½in.

Revolutions per minute. No.	Total load. Lbs.	Friction. Total. Lbs.	Friction. Co-efficient.	Temperature of air. Fah.
51	600	27·5	0·0458	68*
48	1200	43·7	0·0364	68*
42	1800	61·2	0·0340	68†
44	2400	62·5	0·0264	68†
48	2700	96·2	0·0356	82†
43	3000	105·0	0·0350	68†
50	3300	111·2	0·0337	68†
50	3600	112·5	0·0312	68†
70	600	38·7	0·0646	69†
68	1200	57·5	0·0479	69†
72	1800	72·5	0·0403	72†
70	2400	90·0	0·0375	72†
68	2700	90·0	0·0333	69†
70	3000	102·5	0·0341	72†
70	3300	106·2	0·0322	69†
68	3600	155·0	0·0430	72†
87	600	25·0	0·0416	62*
94	1200	60·0	0·0500	62†
96	1800	62·5	0·0347	62†
100	2400	85·0	0·0354	80†
100	2700	95·0	0·0352	72†
96	3000	105·0	0·0350	72†
99	3300	118·7	0·0360	82†
—	3600	—	—	—‡
127	600	37·5	0·0625	72†
124	1200	57·5	0·0479	72†
126	1800	66·2	0·0368	68†
145	2400	105·0	0·0437	68†
142	2700	105·0	0·0389	75†
120	3000	106·2	0·0354	68†
—	3300	—	—	—‡
—	3600	—	—	—‡

* Without water. † With water. ‡ Seized.

TABLE II.

Experiments on the Friction of a Collar Bearing. Results of Table I. reduced to uniform speeds (Fig. 10).

The friction given is that of one face of the annular bearing surfaces, at the mean radius of the face, viz., 6½in.

Speed. Revolutions per minute.	Total load. Lbs.	Friction. Total. Lbs.	Friction. Co-efficient.
50	600	27·0	0·0450
	1200	45·0	0·0375
	1800	64·2	0·0357
	2400	68·7	0·0286
	2700	95·5	0·0354
	3000	104·2	0·0347
	3300	111·2	0·0337
	3600	112·5	0·0312
70	600	38·7	0·0646
	1200	57·7	0·0481
	1800	71·7	0·0399
	2400	90·0	0·0375
	2700	90·2	0·0334
	3000	102·5	0·0341
	3300	106·2	0·0322
	3600	160·0	0·0444
90	600	26·0	0·0433
	1200	59·5	0·0496
	1800	65·0	0·0361
	2400	86·7	0·0361
	2700	93·5	0·0346
	3000	104·5	0·0348
	3300	114·7	0·0348
	3600	—	—
110	600	32·2	0·0537
	1200	58·7	0·0489
	1800	64·2	0·0357
	2400	89·5	0·0373
	2700	97·5	0·0361
	3000	105·7	0·0352
	3300	—	—
	3600	—	—
130	600	38·5	0·0642
	1200	57·0	0·0475
	1800	66·7	0·0371
	2400	98·5	0·0410
	2700	102·0	0·0378
	3000	106·7	0·0356
	3300	—	—
	3600	—	—

SIEMENS-MARTIN STEEL.—The Altos Hornos Company, of Bilbao, Spain, have started a Siemens-Martin furnace of a daily output of 20 to 25 tons. The gas producers are of the Wilson type. No difficulty was experienced in starting the furnace as soon as it was ready, and the quality of the steel turned out is good.

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FARM HOMESTEADS OF ENGLAND.

By Professor T. J. Elliot.

In a former article on this subject, which appeared about two months ago (see page 250), I endeavoured to show the proportion of rent per acre per annum on a farm of 200 acres received by the landlord for his land, and what portion of the annual rent was swallowed up by the homestead. I will now try to show that the landlord gets more rent in comparison for his land per acre as the size of the farm increases. And if I succeed in doing so, the conclusion will force itself upon us—that it is for the landlord's interest to have his estate divided into as few farms as possible, in order to minimise the amount of original capital spent in the construction of their homesteads, and to increase his actual income from land. I will take a farm of 400 acres, which is double the area of the former. It will require a house, a set of farm buildings, and five cottages. Now, a farm of 400 acres does not require double the accommodation of one of 200 acres. The farm house will be the same as far as convenience and size are concerned. The buildings would be slightly larger, with additional yards for young stock, and sheds for waggons and implements, and five instead of three cottages. Thus the proportionate interest of the landlord's capital will be greater on the land and less on the buildings than in the former case. The 400 acre farm at 30s. per acre equals a rent of £600 per annum, allowing the same percentage for repairs as in the case of the 200 acre farm, and estimating the fee simple value to be equal to 28½ years' purchase.

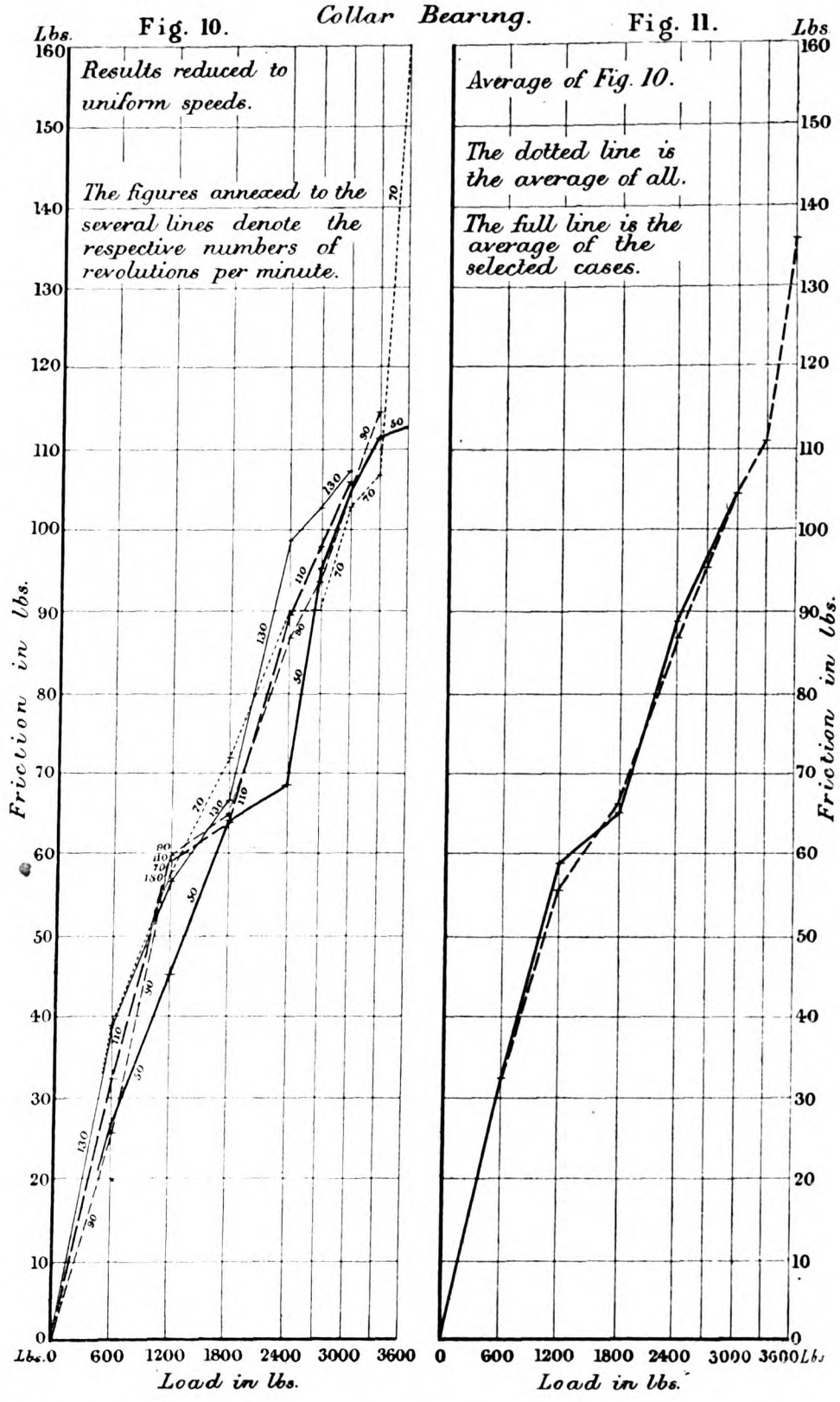
We have £600 by 28·5 years' purchase equal to £17,100 fee simple value of farm, including buildings. A house, set of farm buildings, and five cottages will cost £1,960. Making roads, fencing, and water supply will amount to £500, making a total of £2,460. This amount deducted from the fee simple value of the holding gives £14,640, and represents the value of the land without buildings. Therefore, £14,640 divided by 33⅓ years' purchase (which is equivalent to the value of land without being chargeable with repairs to buildings, and also of Consols at par) equals £439. 4s. per annum, or 22s. per acre. The rent apportionated, therefore, stands thus: For land, 22s. per acre; for buildings, 8s.; making together the rent of the whole farm 30s. per acre. It will be remembered that the proportion on the 200 acre farm was 20s. and 8s. respectively for land and buildings; so that in this case the landlord obtains 2s. per acre increase of rent for his land, and could, therefore, afford to let the farm of 400 acres at 28s. per acre, when at the same time he must charge 30s. per acre for a farm of 200 acres if he is to receive a similar net rent per acre. Instances of this might be multiplied, but I think the two cases I have quoted will sufficiently prove the theory I have advanced. I will only in passing mention that in the case of a farm of 1000 acres being divided into two of 500 acres each, the landlord would have to obtain 10s. an acre increase on the two farms of 500 acres each, so as to be equal to the net rental value of one farm of 1000 acres. These are not mere estimates, but data derived from facts—and facts that every land owner ought to know. It follows, therefore, that it is to the interest of both landlord and tenant that our farms should not be sub-divided into small holdings, such as are advocated at the present day, for by so doing the landlord sacrifices income through expenditure on buildings, and the tenant pays a higher rent per acre.

Again, assuming the landlord to have borrowed the capital required for the erection of the homesteading, cottages, and for making improvements (such as road making, fencing, and water supply) from such a society as the General Land Drainage and Improvement Company, the two cases would stand thus: For the 200 acre farm £1,900 would have to be borrowed, for which the landlord would pay as rent charge £6. 3s. 11d. per annum for thirty-one years for every £100 borrowed (thus paying principal and interest in 31 years), or £117. 14s. 5d. on the total amount, which is equal to nearly 11s. 9d. per acre over the whole farm. In this case the landlord is the loser, as he only receives £100 rent for improvements which have cost him £117. 14s. 5d.—the borrowed capital. For the 400 acre farm it would be necessary to borrow £2,460, for which sum the same society would make a rent charge of £6. 0s. 4d. (see their scale of charges published in the Journal of the Transactions of the Royal Agricultural Society of England, 2nd series, Vol. IV., part I., 1868, page 135) for every £100 borrowed, or £147. 0s. 3d. on the total amount. Here the landlord would reap the benefit, seeing he obtains 8s. an acre, or £160 a year as rent for 7s. 4d. per acre or £147. 0s. 3d. borrowed. This forms another factor as far as the landlord is concerned in favour of large holdings *versus* small holdings. I will not venture to treat the subject from an agricultural point of view, because in doing so I should be going beyond the scope of the subjects generally dealt with in *Industries*. I will only add that agricultural facts would tend to strengthen the claims of the land owners.

THE INSTITUTION OF MECHANICAL ENGINEERS.

(For description see page 465.)

Collar Bearing.



THE CLYDE TIMBER CARRYING TRADE.

That our legislators ought to carefully study the effects of their actions on trade has been most markedly shown by the effect of recent enactments on the Clyde timber carrying trade. From the time the Board of Trade officials adopted what many in the shipping community allege to have been harsh and extreme measures regarding the vessels engaged in this trade, it began to decline, and now the large fleet of timber carrying ships belonging to the Clyde, and sailing between that port and Quebec and the Gulf of St. Lawrence, has practically ceased to exist. Formerly, in the spring of each year, all was bustle about the quays and harbours with the fitting out of the fleets; but now all is changed. After the passing of the Plimsoll Act owners were so much worried and harassed that they disposed of their property, chiefly to Norwegians, who were able to carry on the trade as they pleased and without reference to any Acts of Parliament. While the British shipowner is restricted as to carrying deck loads, the foreigner can do as he likes, and under these circumstances he has entered into active competition with the British shipowner, and being able to sail his ships cheaper, both as to men and provisions, he is able to underbid the British owner in the market, with the result that freights from Quebec for the past two or three years have fallen so low as barely to give a sufficient return to cover expenses, and many wooden ships have been lying up on the Clyde "eating their heads off." Under these circumstances, companies and individuals holding such ships have resolved to get rid of them, and during the past few weeks a large amount of tonnage has changed hands at a low rate. We do not for a moment wish it to be supposed that we object to the Government interfering, when necessary, for the protection of sailors, but we wish most decidedly to protest against any arrangement which gives foreigners an advantage over British shipowners.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 8TH MAY, 1888.

THE IRON MARKET.—The situation has altered but little in the course of the last week, and no other change than a steady development is to be looked for for some time to come. The principal factors are: The course of trade in crude iron in the Eastern departments, and the steadfastness of the manufacturers of the North in their resolve to maintain the prices of finished iron. The blast furnace owners are not likely to yield their position in the face of a brisk demand, rising prices for coke, and low stocks; and the makers of finished iron have shown themselves determined by combination to keep up the rates to a remunerative level. Hence the prospect is distinctly encouraging, and we may reasonably expect that the coming summer will be a period of constant, if slow, expansion. This view is now generally held by consumers, who are laying aside their reserve, and come into the market to buy more freely. The Paris merchants, recognising the necessities of the situation, have at length advanced their prices. One important house has issued a circular fixing the May price of bars at £6, and joists are advanced from £5. 10s. to £5. 12s. A demand has sprung up for old rails, which sell at 66s. to 68s. a ton. Reports received from the provinces all agree in describing business as fairly active and sound.

THE METAL MARKETS.—The event of the week is the collapse of the tin market. For several weeks past it had been plainly evident that the end of the unprecedented inflation was near. It has come, and the collapse has been as unprecedented in extent as the inflation. The record has been badly beaten this time, for never has the price of tin dropped £75 a ton in one week before. Probably we have before us now, as a consequence of the absurdly high rates which have prevailed of late, a long period of low prices. That copper is destined to follow the course of tin no one doubts, the only question being as to when the end will come. Apparently, this time is not at hand yet, for the Société des Métaux has, it is said, contracted with the Cape Copper Company for the whole of its output for three years at least at the price of £70 a ton. The market for copper remains unaltered, a feeble demand, with growing stocks, being its distinctive features. Lead has lost the rise of 8s. a ton gained last week. Spelter, too, is gradually receding. The Vieille-Montague Company has announced a reduction of 16s. per ton for zinc.

JAPAN AT THE PARIS EXHIBITION.—The Minister of Commerce and Industry has just received from the Japanese Government a detailed account of the exhibits by which Japanese industry will be represented at Paris next year. This collection of Japanese manufactures and works of art will be the most complete ever yet brought together.

RESISTANCE OF CONCRETE TO SHELL FIRE.—Experiments made at the camp at Châlons have shown that concrete affords great resistance to shell fire, even when the shells are charged with melenite or other powerful explosives. In consequence of these experiments the Minister of War is about to ask the Legislative Chamber to sanction a scheme for facing the casemated forts situated along the frontiers with cement concrete. The same shell fire which was directed against the concrete covered works proved destructive to iron clad turrets.

BERLIN, 7TH MAY, 1888.

THE COAL MARKET.—In my last letter I drew attention to the increasing imports of coal from Russian Poland, and to the depression in the price of the inferior kinds of Silesian coal caused thereby. This view is borne out by the results of recent tenders invited by the Breslau railway administration. Tenders were invited for 180,000 tons of large coal and 100,000 tons of nuts for locomotive purposes, and the quotations varied between 5s. 4½d. and 4s. 2½d. for large coal and 4s. 9d. and 4s. 2½d. for nuts. Borsig quoted for large coal 5s. 2½d., and Kattwitz 5s., whilst the Waldenburg mine made the lowest tender at 4s. 2½d. for both kinds of coal.

THE IRON MARKET.—The artificial inflation of prices still continues, and on the 20th of last month a further rise of 2s. per ton was resolved upon by the southern group of the German rolled iron syndicate. The base price of rolled iron in the South is now 122s. In Westphalia the struggle between blast furnace and rolling mill owners still continues, and the latter, with a view to emancipate themselves from the burden of high prices imposed by the crude iron syndicate, contemplate the erection of blast furnaces. Thus they regard with disfavour the extension of a policy to other trades which they were the first to inaugurate for rolled iron. Meanwhile, English pig is reaping the benefit of the situation. The condition of the wire trade, especially as regards rolled wire, is unsatisfactory. Inquiries are plentiful, but orders are scarce, and the export trade is almost at a standstill. What little demand there is for export can easily be met by the stocks in the hands of dealers. With the high prices of the raw material and the restrictions imposed by the syndicate, individual wire makers find it extremely difficult to compete against their English and Belgian rivals in neutral markets. At a recent sale of old rails by the Breslau railway administration the highest prices obtainable were 66s. 10d. at Breslau, 65s. 4d. at Oels, 69s. at Kreuzburg, and 75s. 6d. at Tarnowitz.

THE BASIC PROCESS IN SILESIA.—Two large companies, one a mining and metallurgical works, and the other a works for the supply of railway material, acquired in 1884 the sole right to use the Thomas-Gilchrist patent in Upper Silesia, for the consideration of £20,000. Although in Westphalia, and in other parts of Germany, the basic process has resulted in a great financial success, in Upper Silesia this has up to the present not been the case, and the dividends paid by both companies have been extremely meagre, notwithstanding the fact that their sole right to make basic steel has never been infringed.

THE MANUFACTURE OF TAPESTRY.—The state of trade throughout Germany, as regards the manufacture of tapestry, is at present very satisfactory. Cheap articles are mostly in demand, and those of better quality are not much asked for. Our exports to America, Spain, Belgium, Switzerland, and Italy have shown very favourable results; but those to Austria have, in consequence of the increased import duties, considerably declined.

RAILWAY CONTRACTS FOR SOUTH AMERICA.—The Chilian Government asked, a short time ago, for tenders for the construction of eleven lines of railway, amounting in the aggregate to some 700 miles. The time allowed for the receipt of tenders by the Minister of Public Works at Santiago expires on July 31st next. A great effort, to which the Government contributes a powerful support through the Consular agents, is being made to secure the larger part of these contracts for German firms. Letters from Santiago describe the situation as highly favourable to the success of this effort, English influence having been much weakened of late.

HOPS.—The province of Posen is, with the exception of Bavaria, the largest hop producing district in Germany, and the market there is at present very firm. The better qualities of hops are in good demand, but the prices are high in comparison with those quoted by Bavarian and Bohemian growers, and in consequence but few contracts are being made; only small parcels of medium qualities find a market, and no sales whatever are taking place in inferior qualities.

VIENNA, 7TH MAY, 1888.

THE IRON MARKET.—The situation of the iron market throughout the empire is favourable; and although the previous hopes for a brisk trade in building iron have not been fully realised as far as the Vienna market is concerned, the demand for girders and joists from the provinces is sufficiently great to counteract the weakening tendency at the capital. Even crude iron is beginning to revive, and considerable transactions have taken place during the past week. The firmness of the market has been strengthened by the shutting down of two blast furnaces for repairs at the Witkowitz works. These furnaces will not be put in blast again for two or three months. Business is also brisk in bar iron and sheets. The Alpine Mining Company, for instance, have booked sufficient orders for heavy plates to absorb their production for the next three months. In tinned and galvanised sheets business is also good. The Hungarian railways are placing, or have placed, orders for fifty locomotives, and the Austrian State railways are expected to shortly place orders for two hundred locomotives, and for a proportionate amount of other rolling stock. Locomotive and waggon works generally will thereby find remunerative employment for at least one year. The Vienna representative of Messrs. Nobel, of St. Petersburg, has just placed an order for ten petroleum tank waggons with the Austrian State railway works in Vienna. These waggons must be delivered by August next, and are intended for the carriage of petroleum in bulk from Fiume and Trieste to the interior.

SMALL ARMS.—The manufacture of small arms is an old established staple industry of Ferlach, in Carinthia, but like other trades in the duchy it has of late years considerably suffered. The local government, with a view to benefit this industry, have lately approached the Minister of Commerce with a request to assist the Ferlach manufacturers in forming new connections with export undertakings. The result of this step was that a special department has been assigned to the Ferlach manufacturers in the permanent sample exhibition of the Austrian Export Company. This has had the desired effect, as both the Export Company and the Transmarine Trading Company have placed considerable orders in Ferlach. The gun makers there have agreed to supply 1000 guns within six weeks. The weapons are intended for East Africa and for Singapore. Encouraged by this success the Ferlach gun smiths have formed themselves into a syndicate to watch over the interests of the trade.

ELECTRIC LIGHTING BY WATER POWER.—As already reported in one of my previous letters, plans were elaborated last year for a central electric light station for the town of Trient, the power to be supplied by the Fersina brook, a tributary of the Etsch. These plans have been adopted with certain modifications in detail, and work has since then steadily progressed. The waterfall is 2000 yards from the centre of the town, and 330ft. above it. The water for the turbines is carried by a tunnel 2000ft. long to an artificial reservoir of 900 tons capacity, and the supply is at the rate of 1600 gallons per minute. From the reservoir the water is carried by iron tubes of 35in. diam. to the turbine house, which is 2700ft. distant, whilst any surplus of water is drained off through another main 700ft. long back to the Fersina brook. The supply main for the turbines presented special difficulties on account of the many bends which were necessitated by the irregular condition of the ground, and only 70 per cent. of the whole line consists of straight pipes. The lower portions of the supply main have to stand a pressure of 120lb. per square inch; but they have been tested up to 375lb. The sluice valve at the lower end of the supply main is subjected to a total pressure of 164 tons. The total power available varies from 800 h.p. to 400 h.p., according to the season and climatic conditions. The power required for lighting purposes is estimated at 240 h.p., and the town authorities who are carrying out this work propose to utilise an average of 300 h.p. in the day time, and 150 h.p. in the evening for working motors. The tunnel and reservoir have cost 122,000fl., and the central station is estimated at 98,000fl., making a total of 220,000fl. The working expenses, including depreciation and interest, are estimated at 48,000fl., and to cover this expenditure the light would be supplied at the rate of 3·75 kreuzer, or say about ·7d. per 16 c.p. lamp hour; but when a greater number of lamps are taken up by the subscribers the town will be able to reduce the cost per lamp hour considerably below the figure quoted. The installation is to be in working order in November next.

BRUSSELS, 8TH MAY, 1888.

THE COAL MARKET.—The situation is maintained. Prices are 5s. 5d. to 8s. for unscreened coal, 8s. 5d. to 10s. for household coal, and 11s. 7d. for coke, at which rates contracts are being made for three to six months. In several mining districts the men are showing a disposition to strike for higher wages; but it is difficult for colliery owners to make a further advance in the rate of remuneration, as most of them have already given an increase of 10 per cent. The balance sheet of the Marchienne Colliery Company, which has a capital of £100,000, shows a profit of £10,344 on last year's working. The Carabinier Colliery at Châtelet, with a capital of £80,000, made a profit of £2,342. The Belgian producers of coke have difficulty in competing with French producers of the Nord in the Nancy district. In the Longwy districts, Belgian and French coke are on the same footing.

THE IRON MARKET.—There is little change in the iron market since my last letter. Manufacturers of finished iron who have no blast furnaces complain of the dearness of pig iron, which makes it impossible for them to compete in the home market with rivals who have furnaces of their own, or to obtain orders from abroad. It would be far more satisfactory if some understanding could be come to between rolling mill and blast furnace owners. Imports of foreign pig continue to increase largely. In the Charleroi district, English pig is sold at 42s. 5d., and is giving great satisfaction, as it contains less phosphorus than the native pig, and contains about ½ per cent. of manganese, which greatly improves its quality. The price at which it is sold is from 10d. to 1s. 8d. per ton less than that asked for pig made from Belgian ore. There is a good demand from Italy for girders, but at a reduction of 4s. per ton as compared with recent contracts. Steel is weak, and the tendency is in favour of buyers. Formidable foreign competition will have to be encountered at the next State railway contracts. The Société de Construction of Braine-le-Compte has obtained the concession for the Nauplie-Calamata railway in Greece.

GLASS WORKS.—The demand from England and America is good, and orders have been received from the United States which had been withheld during the discussion on the tariff, which has now been adjourned. Prices at New York are firm. The Société Anonyme de Verrerie, of Charleroi, made a profit of £3,546 in 1887, allowing for a dividend of 10 per cent.

TEXTILES.—Owing to the spinning mills having ample stocks, the sale of Russian hemp has been limited in extent. For home grown flax of good quality there is a considerable inquiry at firm prices. The demand for Russian flax is maintained.

THE EXHIBITION.—The nominal day for opening the Exhibition was Saturday last, when the gardens were opened to the public. The actual state of affairs is as follows: The buildings of the English section are ready, and exhibitors are installing their exhibits, under the personal superintendence of Mr. Lee Bapty; the machinery in motion here includes steam engines, spinning, weaving, aerated water, and brick making machinery; and among other industries represented are shipbuilding, cutlery, textile fabrics, china and glass, electricity, gas, and leather. In the German section many exhibitors have arrived, but their stands are not yet ready for them. The Commissary-General is M. Cornély, who is also Inspector-General of the Grand Concours, a combination of functions which is of doubtful expediency. The French section cannot be got ready for a month at least, this portion of the building not being roofed so far. The Belgian portion is also all behindhand; in the machinery gallery the floor is being laid down. The driving shaft for the machinery in motion has been fitted, and the counter shaft for the electric lighting is now being put up. One of the Naeyer boilers is erected, but none of the engines have arrived. There will be four large engines supplied by Carels, Hoyois, and the Phœnix Society for supplying the power for the electric lights; but only half of the available power will be utilised, owing to the adoption of a more restricted scale of electric lighting than was originally intended. No machines have been put up in the gallery, and the annexes are empty. As I have already announced, special efforts have been made to render the gardens attractive, and the electric lighting there

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is very effective. Pieper, of Liège, supplies forty arc lamps of 10 ampères, fitted to posts 40ft. high, and the Brush Company will probably furnish a similar number of lamps. It is difficult to say at the present moment what measure of success the Exhibition is likely to achieve.

DÜSSELDORF, 7th May, 1888.

The Iron Market.—The German market for iron is now, as regards prices, largely dependent upon the state of trade in England. The difference has become such that English iron, both crude and finished, can be delivered duty paid, at a price which leaves a fair margin for profit, and consequently the fluctuations of the English markets, and the general level of prices, operate strongly here, and control, to a considerable extent, the situation. It is the most effectual check we have against a further advance. The trade in crude iron is fairly animated. Forge pig is somewhat dull, but there is increasing activity in other kinds. Life has been infused into the trade in spiegel pig, by orders received from the United States this week for 10,000 tons of the 20 per cent. quality. There are also prospects of other large orders from the same quarter. For basic steel pig there is a steadily growing demand, and prices have risen above the syndicate minimum. Nothing can now be bought for less than 46s. Foundry pig, too, is much sought after. In finished iron and steel the trade is on the whole healthy and strong. Bars are not so eagerly sought after as formerly, but there is a steady demand for home consumption sufficient to keep all the rolling mills working full time without accumulating stock. If only the foreign demand were moderately good, this branch of business would be very animated. Foreign orders for plates are fairly plentiful, and no order can now be accepted for delivery in less than six weeks; but, as I pointed out last week, the Siegen district is less favoured in this particular. The market is dull for sheets, which, however, are likely soon to come into better demand, for besides the fact that the building season is now again upon us, most of the manufacturers who held aloof from the syndicate have now joined that association, and steps have been taken to establish at once a common sales bureau. Founders' orders come to hand plentifully, and engineers are all busy. In nearly every direction the outlook is better than it was three weeks ago.

German Iron Abroad.—The German export trade in iron is constantly shrinking. This effect of the high prices, which are out of accord with those of rival producers, must soon make itself seriously felt. The total exports of all kinds amounted to 71,409 tons in March, against 77,183 tons in February and 78,422 tons in January. An analysis of these totals, however, shows that the falling off is of less importance than it appears at first sight to be; for we find a considerable increase in all manufactured goods, and in angles and plates. The shrinkage is in pig iron and scrap, and half wrought iron, bars, rails, and wire. The following figures show the exports in the first quarter of the current year, compared with those of the corresponding period of 1887: Pig iron, 36,634 (58,664) tons; scrap, 5460 (17,433) tons; half wrought iron, blooms, ingots, and puddle bars, 6558 (12,486) tons; finished iron, bars, angles, plates, &c., 56,258 (72,050) tons; wire, 47,111 (67,150) tons; rails, 18,188 (42,780) tons; other railway iron, 8286 (9985) tons; and manufactured goods other than machines, 48,519 (41,499) tons—total, 227,014 tons, against 323,047 tons last year, a decline of 29·7 per cent.

The Jute Industry.—The jute industry is suffering from over-production. The evil is now recognised, and measures are to be at once taken to remedy it. At a meeting of the Association of German Jute Manufacturers, held last month at Hamburg, to consider the situation, a resolution was agreed to unanimously, to restrict production by reducing the hours of labour to sixty a week. The quantity of raw jute imported in the first quarter of the current year amounted to 231,749cwt., against 227,552cwt. in the corresponding period of 1887, the exports being 5472cwt., against 3796cwt.; the quantity left for consumption in the country is 226,277cwt., against 223,756cwt. last year. The imports of jute yarns in the three months amounted to 8400cwt., against 9254cwt. in 1887, while the exports for the same periods show a small decline from 11,694cwt. in 1887 to 11,628cwt. in 1888.

LILLE, 8th May, 1888.

Textile Manufactures.—The markets for textile goods have developed no new feature since my last report. Generally there is less distrust of the future, leading to a better tone of affairs, which must be regarded as an improvement; but this amelioration is not yet sufficient to enable us to discern an increase of activity. During the past week an average amount of business has been transacted in linen goods. Most of the reports received from the Armentières district express disappointment over this year's spring trade, but this arises more from unrealised hopes of better times than from a falling off of business. In cotton goods there is not much doing. Wool is very firm in price, and the latest Roubaix quotations are a shade higher than those of a week ago. This firmness is, however, due not to a strong demand on the part of consumers, but to speculative buying to cover accounts opened for the fall some two months ago. For manufactured woollen goods there is a fairly active demand in some quarters, but nothing approaching to animation. We learn from Calais that the tulle trade of that locality has not realised the hopes formed concerning it. The season, which was expected to be one of considerable activity, has scarcely risen above dulness. American orders have been plentiful, but the home demand has shown a degree of languor for which it is not easy to account. From Lyons we learn that raw silk is being more actively dealt in. Prices are irregular, but there has been no decline.

Flax and Yarn Markets.—The flax market is lifeless. Only a few dealings of small importance have been recorded this week, and for these the prices are irregular. There is not much home grown flax on offer, while the demand is good. All accounts agree in describing the new crop as making satisfactory progress. The market for yarns has not materially changed since last week; the distinctive features are the same, viz., a brisk demand for the finer numbers, and dulness with prices in favour of buyers for the heavier sorts.

Raw Textile Materials.—The Customs returns show some important changes in the trade in raw textile materials in the first quarter of the current year, relatively to the corresponding period of 1887. Thus, among the imports, the declared value of flax is £921,520 (£823,200); that of jute, £138,520 (£154,080); that of cotton, £1,959,200 (£3,971,760); and that of wool, £4,021,240 (£3,130,080). It will be observed that there is a heavy falling off in cotton, and a large increase in wool. The values of the exports in the same period are: For scutched flax and tows, £110,760 (£118,320); for cotton, £363,760 (£398,760); and for wool, £1,125,040 (£888,520).

The Iron Market.—The past week has brought nothing new to the iron market of this locality, and this statement is, perhaps, the best that could be made concerning the trade in iron, which for several weeks past has been sufficiently active to keep all manufacturers fully employed. The market seems at last to have settled down to a steady course of business, with prices at a fairly remunerative level. From time to time fresh blast furnaces are brought into operation, for the consumption of pig iron is somewhat in excess of production. A serious accident occurred at Hautmont last week, on the occasion of re-lighting two blast furnaces. In consequence, as it seems, of the air not having been completely driven out of the gas pipes, a terrific explosion occurred, seriously injuring twelve men—three, it is feared, mortally—and doing great damage to property.

WINTERTHUR, 7th May, 1888.

The Paris Exhibition.—Up to the present 732 Swiss firms have notified their intention to be represented at next year's Paris Exhibition, as compared with 962 firms which participated at the Exhibition of 1878. They will occupy 3800 square metres of floor space, and 1400 square metres of wall space. The exhibits will represent a value of £108,000. Engineering will be the industry best represented, there being 136 exhibitors in this section, occupying 3000 square metres.

Our Postal Service.—The returns of the Post Office are, in a certain measure, an indication of the industrial activity of a country, and in this respect it may be interesting to note the enormous increase which has taken place in the number of letters and other articles forwarded through the post since the time when Switzerland began to be an industrial nation. In 1850 the Federal Post transmitted 1,290,716 parcels, 10,601,325 book packages, and 15,106,117 letters. Last year the figures were 11,451,456 parcels, 64,373,458 book packages, and 132,313,967 letters. The money orders transmitted amounted to 309,063,981 francs.

MADRID, 7th May, 1888.

Submarine Torpedo Boat.—Major Cabanyes, of the Artillery Corps, has been busy for some time past, with the assistance of the War Department, in making preparations for the construction of a submarine torpedo boat. The motive power will be electricity. The boat will carry 160 large accumulators, and a 60 h.p. Oerlikon electric motor. The accumulators are claimed to surpass all others now existing for storage capacity and duration, but the materials employed are kept strictly secret. So far, Major Cabanyes has taken out no patent for the accumulators, and seems to be inclined to make their construction a War Office secret The accumulators have been tested for some months, and I have been allowed to examine the test book, which proves their storage capacity and rate of discharge to be remarkably high.

Railways.—For many years two powerful financial syndicates—one under the direction of Messrs. Rothschild, and the other under Messrs. Periere—have had an arrangement whereby the former were not to apply for any railway concessions north of Madrid, and the latter gave a similar undertaking with respect to lines south of Madrid. The result has been that fully one-half of the railways in this country are in the hands of companies controlled by these financiers. Their returns have been fairly satisfactory. Baron Alphonse de Rothschild, accompanied by M. Leon Say, has been in Madrid, and this visit has given rise to a rumour that it is intended to amalgamate the syndicates into one powerful company.

The Huelva Fumes.—In view of the possibility of the order to stop the open air roasting of pyrites at Huelva being enforced, one of the companies has discharged three hundred workmen, who are now in great distress. Some thousands will be thrown out of work if the order is carried out.

NEW YORK, 28th April, 1888.

The Iron and Steel Markets.—The condition of the iron trade is as unsatisfactory as ever; so far there is no indication of a change, and the feeling of depression is almost as great as during a period of absolute dulness. The decrease in consumption during the first quarter of 1888 has been over a quarter of a million tons, as compared with the corresponding period of 1887, while there are indications that the second quarter will show a still greater falling off. The decrease in the volume of business is not by any means the worst feature, as the falling off in price leaves producers with little or no margin of profit, while their fixed charges are practically the same. The volume of business is large compared with almost any year before 1886, but the increase of capacity leaves the average of employment very little better than during periods of greater depression, so that the comparatively large business is of but little benefit to individual operators. The enormous consumption of 1886 and 1887 was based largely on railway building, including equipment of all kinds, rails, bridges, cars, locomotives, &c. The demand for rails is not likely to be over two-thirds of that of last year; and while there is not yet much falling off in the other specialties named, business comes in slowly, indicating increasing dulness. Another serious loss to the iron trade is the falling off in the demand for pipes for natural gas, &c. Last year, at this time, almost every mill could get large orders at a fair margin of profit, while to-day an order for 500 tons is rare. Some heavy transactions have been closed during the week in pig iron, but taking the market as a whole there has been no material change since last week. Buyers are not yet satisfied that bottom prices have been reached, and are therefore only buying what is needed for actual use, unless special rates are offered, which has been done in several cases. The offerings of good brands are unusually light for the season, which keeps prices steady. Producers are directing their efforts towards securing lower freights and cheaper fuel, being pretty well convinced that to lower cost is the only means by which they can hope to retain their trade. Standard No. 1 foundry sells at $20 to $21 per ton, with Southern irons from 50 cents to $1 less per ton. There is no improvement in manufactured iron. The only fairly encouraging outlook is in shaped iron, and even that is hardly on a good basis. The steel rail market is very quiet, but there is no change in prices; and from present appearances it is not likely that there will be any for some time. The mills are fairly busy, with sufficient orders on hand to last until midsummer.

The Coal Market.—The anthracite coal trade is inactive, and buyers only order for present needs. There is a large production, but enough is being absorbed by Western trade to keep prices comparatively steady. There does not seem to be any likelihood of furnace coal becoming cheaper, and thereby relieving the iron trade.

The Metal Market.—The copper market is easier, with slightly increased sales. The Calumet and Hecla Mine has not been opened yet. The tin plate trade is dull; stocks are still small. The lead market has been steady, at 4·70 cents per lb. Consumers have bought very lightly, while about 1000 tons have been sold to speculators.

Exhibition at Cincinnati.—Manufacturers and merchants of our Western cities are actively preparing for the Cincinnati Exhibition, which will open on July 4th and close on October 27th. Over £200,000 has been subscribed as a guarantee fund. Eleven States are officially connected with its management, and it will be probably the best exhibition held in this country since 1876. The buildings are now well advanced. The main building, which will be in the shape of a cross, will be 600ft. by 400ft., and the park building, covering an artificial lake, will be 600ft. by 110ft. The power hall will be 1247ft. by 112ft., and will have the Miami and Erie Canal running through its centre. The total available floor space will be 23 acres.

PHILADELPHIA, 28th April, 1888.

Liquid Fuel.—A number of tests has been made at the Salem (Mass.) pumping station to determine the relative commercial advantages of coal and oil as fuel. The station pumps 3,250,000 gallons per twelve hours. The cost of coal for five hours was $4·69 and for oil $3·35, and in addition to the economy in first cost the oil has the advantage of cleanliness, ease of regulation, while maintaining a more uniform steam pressure. Negotiations are progressing favourably for the introduction of oil into several of the large manufacturing concerns in this city. In many of the larger works in the country it has already been introduced with favourable results. The Union Steel Works at Chicago have converted their furnaces at a cost of £20,000, and now consume 1200 barrels of oil per day. At these works the system has also proved very successful.

Electric Transmission of Energy.—A large undertaking in the transmission of power is now being carried out by the Sprague Electric Railway and Motor Company for the Big Bend Tunnel and Mining Company. The latter owns fifteen miles of the bed of the Feather river. As they intend to carry on their mining operations directly in the bed of the river, they have built a tunnel 2½ miles long across the horseshoe bend, diverting the entire stream, and leaving the bed dry. To obtain the necessary power to work their machinery, they have decided to locate their generating dynamos below the exit of the tunnel, thus giving the turbines 300ft. head of water to work under, and the current from the dynamos will transmit power to fourteen different stations around the old bed of the river.

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IMPROVED PULLEY MOULDING MACHINE.

FIG. 1.

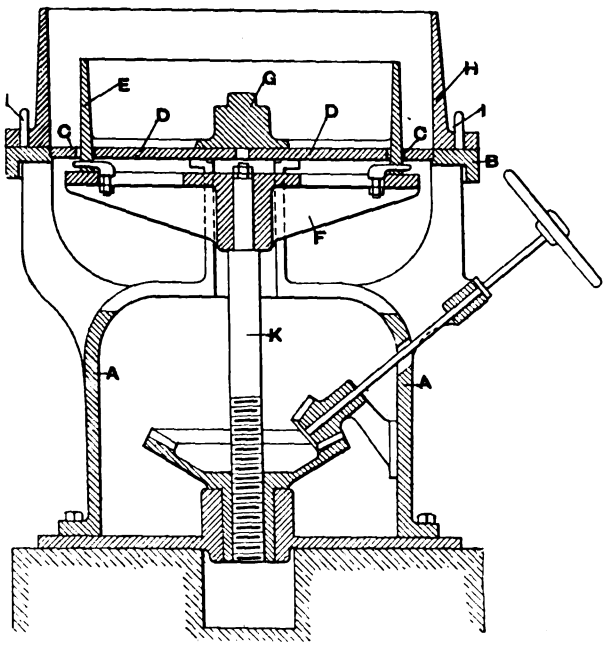


FIG. 2.

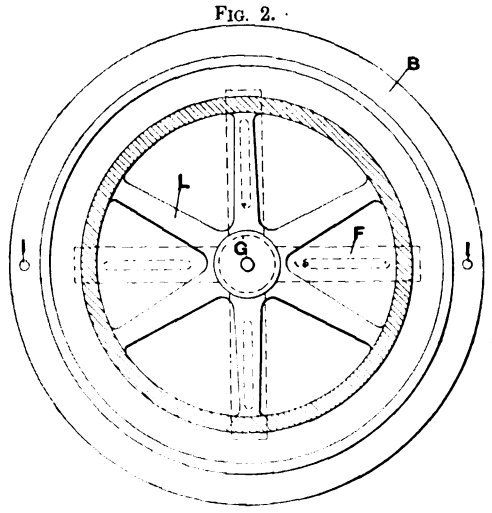


FIG. 3.

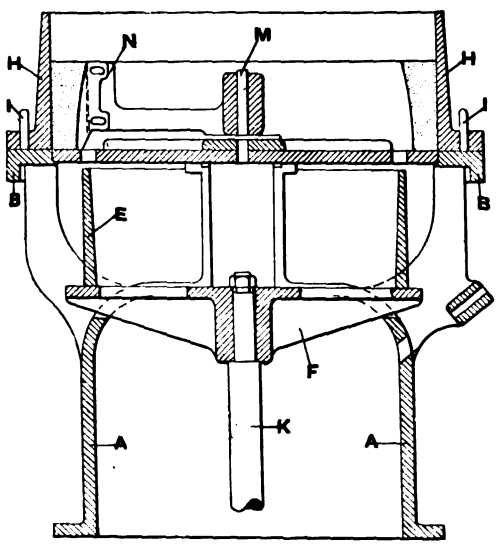


FIG. 4.

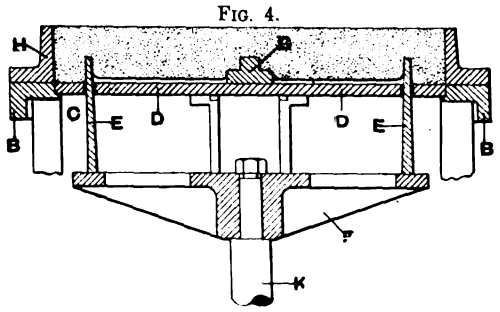


FIG 8.

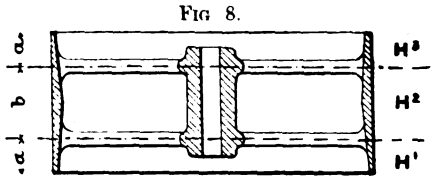


FIG 9.

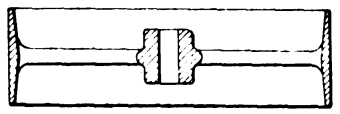


FIG. 5.

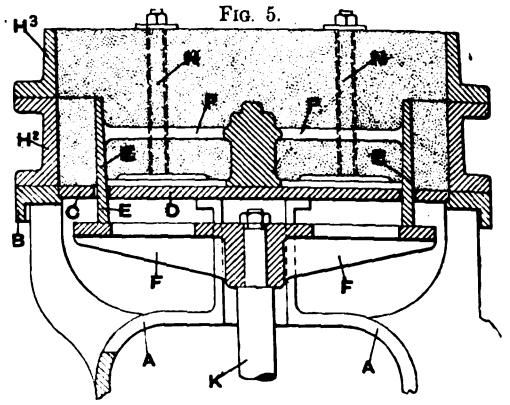


FIG. 6.

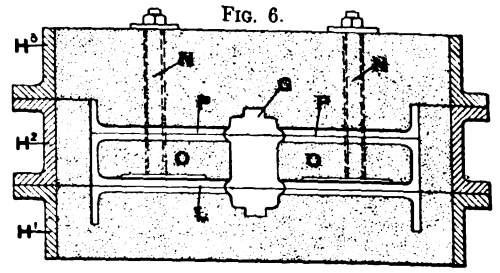
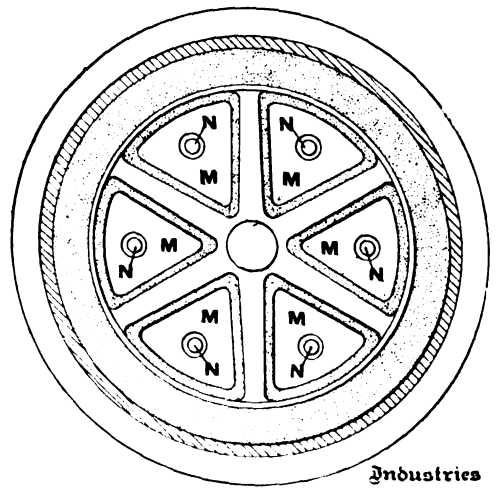


FIG. 7.



Industries

TELEGRAPHIC COMMUNICATION BETWEEN CHINA AND EUROPE.

THE United States Minister to China, in a report to his Government, describes a convention recently concluded at Cheefoo between the representatives of the two telegraph companies having cables landed in China and the Chinese telegraph administration, which has created considerable alarm among the foreign mercantile communities in China, although the convention still requires to be ratified by the Chinese Government. According to it, the Great Northern Telegraph Company of Copenhagen, and the Eastern Telegraph Company of London, have divided the territory in China. The lines of the former run north through Japan to Vladivostock and Eastern Siberia, while the English company's lines run south through Singapore and India. The messages to and from the interior are sent over the Chinese lines, and under arrangements hitherto existing the Chinese telegraph administration received 50 cents per word for messages sent abroad from the interior, while under the arrangement proposed by the convention the Chinese would receive 70 cents. The convention sets forth that the Chinese telegraph administration intends to connect its system with the telegraph lines of adjacent countries, that the two companies also have this connection, and that it is desirable "to avoid competition," and the rates are fixed to the mutual advantage of the Chinese telegraph administration and of the cable companies, and it is stipulated that these shall not be changed, except by mutual consent. The parties to the agreement shall do all in their power to prevent the transmission of messages by any person or corporation at rates lower than those fixed, and neither party shall be interested in any other company by sea or land, to the detriment of either of the others. The cables shall not be extended to any place in China or Corea without the consent of the Chinese administration, but existing land rights shall be preserved. The agreement is to take effect from the day that the administration shall connect their lines with the telegraph lines of any adjacent country in telegraphic communication with Europe, and shall be in force until May, 1903. The American Minister says the substance of this agreement is that China will receive about $150,000 per annum more than she gets now, while the advantage to the cable companies is that for sixteen years they will have no serious competition; for, although any one may lay cables to China from any part of the world, the Chinese are able to prevent any enterprise of this nature by refusing to allow them to be landed on their territory. The rates fixed in the agreement contain a slight concession to the general public, there being a reduction of 50 cents per word. But foreign merchants demand that the price be fixed at $1 per word. The companies, however, take the ground that no man telegraphs except when compelled to do so, and that their business would not be increased if the rate were reduced to $1. This, in our opinion, is short sighted policy, and contrary to the teachings of all experience in such matters.

IMPROVED PULLEY MOULDING MACHINE.

THE accompanying illustrations show an improved moulding machine for pulleys or similar objects, introduced by Messrs. J. G. Neville & Co., engineers, Liverpool. Figs. 1, 2, and 3 show the method for moulding pulleys like that illustrated in Fig. 9, while Figs. 4, 5, 6, and 7 show the way in which pulleys of the shape shown in Fig. 8 are moulded. A frame A A (Fig. 1) supports on a number of arms the ring B, which carries a ring C C, the inner diameter of which equals the outer diameter of the pulley pattern. This ring is interchangeable, so as to allow pulleys of different diameter to be moulded. To the frame A A is attached a circular plate D D, the centre of which exactly coincides with the centre of the ring C C, the diameter of D being smaller than the inner diameter of C, thus leaving a circular space just wide enough to let the pattern E of the pulley rim pass. The pattern E is secured to a cross-shaped plate F, which is moved up or down by means of a screw K, actuated by bevel gearing and a hand wheel. E is made of cast iron, turned, and tapers towards the bottom, so as to make the rim of the pulley thicker in the middle than at both sides. When moulding, E is made to protrude above C and D, exactly half the width of the rim of the pulley to be cast. As will be seen, the thickness of the middle part of the rim is less in narrow pulleys than in wide ones, which corresponds with actual practice. For moulding the arms of the pulley, a pattern L is used, which has half the thickness of the finished arms, and is secured to D by screws. To this pattern the boss G is attached. The moulding is done in the following manner: A flask H is put on to the machine, and fixed in a suitable position by means of the pins I I. The flask is then filled with sand, which is rammed round the pattern in the ordinary manner. After this has been accomplished, the plate F and with it the pattern E is lowered by means of the screw K, as shown in Fig. 3, and the flask lifted off the machine. A second flask is put in exactly the same position as the first flask, by means of the pins I I, and E raised to the same height above D as before; then flask two is treated in the same manner as flask one, and by connecting the two flasks a complete mould of the pulley is made. By this method, pulleys with straight rims are obtained; but in many cases it is desirable to give the pulley rim a convex shape, and a device for accomplishing this is shown in Fig 3. The pattern is first moulded in the manner already described, with the exception that the sand is only filled into the space between the flask and the outside of E, which is then withdrawn, and a pin M secured in the centre of D, round which the template N swings. By this means the sand is cut away to the required curve. After removing the template N the pattern E is lifted up again, and the mould finished in

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the way already described. Figs. 4, 5, 6, and 7 illustrate the method of moulding a pulley with two sets of arms, as shown in Fig. 8. The machine is the same as that shown in Figs. 1, 2, and 3; but three flasks, H_1, H_2, and H_3, instead of two are used in this method. First, the flask H_1 is put on the machine, and E raised the distance *a* (Fig. 8) above D, the arm pattern and the boss G is placed into position, the mould finished, and the flask removed from the machine. Now the flask H_2 is put into position on the machine, and the pattern E moved upwards until it protrudes the distance $a + b$ (Fig. 8) above D. The sand is then rammed in between the flask H_2 and the outside of E to the top of the flask. Before filling the inner part of E, triangular iron plates M (Fig. 7) are put between each two arms of the pattern and connected to bolts N. These plates carry the sand O between the arms L and P (Fig. 6), and are secured by means of the bolts N and nuts and washers to the upper flask H_3. The sand inside E is only rammed to a height equalling the distance *b* (Fig. 8). Then H_3 is put in position, and a whole arm pattern P is put into the place of the half pattern used for ramming O. The flask H_3 is then filled with sand and rammed round the pattern. After lifting H_3 the pattern P is removed and the flasks put together in the manner shown in Fig. 6, which represents the finished mould. The advantages claimed for this machine are, that an apprentice can do the work of two skilled moulders, and that the castings are cleaner and better than those cast in hand made moulds. The machine is made in two sizes; No. 1 for moulding pulleys from 8in. to 24in. diam., and 3in. to 16in. wide; and No. 2 for pulleys from 16in. to 40in. diam., and up to 20in. wide.

Notices of Meetings.

THIS WEEK.

SOCIETY OF ARTS.—Friday, 11th, and Saturday, 12th May, at 2 p.m. and 11 a.m. respectively. Conference on Canals and Inland Navigation.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 11th May, 3 p.m. Paper to be read on "The Formation of Volunteer Field Batteries for Home Defence," by Captain F. G. Stone.

PHYSICAL SOCIETY.—Saturday, 12th May, 3 p.m. Papers to be read: "Note on the Condition of Self Excitement in a Dynamo Machine," and "Note on the Conditions of Self Regulation in a Constant Potential Dynamo Machine," by Professor S. P. Thompson; "Note on the Electrical Action of Light," by Professor W. E. Ayrton; "The Theory and Practice of Applying the Dynamometer to the Investigation of Transformers," by Mr. T. H. Blakesley; and "Measuring the Electromotive Force of Dynamos and Motors," by Professors Ayrton and Perry.

NEXT WEEK.

SOCIETY OF ARTS.—Monday, 14th May, 8 p.m. Cantor lecture on "Decoration," by Mr. G. Aitchison, A.R.A.—Tuesday, 15th May, 8 p.m. Foreign and Colonial Section. Paper to be read on "Emigration," by Mr. James Rankin, M.P. —Wednesday, 16th May, 8 p.m. Ordinary meeting. Paper to be read on "Electric Lighting from Central Stations," by Mr. R. E. B. Crompton.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 15th May, 8 p.m. Papers to be discussed: "The Tay Viaduct, Dundee," by Mr. Peter Crawford Barlow, B.A., M.Inst.C.E.; "The Construction of the Tay Viaduct, Dundee," by Mr. W. Inglis, Assoc.M.Inst.C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, 15th May, 3 p.m. Lecture on "The Plant in the War of Nature," by Mr. W. Gardiner.—Thursday, 17th May. Lecture on "The Chemical Arts," by Professor Dewar.—Friday, 18th May, 9 p.m. Lecture in French on "La Reproduction Artificielle des Roches Volcaniques," by M. Alphonse Renard.

ROYAL STATISTICAL SOCIETY.—Tuesday, 15th May, 7-45 p.m. Paper to be read on "Condition and Occupations of the People of East London and Hackney, 1887," by Mr. Charles Booth.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, 16th May, 7 p.m. Papers to be read: "Report of the Wind Force Committee on Experiments with Anemometers conducted at Hersham," drawn up by G. M. Whipple, B.Sc., F.R.Met.Soc., and W. H. Dines, B.A., F.R.Met.Soc.; and on "The Measurement of the Increase of Humidity in Rooms by the Emission of Steam from the so-called Bronchitis Kettle," by William Marcet, M.D., F.R.S., President.

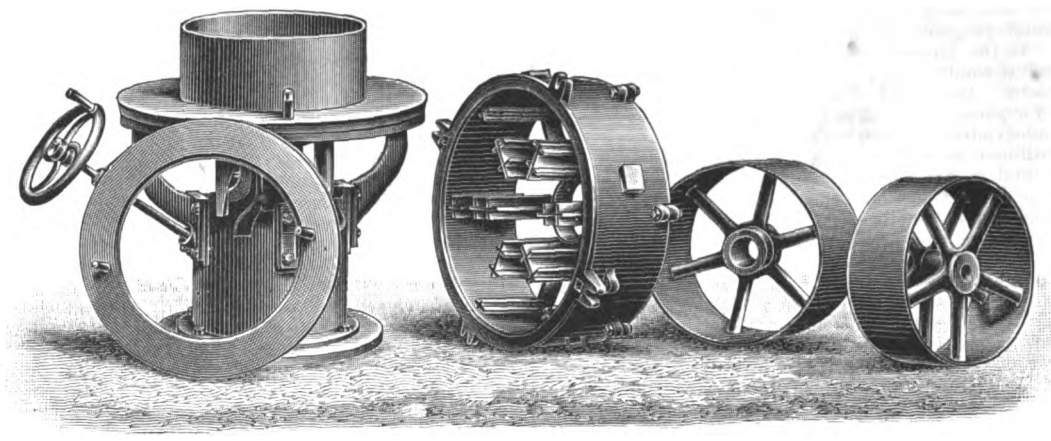
ARCHITECTURAL ASSOCIATION.—Friday, 18th May, 7-30 p.m. Ordinary meeting. Election of officers. Paper to be read by Mr. A. H. Hart.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 18th May, 3 p.m. Paper to be read on "The Naval Defence of the United Kingdom," by Rear-Admiral P. H. Colomb.

GREAT NORTHERN TELEGRAPH COMPANY.—Traffic Returns: Receipts in April, 1888, £21,400; 1st January to 30th April, 1888, £85,200; corresponding months, 1887, £81,520; corresponding months, 1886, £78,480.

WE have been requested to state that Messrs. E. H. Birley and Co. have commenced business as consulting engineers at Queen's Chambers, 80, Deansgate, Manchester. Mr. E. H. Birley was recently a member of the firm of Messrs. C. S. Madan and Co., of St. Ann's Square, Manchester.

IMPROVED PULLEY MOULDING MACHINE.



PRICES CURRENT, 10TH MAY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/-	Cash
Scotch Warrants, m/n		38/2	"
Hematite Warrants, m/n		41/3½	"
Stocks in Stores. Scotch	977,913—Inc. for week,	1845	Tons
Middlesbro'	305,051—Dec. "	2965	"
Hematite	208,086—Dec. "	500	"

Exclusive of stocks in makers' yards.

Market quiet and little doing.

Scotch shipments 8182 tons, against 6649 tons for same week last year.

	No. 1.	No. 3.	
Coltness	47/6	42/6	f.o.b. Glasgow.
Gartsherrie	44/3	41/3	" "
Dalmellington	39/6	38/-	" Ardrossan
Eglinton	38/6	37/-	" "
Glengarnock	43/6	39/6	" "
*Derbyshire	—	35/-	f.o.t. Works.
*Lincolnshire	—	32/-	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 17 6	5 7 6	f.o.t. wks
" Angles	4 15 0	5 5 0	"
" Plates	4 17 6	5 7 6	"
Staffordshire Bars	5 0 0	6 0 0	Manch'r.
" Angles	5 10 0	6 10 0	"
Crown Sheets	6 10 0	6 15 0	"
" Hoops	5 7 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		8 0 0	"
" Ship and Girder		7 15 0	"

METALS.

Spelter:	Ordinary	£17	5	0	to	17	10	0
Copper:	British Cakes and Ingots	81	0	0	"	——		
"	Chili Bars	80	0	0	"	——		
"	Manufactured (strong)	88	0	0	"	90	0	0
Lead:	Common Pig	14	0	0	"	14	2	6
"	English Sheet	14	15	0	"	14	17	6
Tin:	Straits	79	0	0	"	80	0	0
"	Australian	81	0	0	"	81	10	0
"	English Ingots	90	0	0	"	94	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—The copper market remains in much the same condition as reported last week. The spot price is maintained at about £80 per ton by heavy purchases for the syndicate; whilst forward parcels are offered at about £5 per ton less. This is the speculative aspect of the market, the consumers meanwhile looking on and buying as little raw copper as possible, until it can be seen whether the French syndicate can really carry out their undertaking. The fall in tin has led to the forward selling of copper at lower prices, and for the moment it has materially affected the position of copper. Stocks of copper continue to increase rapidly. According to published statistics, the total supplies for the first four months of the current year are 39,308 tons, and for the same period last year 22,341 tons; and deliveries to the trade, 17,056 tons and 28,578 tons respectively; thus showing in the estimated visible supply an increase of 22,252 tons during the past four months. Manufactured is very quiet.

TIN.—Quotations for Straits are again lower. To-day, for spot and short prompt £80 per ton, with a tendency to stiffen again for the moment. The total visible supply, Europe and America, for the twelve months ending April 30th, is estimated as 44,588 tons, and the consumption as 29,773 tons, thus showing an increase during the same period of 14,815 tons.

LEAD is again lower, Spanish being quoted £13 to £13. 2s. 6d. per ton, with a slow demand.

SPELTER.—Quotations are lower, £17. 5s. to £17. 10s. for warrants, with a drooping market.

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/-	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	0	0
" Ceylon	"	24	0	0
Cottonseed	"	21	0	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	18	7	6
Palm, Lagos	"	21	0	0
Rapeseed: English	"	24	0	0
Seal: Pale	"	23	0	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	9	9
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	5⅝
" Spirit	"	0	0	8¼

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	6
" Citric	lb.	0	1	6¾	—	0	1	7
" Oxalic	"	0	0	3	—	0	0	3½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6⅛	—	0	1	6¼
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	11	5	0	—	11	10	0
" Liquor	lb.	0	0	3¼	—		.....	
Bleaching Powder	ton	7	12	6	—	7	15	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	31	0	0	—	31	10	0
Benzole (90%)	gal.	0	3	0	—	0	3	6
" (50/90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	23	0	0	—		.....	
" White Sugar	"	26	10	0	—	27	0	0
" Brown "	"	22	10	0	—	23	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	5⅝	—	0	0	5⅞
" Prussiate (Yellow)	"	0	0	6¾	—	0	0	7
" Sulphate (Basis 90%)	ton	8	17	6	—	9	5	0
Precipitate: Red	lb.	0	3	1	—	0	3	2
" White	"	0	3	2	—	0	3	3
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	8	10	0	—	9	0	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—		.....	
" " (" 60%)	"	5	15	0	—		.....	
" " (Cream, 60%)	"	5	15	0	—		.....	
" Crystals	"	2	10	0	—		.....	
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	2	6	—	6	5	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

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HOME INDUSTRIES.

MANCHESTER, 10th May, 1888.

The Cotton Trade.—For some time the Liverpool traders have been raising the cotton prices by means of the usual prognostications about the exhaustion of the crop. As the Lancashire spinners have plenty of cotton to hand, it would seem to be their policy to buy sparingly at present. As a result of higher cotton prices, the quotations for yarns have materially strengthened, and spinners are endeavouring to restore their profits. This is somewhat difficult to do, on account of the fact that manufacturers find it impossible to obtain any advance on the recent prices for cloth, and they are indisposed to pay more for yarn. In the cloth trade there is some difficulty in obtaining adequate prices, more especially in the staple goods for the Eastern markets. Manufacturers all complain that they have some trouble to maintain their quotations, owing to the very low offers which are being made from India. The low price of silver is detrimental to the merchant and manufacturer, and although there is a great number of orders being offered, the rates at which they are tendered renders their acceptance almost impossible. Another source of weakness in the cloth trade is the continual starting of new looms. The extensions which have recently taken place have not yet ceased. It may be explained that the practice is for sheds to be built, engined, and geared by the proprietors, and then let off in sections sufficient for twenty looms and upwards to tenants whose rent includes power. In some cases the looms are also sold on the hire system, so that it is comparatively easy for an operative who has saved a little money to commence business. In many cases he is able to find many of the workpeople in his own family, and these small ventures are thus worked very economically. The system of yarn sale permits his obtaining the necessary material readily, and it is not difficult for him to find customers for his cloth on a cash basis. Briefly stated, the general effect of this arrangement is that a large number of small firms have been added to the list of those already existing, and the producing power has thus been largely increased.

Wages Troubles.—By a large majority the operative spinners of the Oldham district have resolved upon striking on the 19th inst. if an advance of wages to the extent of 5 per cent. is not granted, and their example will probably be followed by the card room hands. In a minor branch of the business at Blackburn a similar course is threatened, the loomers and drawers having decided to strike for a uniform list of wages. Although the number of men directly affected by this last threat is not very large, yet the result of their action will be indirectly felt by a great number of operatives. In the engineering trades there is still a strike of moulders going on, and no signs of settlement are visible. This trouble only affects the Manchester and Oldham districts, but it is causing some disturbance of business in those two localities. There is also a strike of grinders and glazers in the machinery trade, and the trouble created by their action is altogether out of proportion to the number of men employed.

The Manchester Ship Canal.—The works in connection with this undertaking are making very rapid and continuous progress; and in some sections, notably those at Eastham, Weston Point, and Moore they are beginning to assume the appearance of a canal. It is intended to apply to Parliament to suspend the standing orders to permit of the passage of a Bill which will allow of an alteration of the docks. This involves amongst other things a re-adjustment of the boundary of Salford, the construction of an additional bridge across the river, and the raising of the level of much of the low lying land which adjoins the canal. The consent of the local bodies concerned has been obtained, and it is hardly likely that there will be any serious objection.

LONDON, 10th May, 1888.

The Money Market.—The money market has been stiffened by the resolution of the Bank directors a week ago not to raise the official rate of discount, although heavy withdrawals of gold had been made, and although new loan issues were creating a considerable demand for accommodation. A large proportion of the gold went to Scotland. In consequence of the non-alteration of the Bank rate, the outside rates soon approached the official minimum, and loans were even taken from the Bank rather than from Lombard-street. The Stock Exchange settlement has helped to maintain the rates at the higher figures. Values on the Stock Exchange have not recovered the ascending tendency which was checked ten days ago, although the feeling is more buoyant. Home railway stocks have been very dull; but the improved weather, together with the more favourable trade returns, should result in a rise in their price. Government stocks lack life, as also do foreign stocks; but the American market has an unmistakeably better tendency. Mines are not in great favour.

Companies.—The following new companies have been registered since our last report: Buckley & Bent, Limited, with a capital of £30,000, to carry on the business of cotton spinners; the Carenero Railway and Navigation Company, Limited (Venezuela), with a capital of £650,000; Courage and Co., Limited, with a capital of £1,500,000, to acquire the business carried on at the Anchor Brewery, Horsleydown, Southwark; the Bournemouth Electricity Company, Limited, with a capital of £50,000; Robinson, Skinner, and Co., with a capital of £30,000, to carry on business as glass manufacturers at Warrington, London, and elsewhere; Cheltenham Original Brewery Company, Limited, with a capital of £120,000, to carry on the business of Mr. J. T. Agg-Gardner, M.P.; Bindley & Co., Limited (Burton-on-Trent), with a capital of £170,000, to carry on the business of brewers; the Avenue Mills Company, Limited, with a capital of £16,000, to purchase a weaving shed and buildings at Chorley, Lancashire; the Gwendraeth Tin Plate Company, Limited, with a capital of £50,000; Contractors, Terra-Cotta, and Commercial Agents, Limited, with a capital of £250,000; the Compressed Air Carpet Beating Company, Limited, with a capital of £50,000; the Liverpool Pure Ice Company, Limited, with a capital of £20,000; Patent Cement Company of England, Limited, with a capital of £300,000; the Writtle Brewery Company, Limited, with a capital of £100,000; the Dordogne Mineral and Smelting Company, Limited (France), with a capital of £100,000; Great Northern Salt and Chemical Works, Limited, with a capital of £200,000, to raise and manufacture salt, and to manufacture soda and other chemicals; Morewood's Lion Galvanising Company, Limited, with a capital of £50,000; the Hope Iron, Steel, and Tin Plate Company, Limited, with a capital of £25,000; the Spanish Railways Trust and Investment Company, Limited, with a capital of £2,000,000; Hants and Wilts Brewery, Limited, with a capital of £45,000; the Woolwich Ship and Engine Repairing Company, Limited, with a capital of £20,000; Manchester Zinc and Ammonia Company, Limited, with a capital of £25,000; Leeds Hemp Spinning Company, Limited, with a capital of £10,000, to purchase the business of William Smith & Co., Crown Point Flax Mills, Leeds; the Farnham Brewery Company, Limited, with a capital of £30,000; the Houdol Gold Mining Company, Limited (Transylvania), with a capital of £50,000; Gold Mining Association of France, Limited, with a capital of £1,500,000; the Continental Gold Mines Company, Limited, with a capital of £200,000; the Bechuanaland Exploration Company, Limited, with a capital of £150,000; Notre Dame des Victoires (Transvaal) Gold Mining Company, Limited, with a capital of £250,000; the New River Consolidated Gold Mines, Limited (California), with a capital of £150,000; the Gold Estates (Transvaal) Company, Limited, with a capital of £130,000; Standard Mining Company, Limited, with a capital of £250,000, to acquire mines in Great Britain and Ireland, or elsewhere; Crown Lands (North Wales) Gold Exploration Company, Limited, with a capital of £80,000; the Douglas Witwatersrand Company, Limited, with a capital of £250,000, to acquire mining claims in the Transvaal; Tapia Iron Ore Mining Company, Limited (Spain), with a capital of £15,000; Hayford Brothers & Co., Limited, with a capital of £70,000, to purchase mines on the Gold Coast; the Bebside Coal Company, Limited, with a capital of £104,400; the Jone (Nevada) Silver Mines, Limited, with a capital of £120,000; the Colossus Silver Lead Ore Company, Limited (Wales), with a capital of £30,000; the Mid-Cumberland Silver Lead and Blende Mines, Limited, with a capital of £20,000.

A Union of Telephone Companies.—A very important company has been registered in connection with the proposed federation of the telephone companies, under the title of the United Kingdom Telephone Union, Limited, with a capital of £10,000,000. The promoters had already registered a company a week earlier, with the same amount of capital, the first subscribers being seven in number, as legally required; but this appears to have merely been a matter of formality. The first subscribers to the second company include the chairman, the deputy chairman, and five directors of the Union Telephone Company, Limited, the chairmen of the Lancashire and Cheshire Telephone Exchange Company, Limited, the National Telephone Company, Limited, the Telephone Company of Ireland, Limited, the South of England Telephone Company, Limited, the Western Counties and South Wales Telephone Company, Limited, and the Northern District Telephone Company.

Textiles.—There has been but little change on the whole in the prices paid on the second series of sales of Colonial wool; but there has been rather more competition, and in some instances rates are firmer. The series closed on Saturday last, and it is estimated that over half of the quantity sold has been taken for export. Messrs. Balme state that the consumption is large, and in spite of narrow trade margins of profit and unfavourable external influences, the requirements of machinery are on a scale which hardly admit the expectation of any retrograde movement in the near future, especially as, owing to the rapidity with which the Australasian clip has been despatched this season to the European markets, the subsequent auctions of the year promise to be more lightly loaded with arrivals than the present and the preceding series. The third series of Colonial wool sales will commence on the 19th of June with a limit of 350,000 bales, and the fourth and fifth series on the 18th of September and 27th of November respectively, without limitation as to quantity. Hardly any business is being done in Baltic hemp, either for spot parcels or for arrival. Prices for Manilla hemp for arrival show some weakness.

Board of Trade Returns.—The value of our exports during April amounted to £17,735,474, as compared with £16,411,662 in the corresponding month of 1887, being an increase of rather over 8 per cent. Cotton piece goods show a decrease in quantity of 5 per cent. and in value of 4 per cent., but in all the other principal articles of export business has improved. The quantity of iron and steel exported has increased by nearly 2 per cent. and the value by nearly 10 per cent. In hardware and cutlery the increase in value amounts to 12 per cent., and in machinery and mill work to 19 per cent., this being mainly due to larger shipments to India. The value of the total imports amounted to £32,098,693, as compared with £31,149,925 in the same month of last year, being an increase of 3 per cent. The imports of copper ore and regulus show an increase in quantity of 115 per cent. and in value of 302 per cent.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 29th April amounted to £1,219,781 on 15,850½ miles, as compared with £1,218,442 in the corresponding period of 1887, when the mileage was 15,724 miles. An increase is thus shown in the mileage of 126½ miles or 0·8 per cent., and in the receipts of £1,339 or 0·1 per cent.

Colonial Contracts.—Messrs. Dick, Kerr, & Co. have secured a further large contract for rails and other constructive materials in connection with the Melbourne Cable Tramways.

GLASGOW, 10th May, 1888.

General Business.—The occurrence on two consecutive days of the Scotch Bank holiday and of the public holiday for the opening of the Exhibition, seriously interfered with business during the early part of the week. The Stock Exchange did not hold a holiday on Monday, but this was due to the incidence of the settlement rather than to the pressure of business. The Scotch pig iron shipments for last week showed a slight increase both coastwise and abroad. Freights are still fairly steady, though there is comparatively little being done.

The Boundary Commission.—The Boundary Commission has published its report, which in effect proposes to annex to Glasgow all the surrounding burghs with certain exceptions. All the districts which can properly be called urban have been included in the proposed new city boundary. The scheme of the Corporation of Glasgow has been practically adopted by the Commission. Among other changes proposed in the report of the Commissioners is the abolition of the differential water rate and a rearrangement of districts, so that the thinly populated better class neighbourhoods should be conjoined with more densely populated districts for rating and other purposes.

Glasgow Subway Scheme.—Evidence has been given during the week before the Lords' Committee. Mr. Deas, engineer to the Clyde Trust, in his examination, said that to deepen the river from Glasgow to Greenock would cost upwards of three-quarters of a million. The London and Glasgow Shipbuilding and Engineering Company claim that the construction of the subway would damage their launching ways, and the proprietors of a hotel near the proposed terminus demand that their property should be purchased outright. The Caledonian Railway Company also insisted through the evidence of their engineer, Mr. Cunningham, C.E., that the construction of the subway would affect the foundations of the joint line station in Eglinton-street, under which the subway must pass. The counsel, in answer to the chairman, intimated that there was a likelihood of both the Subway Bill and the Central Railway Bill being disposed of before the Whitsuntide recess.

(From our own Correspondents.)

LIVERPOOL, 9th May, 1888.

The Timber Trade.—The demand for yellow pine during the last month has been very small, and the stock of both waney and square pine is unusually light. The stock of red pine is also very low, and there has been practically no consumption. The supply of pitch pine has been in excess of the demand; four cargoes, principally of sawn wood, were imported last month, and the sales have been by private treaty. The delivery of oak logs has been light, and that of waggon planks moderate; the stock of the latter is now heavy, and the prices are low, and show no signs of improvement. For walnut of prime quality there is a steady demand, and at fair prices; of satin walnut there is a heavy stock, and the prices are very low. There is no Honduras mahogany in stock, and sound logs are in steady request.

Gaseous and Liquid Fuel.—Under the title of the Gaseous and Liquid Fuel Supply Company, Limited, a company has just been registered to take over the patents of Mr. B. H. Thwaite, C.E., F.C.S., of this city, for generating water gas and other descriptions of gaseous fuel, for gas motors, gas furnaces, and for heating purposes generally, and for the application of Mr. Thwaite's patents for heating and lighting with liquid hydrocarbons. The company will establish a fuel testing laboratory, and act as guarantors against smoke nuisance fines. It will be seen that the objects of the company in effecting fuel economy and preventing smoke are likely to be a public advantage.

SHEFFIELD, 9th May, 1888.

Trade Prospects.—There is a confident tone in Sheffield trade. Buyers are purchasing carefully, in the expectation that the prices may decline still further; nevertheless there is a large amount of business being transacted, and money is becoming more plentiful. The town is now practically free from small pox, and merchants, travellers, and country buyers are resuming their trade connections with Sheffield.

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Perhaps in no previous period of its history has the place been busier with orders. In some of the more noted branches of local trade the men are working overtime, and the houses are steadily developing new markets. Although the American inquiry for nearly all kinds of hardware is on the decrease, the Colonial and other distant customers are inquiring eagerly for Sheffield made goods, and the South African, Chinese, and Japanese markets are rapidly extending.

Iron and Steel.—The output at a few of the local and district furnaces is very satisfactory, but there is not a great demand for iron. Pig is in fact very cheap, and in some cases it scarcely pays to make it. For foundry use iron can be bought at from 32s. 6d. to 40s., and forge is selling at from 29s. 6d. to 33s. 6d. Bessemer is going well at about last week's quotations, and orders for billets are increasing almost daily. The converters are kept going at some of the Sheffield works, and the output has never been larger than it is at present. The armour plate departments are revealing signs of greater activity. Further orders have been received at the Atlas and the Cyclops Works; and Messrs. T. Firth & Sons are also well off for orders. At Messrs. W. Jessop & Sons' one or two valuable contracts have been entered into recently, and in spite of very keen competition they are finding a very satisfactory market for their special steel and crucible cast steel castings. Railway material continues in good request. Messrs. Turton & Sons are very busy on railway springs, and Messrs. Cammell & Co. and the Phœnix Works are turning out an enormous quantity of steel rails. The decision to free railway material for India from dock and harbour dues should benefit Sheffield trade, for it practically amounts to a reduction in carriage. Heavy machinery, edge tools, and cutlery are in better demand.

Local Exhibits.—At the Glasgow Exhibition there are to be seen some steel faced armour plates from the works of Messrs. Charles Cammell & Co., as well as examples of crank shafting for marine engines, gun forgings, and railway material.

LEEDS, 9th May, 1888.

An Improved Method of Heating Tram Cars and Railway Carriages.—A very simple and apparently effective method of heating tram cars is now being tried at Bradford. The method has been patented by Mr. J. Langfield, of Tyldesley, Lancashire, who has given attention to heating tram cars and carriages for some years. His arrangement consists of a horseshoe-shaped heating chamber, made of iron or copper, which is placed in the locomotive smoke box. To this chamber a pipe is affixed, through which air from the outside is conveyed to the interior of the chamber, and a further pipe conveys the heated air from the heating chamber to the floor of the cars. The air thus heated is allowed to diffuse itself throughout the interior of the car. When more than one car is drawn by the tram engine, the same apparatus may be used to heat two or more cars by simply arranging for the heated air to be conveyed along a pipe under the car, having flexible couplings to connect with the rear cars. This method has been at work during the winter months, and with an outside temperature of 37°F. the air in the car had a mean temperature of 53°F., which was found quite sufficient for the comfort of the passengers. The inventor claims that his arrangement is specially suited for the warming of railway carriages, and that the increase of temperature in the compartments would be obtained entirely from the waste heat, and without the constant expense connected with the use of gas or oil for heating purposes. Referring to this method, one of the officials of the Bradford and Shelf Tramway Company, Limited, stated that "the apparatus fixed on our No. 10 engine and car is working very satisfactorily indeed. The travelling public on our line are very outspoken in their praise of the comfort it gives."

NORTH STAFFORDSHIRE, 9th May, 1888.

North Staffordshire Tramways Company.—On account of the action of the Stoke Town Council, the application of this company for a renewal of their license to use steam power was temporarily refused, with the result that for some days the district between Stoke and Longton was deprived of this means of transit, much to the inconvenience of the travelling public. The Council complain of the quantity of sulphur and gas emitted by the engines, and the dilapidated condition of the setts on the tram roads. Major-General Hutchinson has been to inspect on behalf of the Board of Trade, and as a result of his report and certain guarantees consequent upon it, given by the Tramway Company, the license has now been renewed, and the trams are running as usual.

Brussels Exhibition.—Several local manufacturers have sent exhibits to Brussels, amongst which that of Messrs. T. Forrester & Sons, of Longton, consisting mainly of vases of a new style of ware lately introduced by that firm, is of conspicuous merit. A good position has been secured by Messrs. Forrester, and the exhibit will do much to prove the continued excellence of British manufactures to Continental visitors to the Exhibition.

BIRMINGHAM, 9th May, 1888.

The Hardware Trade.—Business in these branches of industry is not so active as it was at the corresponding period of last quarter, but the improvement in the weather is leading to more activity. The inflation in the copper market continues to make itself felt, especially in the case of firms manufacturing heavy goods, such as sheets and large tubes. A considerable amount of distress is reported from Selly Oak, a suburb of Birmingham, where two large concerns, Messrs. Elliott and the Birmingham Battery and Metal Company, carry on business. The business of these firms is suffering severely, and the workmen are either unemployed or working only a few days a week. The heavy stocks in the hands of some firms consuming the alloys of copper have up to the present helped to tide them over the difficulty. Before the action of the syndicate commenced, copper was exceptionally cheap, and many concerns had large quantities of the metal lying unused. By melting up all available metal, and utilising unimportant patterns, persons in this position have hitherto avoided the necessity of purchasing to any extent. The metal rollers report a fairly active market, and seem to entertain an expectancy of continued high prices. Wire workers are very busy, and makers of hollow ware are fairly well employed. Screw makers also have plenty of work on hand, but complain of the narrowness of profits. Rule makers, gun makers, and pewterers are also reported to be well employed. Among foreign markets, Holland, Germany, and Spain are just at present the best; the French demand is only moderate. The prolonged discussion in America on the tariff question is unsettling business with that country; but India, the Cape, and Australia are taking a fair amount of hardwares. There is some activity on account of Canada, and Burmah is coming forward as a consumer.

LEICESTER, 9th May, 1888.

Wool Spinning and Yarn Trades.—The wool trade remains in a very unsatisfactory condition, and the recent London sales have not given an appreciable firmness in the local market, and prices are as low as they were three years ago; and it does not appear that there is any great probability of improvement. The new clip, being now very near, gives a slight firmness in prices; but staplers are loth to operate with growers and country dealers at late quotations, as they find great difficulty in effecting sales. Spinners are, as a rule, but very moderately employed; hence their operations are restricted, and their purchases are for only very immediate requirements. The flatness of the spinning branch, and the unstable condition of the raw material market, make the general condition of these trades very unsatisfactory. Yarn merchants are not doing a large business, on account of the unsettled state of market prices in wool.

Boot and Shoe Trade.—A much needed improvement has taken place in this important industry, and firms generally are now more fully employed. Both retail and wholesale buyers are operating more freely in summer goods, and a continuance of good trade is anticipated. In the leather trade, merchants find great difficulty in doing satisfactory business. Competition is extremely keen for orders, and quotations are at a very narrow margin of profit. The tone of the market generally is very low, and prices are remarkably unstable.

BARROW-IN-FURNESS, 9th May, 1888.

Iron and Steel.—There is no change to note in the quiet tone of the hematite pig iron trade. The demand is anything but active, but there is nevertheless a moderate forward inquiry. The consumption of hematite is well maintained, and the deliveries both on home and foreign account are very large. Prices show no variation, and mixed parcels of Bessemer pig iron are quoted at 42s. 6d. per ton net f.o.b., and forge and foundry qualities at 41s. 6d. per ton. In steel there is a good market; but sales are not heavy, owing to the fact that makers are fully sold forward, and are not devoting their attention to negotiating forward sales. Rails are in good demand at last week's prices—viz., £3. 17s. 6d. per ton net f.o.b. for heavy sections, and £4. 2s. 6d. for light sections. There is a very full demand for ship plates and angles, which have been largely sold. Current prices represent £6. 15s. for plates, and £6 for angles. A prominent feature is the large output of tin bars. A brisk business is doing in billets, and in wire and hoops. Iron ore is in very steady demand at from 8s. 6d. to 11s. 6d. per ton net at mines.

The Petroleum Trade.—Arrangements have been completed with the most influential syndicate in the Russian oil trade for the importation of petroleum from Batoum to London and Barrow, the two depôts for the trade. At Barrow the contract has been let to Mr. David Caird for the construction on the docks at Barrow of large storage tanks capable of holding 8000 tons of petroleum. Two large steamers of 3500 tons are being built on the Tyne for the Barrow petroleum trade, and it is expected they will be delivered in September. The principals of the new company are Messrs. Wallace Brothers, of London, and the managing directors, Messrs. MacAndrew & Co., London.

MIDDLESBROUGH, 9th May, 1888.

Pig Iron.—The pig iron market is still quiet, and is declining as far as prices are concerned. No. 3 G.M.B. can be had for 31s. 3d. per ton, and at an even lower rate; but there is very little business being transacted, as buyers are confident that prices will remain as they are for some time. In the meantime Continental buyers are replenishing their stocks at a rate that has raised the expectation in the minds of makers that better prices must shortly rule. Warrants have fallen as low as 31s. 1d. per ton cash. These low prices are the inevitable result of the very low price of Scotch.

Exports of Pig Iron.—Exports are still very heavy; those to Scotland are falling off, but those to the Continent are still on the increase. It is considered, however, that the latter must soon be reduced when the customers are fully supplied. As far as the year is gone the exports are most satisfactory. For the four months ending 30th April they amounted to 298,196 tons, as against 250,597 tons during the corresponding period in 1887, 219,485 tons in 1886, and 264,495 tons in 1885.

Iron Masters' Returns.—Four furnaces have been taken off hematite and put on to Cleveland. The stocks of pig iron, which on the 31st March amounted to 610,698 tons, on the 30th of April amounted to 586,492 tons, being a decrease of 24,206 tons for the month of April; 15,494 tons of these were taken from Connal's stores. During the last three months the decline in stocks has been fully 57,000 tons.

NEWCASTLE, 9th May, 1888.

Chemicals.—At this season of the year the demand for bleaching powder and other products of the chemical factories usually exhibits a stronger tone, and that circumstance somewhat lessens the significance of the improvement which is now taking place in the various branches of the industry. At nearly every important manufacturing establishment on the Tyne the output of the special commodities has increased, and in some instances to a very marked extent. The circumstances of the industry, however, are not such as to warrant the assumption that any exceptional development of activity is imminent, and the expectations of manufacturers will probably be fully satisfied if the present moderately prosperous state of business is maintained during the summer months. Very rapid progress is being made with the new works being erected by Messrs. Allhusen & Co., for the extended manufacture of caustic soda, and the same may be said with reference to the sulphur recovery plant being put down by the Jarrow Chemical Company. The demand for chemical manures is active, and manufacturers are now busily engaged in fulfilling new contracts, as well as others that were entered into some time ago.

Copper.—At the copper works business is somewhat dull; but stocks are being reduced, and other signs are to be noticed which tend to show that a return of briskness is not far off.

Lead.—In almost every instance the lead works on Tyneside are busy, and there appears to be reason to expect a continuance of this healthy state of trade.

Electric Lighting.—Messrs. Clark, Chapman, Parsons, & Co. have obtained some good orders for electric lighting plant. In the building, which was expressly erected for this kind of work, there are in course of construction several patent turbo-electric generators of various sizes up to five hundred lights; and independently of any further orders which may be obtained, the competition of these generators must necessarily keep up the present briskness for a considerable time to come.

DUNDEE, 9th May, 1888.

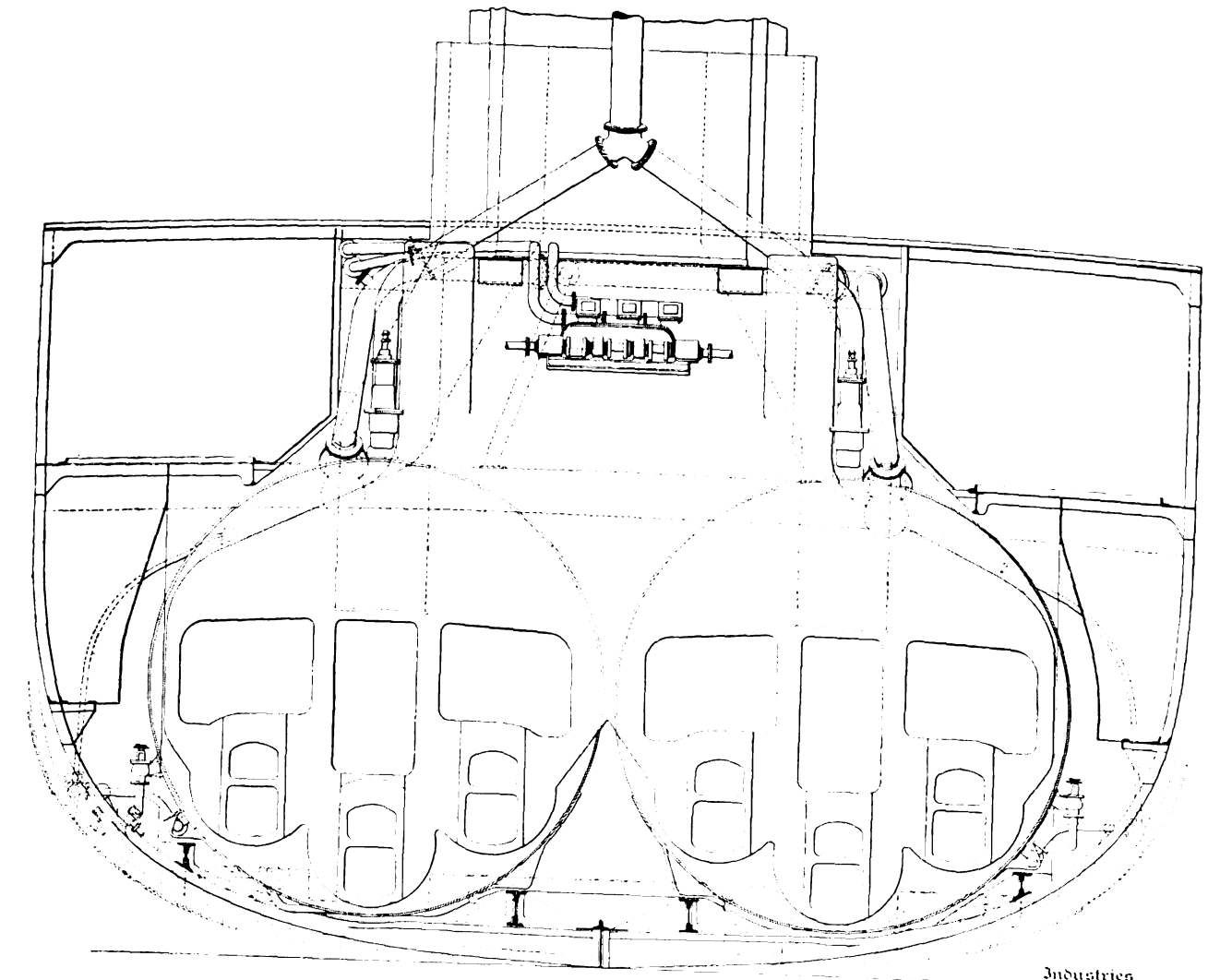
Flax and Jute Trades.—Business in the staple trades of the town and district has been fairly steady during the past fortnight. The jute branches are rather unsettled. The period agreed upon for running short time has expired, and an effort is being made to continue the decreased production for another three months. One or two leading firms, however, seem disinclined to give in their adherence to any renewal. Transactions in the flax market are somewhat limited, buyers being well supplied by the new arrivals. Now that navigation is opened consumers are in a better position to provide for current wants. Flax and tow yarns are selling more freely, but spinners have not been able to obtain any decided advance on previous quotations. Linen goods are in steady demand, and in the Fife district manufacturers are well engaged. Jute on the spot meets a fair inquiry; but buyers are offering very low prices, and most of the parcels in dock for sale are consequently being warehoused. For distant shipment prices are steady. Jute yarns are in somewhat better request, and a small advance is asked; but buyers have been holding off until the result of the short time negotiations is known. In jute goods the transactions are limited; but there is considerable inquiry, and if manufacturers would meet buyers some fair orders might be placed. Bagging and sacking are steady at late prices, and tarpaulin is in good demand.

Seal and Whale Fishing.—The Newfoundland seal fishing season has just closed. Four Dundee vessels were engaged, and their united catch is 66,900 seals, calculated to yield 800 tuns of oil. Last year five vessels were employed at the fishing, and the catch was 51,650 seals. Formerly it was the regular practice of the sealers to discharge their cargo at St. John's, and proceed to the Davis Straits whale fishery. This year two of the four vessels which were at the seal fishing returned home directly. The whale fishing has been unremunerative of late years, and in some cases, where the sealing paid, the profit has been lost in the Davis Straits voyage. However, there will be seven Dundee vessels altogether at the whale fishing this season, including the two which have gone on the sealing trip.

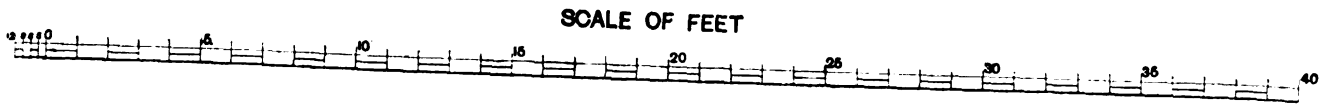
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BOILERS OF THE S.S. "QUEEN VICTORIA."

CONSTRUCTED BY THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GLASGOW.



END ELEVATION.



GLASGOW INTERNATIONAL EXHIBITION, 1888.

THE official opening of the Glasgow Exhibition by the Prince and Princess of Wales took place on Tuesday, the 8th inst. The weather was all that could be desired, the crowds in the streets were enormous and exuberantly loyal, the inaugural music was magnificently rendered by choir and orchestra, the civic dignitaries were apparelled with becoming splendour; in short, the function was brilliantly successful from every point of view. The opening ceremonial consisted of the presentation to the Prince of Wales of a gold key, given by Messrs. Chubb, wherewith to open one of the gates of the grand entrance, and the presentation also of the conveners of committees and of the principal officials of the Exhibition. Subsequently the "Inaugural Ode," written by Mr. Robert Buchanan, and set to music by Dr. A. C. Mackenzie, the well known composer, was sung by the Choral Union, with orchestral accompaniment, Dr. Mackenzie conducting his own music.

When the formal ceremonial of the opening was over, the Royal party made a progress through the picture and sculpture galleries, and then spent a considerale time in the women's industries section. After a short interval they passed down the main avenue to the Indian court, and then on to the machinery annexe, the conveners of the respective sections conducting the party through their departments. The most impressive sight in such pageants is always the crowd, and in this case the formation of the ground immediately surrounding the park was singularly [illegible] view points for the vast crowd [illegible] It is hard [illegible] of people, park alone, while the numbers in the streets must have reached many hundreds of thousands. The Exhibition buildings were filled with a throng of privileged ticket holders, and the grounds were also occupied by season ticket holders, besides large bodies of military and volunteers, including about 3000 boys of the Boys' Brigade. The promenade in front of the University was reserved for holders of privileged tickets, and, like all the high places round the Exhibition grounds, was crowded with sightseers.

During the few days prior to the opening, exhibitors had made frantic efforts to get their effects in order, and that with so much success that practically nothing remained to be done. The cases that only a few days before blocked the passages, and gave the halls an unfinished air, have disappeared, and everything is as trim as if all had been in place for months. Only those who have seen the growth of an exhibition can realise by how much hard labour, and by what prodigies of management, what looks like an Aladdin's palace has been reared and filled in a few months. The experience and the patience of Mr. H. A. Hedley, and of his assistant, Mr. Thomas Hedley, as well as the powers of the conveners of the sections, must have been severely taxed. The successful issue of their efforts even so far does them the most conspicuous credit. It is understood that the capital sum expended upon the buildings and the grounds, amounting to upwards of £70,000, has already been recouped by the proceeds of the sale of spaces and of season tickets. Thus, only the current expenses require to be provided from the amount of cash paid at the gates. This practically secures financial success, so far as the Executive are concerned. The financial results to the exhibitors are not so easily estimated, either by themselves or by anyone else. Some of the exhibitors, indeed, are there more from patriotic fervour, or shall we say the love of fame, than for any result realisable in hard cash.

These exhibits are, however, among the most valuable from an educational point of view, and in such the Glasgow Exhibition is notably rich. The courts, indeed, form the most admirable auxiliary to the technical school in studying almost any of the leading branches of industry. It is an industrial museum, not of archæological but of present interest.

It has successfully passed the testing point of all exhibitions, viz., how to strike a medium between the bazaar on the one hand and the museum on the other. It is not easy to trace the precise lines of influence of exhibitions viewed as means of education; but there can be little doubt that only a quickened and more intelligent grasp of industrial processes can result from the opportunities afforded by so varied and valuable a collection of machines, manufactures, and natural products as that now in the West End of Glasgow.

PADDLE ENGINES OF THE MANX LINE STEAMER "QUEEN VICTORIA."

IN our issue of the 27th January last, we published a two-page engraving giving a general view of the engines of the "Queen Victoria," constructed by the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow, and we now, as promised, publish above and on our double page supplement this week an end view of the boilers and a longitudinal elevation of the engines and boilers. Illustrations showing an end view of the engines, and a plan of the engines and boilers, will be given in a future issue.

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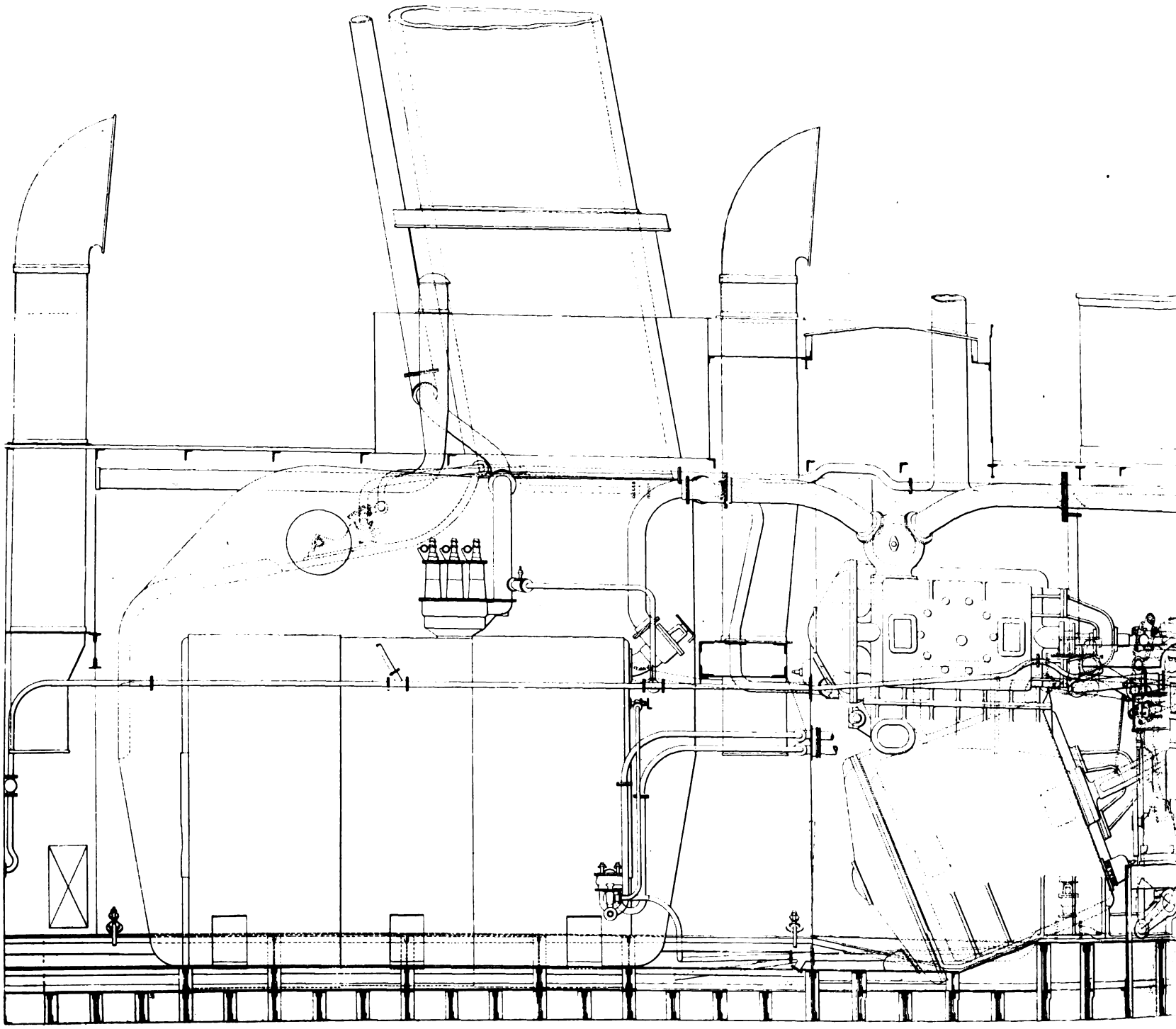
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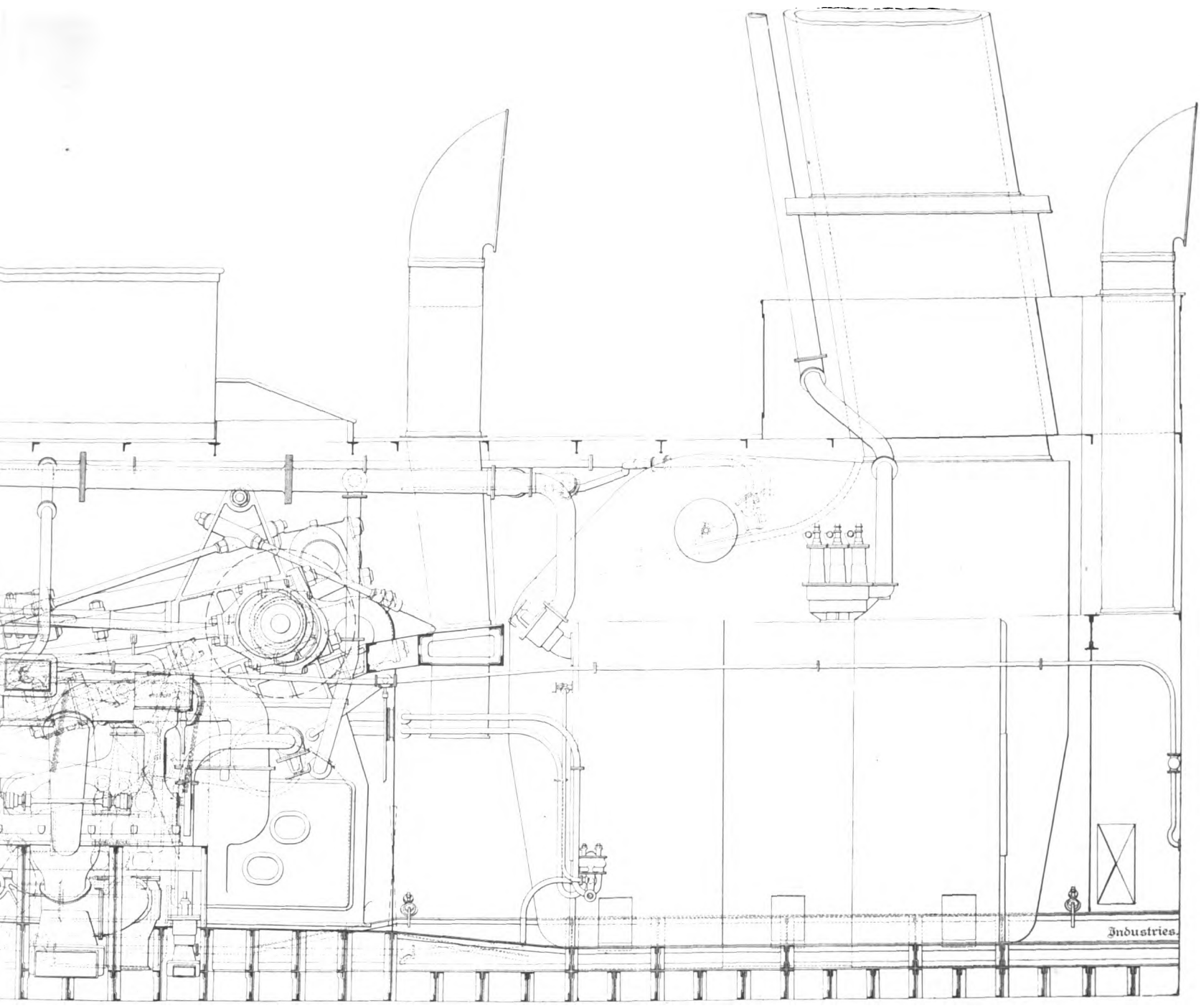
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ILERS OF THE S.S. "QUEEN VICTORIA."

LD SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GLASGOW.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
,, ,, "INDUS, LONDON."
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Telephone number: 684, MANCHESTER.
,, ,, 2785, LONDON.

Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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With a Double-page Supplement, showing the
COMPOUND PADDLE ENGINES AND BOILERS OF THE S.S. "QUEEN VICTORIA."

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 11TH MAY, 1888.

ITALIAN INDUSTRIES.

THE unpretentious Exhibition which opens at Earl's Court to-morrow, is likely to be remembered as one of the landmarks in the history of Italian industrial life, and as a point of special interest in the development of British trade with Italy. Whether we regard it merely as a collection of raw produce and manufactured goods, illustrative of the industrial capacity and commercial position of one of the great nations of Europe, or as an event significative of progress in industry and commerce in a rival people rising into political eminence, the show at Earl's Court is worthy of attention. As a mere exhibition, it will excite surprise. The Italy of to-day is very different from the Italy of a quarter of a century ago; and only those who have carefully watched the progress of affairs in the peninsula are fully aware of the great advances that have been made. The Italy of the past was a nation of consumers, producing but little, and buying largely in our own markets. We have, in consequence, come to regard the markets of Italy as outlets for our produce, for which we have to struggle in keen competition with rival producers in neighbouring lands; but many of us have hitherto failed to realise the fact that our customers are gradually becoming themselves producers. Visitors to the Exhibition will encounter this fact in all its force, and the revelation is likely to be startling. It will appear with surprising impressiveness that some, at least, of our most important outlets are gradually and surely closing against us; that our hitherto excellent customers are striving with some success to render themselves independent of our manufactures; and that the day is not far distant when they may even appear as formidable rivals in foreign neutral markets. Considered as an historical event, the Exhibition marks the close of what may be described as the initial stage in the development of the industrial life of Italy. The manufacturers of the peninsula manifestly feel themselves able to maintain their position as producers capable of competing on equal terms with their older and in some respects more favoured rivals. The boldness with which they assert themselves is evidence of this, for it is a bold step to set themselves down in our midst, bringing with them samples of their productions, and challenging comparison with the products of our old established industries. We see in this step another manifestation of that spirit of enterprise, that vigorous life and sturdy manhood, which has of late impelled the Italians to aspire to the position of a great military and naval power. The degree of success already attained in the latter direction may be taken as a guarantee of equally great achievements in trade and industry.

One of the greatest hindrances to the development of manufacturing industries in Italy in past times was the want of fuel. Nature has been niggardly of her gifts in this respect, for though lignite exists in abundance in some localities, the country is void of the better descriptions of coal. But the last twenty-five years has been a period of constant progress in knowledge, and this advance in the ways of science has enabled us to burn fuel more economically. The work obtainable from a ton of coal has gone on year by year increasing, till now it has become possible for countries where coal is scarce to carry on great industrial operations with imported coal. The favourable situation of Italy, with its extensive sea board, cheap labour, and technical skill, more than counterbalances, in present circumstances, the disadvantage of heavy charges for the long carriage of coal. It was not likely that a shrewd people like the Italians would fail to perceive the altered state of things, or perceiving it would neglect to turn their opportunity to account. Accordingly we find them establishing industries of various kinds throughout the country, and supplying their wants largely from their own manufactures. Some notion of the progress made in recent years may be acquired from a comparison of the quantities of English coal imported by Italy annually. Thus the increase has been from 2,212,111 tons in 1883 to 2,354,103 tons in 1884, 2,703,471 tons in 1885, 2,852,204 tons in 1886, and 3,186,854 tons in 1887. We have in these statistics evidence of rapid growth. The iron industry has developed itself wonderfully within the last ten years, the engineering trades have followed in a way that will probably astonish many visitors to the Earl's Court Exhibition, and the textile manufactures have kept pace with the progress made in these heavier trades. The silk manufacturing industry is making headway against French competition, and cotton goods are turned out at prices that compare favourably with those of British manufacture. Hence we have to take the native industry into account in all our dealings with our Italian customers. Italy is no longer an open market, but one which, for many of our manufactured goods, is being gradually closed against us.

The first impression, then, upon the mind of the visitor to the Italian Exhibition, will be one of discouragement. Manifestly there are grounds for serious apprehensions concerning the future of our trade with a country which has been in the past among our best customers. But there is another, and happily a brighter, side to the question. Amid these changing circumstances, it will be our own fault if we fail to retain our hold upon the Italian markets. Thriving communities are ever creating fresh wants, a disposition which growing industries tend to foster. Hence the Italian demand will, for a time, keep pace with the increase in the power of production; and for this reason our trade is not likely to suffer diminution in the immediate future, provided we are able to hold our ground against the competition of Germany. But the time is certainly approaching when the needs of our Italian customers will, in some classes of goods, find full satisfaction at home; and if we are to retain undiminished the total volume of our trade, we must take care that while old markets are being closed against us, new outlets are being found. Here lies the great value of an exhibition like that which is about to open in London. From the evidence there brought together, manufacturers will learn in what direction and in what degree their goods, now freely bought, are likely to be ere long superseded by home products, and they will be able to discover at the same time what may be substituted for them with the best chance of success. This knowledge the Germans are now seeking through their agents stationed in the chief centres of Italian industry, and already they have turned to good account the information thus acquired. In textile goods especially, and in some classes of manufactured iron goods, they have largely increased their trade within

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the last five years. It is for us to follow their example, and if the Exhibition serve no other purpose than to impress upon British manufacturers the necessity of inquiring more carefully into the matter than they have hitherto done, it will greatly benefit British trade. The time is opportune. Political animosities have brought about estrangement between Italy and France, and a consequent war of tariffs is diverting the current of trade from its former channels. To obtain a share of this trade our enterprising rivals, the Germans, are exerting themselves to the utmost. We, on our part, must also bestir ourselves, and the event which the Lord Mayor will inaugurate to-morrow comes as a timely reminder of the opportunities which are now ready to hand.

PROGRESS IN JAPAN.

The Japanese have for a considerable time expressed their determination to make their country the "Britain of the East," and the progress which has been made in arts and manufactures and in means of communication during recent years seems amply to justify that determination, and to promise that the day is not far distant when Japan will not only be able to supply almost all her own wants in the way of manufactured goods, but will also be one of our most active competitors for the trade of the vast empire of China, which is often mentioned as likely to be our best customer in the future. The Japanese set about their work in no haphazard manner. They had a clear idea that underneath any real industrial progress there must be a good foundation of scientific training, and they founded colleges and schools which, in some respects, are superior to those in this country. In science and engineering special facilities were given to the young Japanese, and they entered on their studies with most enthusiastic ardour, and now in every province of the country we find graduates of the colleges superintending public works and private enterprise. During the past two years especially there has been an almost feverish growth of trade and of joint stock companies, a great part of which is no doubt legitimate; but it is to be feared that some of it is of an entirely speculative nature, and unless this speculative spirit be moderated, it will lead to a very acute financial crisis, and induce reaction. In fact, this great activity is largely a reaction from the great depression of the past few years, and from the changes induced by the financial policy of the Government. Seven or eight years ago it was resolved to contract the volume of the paper currency, and this contraction was accompanied by all the phenomena incidental to such operations. Prices fell, and the fixed charges of property or industry grew heavier, and capitalists withdrew their money from private undertakings and invested in Government securities. Consequently the prices of these were driven up till they attained a figure at which the return was small; and now that the finances of the country have been consolidated it is only natural that capital should return to more profitable investments. Hence the large increase in limited liability companies, with all their advantages and disadvantages; for the competitive spirit has extended to Japan, and there are now to be found in that country, as in this, men who seem to live on the gullibility of their neighbours. All this time Japan labours under the extra-territorial system of jurisdiction which most effectually prevents the introduction of foreign capital and skill; for, although the Government is quite willing to allow the country to be thrown open, it can only do so when foreigners are willing to place themselves under the jurisdiction of her territorial courts. This has always been resisted by the Treaty Powers, and Japan, rather than give way on the point, has resolved to develop her industrial resources without the pecuniary aid of foreigners. We feel confident that if the British Government was fully informed regarding the position of Japan, it would not insist on carrying on the present system.

From Foreign Office and Consular reports, from the correspondents of the leading daily journals, and especially of the *Times*, and from private letters, we have obtained information regarding the recent development of industrial enterprise in Japan, and from these sources we propose to note a few of the most prominent items. Perhaps the most important feature is the increase in railway construction. That was begun in 1868 with funds borrowed from abroad, and at the end of 1886 the total mileage was 370, while during 1887 there were 151 miles of railway completed. Until 1882 the Government was the sole constructor; but in that year a company was formed for constructing lines to the great silk districts north-west of the capital, as well as to the northern provinces, and the Treasury guaranteed 8 per cent. per annum on its paid-up capital. Of the total length of 521 miles of railway constructed, 282 have been built by this company, and the remainder by the Government. To give some idea of the recent progress, it may be mentioned that between 1868 and 1877 the annual rate of construction was nine miles; between 1878 and 1880 it was five miles; between 1881 and 1883 it was 36 miles; between 1884 and 1886 it was 61 miles; and in 1887 it rose suddenly to 151 miles. The first roads built by Government cost more than £10,000 per mile; those last constructed cost only about £3,600 per mile. This is largely accounted for by the fact that all the recent lines have been constructed by Japanese engineers, and Japanese materials have been utilised as much as possible, and the whole service, after construction, is entirely managed and worked by Japanese, with rare immunity from accidents or blunders. The lines of the Japan Railway Company are paying an annual dividend of 10¼ per cent., with every prospect of still larger profits. Their working expenses are about 45 per cent. of the receipts. Last year was remarkable, not only for the rapid extension of the railway system, but also for the fact that eleven railway companies were started, with an aggregate capital of thirty-two millions of dollars. If the treaties were revised, and extra-territoriality got rid of, a wide field would be opened for the enterprise of foreign capitalists.

In a recent issue (see *Industries*, Vol. IV., page 214), we gave an account of the development of the telegraph system in Japan, and to that we would refer for particulars. We need only mention here that the total length of lines at the end of the year 1886 was 5578 miles, and during that year 166 miles were constructed. With regard to shipping in the possession of Japanese, we have not exact statistics; but during the last three or four years large numbers of vessels have been built for Japanese owners, and their mercantile marine is now very considerable, while their navy is not by any means to be despised, as it would form a most important factor in any naval action which might be necessary in the Eastern Seas. A most important work has just been undertaken by the Government in the formation of a naval station at Kure, a well chosen spot in the Inland Sea, within a few miles from Hiroshima, the frontage of the proposed dock yard being about a mile and a half in length, and other smaller naval stations are being organised. These would be found most useful in case of war, and when we mention that during last year 948 foreign vessels entered Japanese ports, with an aggregate tonnage of 1,269,429, it will be seen that the interests of foreign nations involved are very considerable.

But the enterprise of the Japanese has not by any means been confined to larger works of communication or carriage. The Tokio correspondent of the *Times* recently summarised those undertaken during last year. He said that in the three cities of Tokio, Osaka, and Kioto, no fewer than 111 large companies, industrial or commercial, were formed during the year, with an aggregate capital of $21,500,000. Besides these, a number of smaller undertakings found promoters and supporters throughout the provinces. During the same period thirteen banks made additions to their capital, the sum of such increments being $18,000,000. If to these amounts be added the $32,000,000 representing the capital of the eleven new companies already mentioned, it will be seen that shares in various public undertakings to the extent of more than $71,000,000 were taken up by the people during the year 1887, the total representing an average of nearly $2 per head for the entire population. Among the 111 companies all sorts of enterprises are included. There are companies for cotton spinning, paper making, dyeing, glass blowing, lumber dealing, tea and silk exportation, horse breeding, land transport, and engineering companies, as well as others for the manufacture of porcelain, lacquer, bronzes, and other art objects, and a host of other commodities. Among all these the growth of cotton manufactures is, perhaps, the most manifest and significant. At the end of December there were no fewer than twenty-two spinning mills at work, representing 76,000 spindles, and a yearly output of 1,320,000lb. Further, eight large new factories, with 117,000 spindles, had been started, and were being brought rapidly into working order. The *Times* correspondent adds that the meaning of this is plain—Japan intends to make her own cotton goods instead of buying them from abroad. She cannot as yet supply herself with the material, and is therefore obliged to import considerable quantities. But everything points to her success as a manufacturer. She is within easy reach of great cotton growing regions; she possesses an unlimited supply of probably the cheapest labour in the world; her art artisans have no equals elsewhere; and her people enjoy the blessings of settled government and full security of life and property. While we wish Japan all success in her efforts, we at the same time hope that British merchants will clearly realise the facts of the case, and not permit themselves to be overtaken by the enterprising "Britons of the East" in the race for the leadership of the industry of the world.

THE EDISON GLOW LAMP PATENTS.

Our report of the proceedings in this case in our last week's issue concluded with the commencement of the cross-examination of Professor Crookes. In reply to further cross-examination, the witness referred to several passages in Edison's subsequent patents, in which was pointed out the necessity of careful carbonisation to prevent warping, twisting, &c., and to allow for contraction, which he stated to be inevitable; and speaking of Edison's suggestion to coat the filament with a non-conducting non-carbonising substance, he pointed out that the action of these substances upon the filament when placed in the lamp would depend to a very great extent upon the condition of the filament itself. If the filament were a hard homogeneous carbon, and the silicate easily fusible, the silica might run off without attacking the carbon, whereas, if it were a soft porous carbon, it would absorb a fusible silicate like a sponge, and be destroyed when the temperature rose high enough. A lamp handed to Professor Crookes by the Attorney-General, which had been coated with a non-conducting non-carbonising substance was, in Professor Crooke's opinion, made with a filament of parchmentised thread, that is, thread which had been treated with an acid prior to carbonisation. Professor Crookes did not consider this filament was a fair example of the Edison filament described in the specification. He also stated that he had himself experimented with a very large number of substances as coatings for the filaments, and without a single exception he had found them all the reverse of beneficial, by reason of their diminishing the radiating power of the carbon. Returning to the subject of carbonisation, it had been suggested to the witness, in cross-examination by the Attorney-General, that gases were given off during carbonisation, and expelled the air from the crucible. On this point Professor Crookes stated that at the comparatively high temperature at which these gases would be formed, the mobility of the molecules would be much increased, and they would diffuse out rapidly at the same time that the atmospheric air would diffuse in: the luting of the crucible would by this time have become quite dry, and permeable to gases.

The next witness called by the defendants was Dr. Frankland, who was examined by Mr. Graham. He stated that he had lighted his house five or six years ago with incandescent lamps which he had obtained from the Swan Company before their amalgamation with the Edison Company. He remembered seeing the exhibition of lamps at Mr. Spottiswoode's house in December, 1880, on which occasion Mr. Swan explained their construction. The first time he saw an Edison lamp was at the Crystal Palace Exhibition in 1882, when Mr. Sprague, who was Mr. Edison's agent, presented the witness with an Edison lamp, which he produced. This, in Dr. Frankland's opinion, was made of a bamboo filament, and was not made according to the directions contained in the specification now in question. The carbon filament appeared to have been mounted to the platinum leads by some electrolytic process, and the witness had never seen, in the market, an Edison lamp in which the filament was mounted in the manner described in the specification. Dr. Frankland stated that he had endeavoured to make a putty-tar filament, but had not been able to roll it out finer than one millimetre in diameter. He did not attempt to carbonise any of these filaments himself; but he saw an experiment made by Professor Crookes, in which the crucible had not been packed, and all the filaments, including some made of structureless cellulose, were entirely burnt up, leaving nothing but ash. He corroborated Professor Crookes as to the effect of coating the filament with the non-conducting non-carbonisable bodies, and also as to the effect which the carbons would produce on the platinum if the platinum were attached to the filament before carbonising. In his opinion, at the date of Edison's specification, the word filament had acquired no technical or conventional meaning, except in botany, and there it meant, in some cases, a thing of considerable diameter as compared with its length. Speaking of the experiment which Professor Crookes made, where a fine pencil was cut from a stick of lime, which had been impregnated with carbon by flashing in a hydrocarbon gas, and the pencil then placed in a lamp, Dr. Frankland stated that he was looking through a spectroscope at the time, and after a minute or two he saw the calcium hues in the spectrum; soon afterwards the lamp broke. Dr. Frankland had carried out Despretz's process, and produced a material which was identical with Cheesbrough's. If the platinum had been placed in the carbonising chamber, and had thus to some extent been converted into a carbide, then at the time of sealing the platinum into the glass a considerable length of the platinum would be heated to a red heat, and the carbon in the carbide of platinum would burn off, leaving the wires in a very porous state. Dr. Frankland was then cross-examined at very considerable length by the

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Attorney-General. The witness was the principal scientific witness in the action which was brought about two years ago by the present plaintiffs on the same patents against the well known firm of Woodhouse & Rawson. He admitted that the only experiments which he had seen since that trial were those performed by Professor Crookes, and further that during that trial he had not said anything about the insufficiency of Edison's specification, or on the point which had been raised recently about the formation of carbide of platinum. The witness had stated at the last trial that in an old specification filed by Pulvermacher there were sufficient directions to enable a skilled working man to make a carbon filament such as Pulvermacher describes; and he admitted that he was still of the same opinion, but that more specific instructions would be required to enable a working man to carry out the process, because carbonisation, so far as it was known at the date of Edison's patent, always meant partial combustion of the thing being carbonised. Dr. Frankland was then asked by Sir Richard Webster whether he was not aware that in February, 1880, there was an exhibition of Edison lamps in Queen Victoria-street, on which occasion Dr. Fleming explained their construction. Dr. Frankland stated that he was not aware of it. The witness was then asked some questions about the experiments with the lime pencil impregnated with carbon, and admitted that he had not made the experiments for himself, but was present when Professor Crookes carried them out. He said that the bright calcium hues were due to the metal calcium being in a state of vapour, and that calcium would only pass into that state at such high temperatures as that of the electric arc. On re-examination by Mr. Finlay, Dr. Frankland stated that the list of infusible non-conducting substances previously referred to as having been put in by Professor Crookes, specifying some forty or fifty bodies, did not by any means exhaust the number of bodies answering to that description, but was a list of those which were most likely to succeed, although in his opinion not one of them would succeed. He added that this point on Cheesbrough's specification, and the analogous one as to non-conducting non-carbonisable bodies mentioned in Edison's specification, was not referred to at the last trial, on which occasion the sufficiency of Edison's and Cheesbrough's specifications was hardly mentioned.

Dr. Tidy, who had given evidence on behalf of the plaintiffs as to Cheesbrough's patent at the last trial, was now called, and examined by Mr. Finlay, on behalf of the defendants. He stated that he had put fifty filaments into a crucible, and carefully luted the top and raised it to a carbonising temperature, and had found nothing but ash on opening the crucible. He then filled the crucible with charcoal, and succeeded. He then tried making putty-tar filaments, and pointed out that Edison gave no directions as to the proportions of tar and lamp black. If you put too much tar, the mixture ran; if you put too little, the substance came to pieces. After a great many trials, he got a filament about $\frac{1}{25}$in. diam., which he carbonised with charcoal; but he found, on opening the crucible, that it fell to pieces. He considered it was necessary to use a mould in carbonising, which would allow for contraction and prevent distortion. Dr. Tidy was then cross-examined by Mr. Aston, and admitted that it was possible to carbonise a cotton thread, but denied that a putty-tar filament could be subjected to a carbonising process, and come out as a filament which could be used. Dr. Tidy had also coated a thread with tar and lamp black, and he had found that the coating cracked in carbonising. He admitted that in one of the specifications prior to Edison there was a description of carbonising carbons to be used for arc lighting in contact with powdered charcoal. Dr. Tidy stated that in carbonising there were two factors which had to be taken into account: the temperature at which the carbonising was effected, and the rate at which the temperature was raised.

Professor Sylvanus Thompson was the next witness. He was examined by Mr. Finlay as the principal witness to speak to the electrical aspect of the case. Professor Thompson stated that he visited the house of Mr. Stearn at Rockferry in the autumn of 1880, and observed that it was lit with electric lamps, the conductors of which were of a filamentous character. He saw many Swan lamps at the meeting of the British Association at York, in August, 1881, and the first time he saw an Edison lamp was at the Paris Exhibition, in September, 1881. Those lamps, he said, would come within the second claim of Edison's specification, but had been made with many improvements not mentioned in that specification. He pointed out nine respects in which they differed from those described in the specification. Professor Thompson then produced diagrams showing the different ways in which lamps could be used, that is to say, in series, in multiple arc, and in a combination of the two. And he explained that the advantage of high resistance in lamps was an advantage external to the lamps; a lamp of low resistance being more durable than one of high resistance. With high resistance lamps small mains could be used, whereas with low resistance lamps the mains would be large. The witness referred to passages in Lane Fox's and Edison's patents prior to the one in question where this had been pointed out, and to a specification of Edison, in which he had himself pointed out the advantages of low resistance lamps in certain cases. He produced specimens of Carré carbons which he bought from Mr. Carré in 1878, which were one milimetre in diameter, and had orignally been one metre in length, and said that at that time they were the most suitable forms of carbon for use in incandescent lamps. Professor Thompson further stated that the real difficulty of fusing platinum into glass depended upon the glass and not on the platinum. Glass differs much in its rate of expansion, and if a glass is taken which has the same rate of expansion as the platinum, there is no difficulty in sealing platinum wires into it. Professor Thompson was cross-examined by Mr. Moulton, and was much pressed for the purpose of elucidating from him that the pencil of lime impregnated with carbon and put into a lamp by Professor Crookes, was not of uniform section, and that the consequence of this would be that at those portions of the pencil where it was thinnest, the heat might have risen to that due to the arc, while the other portions were still at a low yellow heat, and thus a chemical reaction between the lime and the carbon might be induced at one particular spot, while the rest of the pencil appeared to be at a low temperature.

The next witness was Professor Perry, who was examined by Mr. Graham. He stated that one of the great factors which made incandescent lighting possible was the improvement in the dynamo machine. The first Gramme dynamo brought into this country was shown by the witness to a number of scientific gentlemen in 1874, to whom the machine was quite unknown. In 1878 Brush took out his patent for compound winding, but the merits of compound wound machines were not generally recognised until a year or two after that date. Professor Perry stated that in his opinion it would not have been safe, having regard to the nature of the dynamos then in the market, to use a lamp with a carbon conductor much smaller than that used by Mr. Swan. The advantage of the compound winding was pointed out to be that you may switch on a hundred lamps or more, and switch them all off but one, without producing any material difference in the electromotive force. Professor Perry was cross-examined by the Attorney-General, and said that he thought the gold medal which was awarded to Mr. Edison at the Paris Exhibition was not for his lamps alone, but for his telephone, phonograph, and other things also.

Mr. James Swinburne was then examined by Sir Horace Davey. He stated that about 1881 he was with the Swan Company at Newcastle, and that great difficulty was experienced in properly carbonising the filaments. After some weeks of experimenting, the method had been devised of winding the threads on such a frame as that spoken of by Mr. Edward Gimingham. At one time the Swan Company carbonised each filament separately in moulds something like a water colour palette. Mr. Swan, towards the end of 1880, had taken out a patent for carbonising filaments in the presence of powdered charcoal. Mr. Swinburne had tried long ago to carbonise in sand, and had failed, and quite recently he had measured the quantity of steam and air which came off sand, and he found that 140 cub. cm. of silver sand gave off as much steam and air as would burn up twenty-five to fifty filaments. A sample of grey sand tried by Mr. Swinburne of the same volume, gave off 27,000 cub. c.m. of steam and air. Mr. Swinburne stated that he had considerable experience in testing incandescent lamps, and that he did not think the duration tests which had been made by Mr. Gimingham had been sufficiently hard ones. Mr. Gimingham had tested the lamps at about 16 watts per candle power, whereas Mr. Swinburne considered $3\frac{1}{2}$ to 4 watts a more satisfactory test. It was the one which he usually applied. The case was still proceeding at the time of our going to press.

THE IRON AND STEEL INSTITUTE.

The annual meeting of the Iron and Steel Institute was commenced on the 9th inst., at the Institution of Civil Engineers, Mr. Daniel Adamson, the president, in the chair. The gold medal was presented to the President by Sir H. Bessemer, who gave an interesting account of his early struggles to introduce his steel, stating that Mr. Adamson was the only manufacturer outside Sheffield who thoroughly investigated the invention, and that the modern wide use of steel was to a large extent due to his efforts. After thanking the Council for the honour conferred upon him, Mr. Adamson delivered his address, in which he remarked that the total production of manufactured iron in the United Kingdom in 1884 was 2,237,535 tons, against a total in 1887 of only 1,701,312 tons. The production of Bessemer ingots in 1884 was 1,299,000 tons, while in 1887 it had risen to 2,064,000 tons. In 1884 the total production of steel ingots by the open hearth process was 475,250 tons, and the manufacture has increased every year, until it reached 981,104 tons in 1887.

THE LATE SIR CHARLES BRIGHT.

We regret to have to announce the death of Sir Charles Bright, which took place on the 3rd inst., at his residence in London. He was the youngest son of Mr. Brailesford Bright, the principal partner in the firm of Heron, Bright, McCulloch, & Co., drysalters, in Bishopsgate-street, and head of a well known family in Hallamshire, in the West Riding of Yorkshire. Charles Bright was educated at the Merchant Taylors' School, and very early in life he turned his attention to electricity and chemistry. When a lad of sixteen, he and his two elder brothers joined the service of the Electric Telegraph Company, and Charles, after a short novitiate in the practice room, was sent to Liverpool as junior operating telegraph clerk. Shortly afterwards he was tranferred to Birmingham, and eventually he joined the British Telegraph Company, under Mr. Highton, whilst his brother Edward had meanwhile joined the Magnetic Telegraph Company; and the two brothers brought about the fusion of the two companies, under the title of the British and Irish Magnetic and Telegraph Company. This company became a strong competitor with the Electric Telegraph Company, which was incorporated in 1846, with Mr. John Luis Ricardo, M.P., as chairman, and which original company must be regarded as the parent of all the subsequent telegraph companies. Very early in life Charles Bright was entrusted with erecting telegraph stations and lines in the North of England and in Scotland, and on one occasion he achieved the remarkable feat of laying an underground cable in Manchester in a single night, without causing any interruption to the traffic in the streets. Jointly with his brother Edward, he invented and patented many valuable improvements in telegraphic apparatus, but his greatest achievement was in connection with ocean telegraphy. The late Mr. Crampton, by his cable across the Channel, had shown that signals could be transmitted across the sea; but it was reserved to Charles Bright to conceive the gigantic idea of laying a cable under the Atlantic to join the old world with the new. This was after he had successfully laid the first cable which united Great Britain with Ireland in 1853. He had been experimenting for some time on a system of insulating wires with gutta-percha, and the success with an experimental circuit 2600 miles in length led him and others to the conviction that telegraphic communication with America was possible. The idea found at first but little favour with capitalists in New York and Boston, whom Mr. Field tried to interest in the scheme. Mr. Field came over to England in 1856, and entered into an agreement with Mr. Brett, Mr. Whitehouse, and Mr. Charles Bright, who at that time was the engineer of the Magnetic Telegraph Company. Under this agreement, each of these promoters was mutually bound to push on the undertaking in every possible way, and to share in the ultimate profits to be derived therefrom. Charles Bright and his friends raised the capital necessary for the first Atlantic cable, which was successfully laid by him in 1858, he being then the engineer in chief to the company. He designed the paying out machinery, and the other mechanical appliances required for the submergence of the cable, and associated with him were Sir Samuel Canning, Mr. H. Woodhouse, Mr. H. Clifford, Mr. F. C. Webb, and Sir William Thomson. The two thousand miles of cable required were made in England, and in the laying there were employed four ships lent by the British and the United States Governments. After the great services thus rendered to ocean telegraphy, Mr. Bright was knighted by the Lord Lieutenant of Ireland. Sir Charles Bright was next engaged in submarine telegraphy in the Mediterranean and the Baltic, after which he was summoned in 1864 by the Government of India to complete the telegraphic communication with Europe, which work he accomplished by joining Kurrachee with the northern end of the Persian Gulf. He subsequently superintended the laying of cables between the United States and Cuba, and was also engaged in the erection of telegraph lines between various parts of North and South America. Sir Charles Bright was elected a member of Parliament for Greenwich in 1865, and represented that constituency for several years in the Liberal interest. In 1881 he was appointed by the Foreign Office one of the commissioners to represent Great Britain at the Electrical Exhibition at Paris, and he was afterwards nominated by the French Government an officer of the Legion of Honour. In 1865 he contributed a very important paper to the Institution of Civil Engineers, in which he advocated submarine telegraphy to China and to Australia, and which paper received a Telford medal and premium. He was a member of the Institution of Civil Engineers, the Society of Telegraph Engineers and Electricians, of which he was the president last year, and

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THE LATE SIR CHARLES BRIGHT.



he was also a member or fellow of several other learned societies. The above engraving is reproduced from one by Mr. G. B. Black, Regent-street, London, and kindly lent to us by an intimate friend of the deceased gentleman.

Letters to the Editor.

TELEPHONE PATENTS.

To the Editor of "Industries."

Sir,—It having come to the knowledge of the Equitable Telephone Association that the agents of the United Telephone Company are circulating reports to the effect that the Association have not the intention or the means of defending the action for infringement of patents that the United Telephone Company have thought fit to commence against them, the Association ask the favour of your space to give these most unwarranted reports an unqualified contradiction. They also take the opportunity of stating that not only have they the fullest intention of contesting the action to the utmost, but have also every confidence that they will be successful in upholding the freedom of their telephones.

Yours, &c.,
For the Equitable Telephone Association, Limited,
A. Allwinter, Director.

London, 8th May, 1888.

AN APPEAL FOR THE ROYAL VICTORIA HALL.

To the Editor of "Industries."

Sir,—Will you allow me to add a few words to the letter on the above subject which you kindly inserted a fortnight ago? I wish to mention that the proposed memorial, viz., the purchase of the freehold of the Victoria Hall, has the cordial approval of Mr. Samuel Morley's family. It is also desirable to urge that the present opportunity should be seized without delay. It will never recur. Should we fail to raise the necessary sum, £17,000, by August next, the formal arrangement which has been entered into with the landlord would fall through, and at the expiry of the lease in a few years' time the present admirable work of the "Vic" would cease. If we fail in our present effort, there will be no lack of competitors anxious to secure the hall, and work it on ordinary low music hall lines. The Charity Commissioners can only take over the "Vic" after the freehold has been secured. Friends and admirers of Mr. S. Morley, and sympathisers in a work so well tested and so widely useful, are appealed to for a prompt and liberal response.

An influential Memorial Fund Committee is being formed, and subscriptions will be received and duly acknowledged by the Duke of Westminster, hon. treasurer, and Lady Frederick Cavendish, 4, Upper Brook-street, W.; by Miss Emma Cons, hon. sec., Royal Victoria Hall, Waterloo Bridge Road, and by the London and County Bank, Westminster Bridge Road, S.E.

Yours, &c.,
Lucy C. F. Cavendish.

London, 7th May, 1888.

THE LONGRIDGE GUN.

To the Editor of "Industries."

Sir,—A statement having appeared in the daily papers that a 6in. gun constructed from my designs burst at the first round at Woolwich Butts on Thursday, the 26th ult., I desire to contradict such statement, and to explain what really did take place and the cause of the accident. The gun was fired with 34lb. of pebble powder and a projectile of 99lb. The projectile went all right through the screens to the Butts with a velocity of about 1850ft. per second. In order to explain the nature and cause of the accident, which consisted of blowing off the muzzle of the jacket, reference must be made to the accompanying sketches. Fig. 1 represents a general outline of the gun, which weighs 97cwt. Fig. 2 is a longitudinal section at the breech and Fig. 3 a longitudinal section at the muzzle. The gun barrel consisted of a steel tube, 1·6in. thick at the breech and 1·1in. thick at the muzzle. Upon this was the wire coil, 2in. thick at the breech and ⅜in. thick at the muzzle. The tubes and coil were placed inside a cast iron jacket extending from end to end, but did not touch the jacket except at the two ends. Thus it is seen that there was no connection between the tube and the jacket. The tube was therefore free to move longitudinally in the jacket until its front end abutted against the flange of the steel muzzle ring. On the other hand, it was free to expand backwards, a space of about ⅜in. being allowed at A (Fig. 2) between the end of the tube and the breech ring. The tube was kept up to the muzzle ring by six Belville springs placed at A. As the breech plug takes into the breech ring, which again takes into the jacket, it is evident that there can be no backward longitudinal strain on the tube.

The longitudinal strain generally spoken of is a strain between the breech and the trunnions, and it is in respect of resistance to this strain that the wire system of construction is so often said to be defective. The cry has always been that the breech will blow off. There is, however, another longitudinal strain, the importance of which has, I think, never been recognised; and it is this, I believe, which has caused the accident not only to my gun, but to others which have had their muzzle and front part of the chase blown away. This is a forward strain tending to drive the tube forwards in the line of fire. In my gun, as will be seen from the drawings, the whole of this forward strain came direct on to the muzzle ring, and was transmitted from it to the trunnions through the jacket. What happened then was this—the steel tube and coil were driven forward about an inch, and tore asunder the jacket at the places A and B in Fig. 3. The part in front at A followed the projectile to the Butts; the part between A and B, about 1ft. in length, simply moved forward, leaving a space of about ⅛in. wide at B. The steel tube was uninjured, and so was the coil, except that a small portion of it was dragged off the tube and uncoiled by the gun metal hoop C, which was shrunk on to the end of the coil, and was carried away. The wire, however, was simply uncoiled, and was not broken.

How came it that sufficient provision was not made to resist this forward strain? The answer is very simple. I never had the slightest suspicion that a strain of such magnitude would arise. That there was a forward strain I well know; but I had greatly under-estimated its amount.

This strain is due to four distinct causes: (1) The action of the powder pressure upon the difference of area of the obturator and the bore. This in my gun was 1·52in., and as the maximum pressure was 25 tons per square inch, this gives a forward strain of 38 tons. (2) The strain due to the friction of the projectile through the rifling. This in my gun was about 7 tons. (3) The strain arising from the inertia of the mass of the tube and coil recoiling with the gun. This did not exceed 55 tons. (4) The forward force due to the friction of the products of combustion. About this there is great uncertainty. If the question be treated in the usual way for the friction of air through pipes, that is to say, making the friction a function of the density of the fluid and of the square of the velocity, the resulting strain is quite insignificant. In making my calculations for the strength of my gun, I thought I would be quite safe in allowing for a strain of 100 tons from friction. Consequently I made the whole forward strain 38+7+55+100=200 tons, to meet which I gave a sectional area at the weakest part of the jacket of 55·8 sq. in., so that the strain would be $\frac{200}{55·8} = 3·6$ tons per square inch; and as the breaking strain of the metal was ascertained by actual testing to be about 16 tons per square inch, the factor of safety was about 4·5. I am therefore driven to the conclusion that the effect of the friction of the gases is very much greater than anticipated. I think we must consider the action of the gases, or rather of the mixed gaseous and liquid products of combustion, in the same light as that of a body moving upon another with pressure between the surfaces. The nature of these two bodies no doubt affects the co-efficient of friction; but the law that the force to give motion is directly as the surface multiplied by the pressure per inch of surface, must, I think, hold good.

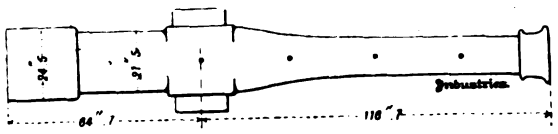


Fig. 1.

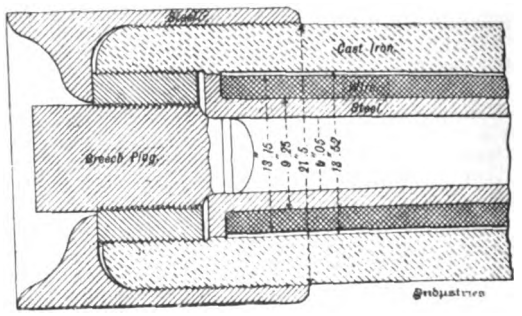


Fig. 2.

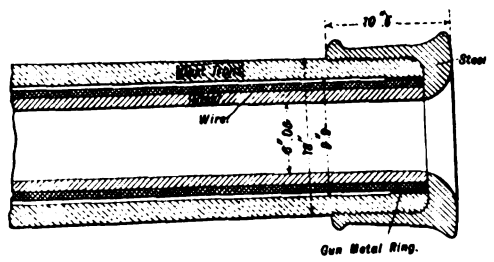


Fig. 3.

Considering the gun from this point of view, I have calculated the effect for two different positions of the projectile: (1) When it has moved 10in. from its original position, at which time the pressure is a maximum. In this case the surface acted on was 836 sq. in., which, multiplied by the pressure, 25 tons, gives 20,900 tons. The velocity of the gases at this time would be zero at the breech, and 636ft. per second against the projectile, or a mean velocity of 318ft. per second; that is to say that we have a body of mixed gas and liquid pressing against the inner surface of the tube with a force of 20,900 tons, and moving at a velocity of 318ft. per second. Making a similar calculation for the moment when the projectile is leaving the muzzle, we get a body of mixed gases and liquid pressing against the tube with a force of 12,160 tons, and moving with a mean velocity of 937ft. per second. Leaving out of account for the present the effect of velocity as increasing the co-efficient of friction, let us see what this would require to be to rupture the jacket.

	Tons.
The strength of the jacket at the period of rupture was ..... $55·8 \times 16 =$	892·8
Deduct the forward strains, exclusive of friction...	100·0
Strain due to friction	792·8

This would give a co-efficient of friction of $\frac{20900}{792·8}$ in the first case, and $\frac{12160}{792·8}$ in the second, or $\frac{1}{26·4}$ and $\frac{1}{15·4}$ respectively. Is there anything improbable in the idea that the co-efficients of friction may not exceed these figures? I think not, especially when we bear in mind the way in which hard steel tubes are scored by the product of combustion. I have very little doubt, then, that the rupture of this jacket was due to this cause.

In the 6in. gun made in Russia from my design, the jacket was arranged differently, and the forward strain was not concentrated at the muzzle end. This gun has fired upwards of six hundred rounds with charges of 39lb. powder and 122lb. projectile, and no accident has occurred. The accident to the gun at Woolwich is due, I freely admit, to an error in the design; but it is an error which may easily be remedied, and which in no way affects the principles of wire gun construction which I have so long advocated. A force whose magnitude was never suspected by me, nor, so far as I know, by anyone else, has manifested itself, and for this I made no sufficient provision.

I believe that the same force greatly contributed to the blowing away the front part of the chase of the "Collingwood" and other guns. In the "Collingwood" gun about 100in. in length was blown off. The surface exposed by this length of the chase at the time of the projectile leaving the muzzle was about 3800 sq. in., and the mean pressure 5 tons. The mean velocity of the products of combustion was about 1500ft. per second, so that there was a pressure of 19,000 tons moving at 1500ft. per second. The friction in this case gave rise to a strain which, no doubt, contributed very largely to the fracture of the chase, if indeed it did not altogether cause it.

Yours, &c.,
Jas. A. Longridge.

Jersey, 1st May, 1888.

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THE BOILER EXPLOSIONS ACT, 1882, AND HOW IT IS WORKED.

TO THE EDITOR OF "INDUSTRIES."

SIR,—It is now nearly six years since the Boiler Explosions Act came into force—that is, from 12th July, 1882—and during that time about 257 preliminary inquiries have been carried through, but the first report of a Formal Investigation has only just made its appearance. I asked, in my letter dated the 21st ult., why make a formal investigation at all, after so many years? Perhaps a reply can be given. During that period many explosions have occurred where the responsibility of the owner was of the clearest description, and where a definite expression of opinion would have been invaluable for the prevention of similar occurrences in the future. Nothing, however, was done; and it is only after the attention of the public has been drawn by the most pointed inquiries and remarks in the Press and otherwise, to the neglect of the Board of Trade officials in carrying out the provisions of the Act, that a formal investigation is at last made. The report is now issued; but it carefully avoids giving any decision upon the most important object of the inquiry.

In referring to this very investigation, Mr. Thomas Gray, Assistant-Secretary to the Board of Trade, in "Memoranda prepared for the consideration of the Right Hon. the President of the Board of Trade," and presented to both Houses of Parliament, now issued to the public, complains that "this Act gives very large powers to the Board of Trade and to its inspectors, *but the powers it gives are simply powers of 'inquiry'* after explosion." He refers to this Act in a stronger manner a little further on, remarking, "As I have said, *it is purely an 'Inquiry' Act*'" (the italics are mine), although he is well aware that the whole of the costs and expenses of a formal investigation can be laid upon any careless or culpable owner—a sufficiently formidable fine. If there had been any disposition upon the part of the Board of Trade officials to stamp out boiler explosions, would they not have used the means provided to their hands for so doing? Why has not a formal investigation been held in every case where neglect and mismanagement have been gross, and the costs enforced in each case? If, as I have before pointed out, this course had been taken, boiler explosions would have practically ceased to happen. The mere dread of such an inquiry, and the imposition of such a fine, has produced a degree of care among steam users sufficient to reduce the rate of explosions during the existence of the Act no less than 42 per cent. Instead of this perfectly obvious course being taken, six years have been wasted, and only one formal investigation made. It seems as if the action of the Board of Trade officials was deliberately intended to defeat the object of the Bill; and, by constant misrepresentation of the facts, to show that nothing but governmental inspection of steam boilers would secure safety. And the answer to my question—Why has a formal investigation at last been made?—appears to be simply to attempt to discredit private boiler inspection, and to endeavour to extract evidence from the case in hand sufficient to show that governmental supervision is the only panacea. A very large portion of the report in question (No. 254) is taken up, as you point out, with the prospectus, proposal form, copy of policy and its conditions, and other purely formal documents of the Midland Boiler Inspection and Assurance Company, which, I think, do not appear to bear sufficient relation to the matter before the Commissioners to justify their insertion. Another large portion is devoted to an examination of the chief engineer of the company which insured the boilers, apparently with the view of showing that the premium charged was not sufficient to pay the cost of efficient inspection.

The general tenor of the Commissioners' conclusions goes to show that there was more anxiety to injure boiler inspection as now carried out, and to elicit evidence to its disadvantage, than to arrive at a decision as to where to place responsibility—the real object intended by the Act—and not a very difficult duty when it was shown by the evidence that the boiler was of a dangerous type, thirty-four years of age, during which time it appears to have worked day and night. The Report states that the boiler insurance company's reports showed "clearly that this boiler had been in an unsatisfactory condition for a great number of years, as appears from the continuous leakages, patching, caulking, chipping of seams, and renewals of rivets, which are alluded to therein," and of which the Commissioners say: "The total abandonment of this class of boiler is naturally most desirable, as, both from its design and mode of working, it must always be looked upon with great distrust by all persons conversant with steam boilers. . . . all that can be said in its favour being that it is capable of being easily cleaned both inside and out." In view of these statements, it is much to be regretted the Commissioners have not seen fit to decide the matter, and fix the costs upon the culpable persons. Knowledge of the result would then have spread over the whole kingdom, and both owners, employés, and insurance companies would have reaped the benefit of the lesson. As it is, the interests of all connected with the use of steam power are sacrificed to the extension of official red tape, and to an attempt to erect another State paid office, with all its expensive dependents.

All who are interested in steam power should get and read the "Memoranda" to which I have referred. They will then see in what manner the officials of a department of State consider it proper to deal with a question of vital import to them, and the value and truth of the statements they use for the furtherance of their objects. It is not a cool, candid, and convincing statement of facts such as a State paper of the kind ought to be, but simply a piece of the most careful special pleading, marshalling all the facts, and certain statements that are absolutely false, in regard to boiler insurance and inspection, in the most careful manner, to produce a feeling that compulsory inspection is essential, and that it can only be properly carried out under the care of the Board of Trade. Even the number of explosions is based upon the experience of the last ten years, entirely ignoring the beneficial action of the imperfectly worked Boiler Explosions Act of 1882, and deliberately referring to boiler explosions as "a great and growing evil," in face of the well known and established fact that boiler explosions have been and are rapidly diminishing, both in number and fatality.

Yours, &c.,

Manchester, 5th May, 1888. ECONOMISER.

THE "CRANDALL" TYPE WRITER.

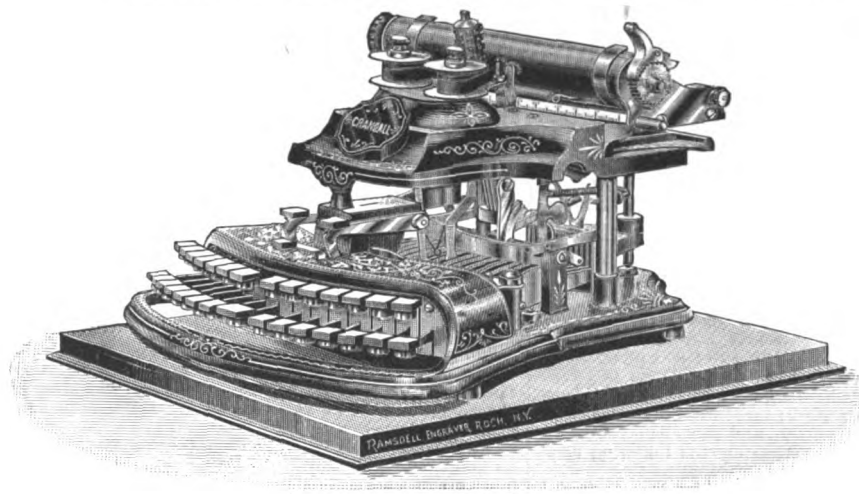


FIG. 1.

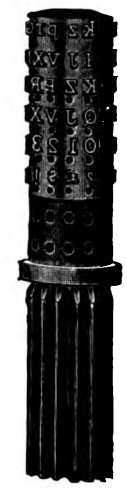


FIG. 2.

THE "CRANDALL" TYPE WRITER.

THE "Crandall" type writer, which we illustrate in Figs. 1 and 2, possesses several distinct advantages over all the similar machines which have hitherto been placed on the market. The chief claims made for it are, that it is a variable spacer, that the distance between the lines may be altered at will, that the writing is always in sight, and that there are only twenty-eight keys, which, however, represent eighty-four different characters. There are no type bars employed, but the letters are all placed upon one solid sleeve, as shown in Fig. 2. The sleeve contains three fields of type, each including small letters, capitals, and figures, punctuation signs, &c.; and the different fields are brought into play by field shifting keys, which are automatically locked down during use. Each character on the sleeve has a corresponding locking hole which closes over a fixed pin, and the sleeve is therefore secured in position until the impression is actually made; this arrangement also prevents the simultaneous depression of two keys. The sleeve can be readily detached from the spindle upon which it works, and can be replaced by another which may carry a different style of type. The ends of the key levers work in inclined grooves cut in a cam at the back of the instrument. This cam actuates a quadrant lever, which is secured to the same spindle as that of the cam, and the teeth on the quadrant lever engage with the pinion on the type sleeve. When a key is depressed the opposite end of the lever rises and causes the cam to move the quadrant lever through a distance which is requisite to bring the corresponding type to the printing position. The letter spacing arrangement adapts the machine for tabulating figures, and for invoicing accounts, besides giving a neater appearance to the printed matter. The machine may be fitted with a paper roller made of hard rubber, which makes it well suited for manifold printing by means of carbon paper. The key board is arranged with the more common letters near the centre, and the space travelled over by the fingers is thus much reduced. The inking is effected by a ribbon, and no handling of this ribbon is necessary, as it moves automatically when the space key is touched; and if desired it can be reeled from one spool to the other at once without the hand being soiled. As a piece of mechanism the Crandall machine is very simple, and on account of there being fewer keys than usual, the number of separate pieces is reduced. Like other instruments of its class, it is made in America; but the manufacturers have an agency at 5, Cross-street, Manchester, Mr. Gardner being the sole agent for the United Kingdom.

NOTES ON AMERICAN FOUNDRY IRON.*

THE iron making resources of the United States of America have so largely increased during the last few years that English iron makers can scarcely afford to look on with indifference while their cousins across the Atlantic are making such rapid progress. Thus, taking the years 1885 and 1886, the production of pig iron in the two countries is returned as follows:—

	1885. Tons.	1886. Tons.
United States	4,529,869	6,365,328
Great Britain	7,415,469	7,009,745

The returns obtained from different sources show some variations, but so far as the purpose of the present paper is concerned, the numbers given may be accepted as correct. It should be mentioned that the quantities for the United States are returned in metric tons of 2000lb.; but even with this allowance the figures are sufficiently startling, for while Great Britain shows a decrease of 406,724 tons, or rather over 5 per cent., the United States on the other hand increased its production by 1,835,459 tons, or rather over 40 per cent.; and this increase was well maintained during 1887, the output last year amounting to no less than 7,187,206 metric tons.

The following notes were suggested by the collection of a set of specimens, prepared by Mr. Keep for the metallurgical department of the Mason College, and intended to be used for teaching purposes. The memoranda accompanying them were not originally intended for publication, or possibly irons might have been selected which would have shown American production in a somewhat more favourable light. But as such a collection is probably the most representative one in this country, and as the information is very complete, it has been thought well to publish it. The irons shown were selected from the collection in the physical laboratory of the Michigan Stove Company, Detroit, of which company Mr. Keep is superintendent. The collection is not intended to show the irons actually used by the Michigan Stove Company, but to illustrate average American foundry iron; these specimens are especially valuable from the fact that in most cases they are samples of the identical irons of which a most complete series of physical tests has been performed, and of which the chemical analysis is known. In a continuation of the present paper Mr. Keep will give details of these tests.

In Great Britain the fuel employed in the blast furnace is almost invariably bituminous coal or coke; but in the United States large quantities of pig iron are produced from anthracite and from charcoal, as shown by the following figures:—

Fuel used.	No. of Furnaces in blast Dec. 31st, 1887.	Production in 1887. Metric tons.
Anthracite	118	2,338,389
Charcoal (Coal and coke.)	74	578,182
Bituminous	147	4,270,635

Michigan produced more charcoal iron in 1887 (213,543 tons) than any other State, while Alabama followed with 95,223 tons. The largest production of any single State is of course that of Pennsylvania, which stands far away ahead with 1,929,777 tons of anthracite iron, 1,742,931 tons made from bituminous fuel, and 11,910 tons from charcoal. The State showing greatest activity in furnace building last year was Alabama, with twenty new furnaces in course of construction. The six States having the largest production stand in the following order:—

	Tons.
Pennsylvania	3,684,618
Ohio	975,539
Illinois	565,453
New York	296,572
Alabama	292,762
Tennessee	250,344
Michigan	213,543

The meaning of these figures will be better understood when we remember that the production of pig iron in the Cleveland district in 1886, is returned as 2,406,276 tons, while South Staffordshire produced only 236,137 tons. Ores of good quality occur throughout extensive districts in the United States. The specimens now shown are intended to illustrate only the irons produced at some of the most important points, and from the principal ore formations. These ore deposits are: (1) The great deposit of magnetic ore beginning on Lake Champlain in Northern New York, and running southward through that State into New Jersey, and still southward to North Carolina; also the brown hematites which accompany this deposit. (2) The great deposit of red fossil ore, running about one hundred miles west of the previous deposit, beginning in Central New York, running through Pennsylvania, and southward to the immense beds of Alabama. This deposit also has contiguous brown ores. (3) The carbonaceous ores of Kentucky and Ohio. (4) The unlimited ore deposits of Lake Superior.

In this brief survey we cannot even speak of numerous other very important deposits, such as those of Missouri, where Pilot Knob and Iron Mountain are of solid ore, or the brown hematites of Tennessee, or the deposits of Wisconsin and other districts. In these instances the ores are chiefly smelted with charcoal. In the case of the Great Southern ore deposit, the ore and coal lie in the same hills, and hence need no transportation; but very

* Paper read by W. J. Keep, C.E., and Thomas Turner, Assoc.R.S.M., on 10th March, 1888, before the South Staffordshire Institute of Iron and Steel Works' Managers.

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frequently in the United States fuel is transported to considerable distances; in other cases ore is carried, while sometimes ore and fuel are both transported to some intermediate locality. In Eastern Pennsylvania are the great anthracite coal fields, which are reached by a complete system of canals and railways from the Hudson River. In Western Pennsylvania are immense bituminous coal formations, from which excellent coke is made. In Ohio is found block coal, which can be used raw in the blast furnace. In Alabama the best of coking coal occurs with the ore. The chain of great lakes—the St. Lawrence River, Lake Champlain, and the Hudson River, with canals and railways—give facilities for cheap transportation of Lake Superior or Lake Champlain ores to the coke of Western Pennsylvania, to the anthracite of the eastern portion of the same State, or to the coals of Ohio. On the other hand, when necessary, the fuel may be cheaply conveyed to meet the ore.

Poughkeepsie Irons.—This may be taken to illustrate the irons made from the magnetites of Northern and Southern New York, and the brown hematites on the east side of the Hudson; the fuel used is anthracite coal. Poughkeepsie is on the Hudson River; the furnaces are of the older type, 60ft. high with 16ft. boshes; temperature of blast about 1100°F., pressure 8lb. per square inch. The ores employed are used in equal proportions, thus: One-third magnetic ore from Mineville, Essex Co., N.Y. (Lake Champlain ore); one third magnetic ore from Fort Montgomery, Orange Co., Southern N.Y.; one-third brown hematite ores from the Sylvan Lake, Beekman, and Clove Valley, Duchess Co., N.Y. These ores have approximately the following composition:—

	Metallic iron.	Silica.	Phospho-rus.	Oxide of Manganese.
Lake Champlain.....	67·19	1·14	0·84	—
Fort Montgomery...	61·95	7·20	0·24	—
Sylvan Lake.....	51·02	8·51	0·06	trace
Clove Valley.....	49·04	11·95	—	2·71

Beekman resembles Clove, but contains less manganese. The limestone used is taken from the bank of the Hudson River, and the furnace charge yields about 55 per cent. of metallic iron. As illustrating the regular working of this furnace, we may mention that in 1870 Mr. Keep made a memorandum of what he saw charged while spending a day at the works, and this exactly corresponds with the above record of what is used at present. The iron is graded as No. 1 and No. 2 foundry, No. 3 grey forge, and No. 4 mottled. They endeavour to make entirely No. 1 foundry, and other grades come from various changes in furnace working; mottled is seldom made. Analyses of the iron are as follow:—

	Carbon.							
	Total.	Graphitic.	Combined.	Si.	P.	S.	Mn.	Iron.
No. 1 foundry...	4·24	—	—	3·01	0·15	0·05	1·46	90·64
No. 3 grey forge	—	—	—	1·17	1·63	0·15	1·03	91·96
No. 1 foundry...	3·266	3·166	0·100	2·946	1·242	trace	0·189	—
No. 2 foundry...	3·572	3·457	0·115	1·642	1·224	0·035	0·241	—

The first two of these analyses were supplied by the Furnace Company; the two last analyses are of pigs from the same stock pile as that from which the pig was taken for physical tests, to be described in our next paper.

Bushong Iron.—This sample illustrates the production of the Keystone Furnace Company, of Reading, Pa., situated in the heart of the anthracite coal region. The ore mixture consists of one-third brown hematites, obtained near the furnace, with two-thirds of magnetite, principally from New Jersey and Lake Champlain. The iron is graded A1, B1, No. 2 plain, and grey forge. They run on A1, but sometimes get off on lower grades. A pig from the same pile as the pig used for physical tests had the following composition:—

No. 1 Bushong.

Carbon	Total	3·343
	Graphite	2·879
	Combined	0·464
Silicon		1·932
Phosphorus		1·089
Sulphur		0·013
Manganese		0·136

Red Fossil Hematite Irons.—The collection includes two samples intended to illustrate the Great Red Fossil Hematite Formation—one from the Franklin furnaces of Clinton, Oneida County, New York, situated at the extreme northern end of the formation; the other from the Alice furnaces of Birmingham, Alabama, at the extreme southern limit of this ore deposit. The Franklin furnaces use anthracite coal from Pennsylvania. The Alice furnaces are fitted with modern Whitwell stoves, and doubtless work hotter and more rapidly. At both localities two veins of ore occur, one hard and the other soft. At Clinton the soft ore is 1ft. thick, and has been abandoned; the hard ore now used is 2ft. thick. In Alabama both hard and soft ore are used, and occur in beds from 20ft. to 30ft. thick. In most cases the ores are self fluxing. The following are examples of analyses:—

	Clinton soft. (Abandoned.)	Clinton hard. (Used.)	Alabama hard.	Alabama soft.
Metallic iron	30·08	47·50	36·00	50·00
Silica	29·72	11·20	8·00	18·00
Alumina	4·13	4·89	—	—
Lime	8·57	5·53	38·00	—
Manganese	0·31	0·10	trace	trace
Phosphorus	0·67	0·52	0·42	0·70
Sulphur	0·837	0·18	—	—

The analyses of the irons were as follow:—

	No. 2. Franklin.	No. 2. Alice.	No. 1. Rising Fawn.
Carbon Total	3·179	2·963	4·233
Carbon Graphite	3·064	2·742	3·981
Carbon Combined	0·115	0·221	0·252
Silicon	3·014	4·853	1·736
Phosphorus	1·433	0·597	0·828
Sulphur	0·007	0·010	0·018
Manganese	0·168	0·199	0·012

The physical tests of Franklin and Alice iron, to be referred to in a subsequent paper, were made from the same stock pile as the above. This specimen of No. 2 Alice is not a fair sample of the iron usually made. It was sold for, and appeared like, a close No. 2; but both physical and chemical tests show it to be a silvery iron. High temperature, with rapid running, has given high silicon and low carbon, while pure ores have produced a low phosphorus. An analysis is also given of iron from the Rising Fawn furnaces in the north-west corner of Georgia, said to be from a No. 1 pig. This shows more time given for carburisation, hence the production of an open grain. In this case also the silicon is rather low; we should say that the silicon in southern irons would usually run between the extremes above given, generally being nearer the lower than the higher value. The manganese in southern irons is very low, and they show but slight tendency to chill.

Dayton Iron.—The collection of specimens illustrating the production of the Dayton Coal and Iron Company, of Dayton, Tennessee, are of special interest, not merely on account of the completeness of the series exhibited, but also because a complete series of physical and chemical tests are at present being conducted on these irons by Mr. Keep and Mr. H. S. Fleming, and of these tests we hope at a future time to give some account. The samples were selected with special care by Mr. H. S. Fleming (who is now superintendent of Mayville furnaces, Wisconsin) while he was chemist to the Dayton Company. The ore mixture remained the same while the samples were taken, and was much the same as that of the other southern furnace previously mentioned, except that a little brown ore is used. Owing to the needs of their trade at Dayton they make an iron which is slightly higher in phosphorus than most other southern furnaces. The grading is strictly in accordance with the practice of southern furnaces. It will be noticed that the highest grade is No. 2 foundry. This is a peculiarity of southern grading, though a southern No. 2 compares favourably with a No. 1 from many northern furnaces. In the South the furnaces are generally of the modern type, with Whitwell stoves, and run so hot and so rapidly that the grain is a trifle close, and the colour light, when compared with the No. 1 from the older furnaces. An old furnace at Birmingham, Alabama, running more slowly, but using the same ores, makes as dark and open a No. 1 pig as any of the northern iron, and shows a high percentage of carbon. This illustrates the difference caused by various methods of furnace working. In the South there are large beds of red ore now opened, and which will shortly have railway facilities; they yield 59 to 62 per cent. of iron, 6 to 8 per cent. of silica, and 0·25 per cent. of phosphorus, with practically no manganese. It will be seen that this is nearly a Bessemer ore. The southern brown ore contains about 0·68 per cent. of manganese, with 0·27 per cent. of phosphorus. On account of this composition, brown ore is used alone in southern charcoal furnaces to produce a chilling car wheel iron. Southern irons are produced cheaply, and on account of their low price have a considerable influence on the iron market of the United States; hence we have given a somewhat lengthy account of them.

Irons from the Carbonaceous Ores of Ohio.—These ores occur in North-east Kentucky and South-east Ohio, and from a village in the centre of this region, where the ores were first used, they obtain the name of "Hanging Rock Ores." They are also called limestone ores, not because they contain limestone, but because they are found upon a limestone bed rock. These ores produce an iron high in silicon, sometimes as high as 6 per cent., and in the market such irons take the name of "softeners." We have selected two samples of such irons, "Wellston" and "Globe." The samples of Wellston irons are specially interesting. Specimens might have been forwarded of iron from other furnaces, which would have been at least as representative of the district as Wellston irons. But this collection is pretty complete, and was selected by the superintendent of the furnaces, while the ore mixture remained the same. The specimens illustrate the grading and characters of these pigs, and physical tests have been performed on these irons, which will be recorded in our next paper. Special interest is attached to Ohio silicious irons, because for the last twenty-five or thirty years this class of iron has, to a limited extent, served the purposes for which silicon pig is now used in England. Now that the reason for such practice is better understood, the use of silicious iron is spreading in America, and as Ohio softeners are generally low in other impurities, the silicon is thus obtained in such a form that it acts beneficially on the other irons in the foundry mixtures. Silicious irons are not used in all parts of the United States, as eastern irons have generally enough silicon in them already. But in those localities where silicious pigs can be easily obtained, irons can also be easily and cheaply procured, either from the rich Lake Superior ores or from the South, which have hitherto been rather too low in silicon for foundry purposes. With the newer furnaces we may expect the southern irons to be more silicious. The fuel used for the production of much of this high silicon iron of Ohio and Kentucky is a mixture of two-thirds raw coal and one-third coke. An analysis of the coal used at the Wellston furnace is as follows: Water, 11·26 per cent.; volatile matter, 28·96; fixed carbon, 55·59; phosphorus, 0·71; ash, 3·46. The limestone used at the same furnace contained: Carbonate of lime, 93·03 per cent.; silica, 1·51; sulphur, 0·02. The limestone ores, which are of the "Hanging Rock" class, are used roasted; partial analyses of samples are as follow:—

	I.	II.	III.	IV.	V.	VI.
Silica	13·61	15·40	26·22	17·90	25·39	25·89
Alumina	3·00	—	·68	—	—	5·16
Lime	2·90	—	5·24	—	1·25	—
Sulphur	·34	—	·11	—	·73	·082
Phosphorus	—	·36	·18	·29	·17	·488
Metallic iron	39·02	27·00	42·93	49·76	—	41·62

Some old analyses, from another furnace, using a mixture of the identical ores mentioned above, may serve to illustrate the grading and characters of these irons:—

	A1, Grey Foundry.	Strong Mill.	Weak Mill.	Hard Silvery.	No. 4, White.
Graphitic carbon	2·576	—	2·59	—	—
Combined carbon	—	—	·16	—	1·822
Silicon	6·671	2·589	3·924	5·063	6·655
Sulphur	trace	·091	·083	·048	·083
Phosphorus	·503	·798	·547	·755	·643

Manganese not estimated, but probably under 0·5 per cent.

The physical tests of Wellston irons, which will be referred to in our next paper, are very interesting, and it is intended to perform analyses of these samples when opportunity offers. The grade of these silicious irons can of course be varied at will by alterations in the quantity of limestone and of the heat of the furnace. Globe iron is from the same district. The sample exhibited is a No. 1 pig, and has the following composition:—

Carbon	Total	3·154
	Graphitic	2·852
	Combined	·302
Silicon		5·899
Phosphorus		1·100
Sulphur		·02
Manganese		1·00

A pig from the same stock pile was also tested physically, and the results will be given in the second part of this paper.

Irons made from the Ores of Lake Superior.—In concluding this very incomplete account of the foundry irons of the United States, we take samples made from the great ore deposits of Lake Superior. Among the specimens exhibited is a collection of the grades of iron made at the Spearman furnace, situated in Western Pennsylvania, near to the well known Connellsville coke district. The ore used is purchased, and is not confined to a definite mixture, but consists chiefly of hard and soft Lake Superior ore. Many furnaces in this district use some 25 per cent. of Lake Champlain ore to give a more neutral mixture. The specimens shown may be considered to fairly represent the product from the large number of furnaces which are situated near the coke, and which purchase their ore; this is obtained either wholly or in large proportion, as the case may be, from the deposits of Lake Superior. There is also a very interesting collection of examples of iron made from Lake Superior ores and smelted with charcoal at the Gaylord furnace, Detroit, Michigan. Several of these specimens have been analysed by Mr. Fleming, and his results are as follow:—

	Silicon.	Phosphorus.	Sulphur.	Manganese.	Iron.
Gaylord No. 2 foundry	1·570	0·240	0·041	—	94·283
" No. 3 foundry	0·800	0·144	0·056	—	94·688
" White	0·186	0 263	—	0·092	—

It will be seen that these irons are of exceptional purity, and may be considered above the average for foundry purposes. They are used chiefly for special purposes, such as the manufacture of car wheels. At a future time we may be able to publish details of physical tests of these specimens.

In a continuation of the present paper (which we hope to publish in an early issue) an account will be given, under the head of "Keep's Tests for Foundry Iron," of the physical characters of the pig irons mentioned in this preliminary portion of the subject.

GLAZES FOR PORCELAIN WARE.

MM. Lauth and Dutailly have recently communicated to the French Chemical Society the results of their investigations on the red glazes which are produced on porcelain by means of copper and its salts. The colour produced in this manner is of a much more permanent nature and of a far superior tint than that which is obtained when oxide of iron is used for the same purpose. This red colour, when used for decorative work on ancient porcelain, is often accompanied with a blue colouring matter beneath the surface of the glaze. It appears that the secret attached to the production of these colours was known only to the Chinese until recently, and that the red, known as Tsi-houng, or *sang de bœuf*, could not be imitated by the French at the porcelain manufactory at Sévres. In 1852, MM. Ebelmen and Salvetat endeavoured to reproduce these copper colours in France by making careful analyses of fragments of Chinese porcelain coloured in this manner, and then imitating, in the composition of the glaze and clay employed, the Chinese specimens. The results of these earlier experiments are now in the ceramic museum at Sévres, and are the first examples of the kind produced in Europe. Other French chemists have since then attempted to improve on the first trials, and the problem has also been attacked by H. Seger, of the Berlin Porzellan-Fabrik, and by H. Bünzli, at Krummnus, in Austria. MM. Lauth and Dutailly have established by their experiments that the maximum temperature which the Chinese red glazes can stand without losing their colour approaches to that used for baking the new Sévres porcelain. By successively associating all the compounds capable of entering into the formation of a colourless glaze with oxide of copper, they have come to the following conclusions: That in the same series of glazes, those which produce the finest red colour with copper compounds have the greatest amount of silica present, and that in a series of glazes of approximately the same degree of acidity, the best results are obtained when there is a large proportion of alkalies and a small percentage of alumina. They have further noticed that if the alkaline metals be increased in relation to the alkaline earths present, a finer red is produced, but at the same time the liability to break is increased. By employing boracic acid or borates this inconvenience may, in some measure, be prevented. Lime, magnesia, various fluorides, and lead and iron oxides have also been tried; but the results obtained by their use have not proved satisfactory. A very good red glaze can be produced when zinc oxide and baryta are the bases present in the glaze. The copper

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can be introduced into the glaze in different ways. Oxalate of copper, simply mixed and not fused with the melt, gives good results; but if previously fused with the glaze, very satisfactory colours are produced. The quantity of copper salt employed depends on the time required for baking the porcelain, and also on the temperature of the furnace. Five per cent. is the quantity which is recommended as the most suitable to use, and the addition of a small quantity of tin oxide is advantageous. The glaze which has given the best results has the following composition:—

Pegmatite	31·17
Sand	36·37
Fused borax	12·98
Dry carbonate of soda	4·76
Barium carbonate	10·39
Zinc oxide	4·33

Corresponding to:—

Silica	61·02
Alumina	5·85
Alkaline oxides	10·72
Baryta	8·42
Zinc oxide	4·51
Boric acid	9·48

This glaze has a degree of acidity represented by the number 5·39, that of the French glaze, No. 1, being 5·14. The bases are in the proportion which corresponds to the formula:—

$$Al_2O_3, 3\ NaKO, BaO, ZnO.$$

By using this glaze with a similar one containing lime, M. Lauth and Dutailly have succeeded in obtaining a great variety of colours on the same material, and in producing some effects on porcelain which have not hitherto been achieved.

Notes.

WINDOW GLASS.

British manufacturers of window glass appear to be neglecting a market for their goods, as a foreign office report from Swatow states that all the window glass sold in the ports of China, and even in Hong-Kong, is of Belgian or German origin, and of a most inferior description, and that it is impossible to procure a piece of glass of sufficiently good quality for a picture. The Chinese paper windows have already largely disappeared in the ports, and the British Consul describes the Chinese made glass as "so inferior in quality that it has no chance even against its present atrocious foreign substitute." China should, therefore, eventually afford a good market for British glass.

OILING THE WAVES.

We published last week an article entitled "The Effect of Oil on Waves," and in connection with this subject we have received from Messrs. A. B. Fleming & Co., Caroline Park, Edinburgh, a letter which has been addressed by J. C. Beckett, master to the Superintendent of Pilotage, Liverpool. Mr. Beckett states: "I experimented with a five-gallon drum of oil on the 20th March last, off Point Lynas; wind, E.N.E. force 7, with heavy sea running and broken water. The following are the results, viz.: First boat hove to, end on to sea, head reaching about one mile per hour; the sea for about 50ft. around the boat was literally smooth, that is sufficiently smooth to launch or lower a boat without any danger. I then ran the boat before the sea, and with the oil going astern, I saw that the sea could not break over the stern of the vessel, as the sea, after coming in contact with the oil, became immediately smooth. I then ran towards No. 2 pilot boat, and saw that the sea was breaking over her bows in heavy spray, while we were in perfectly smooth water. There were several pilots on deck to testify to the above statement. The oil continued to run out for forty minutes."

ELECTRIC LIGHTING AT THE ITALIAN EXHIBITION.

The Italian Exhibition, which will be opened to-morrow, is lighted by three hundred arcs of 2000 c.p. nominal, distributed throughout the buildings and grounds, and one hundred glow lamps, fixed in the Welcome Club. The installation is on the Thomson-Houston system, and has been laid down by Messrs. Laing, Wharton, & Down, of 82, New Bond-street, London. There are ten arc dynamos, each of thirty-five lamps capacity, and one glow lamp dynamo, of one hundred lamps capacity. All the dynamos are driven from one counter shaft, running at 250 revolutions per minute, and provided with 4ft. 6in. pulleys, the pulleys on the dynamos being 16in., and the speed 820 revolutions. Motive power is supplied by Davey-Paxman boilers and engines, there being three locomotive boilers, each of 100 actual horse power, and one compound undertype combined engine and boiler of 40 nominal horse power. In addition, there is fixed a compound engine of the girder type, of 40 nominal horse power, running at one hundred revolutions per minute, and driving from an 8ft. 6in. fly wheel on to a 3ft. 6in. pulley on the counter shaft. There are also two Windsor engines of the inverted compound type, each of 30 nominal horse power, running at 180 revolutions, and driving from a 5ft. 6in. fly wheel on to a 4ft. pulley on the counter shaft.

RICE CULTIVATION IN BRITISH GUIANA.

M. Gilzeau, in a paper contributed to *Timehri*, the journal of the Royal Agricultural and Commercial Society of British Guiana, considers the cultivation of rice to be one of the most promising industries of the colony. Some twenty-two years ago about twenty acres of rice were grown in British Guiana, but difficulties were experienced in cleaning and preparing the grain for the market. At first loss of crops from floods and drought was experienced; but by means of irrigation excellent crops of rice have since been obtained, and on some estates three crops a year have been raised; and the land, with no rotation of crops nor rest, shows no falling off in the yield. When no rent is paid for the land, a considerable profit has attended the growing of this crop in the colony, and even when a small rent has to be paid there is a considerable margin for profit. At present the cleaning is done by the primitive "stamper pot," but it is hoped that the colony will be in a position to keep a mill of its own running before long. The rice grown in British Guiana resembles the finest samples of Java and Italian rice, and cannot be grown in the great rice producing parts of India. M. Gilzeau points out that the development of this industry will cause employment to the gangs in the slack season, as at present the principal labour required is in reaping canes—an operation which lasts only for a few months.

ALUMINIUM BRONZE.

Aluminium bronze is of daily growing importance in the eyes of American military experts. A writer in the current number of the Journal of the United States Cavalry Association, points out that this alloy might with advantage be used in the construction of breast plates. There is no doubt that the days of defensive armour are by no means past; the advantage of the cuirass was shown in the cavalry combats of the Franco-German war, and the far range of the modern rifle may render it every day more desirable that some attempt should be made to counteract its deadliness. Gun shields also will sooner or later become necessary, and it may be that in this alloy will be found the solution of the question—how to protect light artillery and cavalry without sacrificing mobility. Captain W. Hall, the writer above referred to, gives an interesting comparison, which was made by his Government, between the average of 130 specimens of accepted gun steel, and an alloy of 90 parts copper and 10 aluminium. This comparison is as follows:—

	Aluminium alloy. Lbs. per square inch.	Gun steel. Lbs. per square inch.
Tensile strength	111,400	96,150
Probable elastic limit	84,000	51,611

It is considered that modern methods of working aluminium, especially by aid of the electric furnace, will so reduce the price, that it will come into general use for many purposes, and already various grades of alloys are quoted in the United States as commercial articles, varying in price from 16c. to 45c. a pound.

AN AMERICAN MILITARY ENGINEER'S CRITICISM ON THE "DYNAMITE GUN."

At a recent meeting of the Military Service Institution, United States, General H. L. Abbot, of the Corps of Engineers, criticised this weapon adversely. He did not believe in the practical value of the pneumatic gun in coast defence, because its short range restricted its fire to the area already obstructed by submarine mines, and the defenders cannot afford to make every shot that misses the enemy a countermine to destroy the mines, and thus open a route for his passage. The mines are indispensable, because steam vessels can force their way through any unobstructed channel under cover of darkness, whether the projectiles thrown at them contain gunpowder or dynamite; and it would be inadvisable to introduce a new weapon that directly antagonises another of prime importance, which it cannot replace. If it be suggested that the use of the "aërial torpedo" may be restricted to the period of the siege, when, the submarine mines having been destroyed by the enemy, he is ready to attempt to pass the forts, we must remember the high trajectory of the weapon. Vertical fire is not effective against a rapidly moving target, such as would be presented by the enemy's ships when once the channel is opened. For the dynamite gun was claimed the exclusive ability to throw detonating substances with safety; but it was stated on good authority that mortar shells charged with 110lb. of wet gun cotton were fired successfully in Germany, and improvements in the manufacture of such substances pointed to their early use even in guns. The pneumatic gun was more useful in the navy than the army: as a counterminer to destroy submarine mines, it might have a value, although without absolute proof he would be loth to believe that it could do more than moderately assist in the opening of any known and well defined channel from four to six miles long, without which no armoured ship could safely pass the forts. Even then it would be a serious matter to manœuvre an unarmed floating magazine, containing many tons of dynamite, under the fire of modern high power guns, mounted on land at a range of one or two miles.

THE FUMAT SAFETY LAMP.

This new safety lamp, which has been devised by M. Fumat, the chief engineer in the French mines of the Grand' Combe, gives a good light, and is not extinguished when it is violently shaken or held in an inclined position, and does not cause an explosion when placed in a strong current of air charged with fire damp. When lowered into an explosive mixture of air and fire damp, an explosion takes place within the lamp as soon as the flame comes in contact with the explosive mixture; but by the ingenious construction of the protecting network, the heat generated is prevented from raising the temperature of the outer metallic portions of the lamp. Oil is used in this lamp, and it has been used for some time in the mines at the Grand' Combe, and by the firemen in Paris, with very satisfactory results. MM. Mallard and Le Châtelier have also put the lamp to many severe tests in their laboratory, and have found that it fulfils all the conditions of safety which the inventor claims for it. Its cheapness, coupled with these properties, will, it is hoped, cause it to be used in other mines, where lamps of more expensive construction have hitherto been employed.

THE ELECTRIC LIGHT IN THE SUEZ CANAL.

The number of ships navigating the Suez Canal at night with the electric light shows a rapid increase since the new regulations came into force on the 1st March last year. Consul Burrell, of Port Said, gives the following table showing the number of vessels with the electric light passing through the canal in each month last year:—

January	13
February	12
March	15
April	19
May	19
June	25
July	27
August	35
September	45
October	49
November	63
December	73
Total	395

The average time of the transit of the canal in 1887 is given as 33 hours 58 minutes, as compared with 36 hours in 1886. The shortest time taken by an ordinary steamer with the electric light for night navigation was 15 hours 5 minutes. A still faster passage was made by Mr. Gordon Bennett's steam yacht "Namouna," which, being allowed to steam at greater speed than larger vessels, only took 13 hours and 53 minutes from Port Said to Suez.

COTTON GOODS IN CHINA.

The British Consul at Swatow, in reporting on the trade of that port during last year, states that all branches of the cotton trade show an improvement on 1886, the advance being most marked in white shirtings and T-cloths. The figures, however, in most cases were not as high as in 1885, and considerable stocks were left in hand at the close of the year. The Consul states that some British manufacturers have attempted to make imitations of native cloths, but the results have so far not been encouraging. He suggests that manufacturers should give their attention to maintaining their supremacy in the line in which they have already obtained a footing in the Chinese markets, and that they should at the same time try and produce an article as cheap and as durable as the native Chinese cloth. He says that it need not be a close imitation, but should be of narrow width, and that a careful study should be made of the tariffs under the Tientsin treaty, in order to ascertain the dimensions on which the Customs duties would be least. No sizing or filling should be used. Owing to its being much cheaper, cotton yarn from Bombay prevents English yarn from finding a market at Swatow. Our Consul at Pakhoi states that last year's imports of cotton goods at that port were of the value of £445,000, or twice as much as in 1886. The imports of cotton yarn, all of which was derived from Bombay, have also doubled. At Kiungchow cotton piece goods and T-cloths show a small increase over the imports in 1886, but are not equal to those in 1885.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

27th April, 1888.

6232. Stevenson, J. ..... Knitting machines.
6233. Gimson, J., & others..... Machines for skiving and trimming leather.
6236. Martin, E..... Manufacture of cloth.
6246. Walker & Leek ..... Wringing sized or dyed yarns.
6252. Jefferies, E. A. ..... Locomotive, marine, and other engines.
6259. Chartres, A. H. ..... Equilibrium valve for steam engines.
6262. Knowles, W..... Mules.
6263. Entwisle, A. J..... Steam heated drying cylinders.
6266. Haddan, H. J. ..... Tube expanders (*Trubel*).
6271. Lloyd, S. ..... Machinery for transferring boats from one level to another on canals and rivers.
6274. Rothschild, S. A. ..... Means for enabling tramway vehicles to automatically operate points.
6277. Clarke & Mawby..... Manufacture of hoisery.

28th April, 1888.

6286. Anderson, A. ..... Sewing machines (*Singer Manufacturing Co.*)
6288. Foster, H..... Internal flues and fire boxes of steam boilers.
6292. Patterson, W..... Prevention of overwinding in mines.
6297. Kenyon, W., & others... Friction clutches.
6301. Hollingworth, E..... Jacquard looms.
6306. South & Bursch ..... Couplings for railway cars.
6312. Walsh & Wild..... Sizing or taping machines.
6320. Gresham, J..... Vacuum brake.
6326. Greenway, A. G..... Manufacture of iron.
6328. Volonté, C. ..... Pulveriser.
6334. Leigh, H. H..... Machines for making nails (*Liefmann*).
6335. Leigh, H. H..... Machine for jumping the heads of nails (*Liefmann*).
6340. Imray, J. ..... Screening drums for sizing coal (*Bartsch*).
6342. Morawetz, G. V..... Fastening railway rails.
6345. Burley, W. ..... Examination of vessels' hulls while afloat.
6347. Chabeau, A..... Alarm signalling apparatus and break operator for use on railway trains.
6351. Dutton, S. T. ..... Signalling on railways.
6352. Yaryan, H. T..... Purification of water in steam boilers.

30th April, 1888.

6359. Wright, E. ..... Transmitting and controlling motion in machines and hand tools.
6365. Binns & Skinner..... Machines for combing wool.
6367. Robson, R. F. ..... Communicating motion from a prime mover.
6381. Greenwood, A. ..... Ring spinning frames.
6392. Thompson, W. P..... Controlling the draught of furnaces (*Van Hecke & Laurent*).
6396. Wise, W. L. ..... Embroidery machines (*Frey and Kœnig*).
6398. O'Donnell, J. P..... Railway signalling.
6399. Howard & Bousfield.. Railway sleepers and chairs.
6401. Molesworth, T. C..... Bottle washing machinery.
6403. Roe & Kent..... Jacquard apparatus.
6413. Chatwood, S., & others.. Safes and strong rooms.

1st May, 1888.

6419. Burrell, F. J..... Governing steam engines.
6426. Biddiscombe, F. ..... Improved railway line connector.
6427. Masterton, J. F..... Steamboat pier signalling.
6430. George, J. ..... Driving clutch.
6434. McGrady, H. ..... Type writers (*Crandall*).
6435. Martin-Epton, W. ..... Lubricator for solid oils.
6438. Groves, F. ..... Coupling railway carriages.
6441. Clarke, J. K. ..... Lubricators for loose pulleys.
6442. Illingworth, J. ..... Pipes, gas retorts, and other hollow articles.
6443. Sutro, L. ..... Knitting machines.
6445. Granville, B..... Type writing machines.
6449. Higginson, A. ..... Apparatus for directing the flow of fluids.
6464. Whibley, E..... Band sawing and fret sawing machines.
6465. Hale, J. M. ..... Propellers.
6468. Kortynski, K. von ..... Gas engines.
6473. Thompson, W. P..... Screw vessels (*Sylven*).
6475. Boult, A. J. ..... Valves for steam engines (*Tolton*).
6484. Davy, C..... Blowing engine.
6485. Wilkins, F. ..... Type writing apparatus.
6487. Redfern, G. F. ..... Centrifugal apparatus (*Hansen*).
6490. Wright, R. ..... Hydraulic engines.
6493. Tasker, S. P. M. ..... Rolling mills.
6494. Tasker, S. P. M. ..... Roller mandrels.
6505. Cannon & Addison..... Artificial draught.

2nd May, 1888.

6509. Bodden, W. ..... Ring spinning and doubling frames (*McMullan.*)
6510. Smith, S. ..... Moulding machines.
6520. Hutchinson, R. R. ..... Armour clad trains.
6529. Wood, C. ..... Gig mills.
6534. Bottomley & Day ..... Brake apparatus.
6535. Stott, W. ..... Winding frames.
6536. Rhodes & Bywater ... Trip motion for Corliss valves.
6540. Adair, W..... Mills for grinding grain.
6542. Thompson, C. ..... Looms.
6543. Green, J. ..... Self righting boats.
6544. Moore, J. ..... Coupling railway vehicles.
6546. Corcoran, B. ..... Millstone trammel.
6549. Holleman, F. A. ..... Railway brakes.
6565. Brigham, R. ..... Lubricators.
6570. Brasier, E. ..... Apparatus for washing, bleaching, drying, and softening fibrous and textile materials.
6573. Wrigley, J. ..... Steam traps.
6574. Daniels, W. H..... Keels for ships' boats.
6581. Dry, J. R. ..... Operating on jute and rhea canes.

3rd May, 1888.

6584. Maund & Millechamp. Self acting field clock gun.
6589. Lynch, G. ..... Machinery for printing surfaces of cardboard while it is being cut and scored for making boxes.
6594. Sleading, R..... Lubricating machinery.
6596. Butler, E..... Propulsion of tram cars by means of internal combustion engines.
6597. Shaw & Harcourt..... Clutches, couplings, and brakes.
6599. McConnel & Higginson Grinding the flats of revolving flat carding engines.
6602. Simons, J. F. N. B. ..... Manufacture of pipes.
6603. Blamires, T. H. ..... Scribbling carding engines and condenser carding engines.
6604. Smith & Ambler..... Machinery for doubling yarn.
6617. Allen, J. B..... Printing from strips of electrotype, and fixing the same upon printing blocks.
6620. Templeman, G. ..... Knitting machinery.
6621. McEuen, C. H..... Steamboat construction (*Selfe and Selfe*).
6622. Laszgallner & Nöhring Draught regulators in locomotive furnaces.
6631. Mégy, L. ..... Hoisting apparatus.
6637. Robinson, H. E. ..... Locking the fish plate bolts of railways.
6638. Gordon, J. ..... Drill guns.

ELECTRICITY.

27th April, 1888.

6237. Millar, A..... Electric batteries.
6270. Jobson, H. C..... Fixing insulators to telegraph poles.

28th April, 1888.

6314. Hall, J. P..... Dynamo-electric machines.
6322. D'Humy, P. R. de F..... Galvanic batteries.
6344. Davies, W..... Means of conveying telegraph wires.

30th April, 1888.

6373. Dill, L..... Electric batteries.
6390. Mackie & Sharp..... Electrical switches.
6400. Dingle, W. H..... Electrical signalling apparatus.

1st May, 1888.

6416. Hoppe & Hoppe ..... Galvanic batteries.
6481. Lake, H. H. ..... Electrical transmission of power (*Tesla*).
6502. Lake, H. H. ..... Generation and distribution of electric currents (*Tesla*).

2nd May, 1888.

6578. Johnson, J. Y..... Incandescent electric lamps (*Philippart*).

3rd May, 1888.

6613. Miller, S..... Automatic resistance for electric light circuits.
6614. Craven, E. G. ..... Electrical illumination of clock dials.
6627. Tabourin, G. A..... Combined generator of electricity and electric lamp.

CHEMISTRY.

27th April, 1888.

6248. Dawson & Hirsch ..... Purification of nitric acid.

28th April, 1888.

6307. Ruffle, J..... Utilisation of the exit gases from vitriol chambers.
6319. Johnson, J. Y..... Dye stuffs (*The Farbenfabriken vormals Friedrich Bayer & Co.*)

30th April, 1888.

6407. Lake, H. H. ..... Disinfectants (*Shaw*).

1st May, 1888.

6428. Taylor, J..... Soft soap.
6460. Lake, H. H. ..... Aluminium (*Seymour*).
6470. Woods, J. E. T. ..... Recovery of refuse metals.
6478. Thompson, W. P..... Preventing the decomposition of organic substances (*Moro*).
6491. Levick, H..... Tanning.
6495. Pitt, S. ..... Manufacture of metallic oxides (*Bradley*).

2nd May, 1888.

6508. Scaife, J. ..... Utilising waste gums.
6513. Thwaite, B. H. ..... Converting soluble sulphides and sulphates into carbonates.

3rd May, 1888.

6634. Schreiter, M. J..... Refining camphor.

MISCELLANEOUS.

10838A. Rawson & White..... Springs. (This Application having been originally included in No. 10838, dated 6th August, 1887, takes, under Patents Rule 23, that date.)

27th April, 1888.

6230. Chambers, C..... Cork drawing machines.
6235. Bailey, I. ..... Securing cams on to screw shafts employed in gill boxes.
6243. Howat, A..... Rivets used for locking miners' safety lamps.
6249. Okes, J. C. R. ..... Valves and valve boxes.
6256. Clarke, W. R. ..... Torrefying grain.
6260. Forrest, J. C. ..... Haulage clip.
6261. Sellars, J. C..... Cement.
6267. Earle, E. J. V..... Manufacture of boots.
6269. Jutson & Poupard..... Shoes for horses.
6275. Ollendorff, B. ..... Blocks for holding zinc plates for printing purposes.
6276. Whitehouse, D. ..... Manufacture of tin and terne plate.
6280. Bonneville, L..... Explosive compounds.
6282. Berend, O. A..... Filtering water.

28th April, 1888.

6284. Hopewell, H. ..... Superheating rooms.
6285. Born, P..... Apparatus for producing jets of spray (*Schmid*).
6289. Blakeney, W. H..... Pneumatic carrying apparatus.
6291. Ramsdale, J..... Bicycles and tricycles.
6296. Wagstaff, J. G. ..... Radiators for warming air.
6298. Atherton, J. B. ..... Nut locks.
6300. Horton, C..... Tricycles.
6302. Brownlow, R. S..... Filters.
6304. Townsley & Rushforth Ventilating buildings.
6310. Holland & Lever ..... Belting.
6313. Sands, W. ..... Lamps.
6316. Barraclough, B..... Textile fabrics.
6317. Thompson, J. W..... Manufacture of hats.
6325. Fenner, N. J. ..... Distillation of hydrocarbons.
6329. Saner, E. ..... Production of fresh water from sea.
6337. Perret, R. A. ..... Velocipedes.
5338. Smith, J. E. ..... Bricks and tiles.
6339. Diétrich, G. A. ..... Combustion of mineral oils.
6343. Smith, P. C. ..... Stoppering bottles.
6346. Chandler & Chandler Purification of gas.
6348. Kilgour, G..... Sorting minerals.
6354. Knoop, A. ..... Manufacture of aerated liquids.

30th April, 1888.

6357. Bracewell & Hayhurst ..... Springs.
6364. Porter & Langton..... Chimney pots.
6372. Wright & Wright..... Gas burners.
6375. Miller & Bennie ..... Filters.
6378. Hiles, A. E. ..... Cleaning tin plates.
6386. Lee, J. ..... Spades.
6389. Moon & Oswald ..... Composition for covering kilns, steam boilers, &c.
6393. Clark, J. B..... Bullets.
6394. Townsend, G..... Velocipedes.
6397. Arnheim, C..... Safety lock.
6404. Gibbons, J. V. ..... Hay rakes and forks.
6405. Lipscombe, F. R..... Precipitating matter held in suspension in liquids.
6409. Gray, A. ..... Automatic lamp extinguishers.
6411. Maule, F. J..... Pipe joints.
6412. Landauer, G. F..... Dyeing leather.

1st May, 1888.

6415. Westphal, C. ..... Gas pressure regulators.
6424. Rothwell, P., & others Stoppering barrels.
6425. Hargrove, J. R. ..... Lock nuts.
6431. Bezer, H. ..... Bolt and nut.
6432. Thwaite, B. H. ..... Gaseous fuel.
6433. Jones & Jones..... Stoppering bottles.
6448. Rhodes, B. ..... Seatings of packed valves.
6451. Grieve, C. ..... Railway chair.
6452. Williams, J. ..... Coating metal plates with tin.
6453. Ellis, J. ..... Bottles for gaseous fluids.
6454. Brook, E. ..... Gas producers.
6467. Rave & Abbott ..... Automatically extinguishing lamps.
6477. Thompson, W. P..... Cleaning malt (*Jaquett*).
6480. Gardner, W. ..... Safety catch for lifts (*Husband*).
6482. Edwards, E..... Clothes washing machines (*Schmidt*).
6483. Miles, P. ..... Pickets and fences.
6492. Lister & Watson..... Dressing fibrous material.
6496. Frost, E. J. ..... Regulating the quality of carburetted vapour.
6498. Graydon, J. W. ..... High explosive shells.
6503. Richardson & Dixon... Apparatus for shearing sheep.

2nd May, 1888.

6514. Wilson, A..... Gas producers.
6518. Brookes, J., & others... Velocipedes.
6521. Green, R..... Velocipedes.
6524. Wilcox & Smith ..... Tinning wire netting.
6525. Kerr, J..... Disconnecting catch for sling chains.
6526. Richards, C. D..... Lock.
6538. Scott, J. M. ..... Fire escape.
6545. Drew, H. ..... Lanterns for gas burners.
6547. Pohlman, A..... Regulating the flow of water.
6550. Robert, C. W. J. L..... Bicycles and tricycles.
6552. Gerken, A. ..... Gas lamps.
6553. Billing, C. E. ..... Gas burners.
6557. Cussans, W. ..... Colouring Portland cement.
6559. Edenborough, F..... Apparatus for stirring & mixing.
6560. Newton, A. V..... Explosive compounds (*Nobel*).

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6569. Leeds & The L. W. Leeds Patent Floor Warming Stove Company.. Liquid fuel stoves.
6571. Garland & Crooke .... Gas stoves.
6580. Aird, D. A. ..... Locks and means for releasing the bolt or catch by hand or by electricity.
6582. Bell, J. ..... Drawing off liquids from vessels.

3rd May, 1888.

6585. Wilkins & Booker..... Springs.
6593. Sayer, R. C. ..... Wall tanks.
6600. Paul, E. ..... Distilling sea water.
6609. Chadburn, W. ..... Mechanical telegraphs for use in navigable vessels.
6610. Chadburn, W. ..... Pneumatic telegraphs.
6611. Groves, C. B. ..... Lamps (*Lovell & Co.*).
6618. Jackson, J., & others... Moulds.
6619. Luther, W. H. ..... Spray lights or lamps.
6623. Bellet, F. F. ..... Burglar alarm.
6625. Perkins, A. B. ..... Gear wheels.
6626. Sleep & Sleep..... Horse rakes.
6629. Elliott, J. ..... Roofing slabs and tiles.
6630. Payton, W. .... Tool for drilling and tapping holes.
6632. Thomason, C. S. ..... Sharpening cutting tools.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

9256A. Yuly & Andrews..... Expanding pulleys. (Received 27th August, 1887. This application having been originally included in No. 9256, 1887, takes, under Patents Rule 23, that date.)

5th May, 1888.

2964. Freeman, J. ..... Printing machines.
4668. Peters, G. M. ..... Machines for loading cartridge shells.
6152. Thompson, W. P. ..... Portable buildings (*Defiers*).
6327. Wallis, W. P. V. ..... Feeding furnaces so as to economise fuel and to consume smoke.
6544. Martin, T. H. ..... Double acting tool and tool box for planing and cutting machines.
6612. Burnett, C. ..... Apparatus for raising water.
7470. Bullock & Bullock ... Extractor mechanism for drop-down small arms.
7779. Hibbert, G. ..... Rag engines.
7889. Draper, T. ..... Ball turning lathe.
8283. Renshaw, W. R. ..... Pumping machinery.
8399. Bowery, W. ..... Ivory cardboard making machine.
8677. Mercer & Woolfall... Washing machines.
8726. Bedford, C. ..... Looms.
8727. Ramsey & Wright..... Oil feeders.
8744. James & Crowe ..... Lubricators.
8771. Reid, J. ..... Pulsometers.
8903. Thompson, W. P. ..... Machines for separating the seed from colza (*Drevs*).
8968. Toussaint, J. ..... Iron and steel.
9218. Horrocks & Horrocks Stop rod of looms.
9276. Fletcher, J. ..... Injectors.
9279. Horrocks & Horrocks. Picking motion for looms.
9298. Showell, C. ..... Brackets for supporting roller ends.
9308. Stapleton, J. T. ..... Bed mill stones for grinding cements.
9316. Hadfield, R. A. ..... Manufacture of steel.
9318. Lake, H. H. ..... Lifts (*Rossbach*).
9350. Casper, E. ..... Polishing yarn (*Papleux*).
9351. Duckham, H. ..... Hydrostatic weighing machines.
9418. Younghusband, S. S.... Valve gear.
9430. Crabtree & Crabtree Looms.
9450. Blacklock & Hynes ... Spring weighing machines.
9453. Sauvée, A. ..... Working and closing the breech of guns (*Canet*).
9466. Gibson, W. P. ..... Hydraulic lifts.
9503. Knox, A. ..... Wire cloth and carpet looms.
9525. Mewburn, J. C. ..... Printing machines (*Derriey*).
9532. Chamberlin, W. R. B... Propulsion, guidance, and stoppage of ships.
9535. Smith, T. ..... Excavating apparatus.
9570. Williams, H. ..... Switch points on railways.
9804. Boult, A. J. ..... Protecting the hulls of vessels (*Cuervas-Mons.*)
9813. Sauvée, A. ..... Breech loading ordnance (*Canet*).
9851. Vogel, T. ..... Sewing machines.
11472. Tankard & Broadbent Regulating and indicating the production of yarn.
14257. Wood, J. A. ..... Washing and wringing machines.
15518. Hauer, J. ..... Threshing machines.
15657. Tee, W. ..... Hydraulic engines.
17287. Jeffrey, J. ..... Applying sand to prevent slipping of the driving wheels of locomotive engines.
17820. Henderson, J. ..... Feathering gear of paddle wheel floats.
291. Allan & McBlain ..... Punching holes in iron and steel plates.
629. Mayer, M. ..... Calculating machines.
1343. Skerrett, H. ..... Semaphore signals for railways (*Spicer & Schrender*).
1446. Vojáček, L. ..... Centrifugal pumps.
1716. Brown, W. F. ..... Steam engine indicators.
1838. Lake, H. H. ..... Manufacture of ships' masts (*Mansfield*).
2186. Graham, J. ..... Sewing machines.
2244. Essington, H. M. ..... Sewing machines.
2804. Johnson, J. Y. ..... Gas engines (*La Société Salomon frères et Tenting*).
2805. Johnson, J. Y. ..... Starting gear for gas engines (*Delamare-Debouteville and Maladin*).
2923. Johnson, J. Y. ..... Sewing machines.
2999. Day, C. A. ..... Sewing machines (*Arnold*).
3381. Rogers, H. ..... Axle boxes.
3425. Frisbee, G. ..... Crushing mills.
3804. Hainsworth, F. ..... Manufacturing wire fabric.
3907. Segschneider, G. ..... Looms for making cut pile fabrics.
4085. Wood & Wrightson ... Differential pulley blocks.
4117. Hoad, E. A. ..... Testing pressure and vacuum gauges.
4280. Boult, A. J. ..... Increasing the frictional contact between the wheels and rails in railways (*Ries & Henderson*).
4306. Haddan, H. J. ..... Magazine fire arms (*Leineweber, Thielepape, & Schrohe*).
4603. Boldt & Vogel ..... Cork sizing machine.
4735. Walder, C. R. ..... Vices.
4762. Guhl, H. ..... Sewing machines.
4813. O'Neill & O'Neill..... Pneumatic tram car locomotives.
4826. Bade, C. ..... Acoustic signalling apparatus.
4829. Wilmott & Wilmott... Wire netting machines.
4926. Seyfert & Donner..... Knitting machines.
4951. Lindenthal, G. ..... Refining iron.
4970. Stitzel & Weinedel ... Semaphore signalling apparatus.

ELECTRICITY.

5th May, 1888.

7235. Phillips & Harrison... Safety mechanism of electric arc lamps.
7802. Ayrton & Perry ..... Ammeters and voltmeters.
7829. Beck, W. H. ..... Transmission of steno-telegraphic signals (*Cassagnes*).
7834. Edmunds, H. ..... Controlling electric currents.
8214. Thompson, W. P. ..... Telephone systems (*Mauritius*).
9256. Yuly & Andrews..... Regulating dynamos.
15537. Paul, R. W. ..... Electric switches.
17047. King, F. ..... Secondary batteries.
137. Pürthner, J. C. ..... Producing induced electric currents.
3075. Southey, A. W. ..... Electric arc lamps.
3215. Oldroyd, J. W. ..... Electric incandescent lamps.
3235. Miot, G. ..... Dynamo-electric machines.
4277. Boult, A. J. ..... Electro-mechanical movements (*McLaughlin*).
4929. Gillett & Haseltine... Magneto-electric generators.

CHEMISTRY.

5th May, 1888.

6619. Martin, J. C. ..... Manufacture of pigments.
7701. Claus, C. F., & others... Manufacture of soda.
8426. Thompson & White ..... Sodium and potassium.
8816. Simpson, H. J., & others Manufacture of tannins, gallates, and kinos, from a certain tree bark.
9250. Clark, A. M. ..... Amalgamating apparatus (*Williams*).
9257. Imray, J. ..... Azo colouring matters (*La Société Anonyme des Matieres Colorantes et produits Chimiques de St. Denis, Poirrier, Roussin, and Rosenstiehl*).
9389. Burghardt & Twining Aluminium.
9414. Imray, J. ..... Azo colouring matters (*La Société Anonyme des Maiteres Colorantes et produits Chimiques de St. Denis, Poirrier, & Rosenstiehl*).
9425. Taylor, E. J. ..... Spirits.
9468. Shillito, T. R. ..... Red azo colour (*Geigy*).
9873. Parnell & Simpson ... Sulphuretted hydrogen.

MISCELLANEOUS.

5th May, 1888.

6875. Wood, A. M. ..... Treatment of india-rubber, gutta-percha, and analogous gums.
7598. Vallet, L. ..... Internally stoppered bottles.
7874. Claret, J. J. ..... Lock nuts.
7990. Imray, J. ..... Incandescence gas burners (*Clamond*).
8626. Massey-Mainwaring, W. F. B. ..... Safety lamps.
8714. Reynolds, W. J. ..... Mariners' liquid compasses.
8738. Reeve, S. ..... Warming and ventilating apartments.
9091. Golding, W. ..... Velocipedes.
9169. Patterson, E. ..... Miners' safety lamps.
9224. Jackson, I. ..... Tape fastener.
9240. Singleton, T. ..... Stoppering bottles.
9254. Asbury, J. ..... Velocipedes.
9268. Smith, F. A. ..... Manufacture of ice.
9521. Johnson & Hutchinson Filter presses.
9592. Tweedie & Muirhead.. Cartridges.
9717. Ducretet, E. ..... Filtering oil.
9832. Shepherd, G. ..... Apparatus for drying air.
9847. Wootton, W. ..... Stoppers for bottles.
10130. Schoembs, H. ..... Preparing zincographic printing plates.
10244. Rigby, J. S. ..... Cement.
11735. Baldwin, J. ..... Pressing paper whilst in the process of manufacture.
14474. Weatherill, W. P. W. Springs.
15283. Fielden & Slater ..... Shuttle guards for looms.
16833. Stevens, B. W. ..... Line throwing with a gun.
179. Sinnatt, W. H. ..... Stoppers for bottles.
1273. Morisseau, A. ..... Boring tools.
2478. Wilding, R. ..... Rollers for spinning machines.
2532. Singer & Judell..... Cleansing wool.
3006. Lillie, S. M. ..... Evaporating apparatus.
3140. Poole, W. ..... Cinder sifters.
3533. Dronier, P. ..... Magnesium lamps.
4099. Newton, J. H. ..... Refrigerating machines.
4211. Rivière, V. ..... Treating tanned hides and skins.
4405. Higgins, C. M. ..... Bottle stoppers.
4484. Wren, J. E. ..... Manufacture of gas.
4632. Cawkwell, H. A. ..... Manufacture of tiles.
4703. Haddan, H. J. ..... Fasteners for driving belts (*Gingras*).
4747. Lemaire, V. D. A. ..... Hinges.
4761. Adnet, P. ..... Pitch forks.
4822. Newton, P. A. ..... Printing type (*McClure & Virian*).
4827. Bade, C. ..... Extinguishing fire.
5035. Schmidt, C. A. G. ..... Dyeing and bleaching textile fabrics.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 28th January, 1888, inclusive.)

Year 1884.

1861, 1862, 1864, 1869, 1874, 1875, 1876, 1877, 1878, 1881, 1882, 1883, 1885, 1886, 1888, 1891, 1898, 1899, 1903, 1906, 1908, 1910, 1914, 1915, 1918, 1919, 1921, 1922, 1923, 1924, 1931, 1932, 1935, 1938, 1939, 1943, 1944, 1947, 1948, 1950, 1956, 1960, 1963, 1968, 1970, 1971, 1974, 1979, 1982, 1983, 1984, 1989, 1991, 1992, 1993, 1994, 1996, 1997, 1998, 1999, 2001, 2003, 2004, 2006, 2008, 2009, 2012, 2016, 2017, 2021, 2024, 2025, 2028, 2030, 2031, 2036, 2037, 2039, 2041, 2042, 2045, 2049, 2052, 2054, 2057, 2058, 2059, 2060, 2062, 2063, 2064, 2070, 2071, 2074, 2075, 2084, 2088, 2090, 2091, 2093, 2096, 2098, 2101, 2103, 2104, 2105, 2106, 2108, 2109, 2111, 2113, 2115, 2119, 2120, 2123, 2124, 2125, 2128, 2129, 2132, 2133, 2136, 2137, 2138, 2139, 2143, 2145, 2149, 2152, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2170, 2173, 2174, 2176, 2177, 2184, 2189, 2190, 2191, 2192, 2195, 2197, 2198, 2202, 2203, 2205, 2209, 2215, 2220, 2223, 2224, 2227, 2229, 2230, 2234, 2235, 2237, 2243, 2245, 2248, 2257, 2258, 2265, 2268, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2282, 2283, 2286, 5158, 5969.

Year 1883.

363, 371, 387, 392, 395, 296, 402, 438, 464.

Year 1882.

443.

Year 1881.

358, 374.

Year 1880.

374, 378.

Year 1879.

265, 294, 296.

Year 1878.

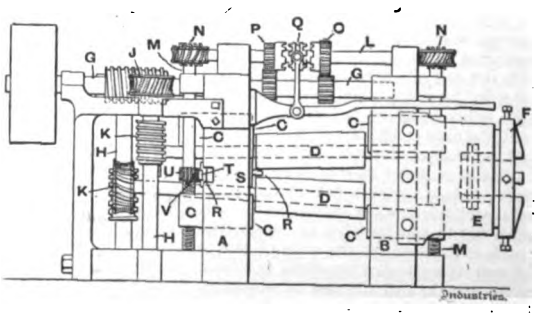
315, 346, 364, 365.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by **W. E. Heys, 70, Market-street, Manchester.**

ENGINEERING.

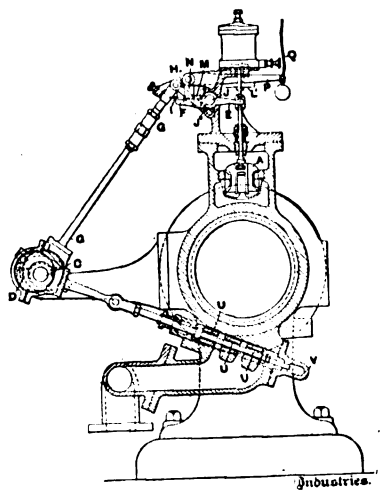
Shaping Metal Tubes.—*A. Paterson, Mackeesport, Pennsylvania.*—The machine described in the specification is intended for giving special shapes to metal tubes. The roll boxes C slide in vertical slots in the housings A and B, and form bearings for the rolls D. The nipple rolls are supported by the carriers R, which slide in horizontal slots in the rear housing A. The



chuck F revolves freely in the bearing E. Motion is transmitted from the driving shaft G to the rolls D through the worm gear J K. The two shafts H are on different sides of G, and are driven by one worm on the shaft G. The vertical screws M are driven by the worm wheels N, and serve to raise and lower the rolls D. The shaft L on which these worm wheels are fixed is driven from the main shaft through the gear wheels P O. A clutch Q is interposed in order to throw either of the spur wheels into gear. The rack T in the rear face of each nipple roll carrier gears with the pinion U on the upright screws M. While the vertical screws are opening and closing the main rolls, the pinions U are simultaneously opening and closing the nippling rolls. The different means for causing these two movements causes the opening and closing of the nippling rolls to take place quicker than the main rolls. Nine claims are made.—No. 17119. December 13th, 1887. 8*d*.

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VALVE GEAR.—*J. Richardson & B. R. Rowland, Lincoln.*—The accompanying figure shows part of the mechanism which has been designed by the inventors for working the trip valve gear of Corliss engines. The Cornish double beat valves A admit the steam, and these and the exhaust valves U are operated by the eccentrics D on the shaft C. The valves A are lifted by levers E, whose outer ends F are depressed by the appliance I. The upper ends of the eccentric rods G are carried by link rods H, which can describe an arc of a circle; when the trippers I descend, the link rods move further from the centre of the lever E, until they release themselves from the end F. The valves A then fall instantly upon their seats. The pin J is made of a round rod, and is movable horizontally in its housings. The fulcrum J is coupled by small connecting rods M to the lever N, by which a



horizontal motion is imparted to the fulcrum by the varying positions of the lever P. The lever P is connected with the governor of the engine. The end F of the tripping lever is caused to approach and recede from the tripper I, and the point of cut-off is thus varied. The lever P may have a cord Q attached to it, and the cord is carried all round the mill, so that in case of accident the engine can be stopped. The exhaust valves U are of the triple ported pattern, and their working faces are those farthest removed from the cylinder. They are thus always pressed towards the face by the pressure of the steam inside the cylinder. The valves can be easily examined or removed for repairs, by simply unfastening the covers V. Four claims are made for the inlet valve gear, and for the exhaust valve as described, and for another modification consisting of an oscillating exhaust valve.—No. 3744. March 11th, 1887. 11*d*.

HOLDING AND GUIDING TWIST DRILLS.—*W. J. Griffiths, Greenwich.*—The appliance designed by the inventor for holding and guiding twist drills consists of three parts, viz., a base plate, on which is cast a vertical socket; a casting, having in it a horizontal cylindrical socket, and supported by a pivot that fits the vertical socket; and a chuck for holding the drill that is to be ground. The forward part of the outside casing of the chuck is cylindrical in form, and fits into the horizontal socket. The chuck is constructed with three wedge-shaped pieces, which enter from the hinder end, and approach each other as they go forward; the wedges are constructed with projecting edges at their hinder ends, and are so arranged that when one of them is moved forward, it carries the other two with it. It is necessary to give the wedges a considerable taper, and in order to hold the different sized drills securely, a screw is placed in a direction parallel with the outside of the wedge which pushes in the other two; a nut on the screw prevents the three wedges from moving back. In order to obtain the necessary rotation of the drill, a cam is fixed at about the middle of the length of the outside casing of the chuck; the shape of this cam is such that when the chuck is turned through an angle of 90° in the horizontal socket, while the cam is kept in contact with a fixed guide bar, the inclination of the axis of the chuck and the drill is altered through an angle of 10°. The drawing back movement is regulated by means of a second cam, which is held in contact with the end of a screw; this screw passes through a nut fixed in a slot in the piece which carries the horizontal socket. The cam has a helical surface, which has at its greatest radial distance from the axis of the chuck a suitable pitch for giving the drawback necessary for the largest twist drill; the pitch will be gradually reduced as the radial distance is diminished, until it vanishes just outside the cylindrical end of the chuck. The drawing back motion can consequently be made greater or less according to the position in which the nut is fixed in the slot; a scale is marked on the side of the slot, and by its means the nut can be set to the required position. Two claims are made for the chuck, and for the combination of the segmental cams for regulating the movements of the drills.—No. 17677. December 23rd, 1887. 8*d*.

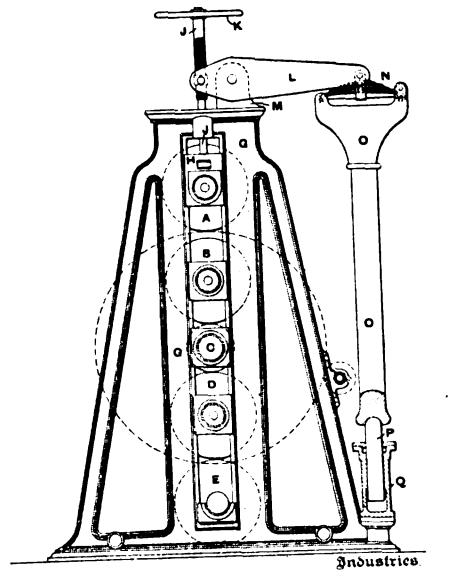
GRAIN GRINDING MILLS.—*H. H. Lake, London.* (*G. Zonca and G. dalla Bella, Venice.*)—A chilled steel cylinder with longitudinal grooves formed in its surface is mounted in bearings, and revolves in close proximity to a sector of the same material. The sector has graduated grooves in its concave surface, and means are provided for regulating the distance between the sector and the roller. The grain enters the narrow space between the sector and the roller, and as it descends it becomes more finely ground, owing to the space being continually reduced. Three claims are made.—No. 7141. May 16th, 1887. 6*d*.

MANUFACTURE OF STEEL.—*J. Riley, Glasgow.*—The walls of basic hearth steel making furnaces have hitherto been built of fire bricks consisting chiefly of silica, and the hearth of dolomite or other basic material. These continuous portions of these two surfaces tend to react upon one another when subjected to great heat, and the result is the formation of a fused slag. By this invention a vertical barrier of a neutral substance is interposed between the boundaries of the basic hearth and the walls of the furnace; this barrier is to have no part of the walls or any other weight resting upon it, so that it shall not be liable to displacement or crushing. The inventor claims the interposition of a neutral barrier in the form of an inner wall completely surrounding the hearth, the top of which wall is uncovered to the interior of the furnace.—No. 2896. February 27th, 1888. 6*d*.

MANUFACTURE OF IRON AND STEEL.—*P. C. Gilchrist, London.*—In converting phosphoric pig iron into iron or steel, the inventor charges a basic lined open hearth furnace with the pig together with as much lime or limestone as can be used consistently with a fluid slag, and from seven to eight times as much iron ore as there is phosphorus and silicon in the pig. The greater part of the impurities of the pig iron are eliminated by this treatment. One claim is made.—No. 7495. May 23rd, 1887. 6*d*.

PORTABLE RAILWAY.—*A. M. Leinwather & H. Glaser, Vienna.*—The cross section of the rails is made of a corrugated shape, and involves the principle of diagonal strutting. The two outer struts form guides, by which the wheels are kept on the rail, and the inner corrugations support the wheels. The rails are connected together by correspondingly shaped chairs, which embrace the lower parts and sides of the rails. Some of the chairs are provided with lateral eyes, so that the two rails may be connected by transverse gauge bars or chains. The carriages which run on these rails may have ordinary wheels, or they may be supported on balls which run on the rails. The inventors claim the ribbed rails, and the combination of the chairs and cross ties.—No. 9514. July 5th, 1887. 8*d*.

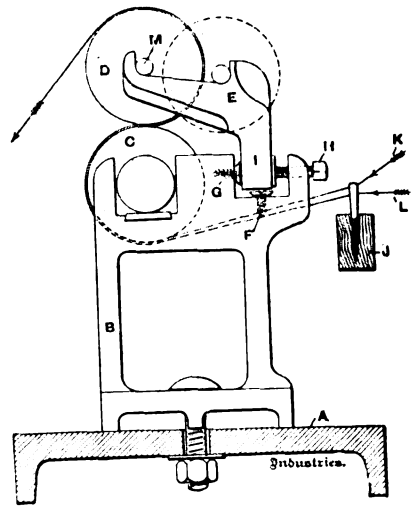
CALENDERING MACHINES.—*W. W. Urquhart, J. Lindsay, and R. Allan, Dundee.*—This invention is applicable to rolling machines which are employed for finishing woven fabrics and for rolling paper, and its object is to improve the method of communicating pressure to the rollers. The figure shows the arrangement fitted to a five roll calendering machine. The rolls A B C D E are mounted in the housings G; the bearing block H of the top roller is raised and lowered by means of a spindle J, which can be adjusted by means of a hand wheel K. The spindle is screwed through a block, which is pivoted between the inner ends of two plates forming a lever L; this lever is



centred on a pin in a bracket M, which is cast on the top of the gable G. The outer end of the lever is connected through the spring N to the upper end of a massive vertical bar O, which is made of such a weight as to be capable of lifting one end of the roller A. The lower end of the bar O rests upon the top of the ram P of a hydraulic cylinder. The top of the ram P is of a spherical form, and fits in a corresponding cavity in the bottom of the weight bar. The pressure of water in the cylinder Q is sufficient to raise the bar O and to apply the desired pressure to the top roller A through the lever L. Three claims are made for the manner of applying the pressure in calendering machines, for combining the counterweights with the pressure apparatus, and for interposing the springs, as described.—No. 2134. February 13th, 1888. 6*d*.

WELDING BOILER FLUES.—*G. H. Lloyd, Sutton Coldfield, A. L. Lloyd, Leamington, and H. Bewlay, Birmingham.*—A boiler flue constructed according to this invention is composed of two or more sections welded end to end. Each section consists of a cylinder whose ends are flanged; the body of each section may, however, be corrugated. The shaping of the edges of the sections may be effected either in the process of rolling the plates or in the process of rolling the sections when in hoop form. Before welding the sections together, the inventors bevel the edges of the plates, so that when they are brought together a V shaped groove is formed between the edges. In this groove is laid a strip of welding metal which projects above the level of the plates. The edges and the filling strip are brought to a suitable heat, and the joint is welded and finished with a swage which is adapted to leave a solid rib along the joint. By this means a weld is obtained which extends to the inner surface of the flue. Instead of a V groove being formed by the bevelled edges of the plates, the bevelling may be in a reverse direction, with the wider portion of the groove below. The rib of the welding strip is in this case made to project through and above the narrower portion of the interstice. During the welding operation the substance of the rib may be partially spread over the adjacent surfaces of the plates. Instead of producing V shaped grooves by bevelling the edges, a similar result may be effected by turning the edges of the plates upwards or outwards to a moderate extent. The welding operations are conducted by the aid of a gas or carburetted air flame; the tuyere is brought within a very short distance of the material under treatment. For welding joints in irregular work, the extremity of the tuyere or its fire brick facing is shaped so as to correspond with the contour of the plate, otherwise a large proportion of the gas would be wasted, and a risk of over heating would be incurred. The inventors claim: (1) The method of welding boiler flues, whereby the strength of the joint is greater than that of the normal thickness of the plate; (2) the employment of the strip of welding metal inserted between the bevelled edges; (3) the employment of a tuyere whose working face corresponds with the contour of the work under treatment.—No. 7828. May 28th, 1887. 8*d*.

DOUBLING AND TWISTING MACHINES.—*C. W. Lancaster, Accrington, Lancashire.*—This invention relates to that class of machines in which the continuance of the top roller in its working position is dependent on the continuity of the yarn. In order to insure the correct adjustment of the top roller in relation to the driving roller, the inventor makes use of supporting screws on which the cap bar is held in position. The arrangement will be seen on reference to the figure. The threads K L pass under the



driving roller C and over the top roller D; when the yarn is broken the top roller runs back in the groove in the cap bar E, and the delivery of yarn is checked. By means of the two screws F G and the set screw H, the cap bar can be adjusted with great nicety; the part I rests on the head of the screw F, and leans against G and H. The centre of the axis M can be adjusted so as to fall slightly to the right of a vertical line through the centre of the bottom roller. Recesses are formed in the circumference of the upper rollers near their ends for the purpose of keeping the yarn from slipping off the roller when the yarn is slack. Two claims are made for the method of adjustment by the adjusting screws F G H and for the recess in the upper rollers.—No. 17182. December 14th, 1887. 6*d*.

SHAPING THE TEETH OF BEVEL WHEELS.—*J. Lindsay & R. Allan, Dundee.*—The object of this invention is to improve the shaping of the teeth of bevel wheels which are made with inclinations to the planes passing through the axis of the wheel. The teeth are formed so that each half is made of a true conoido-helical form. The patterns for making moulds correspond either to a complete wheel or to only one or two teeth. In both cases the pattern for one half a tooth is cut out separately from the pattern for the other half, so that the cutters may work beyond the ends of the half teeth. For cutting the patterns the inventors employ a special modification of the machinery described in the specification of Patent No. 4122 of 1878. In this modification an additional reciprocating rotary motion is given to the part carrying the pattern, and this motion, together with the other motions, gives the conoido-helical form to the teeth. This invention may also be applied when the conoido-helical teeth are not made with one half of each at an angle with the other, but with the whole of each tooth inclined the same way. Two claims are made, one for the form of the teeth, and one for the special adaptation of the machinery as described.—No. 11515. August 24th, 1887. 8*d*.

PAPER MAKING MACHINES.—*J. Wood, Leith, Midlothian.*—This invention has been designed for the purpose of giving the paper pulp a motion which will cause the fibres to settle together in a regular manner while the water is drained from them. Two endless wire cloths are used; the first receives the fresh pulp and delivers the web at the other end to the second, by which it is carried through the usual couch rolls. The first wire cloth passes horizontally over a number of rollers. The frame of the rollers is supported in such a way as will admit of a horizontal motion being imparted to it. In one modification the frame is carried by four or more legs made with hemispherical ends, the upper ends fitting in corresponding cavities in the under side of the frame, and the upper ends resting in cavities in stools on the bed. The motion is imparted to the frame by cranks or eccentrics on two vertical shafts. The rollers at the end of the frame are larger than the intermediate rollers, and the roller at the delivery end is surmounted by a roller covered with felt for the purpose of giving some pressure to the web. The entering end and roller of the second wire cloth is placed at a suitable distance from the delivery end of first wire cloth, so that the motion which the web receives from the first wire cloth may not interfere with its progress on the second. The two bands are ordinarily driven at the same speed, but gearing may be introduced for enabling the attendant to adjust their relative movements as desired. One claim is made.—No. 8160. June 7th, 1887. 8*d*.

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ELECTRICITY.

ELECTRIC ARC LAMPS.—*W. Mackie, London.*—This form of lamp has all the usual distinguishing features of a differential arc lamp, but the feed is governed by the action of the shunt coil. The main coil is free to move, and is placed in such a position that it is capable of striking an arc, and afterwards of affixing itself to the core of the shunt solenoid. The main solenoid coil is itself suspended upon one end of a balance beam, the opposite end of which is weighted. This coil is suspended over its own core to a sufficient distance to enable it in its descent to strike the necessary length of arc. The solenoid core is connected through a dash pot to the core of the shunt solenoid, and the total weight of the cores and the interposed dash pot is greater than that which is necessary to strike the arc; they will thus remain stationary until the shunt coil becomes of sufficient strength to lift them. By another method of accomplishing the object of this invention, the main solenoid coil is fixed and has two iron cores; one of them actuates the striking gear, and the other is attached by a non-magnetic distance piece to the shunt solenoid core. These main cores have a space between them at starting, and the amount of iron protruding out of each end is equal. The action of the current in the main coil will tend to draw both cores into it, and the core striking the arc will then attach itself on to the other core. As there would then be an equal amount of iron through each end of the coil, very little power would be required to move these combined cores up and down through some distance. The shunt coil controls this system of cores and regulates the feed, without the main coil having any appreciable influence on it. A brake is sometimes used for the purpose of striking the arc and controlling the feed. Four claims are made for the application of the movable main coil, as a connecting link between the feeding gear and the regulating gear of the lamp, for the regulation by means of the shunt coil, which may be partially retarded from feeding by the action of the main coil, and for the brake.—No. 7184. May 17th, 1887. 8*d.*

ELECTRICAL TRANSFORMERS.—*W. M. Mordey & C. E. Webber, London.*—Fig. 1 is a side view, Fig. 2 an end view, and Fig. 3 a transverse section of one form of a transformer constructed according to this invention. P is a primary conductor, and K a secondary wire; the sections of these two wires are in the inverse ratio of the tension of the inducing and induced currents. These coils are respectively connected to the terminals O and L. The pieces of thin sheet iron A have each an opening N through them, and the pieces of iron B have no opening through them. The pieces A or B have an insulating substance on one side, such as varnish or paper. For the sake of economy the pieces A and B are so proportioned that the pieces cut out of A may serve as the pieces B. The pieces A are placed around or over the conductors P K, and the pieces B are inserted between the pieces A, so that A and B shall alternate

FIG. 1.

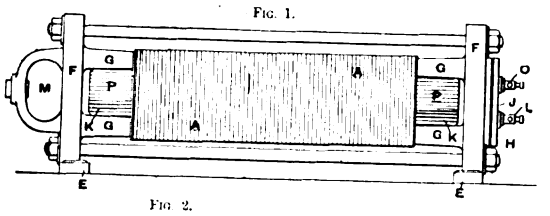


FIG. 2.

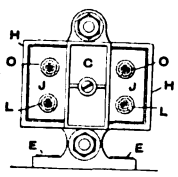
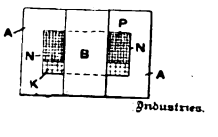


FIG. 3



Industries.

with each other. The pieces B pass through the coils, as shown in Fig. 3, and are in contact with the pieces A. As there is an insulating material on one side only of the pieces A or B, electrical contact only exists between the adjacent pieces on one side of each piece. The pieces are held together by the bolts passing through the end plates C F. The plate C carries a frame H, in which an insulating board J is supported, and on the plate F is formed a loop M, by which the apparatus is suspended. The extensions G are for the purpose of pressing the iron strips together when the bolts are screwed up. The spaces between A and B may be occupied by U shaped pieces of iron; but it is preferable to leave them open, in order to provide for ventilation. The end portions of the coils may be occupied by slips of sheet iron, varnished on one side; they are placed in the end portions of the coils at right angles to the pieces B, and the outer portions of the ends of the coils are covered by U shaped pieces of sheet iron. These pieces are placed at right angles to the pieces A, and meet the slips of iron occupying the inner portions of the ends of the coils. These parts are, however, preferably dispensed with, and are not shown in the figures. Four claims are made for this form and for another modification.—No. 6917. May 11th, 1887. 8*d.*

ELECTRICAL MEASUREMENTS.—*P. B. Elwell, Wolverhampton.*—The instrument here described is a combination of a volt meter, ampère meter, and electric meter. A high resistance solenoid is employed for indicating the e.m.f., and a low resistance solenoid for measuring the current. The high resistance solenoid is in a shunt between the lead and return mains. Coincident or parallel with the axis is mounted a spindle of non-magnetic material, which carries a wheel or other carrier within the solenoid; an iron bar or bundle of wires is fixed to the spindle in a direction parallel to the solenoid. Within the solenoid and close to the coils is fixed an iron bar or curved plate, which occupies such a position that the swinging bars may be adjacent to it when at rest; the weight of the bars always brings them to rest at the bottom. A platinum contact or a pair of contacts is attached to the fixed bar or plate, and to the rotating bar fixed upon the carrier; the circuit through the solenoid may thus be closed when the fixed bar and the moving bar on the spindle are at the point of nearest approach. The speed of the rotating spindle depends on the e.m.f. of the current, and this speed may be employed to indicate the e.m.f. The low resistance solenoid is wound with a few turns of thick wire, and is inserted in the main circuit. Within the solenoid are two or more bars of iron or bundles of iron wire, which are carried by non-magnetic carriers, mounted on central concentric axes. Upon one side of the interior of the solenoid is fixed a piece of iron similar to that in the high resistance solenoid. A pointer may be attached to one of the suspended bars. On passing the current through the coils the bars become similarly magnetised, and they move through a space depending on the strength of the current. By suitable gearing the angular motion of the suspended arms may be caused to traverse a small friction pulley upon the face of the disc on the high resistance solenoid. The friction pulley may have a flexible centre, obtained by connecting the rim to the boss by means of india-rubber or springs. Upon the axis of the friction pulley is mounted a worm pulley, which operates a suitable counting mechanism. The number of revolutions of the counting apparatus in a given time will be governed by the speed of the disc, which is controlled by the quantity of the current; the meter will thus give a record of the value of the current. The inventor makes four claims for the combination and arrangement of the high resistance solenoid, having one fixed magnetic bar, one or more rotating magnetic bars, and a rotating disc; with the low resistance solenoid, having one fixed magnetic bar and one or more rotating bars, a rack and pinion or equivalent device for transforming rotary into reciprocating motion, and a friction pulley operated by the rotary disc, for the purpose described.—No. 4447. March 25th, 1887. 8*d.*

ELECTROMETERS.—*A. Le N. Foster & F. W. Andersen, London.*—This invention relates to the class of electrometers in which a movable disc is mounted on an axis perpendicular to the plane of the needle. In the improved apparatus the movable needle is made bipolar, so that it receives two opposite electrical charges simultaneously. The needle is arranged between two pairs of inductive plates, which are charged with potentials of opposite polarity at the same time as the needle. The needle is constructed of a circular disc of mica, and is provided with two insulated coverings of tin foil. The needle is suspended from its centre, and electrical connections are made respectively from the two metallic coatings to two fixed points from which the coatings are charged. The electrical connections are made through the two ends of the suspendid axis. When several needles are employed, they are fixed upon one axis; the metallic coatings of the discs are electrically connected together in two sets in such a manner that one coating on every needle is positively charged, while all the other coatings are negatively charged. Two sets of inductive plates are arranged so as to enclose and partly cover the needles. These plates are fixed opposite one another symmetrically with the axis of the needle, and are constructed either of solid metal plates or of insulating material covered with a conductor. In one modification, instead of constructing the needles out of discs, the needles are made in cylindrical form with the metallic coatings symmetrically disposed around the circumference, and the inductive plates are constructed in a semi-circular form to envelop the needle. The inventors claim: (1) The bipolar needle arranged to oscillate between bipolar inductive plates and charged with potentials whose difference it is desired to measure; (2) arranging the series of needles upon the common axis; and (3) the construction of the instrument, as described.—No. 6104. April 26th, 1887. 8*d.*

DYNAMOS.—*C. Coerper, Ehrenfeld, Cologne, Germany.*—The object of this invention is to reduce the speed of revolution of the armature or field magnets without detracting from the value of the machine. This is accomplished by rotating the magnetic field in an opposite direction to the armature, and a special device for effecting these contrary revolutions is designed by the inventor for the purpose of reducing the wear and tear to the greatest extent possible. The motors are made with one or more cylinders. In motors with one cylinder, two connecting rods are actuated by one piston rod; one of the connecting rods turns a crank shaft on which is mounted the field magnets, and the other turns a second crank shaft on which the armature is secured. In motors having two cylinders, the crank shaft is divided, so that one cylinder with its crank shaft drives the magnetic field, while upon the crank shaft of the other cylinder the armature is fixed. In this manner the number of revolutions of the generators is reduced one half. The inventor claims the construction of generators in which the magnetic field and armature are rotated in opposite directions by means of two connecting rods in combination either with the piston rod of a cylinder, or with two or more piston rods of two or more cylinders.—No. 2308. February 15th, 1888. 6*d.*

CHEMISTRY.

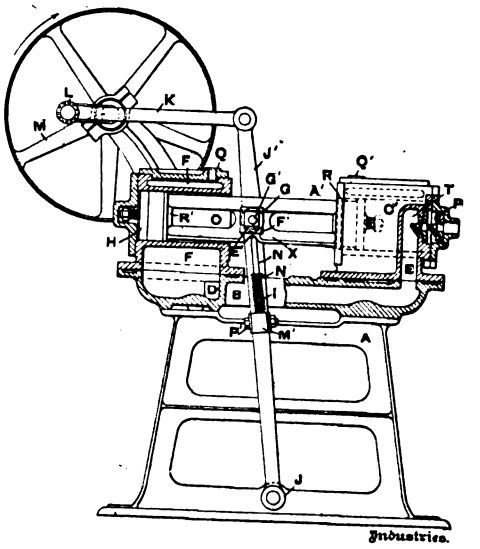
LACQUERS AND VARNISHES.—*F. Crane, Short Hills, New Jersey, U.S.A.*—The object of this invention is to prepare a varnish or lacquer which does not dry so rapidly as those at present employed in coating metals. For the methyl alcohol or methylated spirits the inventor substitutes amyl alcohol, or fusel oil, or amyl acetate. A medium varnish prepared on this principle may be composed of methyl alcohol five gallons, fusel oil four gallons, benzine four gallons, gum resin ten gallons. Six claims are made.—No. 7376. May 20th, 1887. 6*d.*

WASHING ORES.—*M. Kennedy, Ulverston, and G. Green, Aberystwith.*—The ore is first passed through an inclined iron cylinder together with a stream of water. An internal screw, made of angle iron, elevates the ore, and at the same time the loosened clay escapes with the water to the bottom of the cylinder. The rough ore having been cleansed passes out at the upper end of the cylinder, and falls upon a picking and shaking table. A length of 3ft. at the upper end of the cylinder is perforated, so as to allow the finer particles of the ore to pass through into a trough, and on to a sieve which is of finer mesh than the perforation of the cylinder. The material which does pass through the sieve is delivered to a "jigger," which separates the quartz and silicious matters from the ore. A series of sieves and jiggers are employed, and the meshes of the sieves become gradually finer. All the fine particles which pass through the mesh of the third sieve are conveyed by a launder to a first water current classifier, which deposits the roughest portions on a propeller "buddle;" the particles are scrubbed on the buddle by wire brushes and oblique scrapers; the water and materials passing over the first classifiers are led to a second, which delivers the material to the second propeller buddle. One claim is made for these combinations.—No. 7998. June 3rd, 1887. 8*d.*

A NEW MONO-SULPHO ACID OF ALPHA-NAPHTHOL.—*A. Liebmann and A. Studer, Manchester.*—In preparing the new mono-sulpho acid of alpha-naphthol, the inventors mix one part of alpha-naphthol with four parts of concentrated sulphuric acid. This mixture is maintained at a temperature of 130°C. for about an hour, and resulting sulpho acids are then converted into their corresponding barium salts. These salts are afterwards suspended in about ten parts by weight of water, and exposed to the action of a stream of gaseous hydrochloric acid. When the water and its contents are saturated with the gas, they are heated for about two hours in a reversed condenser; the excess of hydrochloric acid is evaporated, and the precipitate of barium sulphate is filtered off. The solution of the new sulpho acid is neutralised by the addition of barium carbonate, and on evaporation the dry barium salt is obtained. The barium salt is easily soluble in water and in ethyl alcohol which has been slightly diluted with water. The new sulpho acid has properties by which it can be readily distinguished from others of the same class. It does not on nitration lose its sulpho group, but yields dinitro-sulpho-alpha-naphthol, which none of the hitherto known mono-sulpho acids of alpha-naphthol do. It also combines with diazo compounds to form dye stuffs. One claim is made for the production of this new compound.—No. 7812. May 28th, 1887. 6*d.*

MISCELLANEOUS.

AIR PUMPS.—*E. M. Eckardt, Dresden.*—In the accompanying figure, A is the frame on which the pump is mounted, and B is the casting which connects the air chambers and the water mantle of the cylinders C C¹. The valve boxes of the cylinders contain the pressure valves T, through which the compressed



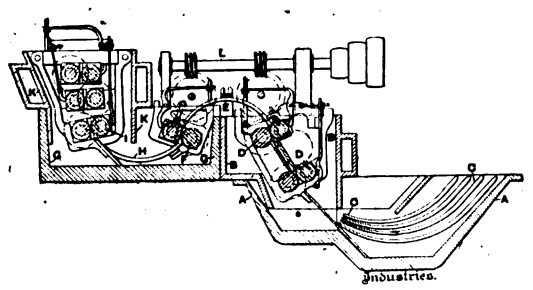
Industries.

air enters into the air collector in the casting B. The suction valve P is arranged in the lid of the cylinder; D and F are the ways for the cooling water, and Q Q¹ are the outlet openings for it. The pistons are connected by the beams A¹ and X, and receive their motion from the lever J, whose upper end is connected by a rod K to the crank L on the strap drum M. The upper end of the lever J¹ is bifurcated, and embraces a slide G, whose trunnions G¹ bear in the forked arms. The slide moves in the slot E¹ in the massive part F¹ of the piston. The piston is supported by means of a device for decreasing the wear and tear. This device consists of a block M¹, which slides in the forked part of the lever J¹, and which can be fixed by means of a bolt P¹. The piston is supported by a rod N which fits into a recess in X, and the rod N is provided with a collar N¹ against which the spring I presses. The interior of the pistons R¹ are connected with each other by a tube through the rod A¹, and a valve in the interior of the pistons allows the air to pass from the interior to the space behind the pistons. If the driving wheel M is rotated in the direction indicated by the arrow, the piston will move from C to C¹, and the piston R¹ sucks, and the piston R presses. In consequence of the air pressure behind R, the valve in R¹ will be closed, and compressed air will flow into the hollow space of the piston, and through the tube A¹ into the piston R¹. In carrying out the reverse movement, the piston R¹ will press, and the piston R will suck. Three claims are made for the application of the hollow rod for the adjustable rod N for the purpose described.—No. 17. January 2nd, 1888. 8*d.*

HYDROMETERS AND SACCHAROMETERS.—*J. J. Hicks, London.*—Certain additions to the usual parts of these instruments have been designed by the inventor, for the purpose of preventing them revolving in the liquid, and of forming supports which will enable them to stand upright when out of the liquid. To the lower end of the stem of the metal hydrometer are soldered a number of flat wings, which are so formed as to serve the above mentioned purpose. In some cases the wings extend sufficiently far from the stem to serve as a guard for the floating bulb, so that when the instrument is laid down on the table the bulb shall not be in contact with it. In applying this invention to glass hydrometers, the inventor fuses three or four plates of glass upon the weighting bulb or upon the lower part of the stem. Two claims are made, for fixing the wings to the metal hydrometers and saccharometers, and for fusing the plates to the glass instruments, as described.—No. 14169. October 18th, 1887. 8*d.*

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COATING METAL PLATES WITH TIN.—*D. Edwards, R. Lewis, and P. Jones, Swansea.*—The tinning vessel is constructed as described in Patent No. 5702 of 1885, except that apparatus is introduced for the purpose of passing the plates along without handling them. The accompanying figure illustrates this improvement. A is the tinning vessel containing the molten metal, and B is the grease bath above it; C is the rack of curved guide bars between which the plates are inserted. The rack is formed to receive three plates, two of which remain at rest in the bath, whilst the third is being pushed forward to the withdrawing



rolls D. As the plates emerge from between the upper pair of rolls, they pass below the curved guide bars E, which deflect the course of the plates and conduct them to a pair of rolls F. These rolls are necessarily immersed in the molten metal contained in the finishing pot G, otherwise the scruff floating on the surface would adhere to them. As the plates pass from the rolls F they come against curved guide bars H, which turn their course upwards and lead them to the lowest pair of rolls I. The plates are then carried upwards through the grease contained in the pot K. The wheels which drive the rolls D and F receive their motion from worm gearing on the driving shaft L. The inventors make three claims for the apparatus for coating metal plates, so constructed that the plates, as they are raised by rolls through a grease or flux bath from a vessel containing a coating metal, are deflected downwards by curved guides, and without being passed between any nipping rollers, are conducted to rolls completely immersed in a second bath of molten coating metal. —No. 7139. May 16th, 1887. 8*d.*

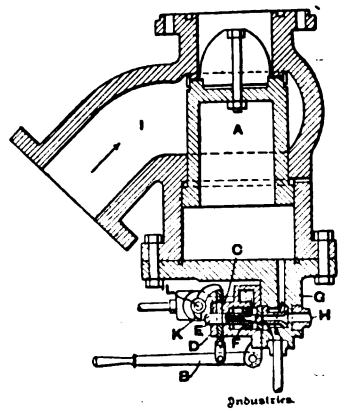
ENDLESS BANDS FOR THE CONVEYANCE OF MINERALS.—*J. Clarke, Alfreton, Derbyshire.*—Certain improvements are here introduced into the construction of the metal bands used in conveying minerals. In order to prevent the escape of the mineral while the drum is being passed, the inventor makes one edge of each plate to underlap the adjoining plate; the underlapping edge is curved to the arc of a circle, the centre of which is coincident with the centre of the pivot of the links. The overlapping or plain edge of the plate moves in close contact with the curved underlapping edge, and no space is left for the escape of the mineral. To allow of this curvature of the underlapping edge, the curved edge may be notched at one or more points according as there are two or more sets of links in the chain; there is thus room in the notches for the adjoining link to clear the plate when the belt is straight. These notches, however, allow the dust to escape through them, so that instead of notching the curved edge, the inventor sometimes forms a notch in the adjoining link, into which the curved edge will fit when the belt is straight. The strength of the plates is further increased by the plate being embossed with transverse corrugations running parallel with the curved edge. The belt may, however, be strengthened by the part of the plate between the links being buckled by Mallett's method. Two claims are made, for the manner of preventing the escape of the minerals, and for the means of strengthening the plates.—No. 14617. October 27th, 1887. 8*d.*

BOBBINS AND SPOOLS.—*G. O. Boynton & F. C. Johnson, Boston, U.S.A.*—This invention consists of an improved method of protecting the bearing ends of bobbins and spools. A portion of the wood is turned away, and a copper wire is wound round the reduced end. The end, after being coated with some metallic varnish, is immersed in an electrolytic bath. When there is a sufficient accumulation of metal, the bobbin is removed, and the deposited metal is turned in a lathe. A protective bearing is thus formed on the end of the bobbin. Four claims are made for this bobbin protected at its ends.—No. 3468. March 6th, 1888. 8*d.*

BLADES OF AIR PROPELLERS.—*F. J. Crossley, London.*—The object of this invention is to form a surface which shall replace the screw surface at present employed. In a circle having a diameter about one quarter that of the propeller, and having for its centre the point which represents the vertical trace of the axis, as many points are taken as the propeller is to have blades. As the centre of the circle represents the end view of the axis, so each of these points will represent the vertical trace of other lines running in the same direction as the axis. The generating line of the surface turns upon each of these points in succession, but the end which is in this point does not advance along the line of which that point is the vertical trace. One end of the generating line is made to coincide with one of the points in the circle, and the line is in contact with the line of which the adjacent point is the end view; it is prolonged beyond its point of contact with that line until its outer end meets a plane, which cuts the axis at a given distance from the plane of the circle; by the intersection of this plane with the generating line the diameter of the propeller is determined. The generating line is not at right angles to the axis in its first position, but the end on the circle is in advance of the intersecting plane. When the line is moved it is turned round the point in the circle, and that point does not advance. The outer end of the line advances towards the plane in which that point is situated when it is at right angles to the axis; passing through this plane it completes the generation of the surface by finishing at a greater or less angle with the plane than at first, but inclined in the opposite direction. In making this movement, the outer end of the generating line should follow a curve which becomes more and more parallel to the axis the further it advances from the plane which it originally touched. The whole or part of the surface generated forms one blade or wing of the propeller or fan, and the surfaces of the other blades are formed in the same manner, starting from the other points in the circle. The generating line may be straight or curved, or partly curved and partly straight. Six claims are made.—No. 7672. May 26th, 1887. 8*d.*

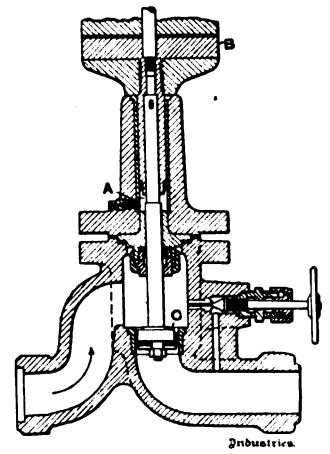
GERMAN PATENT ABSTRACTS.

ORDNANCE.—*N. W. Pratt, New York.*—This invention relates to an improvement in automatic valves for regulating the supply of compressed gases used for propelling projectiles. As long as the compressed gas acts on both sides of the valve A, the latter is kept shut. After inserting the projectile the lever B is pressed downwards, thereby bringing the perforation C of the



bolt D opposite to the piston rod E, and releasing E. As the pressure of the compressed gas is greater on the larger piston F than on the smaller one G, the latter one is moved to the left, thereby opening the exhaust H and relieving the pressure under A, which opens by its own weight, allowing the compressed air to enter through I, behind the projectile, which is discharged. When G is opened the piston rod E actuates the lever K connected to a piston valve L, which is thereby turned into such a position as to relieve the pressure on F. The compressed gas then forces G to the right, thereby closing the exhaust H, and an equilibrium is again established above and below A, so that the latter is closed after the discharge of the projectile. The lever B is then moved upwards and locks the piston rod E, while the upper end of D actuates a lever connected to L, and reverses L, thereby bringing the apparatus back to the same condition as before discharging the shot.—No. 42751. June 28th, 1887.

SAFETY VALVE.—*H. Brewer & Co., Höchst a. M.*—This safety valve is intended for automatically closing a high pressure main in case of breakage of a pipe. As long as the pressure is normal



the piston valve C is kept open on account of the difference of area. If a pipe breaks, the valve C is closed by the pressure of the water and the weight B. A dash pot A is provided for checking the too rapid descent of C.—No. 42622. July 1st, 1887.

UNITED STATES PATENT ABSTRACTS.

WHIP ROLL FOR LOOMS.—*A. F. Parker, Charleston, South Carolina.*—The whip bar, to which the bearing bar is attached, is provided at its ends with V shaped projections fitting into corresponding recesses in the levers. The levers are capable of vertical adjustment by means of the boxes in the loom frame, and the springs employed for holding the bearing boxes against the warp have nut and bolt connections with the levers; a variation of the tension is thus obtained. Two claims are made.—No. 371720, dated 24th April, 1888.

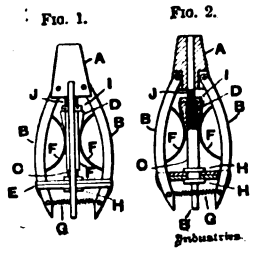
SEA OILING CARTRIDGE.—*A. H. Walker, Hartford, Connecticut.*—The cartridge consists of an elongated cylindrical shell, at the rearward end of which is a separate chamber containing powder. At the end of the oil chamber nearest to the powder is placed a weight, which tends to make the cartridge sink in the sea. At the opposite extremity is an air chamber, which sustains the cylinder in an upright position in conjunction with the weight. The wall of the cartridge is perforated so finely that the oil will not escape into the air, but directly the cartridge is immersed in the water the oil passes through the holes in the manner required. Three claims are made.—No. 380369, dated 3rd April, 1888.

SOAP.—*R. A. MacCullough, Milwaukee, Wisconsin.*—A certain amount of borax is added to the water contained in an open kettle, and afterwards some liquid caustic soda, cocoa nut oil, and tallow are mixed with the other ingredients. The mass is heated to a temperature of 190°F. to 240°F., and is agitated until it becomes homogeneous. A second mixture is made by melting a similar quantity of cocoa nut oil and tallow, and running them into an open tank; about the same proportion of liquid caustic soda is here added. On the completion of this process the two liquid masses are mixed together with a specified quantity of silicate of soda and dissolved starch. The saponification becomes complete after the whole mass has remained for an hour or so in the tank, during which time it is occasionally agitated. One claim is made.—No. 381503, dated 17th April, 1888.

LET-OFF MECHANISM FOR LOOMS.—*G. F. Hutchins, Worcester, Massachusetts.*—The rolls between which the pile warps pass are geared together, and are actuated by a ratchet and pawl. This mechanism is operated from a harness lever through a suitable combination of links and knee levers, according to the requirements of the pattern. A hand lever is provided, which serves to disconnect the train for actuating the warp rolls, and also to unclutch the operative shaft from the driving gear when desired. One claim is made.—No. 381787, dated 24th April, 1888.

FLUE CLEANER.—*C. G. Davidson, Union City, Pennsylvania.*—The flue cleaner here illustrated is adapted for cleaning the flues of any sized boiler. A stem C is fixed to the head A, and is provided with a screw thread J and with a square recessed head H at its outer end. Four arms B are pivoted to the head A, and carry the semi-circular scrapers E, and notches in the

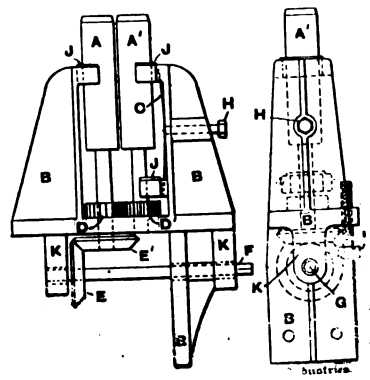
FIG. 1. FIG. 2.



scrapers embrace the steam head H. The springs F keep the arms B expanded, and the spiral spring G holds them together. In order to adjust the width of the scrapers to the diameter of the tube, the nut I is screwed up or down the thread. The wedge D is thus altered in position, and the springs F and the arms B are either forced out or retracted. Three claims are made for this flue cleaner.—No. 379564, dated 20th March, 1888.

SEPARATOR.—*J. J. Lowden, Boston, Massachusetts.*—This apparatus is employed for separating dirt and grease from water as it flows through pipes. A chamber is inserted in the length of the pipe, and inside the chamber three screens are fixed at right angles to the flow of the water. A series of perforations in the three plates are located at such points that the water shall pursue a sinuous course while passing through the chamber. This baffling of the current arrests the passage of impurities in the water. At the bottom of the chamber is a wide opening which leads to a waste pipe. Inside this bottom extension is an automatic float valve, which allows a free course to the sediment into the waste pipe when sufficient has accumulated to operate the valve. Three claims are made for this separator.—No. 381150, dated 17th April, 1888.

SIDE DRESSER FOR BAND SAWS.—*C. E. Cleveland & J. Hanson, Fort Waine, Indiana.*—The accompanying illustration shows the arrangement of the side dress for band saws designed by the inventors. The rollers A A¹ are mounted on shafts, to which the gear wheels are also fixed. Their ends are bevelled as



shown, and their bearing boxes J are made adjustable by means of the spring C and the nut H. The rollers acquire their rotary motion from the driving shaft F by means of the mitre gear E E¹. The whole is mounted in the frame B. Three claims are made for this side dresser.—No. 380089, dated 27th March, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED CYLINDER LUBRICATOR.

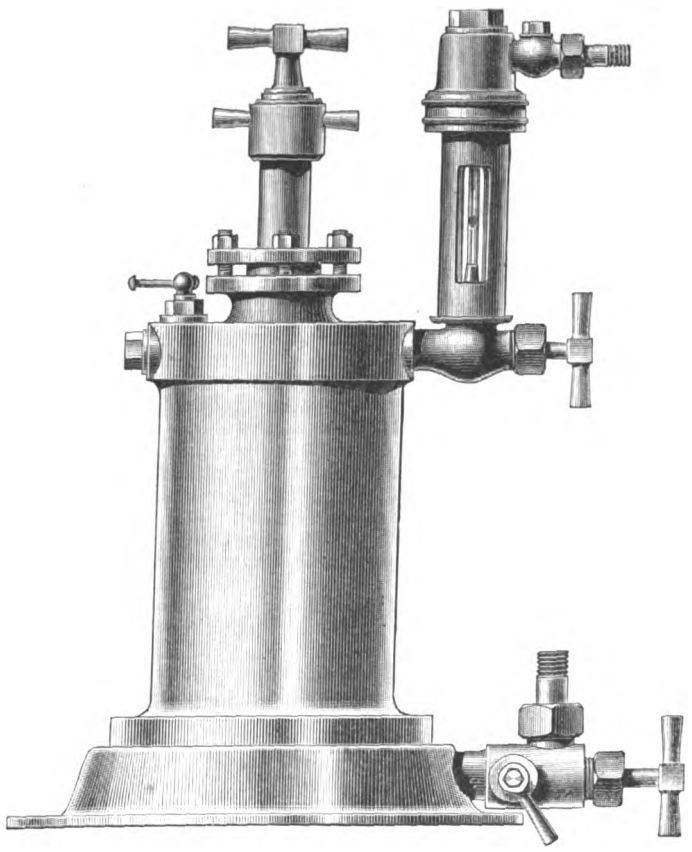


Fig. 1.

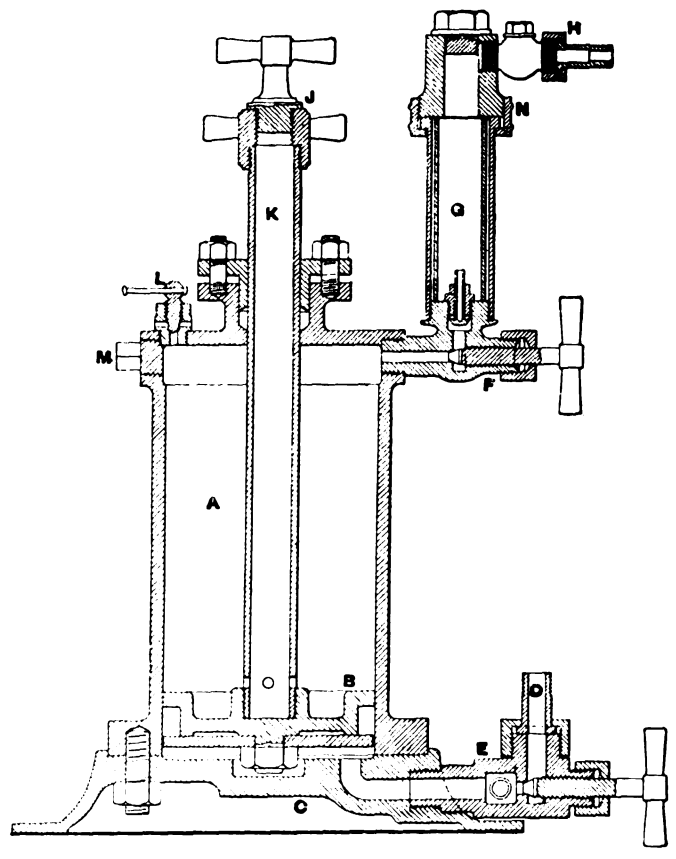


Fig. 2.

IMPROVED CYLINDER LUBRICATOR.

The above illustrations represent an improved steam cylinder lubricator put on the market by the Steam Cylinder Lubricator Company, Standard Chambers, King-street, Manchester. This lubricator is of the sight feed type, *i.e.*, the lubricant may be seen passing through a glass tube, thereby enabling the attendant to regulate the supply of oil to the required amount. The lubricator works in the following manner: The piston B, which is provided with asbestos packing, is brought into the position shown in Fig. 2, the screw plug J is removed, and the oil poured into the hollow piston rod K, entering into A through the perforations in K, just above the piston B. The air in A escapes through the valve L as the oil gradually fills A. J is then replaced, and the valve D opened, admitting steam under the piston B, which is forced upwards, owing to the difference in area between the top and bottom of B. The oil passes through the valve F into the sight feed G, and then through the pipe H to the steam pipe or steam chest of the engine. The supply of oil is regulated by the valve F. E is a run-off valve, and M a screw plug, which may be removed and another sight feed inserted. C is the base on which the lubricator is fixed. The advantages of this lubricator are as follow: It is easily fixed, and by attaching two or three sight feeds the lubricator may be used for supplying two or three cylinders at once. The oil is displaced, not by the accumulation of condensed steam, but by the pressure of steam from the boiler on a piston, the action of the lubricator thus being positive. The piston rod serves as a gauge, indicating the amount of oil left and the need of replenishment. The apparatus may be regulated to deliver large or small quantities of the lubricant, the amount varying from one drop to two hundred drops a minute. As no condensed steam comes in contact with the oil, the glass tube in the sight feed is kept clean, and breakage of it arising from the heat due to condensed steam is also prevented. As will be seen, the apparatus is compact and very neatly designed.

THE IRON AND STEEL INSTITUTE.

As we briefly mentioned in our last week's issue, the annual meeting of the Iron and Steel Institute was held on Wednesday and Thursday, the 9th and 10th inst., at the Institution of Civil Engineers, the President, Mr. Daniel Adamson, occupying the chair. Sir Frederick Abel was elected a member of the Council in place of the late Mr. Henry Robertson, and, on the proposal of the President, H.R.H. the Prince of Wales was elected an honorary member of the Institute. The Bessemer gold medal for 1888 was presented to the President, in the name of the Council, by Sir Henry Bessemer, who reminded the members that some thirty years ago, before the Iron and Steel Institute had been established, there was great difficulty in inducing manufacturers in the iron and steel trades to adopt improvements. Even in Sheffield, the stronghold of steel making, the speaker could not find one single manufacturer who would sympathise with him, and who would assist him in the introduction of his new process; but, fortunately for him and the world, there was outside of Sheffield a man who could appreciate the process, and who was determined to investigate it. That was his friend, Mr. Daniel Adamson, who, after convincing himself by trials of the best way to work up the new material, adopted it for boilers with the most beneficial results. Six boilers, 7ft. in diameter and 30ft. long, made from this material by Mr. Adamson twenty-two years ago, are still at work on their old seatings. It was perfectly well known to members of the Institute that the services rendered by Mr. Daniel Adamson to the steel industry generally were of the highest character, and they would all agree that he had fairly and honourably earned the medal which the speaker then had the pleasure of presenting to him.

Mr. Daniel Adamson, in accepting the medal, thanked Sir Henry Bessemer and the members of the Institute for the honour they had conferred upon him, and he explained that he was induced to try Bessemer metal because, in 1877, some puddled steel had passed through his hands which turned out unsatisfactory. He visited Sir Henry Bessemer's experimental works at Sheffield, and also saw the new material rolled at Messrs. Brown's, of Rotherham, where he was allowed to cross-examine the workmen, and the favourable opinion entertained by them induced him to make experiments in his own works. At first there was some trouble, due to the material lacking uniformity; but by annealing every plate and testing every plate himself, he was able to produce a perfectly reliable material. He had now 3000 of his boilers working, the majority being made of Bessemer steel. So thoroughly was he satisfied with the advantages of the new material, that he eventually solicited a license from Sir Henry Bessemer to manufacture it, and the result was the works at Penistone, now owned and carried on by Messrs. Charles Cammell & Co., Limited. These were the first works specially constructed to produce Bessemer metal to the exclusion of every other kind of steel. In his endeavour to introduce the new material he had been largely assisted by the late Mr. John Platt, of Oldham, and by Mr. William Richardson of the same firm, also by Mr. John Tosh, the managing director of the North Lancashire Iron Works, who was the first to give him orders for locomotives made entirely of steel. The President then delivered an address of which the following is an abstract:—

This being the fortieth meeting since the formation of the Iron and Steel Institute in 1869, it is satisfactory to note that the Institute continues in a flourishing state. During the year of formation there were elected 336 members, whilst in the following eighteen years a total of 1758 members was elected, or a yearly average of over ninety-seven. The total number of members elected from the beginning up to date is 2116. Allowing for deaths and resignations, the actual number of members would at present be about 2000. The importance of the Institute will be seen from the fact that the production of pig iron in the United Kingdom, in the United States of America, and in the leading iron producing countries of Europe, amounted last year to 21,832,663 tons. The total quantity of manufactured iron and steel for the years 1884 to 1887 inclusively is given in the annexed tables, which show that whilst the production of manufactured iron decreases that of manufactured steel increases:—

Table I.

Total Production of Manufactured Iron in Great Britain in the Years 1884, 1885, 1886, and 1887.

Year.	Tons produced.	Decrease since 1884. Per cent.
1884	2,237,535	—
1885	1,911,125	14·588
1886	1,616,701	27·747
1887	1,701,312	23·965

Table II.

Total Production of Bessemer Steel Ingots in Great Britain in the Years 1884, 1885, 1886, and 1887.

Year.	Tons produced.	Increase since 1884. Per cent.
1884	1,299,000	—
1885	1,304,000	0·462
1886	1,570,000	21·048
1887	2,064,000	59·136

Table III.

Total Production of Open Hearth Steel Ingots in Great Britain in the Years 1884, 1885, 1886, and 1887.

Year.	Tons produced.	Increase since 1884. Per cent.
1884	475,250	—
1885	583,918	22·865
1886	694,150	46·059
1887	981,104	106·439

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The production of Bessemer steel in the eight chief iron and steel producing countries of the world amounted last year to 7,269,767 tons, and that of open hearth steel to 1,672,340 tons, both figures showing a considerable increase over the previous year.

The use of Bessemer metal results in a great saving to railway companies and to shipowners. From Table IV., supplied by Mr. Parker of Lloyd's, it will be seen how rapidly mild steel has taken the place of iron for shipbuilding purposes.

TABLE IV.

Table showing the Annual Increase since 1878 in the Use of Steel for Steamers and Sailing Vessels built under Lloyd's Survey.

	Approximate weight of material.			
	Steel.		Iron.	
Year.	Steam. Tons.	Sail. Tons.	Steam. Tons.	Sail. Tons.
1878	2,682	—	243,717	66,897
1879	—	—	78,411	25,603
1880	21,895	1,002	268,433	24,009
1881	41,019	1,900	354,301	41,190
1882	69,269	7,486	403,644	67,711
1883	84,931	8,515	445,375	68,818
1884	65,386	8,016	274,189	78,011
1885	92,549	18,341	89,104	96,020
1886	96,583	18,352	49,320	58,627
1887	195,907	14,433	24,052	28,150

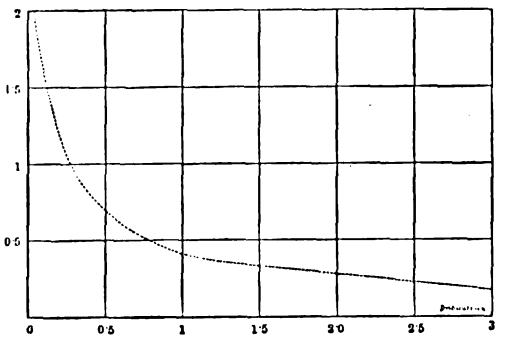
Steel ship plates can now be obtained at about 30s. per ton more than iron plates; but the reduction of the scantlings, due to the greater strength of steel, practically counterbalances the increased cost, so that by adopting steel shipowners obtain a vessel of superior material, and capable of carrying about 4 per cent. more cargo. The introduction of steel boilers has conferred a further boon on the shipowner, because allowing of a higher pressure, and consequently of more economical engines. For the last four years Lloyd's have scarcely had an iron boiler submitted to them for approval, whereas during each of those years there have been built under the inspection of the surveyors about six hundred steel boilers, representing about 24,000 tons of material. The improvements brought about by the introduction of steel has resulted in a saving of 25 per cent. in fuel, whilst at the same time increasing the carrying capacity of the vessels by about 4 per cent. The introduction of steel for bridge building has greatly widened the capabilities of the civil engineer, and it is not too much to say that a gigantic structure like the Forth Bridge could not be built with iron. In certain details of machinery, however, steel has not yet been able to supersede iron, especially when case hardened parts are required. In connection with this subject the President quoted from a letter received from Mr. T. Hurry Riches, of Cardiff, who did not find steel economical either for slide bars, motion work, or for outside crank pins, for which purposes case hardened iron surfaces were much better. Messrs. Platt Brothers and Co., of Oldham, state that notwithstanding careful trials, steel for case hardening purposes has, up to the present, been a complete failure, and that if steel is to supplant wrought iron for such purposes some special compound will have to be adopted which should be more in accordance with the composition of high class Yorkshire iron. Referring to manganese steel, the President quoted from Mr. Hadfield's recent paper, read before the Institution of Civil Engineers. A steel containing 2·5 to 7·5 per cent. of manganese was as brittle as glass; but when the manganese was further increased up to 17 and 20 per cent. the transverse strength of the metal was about eight times greater than that of the metal containing the smaller quantity of manganese. When 12 to 14 per cent. of manganese are present, high carrying power and great elongation are secured. In one specimen containing 13·75 per cent. of manganese the breaking stress was 57·02 tons, and a permanent set was produced with 29½ tons with an elongation of 39·8 per cent., thus showing a power of endurance with great toughness unequalled by any class of metal called steel. This metal is toughened by heating it up to a white heat and plunging it into water of 72°F. Manganese steel has, however, the drawback of being extremely hard and difficult to machine.

The President next referred to cast iron. As the United Kingdom is the largest producer of pig iron in the world, individual members of the Institute might do great good by turning their attention to the subject of cast iron and some of its alloys, as a judicious selection of the ingredients of cast iron may lead to the production of compounds suitable for special purposes, in the same way as special kinds of steel are now made. Mr. Wood, of Middlesbrough, had informed the President that by a more careful selection of pig iron containing a definite amount of silicon, the transverse strength of cast iron has been increased by 11 per cent. Great importance is attached to the wise selection of materials for producing cast iron, since, without using some of the higher priced iron which is now considered necessary for certain purposes, it may thus be possible to obtain a suitable cast iron at a moderate cost.

The first paper read at the meeting on Wednesday, was by Mr. Thomas Turner, on

SILICON AND SULPHUR IN CAST IRON.

The author divided the subject into two parts, the first treating with laboratory experiments, and the second with observations on the products of blast furnaces. The laboratory experiments were made with the object of obtaining a rich silicide of iron from which silicon would crystallise out. A quantity of pig containing 10·2 per cent. of silicon was placed in small fragments in a covered clay crucible, and heated to nearly the melting point of cast iron. A quantity of sulphur was then introduced and the lid replaced. The addition of sulphur was repeated, and the temperature greatly raised until the whole metal was thoroughly melted; more sulphur was then added, the contents of the crucible being at the same time agitated by a stirrer. The lid was then replaced and the crucible allowed to cool. On examining the contents they were found to be divided into three distinct portions. At the bottom was a mass of metal weighing rather more than half of the whole material. Above this was found a number of balls resembling "sulphur balls," and the top layer consisted of powdery material not unlike coke in appearance, though it was covered in parts with a white film of fibrous silica. The metallic matter was very brittle, and when powdered in an iron mortar exhibited beautiful white scales, consisting of 10·93 per cent. of sulphur and 10·15 per cent. of silicon. The chemical composition of the metallic matters would thus be represented by the formula Fe_4SiS. Further chemical treatment showed that part of the sulphur originally present could be removed as sulphuretted hydrogen on treatment with hydrochloric acid, whilst the rest of the sulphur was left among the graphitic matter which was not attacked by the hydrochloric acid. The author then mixed 50grm. of silicon pig with 50grm. of the silicon-sulphur-iron, and melted it in a crucible. The button obtained weighed 89grm., and contained ·45 per cent. of sulphur and 10·78 per cent. of silicon. Thus by re-melting nine-tenths of the sulphur was



eliminated from the metal, much of it passing into the slag. On re-melting the silicon-sulphur-iron without any addition, the sulphur was reduced to 1·46 per cent., and the silicon increased to 13·45 per cent. The button was covered with a substance containing 22·14 per cent. of sulphur, 5·55 per cent. of silicon, and 72·27 per cent. of iron with a little manganese. It would thus appear that by merely re-heating, the original material was split up into two perfectly distinct bodies, one containing the greater part of the silicon, whilst the other was exceptionally rich in sulphur. From this result the author concluded that it is not possible for considerable amounts of sulphur and silicon to exist together in pig iron; in other words, that silicon has the power of expelling sulphur from cast iron. The author then referred to several previous experiments by M. Janoyer, Dr. Percy, Mr. A. R. Smith, and Mr. Weston, from which it appears that under certain conditions iron compounds may be obtained which are rich in sulphur and silicon, but the compounds are unstable. On melting, the silicon with the greater part of the iron remains, whilst most of the sulphur is eliminated, passing away in gaseous form or going into the slag. The author considers it probable that with a certain percentage of silicon there is a definite amount of sulphur which cannot be exceeded under given furnace conditions.

In the second part of the paper the author cited Sir I. Lowthian Bell's investigations, showing (1) that a low temperature favours the union of sulphur with iron; (2) that the composition of the slag greatly influences the absorption of sulphur. In attempting to commercially recover sulphur from alkali waste, the material was fused in a small blast furnace with oxide of iron, and a sulphide of iron containing 30 per cent. of sulphur was obtained at a moderate temperature; but when the temperature of the furnace rose above a certain point, white iron was produced instead of sulphide. Mr. E. Riley, when experimenting with Welsh iron, found that the sulphur increases as the richness decreases, and in each case the increase of sulphur was connected with a decrease of silicon, and upon the character of this twofold change the variation in richness chiefly depends. The author suggested that there may be a general law which governs the proportion of silicon and sulphur in cast iron, as long as the temperature and furnace conditions remain constant. This law can be represented by what the author calls a maximum sulphur curve of the general character shown in our illustration, the ordinates of which represent the percentage of silicon and sulphur. The general conclusions drawn by the author from his and other experiments are: (1) That high temperature tends to prevent the absorption of sulphur by iron; (2) that a slag rich in lime readily combines with sulphur; (3) that the amount of sulphur actually retained by the metal is influenced by the proportion of silicon; and if by any means an excessive amount of sulphur should be present, re-melting eliminates the excess.

The discussion on this paper was opened by Mr. Snelus, who did not agree with the author in his statement that the amount of sulphur actually retained by the metal was influenced by the proportion of silicon present. In the charge of a blast furnace they had an almost constant proportion of silicon and sulphur, and yet the product varied, and the variations were due to the reducing power of the gases—a circumstance which had been overlooked by the author. If the reducing power of the gases in the blast furnace is perfect, it has the effect of reducing silica to silicon, and lime to calcium. Sulphur had a strong affinity for calcium, and thus the sulphur would pass into the slag quite irrespective of the silicon present. The reducing power of the gases, which depended upon a variety of circumstances, would, however, also affect the amount of silicon passing into the slag.

M. Gautier pointed out that the author's theory of silicon expelling sulphur from iron was not new. Herr Ledebur, of Freiburg, had already directed attention to this fact in an attempt to explain the occurrence of blow holes in cast iron.

Sir Lowthian Bell thought that the operations carried on in the interior of a blast furnace were of so complicated and so varying a character that it was extremely difficult to draw any general conclusion from a few isolated experiments. He doubted that silica was reduced at all in that portion of the blast furnace where carbonic oxide was being formed, and they knew that the temperature necessary for the reduction of oxide of iron by carbonic oxide was low. It could be carried on at a red heat; but he was inclined to the belief that the last portion of oxygen removed from the ore and silica was not effected until the burden reached the hearth itself, where the temperature was much higher. He had arrived at this conclusion from observations of the composition of the gases in various parts of the blast furnace. He thought that the changes in silicon and sulphur to which the author had alluded were, in a great measure, due to temperature. They all knew that the lower the temperature of the furnace the less satisfactory would be the iron produced, and they invariably found that with a lower temperature they had a smaller quantity of silicon in the iron.

Mr. Edward Riley considered the temperature to be the whole gist of the question. White iron made in a charcoal furnace, and at a low temperature, contained more carbon than some of the most graphitic iron. If an iron was rich in silicon there would be little carbon present, and *vice versâ*, and he thought that the driving out of the sulphur was due more to the carbon than to the silicon. He considered that the regular way in which the sulphur decreases with an increase of silicon in the author's analyses was rather accidental. If they wished to get rid of sulphur, they must use a very heavy burden of lime, so heavy that the cinder would not melt unless some aluminous ore were mixed with the materials, and, in his opinion, the condition for getting rid of sulphur was a very high temperature and plenty of carbon.

Mr. Hatfield could not agree with the author that an iron high in silicon must be low in sulphur. His firm use for certain purposes iron containing from 8 to 12 per cent. of silicon, and according to the author, they should get it very free from sulphur; but, unfortunately, in practice they very often did not succeed in getting the sulphur lower than ·11 to ·15 per cent., and occasionally it was as high as ·32 per cent. They found that if they got the manganese above 1½ per cent. there was not much difficulty in reducing the sulphur, and with manganiferous alloys combined with silicon, they could get iron containing as little as ·03 to ·04 per cent. of sulphur. He had made some experiments in producing what he called "sulphur steel." The original steel had 1·44 per cent. of carbon, ·7 per cent. of silicon, ·07 per cent. of sulphur, ·07 per cent. of phosphorus, and ·86 per cent. of manganese. They added sulphur and produced metals containing ·9, 1·6, 2·28, and 5·24 per cent. of sulphur in which carbon and silicon had remained almost constant, but the manganese had been reduced to about half its former percentage.

Mr. Stead confirmed Mr. Turner's opinion regarding the power of silicon to prevent the absorption of sulphur. If they melted a pig high in silicon with coke containing

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much sulphur, the resulting metal would contain very little sulphur; but if the pig were low in silicon, the metal would be high in sulphur. If the melting were done at a low temperature, they would in all cases get a metal high in sulphur. They all knew that as the temperature increased in the blast furnace the pig became richer in silicon and lower in sulphur, and they also knew that a slag rich in lime would absorb much sulphur.

Mr. Turner, in reply, thought that the difference of opinion between Mr. Snelus and himself was not so great as might at first sight appear. Mr. Snelus had dealt more particularly with the earlier stages of production, whilst his own observation referred to the later stages at the lower part of the blast furnace, where the metal was in contact with the slag. There was no doubt that a part of the sulphur in the slag was present in the form of sulphide of calcium, but another part might exist in a different shape. The point he wished to bring out in his paper was that when silicon and sulphur existed together in the pig, a portion of the sulphur would pass off and the silicon remain, but silicon would only eliminate a definite quantity of the sulphur.

The next paper read was by M. Ferd. Gautier, of Paris, on

The Melting in Cupola Furnaces of Wrought Iron or Steel Scrap Mixed with Ferro-Silicon.

As this paper was very short we reprint it in full.

Some twenty years ago experiments were made with a view to smelting wrought iron and steel scrap in cupola furnaces, and the connection of the name of Mr. G. Parry with such a process as applied to the manufacture of steel is tolerably well known. At that time the only known process for the elimination of phosphorus from pig iron was that of puddling, and it occurred to Mr. Parry that if he could only puddle moderately phosphoric pig iron, and melt this iron afterwards in a cupola, he could obtain a material suitable for the Bessemer process. The cupola process of melting wrought iron or steel scrap has many points in its favour. To begin with, the operation is accomplished more cheaply and more quickly than it would be in a reverberatory furnace; but on the other hand the temperature of the cupola is not high, and the conditions present for the reduction of silica and the introduction of carbon and silicon in the metal are not quite what they should be. The process yields an iron with practically no silicon, and with only 2 or 3 per cent. of carbon, the product being, indeed, white pig iron, which is not very fluid, which will hardly run out of the furnace, and which is as ill adapted for the Bessemer process as for foundry work. In order to overcome the absence of silicon in the metal thus obtained, Mr. Parry added about 50 per cent. of good hematite pig iron, high in silicon, which enabled him to reduce by about one-half what remained of the phosphorus. The cost of the process, however, interfered to prevent a successful employment of the cupola furnace, and its use having therefore been abandoned, the process has since been interesting only as a short chapter in the history of dephosphorisation. When we recollect that the cupola process was found to be very unsuitable for the melting of wrought iron and steel scrap, that the metal obtained thereby was white, that the 2 or 3 per cent. of carbon which it contained were, of course, combined with the iron, and that the iron was, therefore, too hard, and otherwise unsuitable for the foundry process, we can understand that Mr. Parry's experiment was not sufficiently encouraging to lead others to follow in the same direction, unless some new and important facts had, in the meantime, transpired to throw more light upon the matter. The introduction of ferro-silicon, which has been attended with a good deal of interest in metallurgical circles, has provided us with a new alloy, that has the power of converting a white pig into a grey one, and which is well adapted for the majority of foundry uses. In France it has been found that this power of precipitating the combined carbon of the white pig into the fine grained graphite is exhibited in an interesting way when a mixture of wrought iron or steel scrap is melted in a cupola, with a suitable addition of ferro-silicon. The first experiment in this direction was made in a shipbuilding establishment at Havre belonging to the Forges et Chantiers de la Méditerranée, when the charge consisted of—

Soft steel plate scrap	79
Ferro-silicon, 13 per cent.	21
	100

The percentage of silicon in the metal which was run out of the cupola was 2·60 per cent. One of the ingots obtained by the process could be hammered from 40mm. square to 35mm. square without any crack or flaw. This result is both novel and interesting as regards a metal containing about 2 per cent. of graphite and more than 2 per cent. of silicon. In France the drop trials adopted in the testing of artillery are as follow:—

Size of the square bars	30 × 30mm.
Distance between the supports	160 ,,
Weight of the ball	16 kilo.

The hammered cast ingot obtained in the process described supported twelve drops, commencing with 35cm., and was only broken at 1m. In another experiment, made at the works of Terre-Noire, the charge consisted of—

Steel scrap	77
Ferro-silicon, 9 per cent.	23
	100

In this case a square ingot of 30mm., submitted to the usual artillery test, was broken with the tenth fall of the hammer at 1m. 10mm., and was not hammered. If we consider that the ordinary pig iron for foundry purposes—as, for example, Scotch pig—when submitted to similar trials, usually breaks with an average fall of about 40cm., we can appreciate the increase of strength afforded in the case of the white pig by an addition of ferro-silicon. The softness of the metal obtained by the mixture of ferro-silicon and steel scrap was very considerable, and quite equal to that realised with white or light grey pig iron and ferro-silicon. This is undoubtedly due to the addition of silicon, and to the small proportion of carbon which remains in a combined state. The chief disadvantage of the employment of such a mixture of wrought iron and steel scrap with ferro-silicon appears to be that of its cost. Experiments, however, which I was enabled to make in a foundry near Paris have demonstrated that ordinary wrought iron scrap, and especially of the smallest kind (which may be had at a very low price), yields probably as good results as castings made with ordinary steel scrap. In this case grey metal is obtained with a close grain, and very sound castings, which are homogeneous and absolutely without blow holes; and if we consider that the resistance of the metal to shock is usually double that which is obtained with ordinary good cast iron, it appears to me that there is a special market for such castings, which might, at a comparatively low price, be substituted in many cases for the steel castings now generally employed.

Sir Henry Bessemer pointed out that experiments analogous to those of the author had been conducted at his own works some twenty-five years ago. At that time they manufactured large numbers of railway crossings and stamp heads, which were produced from a mixture of steel and cast or malleable iron. His metal was mixed with ordinary grey foundry iron, or with white iron, when intended for stamp heads. The mixture contained two parts of malleable metal and one part of the highly carburised iron, producing a close grain entirely free from blow holes. The stamp heads lasted three times as long as those made in the ordinary way. The speaker referred to this to show iron founders how, with the addition of a small converting plant, a most valuable metal could be produced.

Mr. Windsor Richards corrected a statement of the author regarding Mr. Parry, and said that this gentleman had no difficulty whatever in producing perfectly fluid pig. The speaker was associated at the time with Mr. Parry, and they intended to evade Sir Henry Bessemer's patent, but eventually they adopted his converter. They had no intention of dephosphorising by their process.

A letter from Mr. John Hardisty was then read by the Secretary, in which the writer stated that the utilisation of steel scrap in the cupola is not a new departure, as he himself had done this daily for two years. With small Bessemer converters, and a light blast through the bottom, there is difficulty in getting the blast sufficiently hot for the production of small castings, and as long as he used hematite pig iron it was only on rare occasions that he could get metal hot enough to cast without getting skulls in the ladle. The charge cooled towards the end during the combustion of the carbon, and therefore the writer desired to eliminate most of the carbon before commencing to blow, and for this purpose he used steel scrap and ferro-silicon containing 10 per cent. of silicon and 1·50 to 1·75 per cent. of carbon. The steel scrap contained from ·2 to ·4 per cent. of carbon, and consisted principally of the heads and runners from the foundry. The mixture that gave best results consisted of 19cwt. of steel scrap, 1cwt. of ferro-silicon, and 6cwt. of No. 3 hematite pig. The castings made from this mixture contained only ·2 per cent. of carbon. The metal showed a tensile strength of 27·8 tons, with an elongation of 36·6 per cent.

Mr. Turner pointed out that the mixing of steel scrap and pig iron was not the novelty in the author's paper, but the novelty consisted in the use of silicious iron. Many members would remember Stirling's patent of 1847 for the production of toughened cast iron, and there are many bridges now standing made of this metal. The method consisted in running grey cast iron upon wrought iron scrap, and then re-melting in a cupola; but the product was always more or less irregular.

Mr. Wood had occupied himself for many years with experiments intended to increase the strength of Cleveland iron by the addition of scrap steel in the cupola. With the present height of cupola it was, however, impossible at one operation to perfectly melt the steel so as to get a proper amalgamation. Even when charging the steel as turnings, they would upon planing the castings find some of the steel quite distinct from the rest of the metal.

M. Gautier in his reply said that there was a kind of dephosphorisation going on in his process, and he could make by it from Welsh or Northampton ores a reliable material. The difference between himself and Mr. Hardisty was that the latter gentleman blew his material in a small converter, whereas he did not blow at all except in the cupola where the ordinary horizontal tuyere was employed. The difficulties mentioned by Mr. Wood might be due to the surface of the scrap being oxidised. He had made castings from a mixture of 20 per cent. of wrought iron and steel scraps, 10 per cent. of ferro-silicon, and 70 per cent. of cast iron, which showed a tensile strength in the rough state varying from 13 to 15·4 tons.

The next paper read was by Mr. Herbert Eccles, on

An Imperfection in Mild Steel Plates Considered Chemically.

We print this paper *in extenso* in another part of the present issue. Mr. James Riley, in opening the discussion, complimented the author on the clearness of the statements which he had brought forward; but if he would look up previous discussions on this subject, which took place at the Institute, he would find many of the difficulties alluded to. The liquation of the metalloids and other matters had been mentioned, but none of them thought it desirable to enlarge too much upon these difficulties in the early days of the manufacture of mild steel, as it would have alarmed their customers. In the early days, when smaller quantities of material were dealt with, the difficulties were, moreover, not so pronounced, but with the large and heavy plates made now absolute homogeneity is more difficult to obtain. He had, in a paper read at this Institute, pointed out that ingots should not be made thicker than necessary, in order that the particular failing dealt with by Mr. Eccles might be avoided.

Mr. Snelus thought that some of the faults of lamination mentioned by the author were simply due to overlap, a defect they were sometimes troubled with, especially when the plate had been rolled from a thick ingot. In other cases, however, there seemed to be no doubt that the failing was due to an excess of phosphorus in particular places. He agreed with Mr. Riley in his recommendation to keep the ingots as thin as was compatible with the size of the plate to be rolled. For this reason he always made plates from slab ingots, so as to prevent, as far as possible, the accumulation of liquated material in the centre of the ingot.

Mr. John Head, who agreed generally with the previous speakers, called attention to the fact that steel made in the ordinary way was always porous. Professor Bishop, when experimenting on the pressure at which microbes would be killed, had occasion to use a pump filled with mercury, with which he desired to produce a pressure of 11,000 atmospheres. He bought a pump from a very respectable firm in the North of England, but he found that the steel plunger was porous, and allowed the mercury to pass through. He then substituted another steel plunger made by a Sheffield firm, but with no better result. On the recommendation of the speaker he applied to Messrs. Osborne & Son, and a plunger made by that firm was perfectly successful, producing a pressure of 4000 atmospheres without any leakage of mercury. This plunger was made from steel heated by radiation, by which means a perfectly non-porous material can be obtained.

M. Gautier pointed out that when the cooling of Bessemer or Siemens-Martin ingots was too sudden, they found a hole in the centre; but with crucible steel made pot by pot, very slowly, this was not the case.

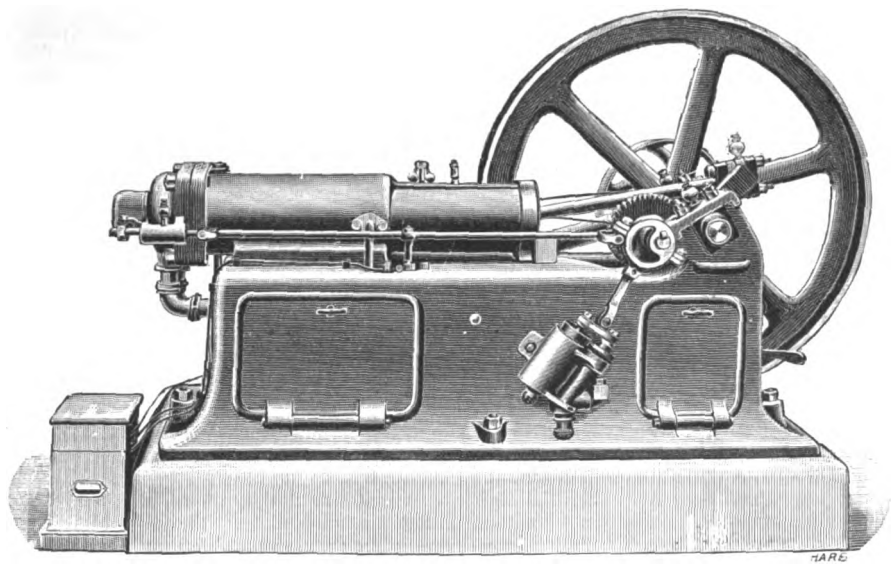
Mr. Harbord thought the size of the ingots from which the plates were rolled of great importance. From the analyses it appeared that the phosphorus had increased three times, so that if starting with ·06 of phosphorus, they might get in certain parts ·18. He had not found so great an increase in his own experiments with smaller ingots, although the increase was still considerable. Since, with the present demand for big plates, they could not use small ingots, he thought a possible remedy might be found in the employment of a very pure steel made from hematite iron. If they had ·01 of phosphorus in the side of the plate, they would at the worst have ·03 in the centre, and this was perfectly safe.

Mr. Le Neve Foster corroborated the statements of the author. In his experience he had repeatedly come across samples similar to those illustrated in the paper. He had succeeded in gradually obviating the defects by discarding one-third of the ingot at the top.

Mr. Stead said that owing to the defects described in the paper, the plate consisted in reality of three layers, two soft layers outside and a harder layer inside, which formed a very good arrangement for general work. The inner portion formed a kind of backbone to the whole mass.

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THE PRIESTMAN PETROLEUM ENGINE.



The President had investigated the relative proportion of carbon in different parts of an ingot, and found it to vary between ·22 and ·78, which was more than one to three. He was pleased to hear from Mr. Stead that the plate produced by a thick ingot was really a kind of compound armour plate, with two outside tough sections and a rather harder interior. He thought that the disturbing elements should be kept down to a low measure, and that it might be desirable to increase the manganese, the proportion of which would not vary so much throughout the ingot, as it has nearly the same specific gravity as steel, and being slightly less fusible fixes itself more quickly. If they had a plate with a fair percentage of manganese and a small percentage of the other disturbing elements they would obtain a very uniform and reliable material.

The next paper read was by Mr. A. Wilson, on

Water Gas as used for Metallurgical Purposes.

We shall reprint this paper in an early issue, and give, therefore, only a short abstract at present.

When steam is passed through red hot carbon, a mixture of gases is produced containing carbonic acid, carbonic oxide, and hydrogen. The proportion of carbonic acid decreases when the temperature rises, until at 1000°C. no carbonic acid at all is produced. Carbonic acid passed through carbon begins to be reduced to carbonic oxide at a temperature of 550°C. The whole reaction is therefore as follows: The decomposition of steam produces hydrogen and carbonic acid, and by continued contact with the incandescent coke, the carbonic acid is transformed into carbonic oxide. When carbonic oxide and steam are heated together above 600°C. there are produced carbonic acid and hydrogen. These chemical reactions are employed for the production of water gas. A mass of coke is heated by means of a blower, and during this time Siemens or generator gas is produced; the air supply is then shut off and the steam supply is turned on, when water gas is produced. The characteristic of this generator consists, therefore, in alternately producing Siemens gas and water gas. At the beginning of the second operation the gas coming from the generator is entirely free from carbonic acid and steam; but as the mass of combustible is cooled the gas acquires a larger quantity of one or the other, and in practice, the passage of 1100 litres of gas yields in the condenser 24 cub. cm. of water, which is equivalent to 4 per cent. by weight. As the fuel generally employed is small coke, leaving a considerable quantity of ash, it is desirable to construct the generating apparatus in such a way that large quantities of cinders may be easily withdrawn; and this problem has been solved by dispensing with a grate and surrounding the hearth with a conical water jacket, beneath which there is an annular space through which the air enters during the blowing operation, and through which water gas escapes in the next process. The slag is deposited on the conical surface of the fuel in a covering which extends up to the opening of the water ring, and the cinders are withdrawn by four cleaning doors. The cleaning out is done every six hours, and occupies from fifteen to thirty minutes. The water jacket acts in a certain sense as a regenerator heating the air supply, and cooling the water gas passing away. The first water gas plant successfully established in Europe was erected at the works of Messrs. Schulz, Knaudt, & Co., at Essen, and consisted of two generators, each capable of producing 10,000ft. of water gas per hour. At first the steam was highly superheated in a regenerator through which the hot gases were passed; but this practice was discontinued, owing to the rapid destruction of the bricks in the regenerator. The steam was then only heated to 500°C.; but, contrary to expectations, the consumption of fuel was not increased by this change. The next plant established was at the Witkowitz iron and steel works in Austria, where water gas is used for open hearth steel melting furnaces, for lighting the works, and for heating the billet furnaces. A similar plant has been erected at Hoerde, and at the Leeds Forge Company's works water gas plant for metallurgical purposes has also been erected. The author next touched upon the employment of water gas for lighting purposes. A flame of ordinary gas with the same speed of combustion has six times the surface of a flame of water gas, and consequently the temperature obtained by the latter is much higher. In using this gas for lighting, a comb, composed of little magnesia rods, is suspended in the flame, and raised to a state of white heat. The light possesses the advantages of absolute steadiness and purity, being superior to the electric glow light in whiteness, without having the bluish tint of the arc light. The author next referred to the most approved and economical types of generators which work with a mixture of air and steam and thus make a mixture of producer and water gas simultaneously. The cost is about the same as when producer gas and water gas are made separately, as before described. One ton of slack coal, at 5s. 6d. per ton, yields about 150,000ft. of producer gas, and one ton of inferior coke, at 6s. 3d. per ton, about 35,000 cub. ft. of pure water gas, and about 140,000 cub. ft. of generator gas, being at the rate of ·43d. per 1000 cub. ft. for fuel.

The discussion was opened by Mr. Morris, of the United States, who said that in his country water gas had been used for some years, but mostly for illuminating purposes. He was not aware of its being employed in America for metallurgical work. In his opinion gas firing was in every way an improvement upon the use of solid fuel, not only for the purposes mentioned in the paper, but also for the firing of steam boilers, where they would have a more perfect combustion, greater cleanliness, and less injury to the boiler plates than with the present system.

Mr. Walker, of Leeds, had seen the water gas plant put up by Mr. Sampson Fox, and testified to the excellent work done with it. The cost was also much lower than formerly, when the Leeds Corporation gas was used, although this, as they all knew, was very cheap.

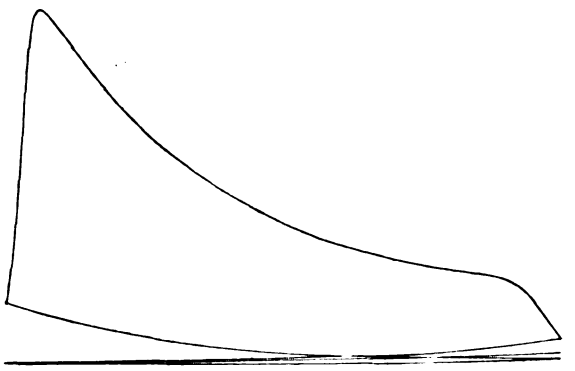
Sir I. Lowthian Bell thought that water gas could only be produced so cheaply because the fuel was taken at 6s. 3d. per ton; but if water gas were generally used, they would find some difficulty in procuring coke at this figure. He had seen the water gas plant at work in Essen and Frankfort, where it was used for welding in the manufacture of tubes, and he made some inquiries as to its application for lighting. On this subject he consulted Sir Frederick Siemens, Sir Douglas Galton, and others, and they all declared that, on account of the poisonous nature of carbonic oxide, the application for lighting purposes would be inadmissible. He was aware that, notwithstanding this danger, there were several cities in the United States lighted exclusively with water gas.

Mr. Stead had seen water gas employed in Mr. Wilson's house, both for lighting and heating purposes, with excellent results. The danger of carbonic oxide could easily be obviated by impregnating the gas with naphtha or some other compound which has a pungent smell, and any leakage would thus be immediately detected.

Mr. Wilson, in his reply, said that steam boilers are fired in this country, not by water gas itself, but by generator gas, which is a by-product in the manufacture of water gas. In America there were over three hundred cities or towns now lighted by water gas, and the proportion of fatal accidents was not greater than in the case of cities lighted by ordinary gas. For the purpose of detecting a leakage, the gas was impregnated with a small quantity of coal tar naphtha added whilst it passed through the purifiers.

THE PRIESTMAN PETROLEUM ENGINE.

It will perhaps be remembered that a year or two ago a new petroleum engine, known under the name of the Etève engine, was introduced into this country. It met, however, with little success, because necessitating the use of very light and volatile hydrocarbons, which for various reasons were objectionable. Not only are they difficult to obtain in certain localities, but if obtained, great precaution is required in storing them. There are also legal difficulties connected with the use of very light hydrocarbons. Fully recognising the defects of this engine, Messrs. Priestman Brothers, of Hull, have taken the matter up and have introduced various improvements, resulting finally in the production of an engine in which any heavy common petroleum may be used, whilst the mechanical details of the original Etève engine have been greatly simplified. The engine which we illustrate herewith, and which is now exhibited at their London offices, 73A, Queen Victoria-street, appears indeed to be far more simple than an ordinary gas engine. It is single acting, with an explosion at every second revolution, the charge being ignited by a spark from an induction coil worked by a single large bichromate cell. The base plate of the engine contains under the crank shaft a small closed tank, which holds about a day's supply of oil. This tank is filled from the outside by means of a pipe and bend, upon which is screwed an oil filter. The employment of an oil filter is of importance, because, as will be presently seen, the oil has to pass a very small orifice, which might become choked if there were any impurities present. At the other end of the bed plate under the cylinder is fixed a tank in which the oil is vaporised. From the first tank there lead two pipes into the vaporising tank, one for the oil and the other for the air. A combined air and water circulating pump is attached to the sides of the base plate, and driven from a lay shaft which also actuates an eccentric for

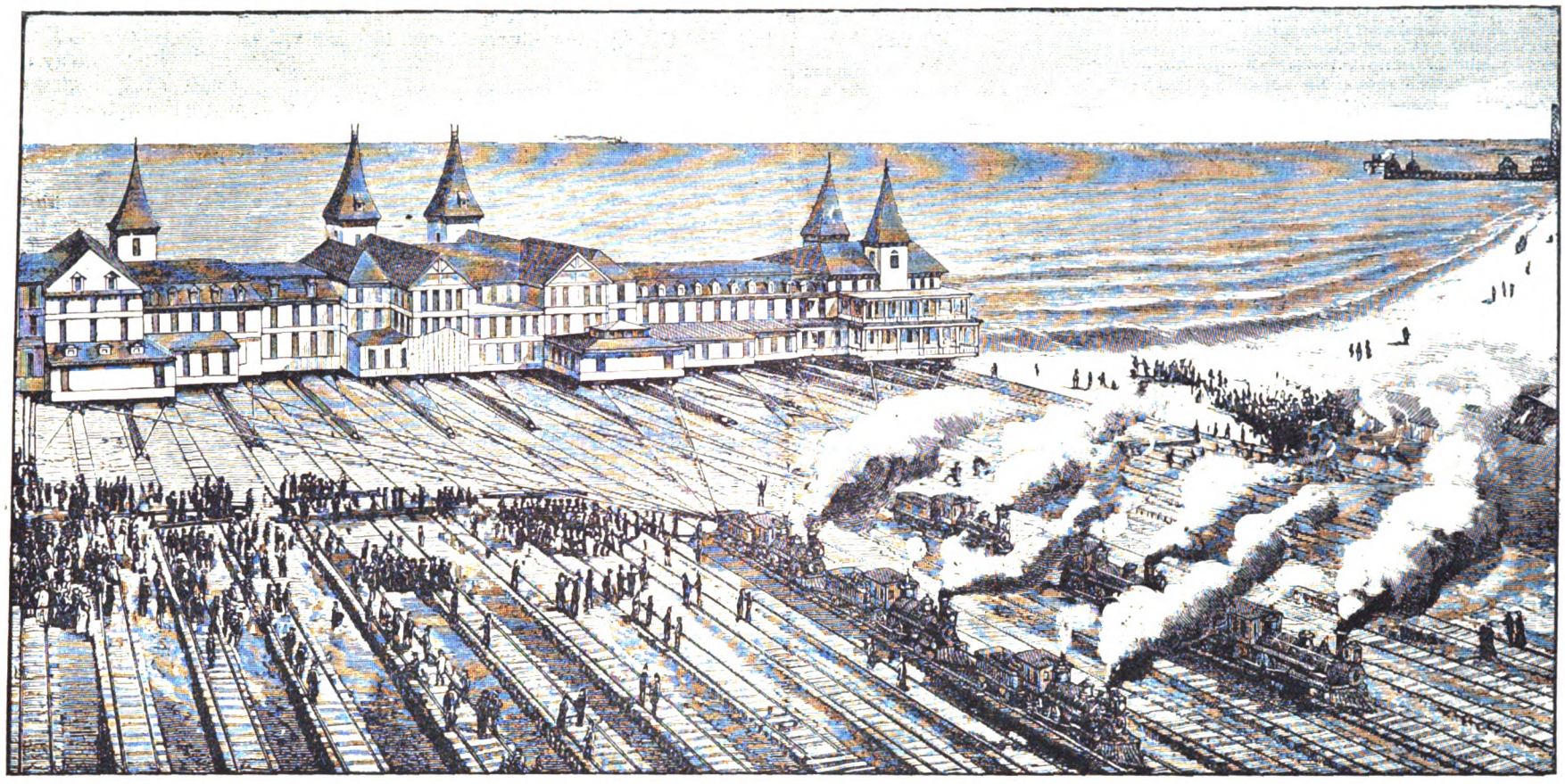


Indicator Diagram.

working the exhaust valve. The base plate of the engine stands upon a hollow pedestal of cast iron which forms the water tank, so that no external tank is required for the cooling water as in gas engines. The pump just mentioned serves to circulate the water through the jacket of the cylinder. The air pump delivers air into the top of the oil tank, and produces there a pressure of about 5lb. per square inch. The oil pipe dips nearly to the bottom of the tank, and by means of this pressure the oil is forced up the pipe and along it. At the end of the oil pipe within the vaporiser there is a very fine opening, through which the oil issues in a continuous and very fine jet. This jet is transformed into spray by an air jet, the supply of air being derived from the top of the oil tank, in which, as already mentioned, a pressure of 5lb. per square inch is kept up by the air pump. Thus within the vaporiser there is an atmosphere of air saturated with petroleum in suspension; the proportion of air to petroleum can be regulated by valves, so as to insure a proper strength of the explosive mixture. The petroleum vapour in the vaporiser is kept hot by the exhaust from the engine when at work; but to facilitate the starting, a small petroleum burner is provided under the vaporiser. This must be lighted a short time before starting. The charge

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MOVING AN AMERICAN HOTEL.



is taken in at the outstroke of the piston and compressed at the next instroke. At the following outstroke it is fired, giving an impulse at every two revolutions. A valve in the inlet pipe prevents the propagation of the explosion back into the vaporiser. There is no slide valve properly speaking, but simply an exhaust valve which is worked by an eccentric. To the eccentric rod is attached, by means of an insulating handle, a metal knob, which describes a path somewhat resembling an ellipse, and is so placed that once in every revolution of the eccentric, that is to say, once in every second revolution of the crank, it bridges two metal springs which are insulated from each other and from the frame work of the engine, and which form the terminals of the primary circuit of the induction coil. By this means once every second revolution the induction coil is set going and the charge fired at the right moment. We have received from the makers a tracing of an indicator diagram taken from this engine, and which we publish herewith. The diagram is of an engine having an 8in. cylinder and 13in. stroke, and making 136 revolutions per minute. The scale of the diagram is 1in. to 80lb. We are informed that no lubrication is required for the cylinder, the petroleum vapour serving to keep the surfaces in good condition. The engine has been tested by Sir William Thomson, Mr. Boverton Redwood, Sir Samuel Canning, and by Messrs. Alabaster, Gatehouse, & Co., who have reported very favourably on its performance.

MOVING AN AMERICAN HOTEL.

Our American contemporary, the *Scientific American*, recently published illustrations of the method of moving the Brighton Beach Hotel, Coney Island, near New York, one of which we reproduce. The sandy beach on which the hotel was erected crumbled away under the action of the waves to such an extent that serious fears for the safety of the building were entertained, as the water made its way right under the structure, and threatened to carry it away. An adjoining building had to be moved several times, for which purpose it was cut into three pieces, which were removed separately. The same course was proposed for the hotel; but the cost of the undertaking in that shape was excessive. Buildings have been often moved before in America; but the operation we now describe is on an unusually large scale. Mr. J. L. Morrow and Mr. E. L. Langford finally devised the original and ingenious method of accomplishing the task, and Mr. Morrow was entrusted with the execution of the scheme. The undertaking was no small one, when we consider that the building is a wooden structure 465ft. long, 150ft. deep, and three storeys high, and that the estimated weight is about 5000 tons. It was proposed to support the building on freight cars, and move it by means of locomotives. To that end a series of parallel tracks were constructed, the gauge being about 4ft. 9in., with an average allowance of $\frac{3}{8}$in. play. Twenty-four of these lines were laid down, and 112 platform cars, supplied by the Iron Car Company, were placed on them for supporting the structure. The building was then raised by means of hydraulic jacks, in sections of 20ft. length; one 90-ton, three 60-ton, five 30-ton, and four 10-ton jacks being in operation. The sills were raised from the supporting posts, and the cars run under the building, each piece of which rested on two cars on adjacent tracks. The building was then lowered, and its weight kept the cars in place until the whole of the structure was supported on the cars. By means of blocks and ropes the cars were securely connected to six locomotives, arranged on two tracks, as shown in the illustration. On the 3rd April everything was ready, and the signal for the start was given, and the whole building moved forward. Only a short distance was traversed, when a thorough examination of the structure showed that everything worked perfectly. The hotel was then moved through a distance of 239ft., when the rails, sleepers, and stringers left between the house and the water were brought to the front and connected to the rest, after which the building traversed the whole distance of 495ft. without accident. The total weight moved is estimated at 6000 tons, of which 1000 tons was the estimated weight of the cars.

THE CYCLONE OIL BURNER.

The accompanying illustrations, for which we are indebted to our American contemporary the *Iron Age*, represent the cyclone oil burner manufactured by Messrs. L. Schutte & Co., Philadelphia, Pa., and intended for burning petroleum or any other liquid fuel. Fig. 1 shows a longitudinal section of the burner, while Fig. 2 illustrates the arrangement of the plant in connection with the burners. The oil is forced from a tank by means of a small steam pump through the pipe A (Fig. 1) into the burner, passes through the strainer F along the pipe C, and is discharged through a nozzle attached to C. This nozzle is provided with a screw blade round which the oil passes, thereby receiving a gyratory motion. By this means the oil issues from the nozzle in form of such fine spray as to resemble vapour. The air enters at B, and passes a screw blade similar to that fitted in the nozzle C, thereby receiving a gyratory motion resembling that of the oil. Oil and air are mixed in D, forming a cone which is ignited and produces the flame. E is a slide which regulates the air drawn in through an auxiliary inlet. Any dirt in the oil is retained by the

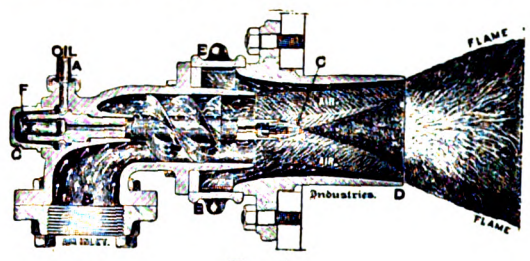


Fig. 1.

strainer F, which may be cleaned by taking off the cap shown in the illustration. This arrangement prevents the nozzle from getting choked by dirt. All parts of the burner are easily removed and cleaned. The oil ought to be supplied to the burner under a pressure of no less than 35lb. per square inch, which is most conveniently obtained by a small steam pump mentioned above. The

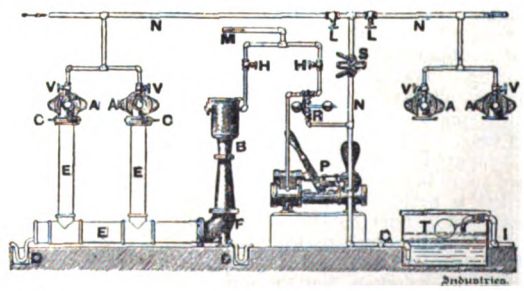


Fig. 2.

supply of oil is controlled by an automatic attachment to the steam valve. In Fig. 2, A A represents the burners, B the blower, C the blast gates, D D the drip pipes, E E the blast pipes, F the blower elbow, H H the steam valves, I the oil supply pipe, L the valves for regulating the oil supply, M the steam pipe, N the oil pressure pipe, P the steam pump, R the pressure regulator, S the duplex strainer, T the strainer tank, V the regulating valves.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 15TH MAY, 1888.

THE IRON MARKET.—A great improvement is visible in the iron market here this week. The merchants, alarmed at the action threatened by the manufacturers of the North, have hastened to come to an understanding among themselves, and have put up their prices all round. The quotations now are: £6. 4s. for bars, £5. 16s. for joists, and £7. 12s. for common plates; old rails are sought at £3. 6s. Paris prices are now in accord with those of the provinces. Doubtless the effect upon the iron trade will be good, for many consumers hesitated to involve themselves in large contracts so long as there was an appearance of weakness in the market. In the Haute-Marne bars and special sections are in brisk demand, and prices are very firm. Wire is more inquired after, and wire nails are actively dealt in. There is briskness in the trade in bars and plates in the Ardennes, where the Paris merchants are now buying largely, with a view to render themselves less dependent on the Nord. The latest reports from the other centres of the iron industry agree in describing the situation as steadily improving.

THE METAL MARKET.—The collapse in tin has given a downward tendency to the metal market generally. The price of copper is maintained, because the syndicate buys up promptly every ton offered for sale; but this is a state of things that cannot long continue. Despite the enormous fall in tin, consumers refrain from buying, in the belief that prices have not yet touched bottom. In sympathy with the tin market, lead has receded a point, and spelter has further declined. The latest quotations are: Chili copper bars, £82; Banca tin, £126; lead, £13. 16s.; and Silesian spelter, £19. 4s. per ton delivered at Havre.

MARGARINE IN BUTTER.—The great event of the last meeting of the Société des Agriculteurs du Nord was the reading of a paper by M. Thibaut on a process for detecting margarine in butter, discovered by M. Dubernard, director of the Station Agronomique du Nord. Hitherto it has been impossible to detect the presence of margarine in butter, a circumstance which the adulterator has turned to good account. The simple process invented by M. Dubernard is as follows: Three grammes of the sample to be tested are put into a tube divided into equal parts, and heated in a sand bath to about 212°F. After the butter has been kept for a few seconds at this temperature, 5 cub. cm. of ammonia at 30° are added. The tube is then closed and vigorously shaken, after which it is replaced in the sand bath and kept for a short time at the previously mentioned temperature of 212°F. Under the influence of this temperature, the ammonia is driven off, producing a thick froth, which rises to a greater or less height in the tube according to the larger or smaller proportion of margarine present. In the case of pure butter, only a few small bubbles are formed on the surface of the liquid.

THE SUGAR BOUNTIES.—A deputation, headed by M. Mazurier, president of the syndicate of sugar manufacturers, waited, on Friday last, on M. Goblet to learn from him the actual state of the negotiations going on in London. The Minister of Foreign Affairs assured the members of the deputation that matters are not so far advanced as they have been reported in the newspapers to be, and that France has reserved to herself complete freedom of action pending a full investigation into the legislation on the subject existing in the several countries interested.

BERLIN, 14TH MAY, 1888.

THE COAL MARKET.—The negotiations which have been going on among the members of the Upper Silesian Coal Mining and Metallurgical Society, with a view to the restriction of the output of coal in that district, have never been regarded as likely to succeed; but the failure became apparent at the last general meeting of the Society. The principal cause of the failure is the fact that the two great fiscal collieries, which produce one-fourth of the total quantity of coal raised in Upper Silesia, refused to agree to any such proposal. The efforts which have been put forth to obtain a reduction in freight for the carriage of coal from this district to the northern provinces, in order to increase the sale of Silesian coal there, have also been futile. Meanwhile, the imports of English coal are augmenting. The prices at which contracts for forward delivery are at present being made, are such that no improvement in the coal trade is expected to take place this year. Contract prices not only show no improvement, as compared with those obtained last year, but in some cases there is even a decrease. For the Rhine district the market is better. The producers of coking coal in the Dortmund district have decided on an increase in price of 4d. per ton, to come into force at once.

THE IRON MARKET.—It is proposed to form a syndicate of fine sheet makers, but those interested anticipate great difficulty in the determination of the output of individual works. Should the syndicate be established, two sales bureaux will be formed in the Rhenish Westphalian district—one in Siegen and the other in Dortmund. The state of trade generally is satisfactory. The prices of forge and foundry pig have not changed since my last report. The export business at the present moment remains extremely quiet. The demand for bar iron for home consumption is very active. Boiler makers are exceedingly well employed, and heavy sheets are consequently in good request; fine sheets are also in good demand. It is stated that the reduced freight charges, granted last year by the Rhenish Westphalian State railways for the carriage of crude iron for export *vâ* the Dutch ports, will be discontinued on the 1st July next. The reason for the change lies in the loss of traffic receipts suffered by the Hanover railway administration. On the other hand, if the rates should again be raised to their former level, the iron masters of the Siegen district will find their export trade to be injured thereby. Reports from Upper Silesia state that some of the leading iron founders are going to renew their project of establishing a price convention for castings, which has been once before attempted, but had to be abandoned for want of support in the trade.

ENGINEERING WORKS IN SAXONY.—According to reports received from Chemnitz, the engineering trades there are at present in a satisfactory condition as regards the quantity of orders, but the prices obtainable are very low. The Saxon Machine Works (Hartmann) have orders on hand to the value of £100,000, and these are chiefly from abroad. The export trade to Japan is specially brisk. Large orders have recently been received from Russia, and from other countries, for knitting machinery, in which branch Chemnitz is specially efficient. Up to now work in this branch was scarce; but with the introduction of improved types, finding favour abroad, the export trade has now revived. Prices rule lowest in steam engines. Business in textile machinery and machine tools is fairly active. The Saxon Machine Works is well employed in the construction of locomotives, but prices are not very remunerative. This firm has recently taken up the construction of weaving looms on a large scale, and these machines are mostly disposed of in the German market. Last year embroidering machines were scarcely saleable, but now some little business is being done in this branch.

ELECTRIC TRACTION.—An electric tramway locomotive has been built by the Schwartzkopf Company of this town. It can exert a maximum tractive force of 8cwt., which is sufficient to haul on the Berlin lines three ordinary tram cars fully loaded, but without seats on the roof, or two tram cars with seats on the roof. The total weight of the locomotive when in service is 6½ tons. The current is supplied by a battery of sixty storage cells having a capacity of 320 ampère hours, and weighing 2 tons 4cwt. The motor is a disc dynamo, with double winding on the armature and two commutators. The windings can be put either in parallel or in series, so as to vary the speed and tractive force.

VIENNA, 14TH MAY, 1888.

THE IRON MARKET.—The general tendency of the iron market has remained unchanged during last week. Merchant bars, angles, and other rolled iron are in good demand on the part of agricultural engineering works, and business in building iron remains fairly active. The only articles in which there has been a slight reduction in price are black sheets; but the reduction was merely a local movement on the part of some works in Bohemia, resolved upon to meet a temporary competition from Germany. The fall in tin has not as yet had any influence upon other metals, and on the whole the characteristic features on the metal market are high prices and little business.

PROPOSED NEW IRON WORKS.—It is not generally known that ferro-manganese and spiegel were made in Austria before this industry took root in Germany, and the spathic ores of Styria and Carinthia were at one time extensively utilised for the manufacture of charcoal and spiegel. With the improvements in the process by which the smelting can be done by coke, the trade passed to the Rhine district, and now our Bessemer works are importing nearly the whole of their requirements of ferro-manganese from Germany. Under these circumstances the owners of works in Upper Carinthia still making spiegel with charcoal, which is becoming scarce, are now proposing to abandon them, and establish jointly a large works at Sava with Martin basic furnaces, by which the large stocks of Carinthian pig and old scrap iron now on hand might be utilised. The proposed site of these works is near the railway station, and water power of 2000 h.p. is available in that locality. The neighbourhood of Pontebba and Trieste would offer considerable facilities for export.

THE HUNGARIAN SMALL ARMS FACTORY.—This undertaking, which I have already mentioned in some of my previous letters, has at last been fairly floated. Subscriptions have been opened in Vienna and Berlin for 24,000 shares, representing a total nominal capital of 13,600,000fl. in silver, and bearing interest at 4 per cent., under the guarantee of the Austrian and Hungarian Governments. The Hungarian Government are assisting the undertaking by free grants of land, freedom from taxation, remission of import duties on machinery and materials required by the works, and by a reduction of tariffs over the State railways. They have also placed an order with the company for the supply of 180,000 Mannlicher repeating rifles, which must be completed by March, 1892. Amongst other orders already received is one for 1000 rifles, which must be delivered by the end of next year. It is estimated that when fully equipped the works will be able to turn out 250 rifles per working day.

ENGLISH CAPITAL IN AUSTRIAN PUBLIC WORKS.—The fact that German financiers are now regarding Austria as a profitable field for the employment of capital seems to have had the effect of directing the attention of English capitalists to this country. There are two undertakings which are now receiving the support of English money. One is the tin mines of Abertham, near Joachimsthal in the Erzgebirge, and the other is the regulation of the Iron Gates of the Danube. In the Berlin Treaty Austria undertook to remove this obstacle to navigation, and the work will have to be carried out by Hungary. The necessary plans have been prepared by Government engineers; but the estimates show that the cost of this undertaking would be far greater than the Hungarian Government could at present incur, and I learn that an English syndicate of capitalists has declared its willingness to undertake the work on certain conditions, the details of which have not yet transpired.

SULPHURIC ACID.—For some time past considerable activity has prevailed in the production of sulphuric acid, both imports and exports being on the increase. Twenty years ago the imports of sulphuric acid did not exceed 300 tons per annum, whilst the quantity exported amounted to about 450 tons. The impetus which this branch of trade has received since that time will be seen from the fact that the total quantity of sulphuric acid which was imported last year amounted to 2600 tons, whilst 2500 tons were exported. As a rule the exports do not materially exceed the imports; but in 1883, 1884, and 1887, the quantity imported was considerably greater than that exported. There is a great difference in the quality of the imported and exported article, the latter being three times more valuable than the former, which is mostly obtained from Prussian Silesia. Southern Germany and Russia receive the largest quantity of our exports.

BRUSSELS, 15TH MAY, 1888.

THE COAL MARKET.—There is considerable animation in the coal market, and an active demand for coal and coke for metallurgical purposes at unchanged prices. Coke dust is quoted at 7s. 2d., and large coke at 12s. per ton, whereas at this season last year only 9s. 2d. was paid for coke. The Charleroi section of the Association of Engineers has been giving its attention to the subject of the manufacture of coke from coal briquettes. M. Marsigny, of the Couillet Company, has given some interesting information on the subject. Patents have existed in England and Belgium for the last forty years in connection with the conversion of poor coal and anthracite, mixed with tar or resin, into coke. The idea, therefore, is not new; but the methods adopted at Châtelet present some novel features. The briquettes are piled on an iron plate, which is drawn into the furnace by means of a winch. The furnace door is then closed, and the plate is withdrawn through an aperture left for the purpose. The results hitherto obtained are not very encouraging, the coke thus produced being of much inferior quality to that made from rich coking coal.

THE IRON MARKET.—The announcement of the continuance of the iron syndicate for the current year has been accompanied by an increase of orders. A further rise is spoken of, with a base price of 96s. for rolled iron. There has been no alteration in the price of pig iron, and stocks are increasing, thus tending to relieve the market. Forge pig made in Belgium is quoted at 38s. 5d. to 40s., and English pig at 42s. 5d. Fine plates are 144s., and girders for home consumption 92s. per ton. Important contracts will be made to-morrow, the 16th, by the State railways, for railway material, including 750 tons of frogs of mild steel. It is not yet known whether offers will be received from abroad for the contract for 8000 tons of steel Goliath rails, which will have an important bearing on the prices of the tenders by Belgian manufacturers. The Ougrée Company have obtained an order for 700 tons of steel rails for the Amblève railway at 96s. per ton, which is considerably higher than the prices of the last State railway contracts. The Angleur Steel Works have made an arrangement with the Esperance Works of Liège for the construction of a new blast furnace near Seraing. The pig iron is to be used for the production of Thomas, or possibly, at a later period, of Bessemer steel. Further orders are expected for metal sleepers, the Grand Central Railway having reported very favourably upon them.

GLASS WORKS.—There is still a good demand; but, owing to excessive over-production, prices are falling, and the English market in particular is weak, owing to a want of combination among our manufacturers. It is, however, hoped that the plate glass syndicate will be maintained. Notwithstanding the condition of the industry, many of the old firms are extending their works, and the Anvelais Plate Glass Company have ordered a steam engine of 1000 h.p. for their new works from the Société de Couillet.

TEXTILES.—The markets show an improvement since my last report, both cottons and flax being in better demand. Some business has been done in Russian flax at fair prices. There is little doing in linens.

BELGIAN INDUSTRIES.—According to an official report there are in Belgium 4077 flour mills, 2574 breweries, 2249 cloth mills, 1333 potteries, 800 tanneries and leather works, 666 tobacco factories, 660 slate, stone, and marble works, 577 printing works, and 544 oil mills, making a total of 13,489. To these must be added collieries, metallurgical works, india-rubber factories, glass works, arms factories, and powder mills, bringing up the total of all industrial establishments, large and small, to 26,500.

ECONOMIC RAILWAYS.—The general meeting of the Economic Railway Company has been held, at which complaints were made regarding the delay in constructing certain lines, and the loss in working others. The total length of lines open for traffic in 1887 was 275 miles, and of lines in construction 65 miles; making a total of 340

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miles. Since the formation of the company, up to the 31st of March, 1888, £330,727 have been spent on the permanent way, £237,277 on rolling stock, and £188,092 on buildings; making a total of £756,096. Demands for concessions for two hundred miles more of narrow gauge railways are now before the Government.

DÜSSELDORF, 14TH MAY, 1888.

THE COAL MARKET.—The coal trade affords the best possible evidence of the revival of industrial activity throughout the country. The market continues animated and strong for all classes of coal except house coal, which is never in very brisk demand at this season of the year. Prices, too, continue to advance. The Association of Gas Coal Owners have further raised their rates 3s. a 10-ton truck load. Coke, especially the qualities suitable for metallurgical purposes, is in strong demand. At a meeting of manufacturers at Bochum last week, representing 80 per cent. of the production of this locality, it was unanimously agreed to establish a new company, to be known as the "Aktiengesellschaft Westphalische Kohksvereinigung," to transact the business in coke through a common sales bureau, with a view to maintain the present satisfactory situation, The production of coal in the Dortmund mining district in the first quarter of the current year amounted to 8,085,318 tons, against 7,340,968 tons in the corresponding period of 1887, an increase of 10·14 per cent. The import trade, too, is very active. The total imports of coal and coke in the first quarter amounted to 1,538,676 tons, against 1,406,190 tons last year, an increase of 9·42 per cent. The exports show also a slight expansion, being 2,480,716 tons in the three months, against 2,439,405 tons last year, an increase of 1·70 per cent. The consignments of Westphalian coal to North Germany, where competition with English coal is extremely keen, steadily increase; but this gain is to be attributed rather to a larger consumption of coal than to any headway made against English competition.

THE IRON MARKET.—The iron market remains in its main features unchanged from what it was a week ago; but here and there some improvement is visible. The United States demand is weaker, and there is still the depressing influence of the low prices in England to take into account. More life has appeared in the business in crude iron. Forge pig is much more actively sought after, and the opinion gains ground that a further advance in prices will shortly take place. The market is animated and strong for spiegel pig. Thomas iron is in brisk demand, and foundry pig is being largely bought at prices considerably above the syndicate minimum. Most of the buying is now for delivery in the fourth quarter of the year, a circumstance which guarantees the maintenance of the prices of finished iron to the end of 1888. There is a steady business in bars; but merchants exhibit a reluctance to enter into important engagements. The foreign trade in bars and joists grows worse; transactions are few, and the prices obtained leave no profit. In the present state of our trade, Belgian competition cannot be successfully met. Manufacturers who work for the export trade claim some concession from the blast furnace owners; but the latter declare themselves unable to offer any reduction while ore and coke maintain their present rates. As far as coke is concerned, there is no prospect of lower prices. The home demand for hoops is reviving. Plates and sheets remain unaltered; the former are in brisk demand, and the latter are but little sought after. There is no change to report in the wire trade.

INTERNATIONAL GARDENERS' EXHIBITION.—An International Gardeners' Exhibition, to be held in Cologne in August next, will be of some industrial importance, inasmuch as green house and garden house structures, heating apparatus, tools, and other appliances used in gardening, will form the principal feature. To insure success to this undertaking the Government has instructed its representatives in Vienna, St. Petersburg, London, Rome, Constantinople, Brussels, The Hague, Copenhagen, Stockholm, Berne, Athens, and Washington, to invite manufacturers and others to exhibit at Cologne, and to afford all requisite facilities. The Minister of Agriculture has informed the General Committee that he is prepared to offer ten first class and ten second class silver medals, and twelve third class bronze medals, to stimulate competition.

LILLE, 15TH MAY, 1888.

TEXTILE MANUFACTURES.—The absence of spring weather has greatly restricted the spring trade in textile goods. This has been an unfortunate circumstance for the manufacturers who, judging from the apparent course of events at the beginning of the year, had accumulated stocks in anticipation of a brisk demand. The consequence now is a considerable depression. The turnover last week in linen goods shows a further decline, and compares unfavourably with the corresponding week of last year. In woollen goods, too, the latest report received from the Roubaix-Tourcoing district is a little disappointing. A few weeks ago it seemed that a genuine revival had set in; but on the whole, though a few classes of "fancy" have been in brisk demand, no further progress has been made. The causes of this discouraging state of trade are, a cold spring season and political insecurity. The jute manufacturers, as I reported some months ago, claimed from the Customs administration the collection of the same duty on full sacks imported in the foreign grain and seed trade as is levied on new sacks, their contention being that such sacks when emptied of their contents were equal to new, and were sold in the home market to the detriment of the native industry. Further it was asked that whenever an imported package was found to have a double covering, unnecessary for its protection, the outer covering should be held dutiable. By a ministerial decision it is now declared impossible for the Customs administration to deal with the matter under existing laws. It is, therefore, a question for the Legislature.

FLAX AND YARN MARKETS.—The flax market remains in a lifeless state. There is practically nothing doing either in home grown or Russian. Interest is for the time diverted to the growing crop, the development of which has been seriously retarded by the ungenial spring season. According to some authorities, but little permanent injury has yet been done; but much depends on the weather of the next two or three weeks. Business in yarns is quieter, and prices tend in favour of buyers. Jute yarns move heavily in the market, and sellers find themselves compelled to offer important concessions to induce customers to buy.

THE IRON MARKET.—If business in iron does not increase it certainly has suffered no abatement in the course of the last two or three weeks. Consumers have in many instances waited for the result of the contest between the manufacturers of this locality and the merchants of Paris. Now that the latter have been driven from their position, and practically compelled to raise their prices to the syndicate minimum, we may expect greater activity in the market. In the meantime, orders are sufficiently plentiful to keep manufacturers fully employed. As to the probable course of prices, an indication is afforded by the refusal of the coal owners to renew contracts at the old rates.

WINTERTHUR, 14TH MAY, 1888.

TECHNICAL EDUCATION.—The Polytechnic School at Zürich has long had the reputation of being one of the best Continental establishments for the education of engineers, architects, and chemists. A few years ago a new and very large chemical laboratory was added, and now there is in course of erection a still larger physical laboratory. Formerly the curriculum of the mechanical engineers' school contained only a very moderate amount of instruction in physics, and the head of the mechanical school was invariably an engineer. Now, however, this policy has been entirely changed. The head of the mechanical school is Professor Weber, a distinguished scientist in physics, but not a mechanical engineer, and under his auspices lessons in physical science occupy a very much larger share of the instruction supplied to those who wish to become mechanical engineers. The new laboratory will, when completed, have cost about 3,200,000fr., and will contain thirty-eight rooms where physical investigations will be carried on. Among these there will be four underground rooms, situated so low that the temperature in them will only vary by ·2°C. between summer and winter. These are intended for experiments which must be carried out at a constant temperature. In the basement of the laboratory will be installed various engines and dynamos, so that students will be able to carry out experiments on a large scale. No student will be allowed to compete for the diploma of mechanical engineer unless he has worked for at least forty days in the physical laboratory. Practical engineers here consider that this new departure in the training of mechanical engineers will not prove beneficial. They admit that a somewhat larger share of instruction in physics is desirable; but they consider that under the new programme the interests of practical engineering are likely to be injured by an overdose of theoretical physics.

MADRID, 14TH MAY, 1888.

THE ALTOS HORNOS COMPANY.—A dividend of 5 per cent. has been declared on last year's working of this company. These are the only works in Spain which roll Bessemer steel rails; but the quantity sold in 1887 was under 15,000 tons, although 70,000 tons to 80,000 tons could have been turned out. This is due to the fact that most of the railway lines are allowed to import rails duty free.

THE QUIROS IRON COMPANY.—The Quiros Iron Company, which was formed by a powerful syndicate of French capitalists, has, as I once mentioned before, proved a very disastrous concern, owing to want of judicious management; and after many years of useless attempts to keep the works going at a profit, they were closed more than a year ago. The property has now been sold to the Mieres Company for £30,000, the actual cost having been £250,000. The property includes very rich and extensive iron ore mines with ores of 48 per cent., which can be worked at a very low cost; coal mines, the actual value of which has not been ascertained; a narrow gauge railway, ten miles in length, forming a connection with the general system; and iron works at Trubia, with rolling mills for merchant bars. These works can make common iron bars cheaper than their competitors; but the small market offered by Spain having been secured by works established previously, they had a difficulty in competing.

NEW YORK, 5TH MAY, 1888.

THE IRON AND STEEL MARKETS.—The past week has been rather encouraging to the trade, as there is more disposition to buy, and consumers are now carrying very light supplies. Prices have not yet responded, however. A larger amount of business has been done in pig iron than for some time past, but at a low range of prices. There is not much chance of higher rates; but it is satisfactory to know that there is a bottom to the market, and that it is already within reach. Business has been very dull in manufactured iron, and there are no signs of improvement either in price or demand. The ordinary supply of orders is not nearly sufficient to keep mills running, while large orders are few and far between, and only obtainable by greatly reducing prices. Consequently, mills are running irregularly, and most unsatisfactorily to their owners. Prices are about 1·8c. to 1·9c. per lb. for best refined bars; but there is no uniformity, and orders can generally be placed at better rates. Manufacturers of steel rails are beginning to look forward for business to keep their mills busy after the middle of the year. All the Eastern and Southern roads have, so far, bought nearly as many rails as during the same period of last year; but the Western roads have hardly purchased over a quarter of last year's amounts. There are still many Western orders withheld, which must be placed before long. The next three months are likely to bring a heavier business than the corresponding period of last year. So far as can now be judged, the falling off in the demand for the year will amount to about 500,000 tons, which will about be equivalent to the falling off in track mileage from 13,000 to 8000, which is now probable. As the rail mills are now 850,000 tons behind last year, there has been a withholding of orders to the extent of about 350,000 tons, and most of these are likely to be placed in the next three months. There have been very light sales at old prices.

THE COAL MARKET.—An agreement has been come to among anthracite colliery owners to restrict the production to some extent. At present buyers take only small lots for present requirements, and there has been some accumulation of stocks.

THE METAL MARKET.—The copper market has been easier; but leading mining companies report that consumers are beginning to make inquiries, as stocks are getting low. Tin has been unsteady. Sales have amounted to about 100 tons. The decline in the iron trade is beginning to affect the tin plate trade. There has been little change in the price, but the tone is decidedly weaker. The lead market is still in the hands of speculators, and consumers are buying very little. Prices range from 4·65c. to 4·70c. per lb., with but little business done.

SHIPPING.—The question of free ships and bounties is again under discussion in Congress. A committee has reported adversely to the Lower House on the Bill for the payment of a bounty of 30 cents per 1000 miles per ton on vessels owned and built wholly in the United States and engaged in the foreign trade, and reported favourably on what is known as the Dunn Bill, which makes it lawful to buy vessels built wholly or in part in any foreign country, import them free of duty, and have them registered as United States vessels, and entitled to all the rights, and subject only to the same regulations as vessels built wholly in the United States. The same Bill allows materials to be imported in bond after January 1st, 1889, no duties being payable on the same if they are used in ship construction. The minority report will favour bounties and oppose free ships. It is not probable that any measure as sweeping as the free ship scheme can become law, as the bounty scheme is gaining more adherents each time the subject is agitated.

PHILADELPHIA, 5TH MAY, 1888.

THE IRON MARKET.—Pennsylvania irons have fallen a little, having been forced down by outside competition; but it is to be hoped that they have now reached their lowest limit. Prices are $20 to $20·50 per ton for No. 1 foundry, $18 to $19 for No. 2, and $16·50 to $17 for grey forge, with both supply and demand moderate.

ELECTRIC FEED WATER ALARM.—There has been for some time an electrical water level indicator in use in some of our mills, which is one of the most successful pieces of apparatus yet introduced for the purpose. A vertical vessel communicates by pipes above and below respectively with the steam and the water space of the boiler. In this vessel is a float attached to an arm which rises and falls with the water level in the boiler. To the spindle of the arm is fitted a pointer on the outside of the vessel, which moves over a graduated arc showing the level of water inside. To the same spindle is keyed a brass disc about 4in. in diameter, carrying on one side two pieces of wood set radially on opposite sides of the spindle. These pieces of wood can be set at any angle, and each serves to support a hermetically sealed glass tube having two platinum wires sealed in at one end, and containing a small quantity of mercury. According to the inclination of the tube, which depends on the water level in the boiler, the mercury is either at one end or the other, that is to say, establishing a circuit between the platinum wires or breaking it. Proper connections are made to an annunciator in the office, or wherever desired, and to a battery of about four Leclanche cells. When the water is at its normal level the mercury in both tubes is out of contact with the platinum wires, and no current passes; but if the water falls below a certain level, the mercury in one tube closes the circuit through the platinum wires in that tube, and causes the annunciator alarm to ring and a pointer on the annunciator to show "low water." In the same way, if the water gets above a certain level, the mercury in the other tube causes the annunciator alarm to ring and to show "high water."

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AN IMPERFECTION IN MILD STEEL PLATES CONSIDERED CHEMICALLY.*

At the spring meeting of this Institute a year ago it may be remembered that a great deal was said against the careless treatment which steel plates often undergo during their process of manufacture and manipulation. Most of the failures of soft steel were attributed to gross carelessness on the part of the workmen, arising from ignorance of the properties of steel. Latterly, it is pleasing to note that these failures are less frequently heard of, as no doubt the manipulators exercise more care, and now treat the plates in a more rational manner. There may be, however, other imperfections in mild steel plates apart from rough treatment, such, for instance, as are produced by the unequal distribution of the metalloids, carbon, sulphur, and phosphorus. The irregular distribution of these elements in steel ingots has recently had considerable attention paid to it, and a more interesting treatment of the subject than occurs in Mr. Adamson's presidential address to the Manchester meeting last autumn could scarcely be found. Reference will again be made presently to this exposition. The reader of this paper begs to lay before the Institute the results of some observations and experiments which serve in tracing the physical and chemical effect of the unequal distribution of the metalloids upon mild steel plates themselves. It will be agreed at every steel works where the surveyors from Lloyd's, Board of

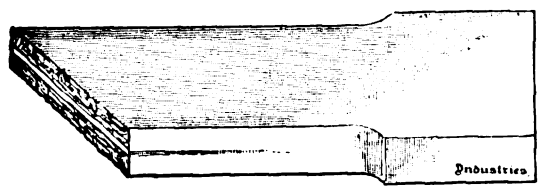


FIG. 1.

Trade, or the Admiralty have occasion to test samples of steel plates by the ordinary tensile stress, that they often meet with test pieces which after breaking present very defective fractures, and instead of the ordinary silky fracture throughout, there can sometimes be observed a white granular seam of varying thickness extending right across the sample; and it is possible to trace this seam on the outside of the polished test piece, especially after testing. (See Fig. 1.) A specimen like this behaves in a peculiar manner in the testing machine. It takes a comparatively greater amount of stress in a shorter time than ordinary sound steel, and the lever of the testing machine drops all at once, without any warning, after the maximum load has been applied; in other words, it behaves like steel short of ductility. The average mechanical tests of a large number of samples, compared with sound steel from the same cast, are as follow:—

	Good Sound Fracture (all Silky).	Faulty Fracture (with Granular Seams).
Tensile resistance per sq. in...	26·0 tons.	23·5 tons
Elongation, per cent. in 10in.	25·0 „	17·0 „

But even if the defective sample is fortunate enough to just reach the required tests, which is seldom the case, the custom of the surveyors is to reject the sample on account of bad fracture. If one of these faulty test pieces be immersed in dilute acid (preferably hydrochloric acid—1 acid to 50 water) for a few weeks, the acid being renewed from time to time, a very curious effect is produced. The interior granular seam just referred to is attacked more readily than the remainder of the metal, and if the action be sufficiently prolonged the specimen becomes almost severed in two. (See Fig. 2.) In this way twenty specimens were pickled, some having well defined seams, others with seams not so well marked, and others with good silky fracture; and the invariable result was that the interior was eaten away proportionately to the amount of the granular seam present. But even in the most silky fracture that could be obtained from a selection of thousands of samples, it was observed that the inside of the test piece was acted upon slightly more readily than the outside. The inference to be drawn from these simple experiments is, that a steel plate is chemically purer nearer the surfaces than in its interior; for we can compare the local action which causes the ready solution of the interior of the samples to the employment of impure zinc in a galvanic battery, in which case the zinc is very rapidly dissolved; the pure metal being, on the other hand, attacked only in proportion to the amount of galvanic action. With the view of ascertaining the difference of chemical composition, several test pieces were

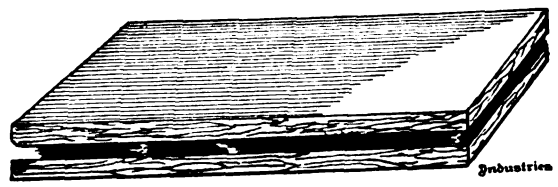


FIG. 2.

polished, in order to remove the outer skin, planings were taken from the outside and likewise from the inside or granular part, removed by a small cutting tool; the samples thus obtained were then subjected to a careful analysis, with the following results: Specimen 1.—Exhibiting well marked seam. Another portion of the same test piece, when pickled in acid, gave a well defined groove, as in Fig. 2.

	Inside (Granular Seam).		Outside (Silky Fracture).
Carbon	·160	.....	·115
Sulphur	·073	.....	·030
Silicon	trace	.....	trace
Phosphorus	·112	.....	·038
Manganese	·59	.....	·576

* Paper read by Mr. Herbert Eccles, F.C.S., before the Iron and Steel Institute, May 9th, 1888.

It will be noticed that the proportion of the impurities is widely different in the two parts of the plate, and corresponds with the solvent action of dilute acid. Specimen 2.—Sent for the purpose of experiment from a Sheffield steel works. Exhibiting broad irregular seams; pickled in acid, was attacked all over, but chiefly near the middle, as in Fig. 3.

	Inside (Granular Seam).		Outside (Silky Fracture).
Carbon	·155	.....	·105
Sulphur	·239	.....	·105
Silicon	trace	.....	trace
Phosphorus	·106	.....	·057
Manganese	·655	.....	·576

It will be noticed that the sulphur is very high in both parts, which may account for the irregular action of acid upon it. Specimen 3.—A test piece with a remarkably fine silky fracture throughout; the mechanical tests being very good:—

Tensile resistance	26 tons per square inch.
Elongation per cent. in 10in.	31 „ „

Pickled in acid, the inside was only slightly more readily affected than the outside, and the analyses show a less difference than in the previous instances:—

	Inside (Silky Fracture).		Outside (Silky Fracture).
Carbon	·135	.....	·115
Sulphur	·072	.....	·041
Silicon	trace	.....	trace
Phosphorus	·051	.....	·044
Manganese	·518	.....	·518

These are a few of the many analyses made, in all of which a seam across the sample corresponds to a layer of impure metal, *i.e.*, high in phosphorus, sulphur, and carbon; the manganese not being particularly affected. Silicon being almost absent, no conclusions could be deduced as to its behaviour. It now remains to be shown in what manner the impurities find their way to the centre of a steel plate, or, in other words, to account for the presence of the objectionable granular seam. Mr. Stubbs, of Manchester, first pointed

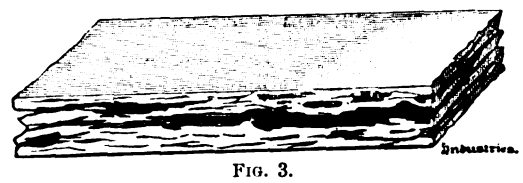


FIG. 3.

out the irregularity of the distribution of the elements in a steel ingot at a meeting of the Iron and Steel Institute held in 1881, and Mr. Snelus confirmed the observation by reading a paper describing a very exhaustive series of analyses of steel of moderate hard quality. Similar results are obtained in the case of soft steel, samples of which, taken from the inside and outside of an ingot, gave:—

	Centre of Ingot.		Outside.
Carbon	·14	.....	·11
Sulphur	·052	.....	·036
Silicon	·013	.....	·013
Phosphorus	·072	.....	·027
Manganese	·576	.....	·61

Quite recently a paper has been read by Colonel Maitland, before the Institution of Civil Engineers, in which he shows that the carbon varies very little close to the surfaces of an ingot, but that there is a funnel-shaped mass in the upper part where the carbon is doubled in quantity; between this accumulation and the bottom of the ingot there is a mass of metal in which the carbon is reduced considerably below the average. More recently still, Mr. Adamson, in his presidential address already

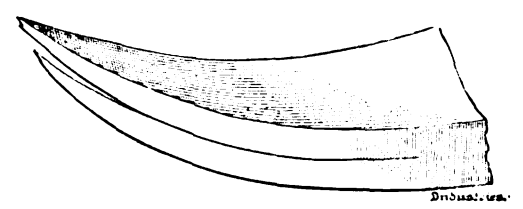


FIG. 4.

referred to, treats in a skilful manner of the conditions under which the separation of the metalloids takes place in a steel ingot, and has classified in an interesting table the difference in the fusibility, specific heat, and specific gravity of pure iron and the metalloids in question, showing clearly how the difference of these physical properties accounts for the variableness in composition observed in cast steel ingots. Probably most chemists would object to basing an explanation on the phenomenon of dissociation, *i.e.*, the severance of the bonds of union between steel and its metalloids taking place during cooling; for we have no reason to believe in any disunion of the alloys in steel in a chemical sense. Observation merely points to an accumulation of the alloys in a certain part of an ingot; and looked at in a mechanical light, the following explanation may suffice: The outside and bottom of an ingot, because they are in contact with cooling surfaces, solidify first, and in contracting cause the more fusible impurities to be squeezed towards the still fluid centre. At the same time, being specifically lighter, they have a tendency to ascend. We may consider steel to be pure iron, in which are dissolved carbide, sulphide, and phosphide of iron; and these compounds or alloys, as pointed out in Mr. Adamson's address, being much more fusible, and specifically lighter than iron itself, are thus to be found accumulated in the centre and top parts of an ingot. A similar phenomenon occurs, as shown by Dr. Ball, when a molten mixture of the metals copper, antimony, and lead is solidified. The copper and antimony form a definite alloy called regulus of Venus, which on solidifying ejects the greater part of the more fusible lead, driving it to the centre of the mass, so as to form a sharp line of demarcation, made particularly stiking by the difference in colour of the metals. We have another illustration furnished us by the investigations of geologists: It is generally accepted that when lavas pass from the fluid to the solid state, the component parts solidify in the order of their fusibility, especially when the lava has been subject to a dry fusion, and so unattended with complicated influences. Hence, in the interior of such rocks are to be found the most fusible minerals. Admitting that the middle of the ingot is the most impure, it seems only natural, after it has been hammered out and rolled, to find the impurities existing in a corresponding position in the plate; and if, from any reason, the determination of these impurities to the middle of the ingot should be abnormally increased, then we produce the objectionable seams observed in testing steel plates. Constant observation has shown that the larger the size of the ingots, and the more frequently are these seams found in the plates made from them. A shearing from the interior of a large steel plate, 1in. thick, on being sheared showed signs of lamination; in fact, all the pieces cut off had begun to split, and the

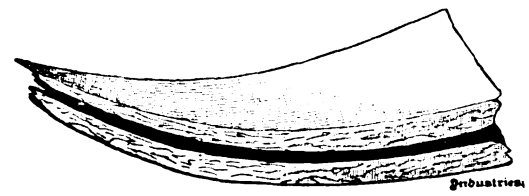


FIG. 5.

line of fracture could be traced along the entire edge of the shearing. (See Fig. 4.) The laminated surfaces, on being torn asunder, showed no signs of dirt whatever; on the contrary, they were perfectly bright. A piece of the shearing, about 4in. long, was pickled in dilute acid as before, when the interior became eaten away almost entirely, and the groove so formed was filled up with impure carbonaceous matter. (See Fig. 5.) Another portion of the shearing was analysed with the following results:—

	Inside, near Line of Fracture.		Outside.
Carbon	·24	.....	·15
Sulphur	·155	.....	·054
Silicon	·01	.....	·01
Phosphorus	·127	.....	·060
Manganese	·614	.....	·648

The explanation to account for the lamination seems obvious. The inside layer of the plate became so weakened by the accumulation of impurities that it was no longer able to withstand the work put upon it by shearing.

The conclusions sought to be drawn from this paper are, that a certain amount of care is required in selecting material for steel melting in order to minimise the above mentioned accumulation of impurities, and also to point out the necessity amongst chemists of a more careful method of taking samples. Samples taken from different parts of steel castings, blooms, rails, pigs, plates, and there is every reason to believe of pig iron also, may give provokingly varied results, and so bring discredit upon valuable analytical methods, whereas the fault lies solely in the samples themselves. It is submitted that a wider knowledge is still required in respect to the variableness in composition of iron and steel.

THE ITALIAN EXHIBITION.

THE Italian Exhibition at West Brompton was opened on Saturday last by the Lord Mayor, who attended in civic state. Judging from the number of visitors on the opening day, the Exhibition should prove a success commercially, notwithstanding the opposition which it will encounter from other similar attractions, in London and elsewhere, this year. The American Exhibition, which was held last year in the same grounds, was alone in the field, so far as London was concerned; but the fact that there are rivals on the present occasion has doubtless been advantageous in making it necessary for the management to do their utmost to make the Exhibition worth visiting. The American Exhibition was somewhat handicapped by a fear on the part of manufacturers and inventors in the United States that it had been got up for the sake of enabling their British rivals to steal ideas—a fear which was totally unfounded, but which had the result of curtailing the number of industrial exhibits. In the case of the Italian Exhibition, affairs have been different, as the Italian Government has looked upon it with favour, and given its assistance to the promoters. The King of Italy is among the list of patrons, while the Crown Prince is honorary president.

Those who are in the habit of attending exhibitions are not surprised at finding that at the date of opening the exhibits are not all ready. The only question considered as a rule is the degree of the state of incompleteness, and this year already, the Exhibitions at Brussels and Barcelona have been in a condition of chaos at the time fixed for opening. It is, therefore, not a matter of astonishment that the Italian Exhibition is not yet ready; but on the whole the progress has been satisfactory. The art sections are completely in order, and most of the exhibits in the main building, which constituted last year the only part of the American Exhibition proper, are in their places. The display here is mostly of art manufactures in their finished condition, such as elaborate wood carvings, furniture, Venetian glass, and majolica, and some excellent work in ornamental wrought iron by Signor Olivotti, of Venice.

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An interesting exhibit has been sent by the Italian Ministry of Marine, consisting of about thirty models of vessels in the Italian navy, showing the progress which has been made since 1861. In addition to the vessels of the older types there are models in longitudinal section of the "Duilio" and "Dandolo," of 11,600 tons displacement and 7500 h.p., and of the "Italia" and "Lepanto," of 14,000 tons displacement and 18,000 h.p.

The following is the classification of exhibits which has been adopted:—

Class I., Vegetable products; II., Farm and dairy produce and preserved food; III., Wines, liqueurs, and other beverages, oils; IV., Minerals and metallurgy; V., Mechanical engineering, machinery, electricity; VI., Colonial and chemical products, processes connected with applied chemistry, drugs; VII., Textile products and fabrics; VIII., Paper, printing, bookbinding, &c.; IX., Furniture, decoration, carriages; X., Artistic industries (including porcelain, glass, mosaics, ceramics, jewellery, &c.); XI., Manufactures not otherwise classified; XII., Products of the sea, naval architecture, fisheries; XIII., Education, Italian institutions; XIV., Music and musical instruments; XV., Fine arts, sculpture, oil paintings, water colour drawings, etchings and engravings, gouaches, works in black and white, architecture, carvings, archæology, photographs, and chromo-lithographs.

Some new buildings have been erected in the western part of the grounds, but the exhibits were not in readiness on the opening day; and as these sections comprise metallurgy, engineering, industrial manufactures, and all those subjects which will prove of most interest to our readers, we shall have to defer a detailed notice of the Exhibition until such time as they shall have been put into order.

We understand that the House-to-House Light Supply Company, Limited, London, have ordered for their first central station at West Brompton three horizontal compound steam engines, from Messrs. John Fowler & Co.; and three water tube steam boilers, with water heaters and feed pumps, from the Babcock & Wilcox Company.

We have just received from Messrs. Mather & Platt, engineers, Salford Iron Works, Manchester, two catalogues of electric light machinery, containing illustrations and particulars of their well known "Edison-Hopkinson" and "Manchester" dynamos. The illustrations are neatly executed and the information given is very complete, containing particulars of tests as to efficiency and durability, the description and output of the different sizes and types, and the prices of both dynamos.

North-East Coast Institution of Engineers and Shipbuilders.—The closing business meeting of the fourth session was held in the Lecture Hall of the Literary and Philosophical Society, Newcastle-on-Tyne, on Wednesday evening, the 9th inst., Mr. W. Theodore Doxford, president, in the chair. A discussion took place upon Mr. Alex. Taylor's paper on the "Construction of Pontoon and Floating Dry Docks," after which the following general business of the Institution was taken up: It was agreed to increase the subscriptions of the junior members, and if the funds would permit, to open central offices for the Institution in Newcastle-on-Tyne, and to found a reference library for the use of the members. It was also suggested that as the number of members who reside in the Hartlepools and Tees ports had considerably increased, the Institution should endeavour to hold some of its meetings in that vicinity. The President intimated that the committee appointed to formulate a rule for the horse power of marine engines had, after two years' work, presented its report to the Council, and that the report should be printed in the present volume of the Transactions, and copies of it should be also laid before the kindred institutions and societies of the kingdom. Arrangements were also being made for the Institution to pay a visit to the Forth Bridge works, which visit would likely take place during the last week in July next.. The President then announced the result of the ballot to fill up the vacancies in the Council for the ensuing year.

Liverpool Engineering Society.—The last meeting of the present session of this Society was held on the 9th inst., Mr. C. H. Darbishire, president, in the chair. A communication was read by the secretary from Mr. E. Gobert on the paper read at the previous meeting by Mr. Bamford, on air brakes. Mr. Gobert said the question now was which kind of brakes, vacuum or compressed air, was most advantageous. When they considered the question, both from a practical and theoretical point of view, its solution must decidedly be in favour of the air pressure brakes, the most perfect and efficient of this class being the Westinghouse automatic brake, both in its usual form and the latest addition it has recently received from the inventor himself. The automatic brake, in its present form, might be a very serviceable brake on short trains, as used in this country; but it was entirely unsuitable for long trains, such as it is the practice to run on the Continent and in America. It was not known yet whether the automatic vacuum brake is affected by intense cold, as the old vacuum brake used to be; but intense cold had no effect on the Westinghouse brake, as the writer had occasion to witness some two years ago, whilst he was in Transylvania, where the winter is generally more severe than it is in this country. It might, he said, be asserted with fairness that the Westinghouse brake had attained finality in the latest type produced by its inventor. An interesting discussion followed. The following officers were then elected for the ensuing year: President, Mr. C. H. Darbishire; vice-presidents, Messrs. J. J. Potts and H. H. West; honorary secretary, Mr. J. H. T. Turner; hon. treasurer, Mr. O. S. Pilkington; hon. librarian, Mr. J. A. Brodie. During the recess it is proposed that the members shall visit the Forth Bridge, the Vrynwy Water Works, the Preston Dock Works, and the Weaver Navigation Works.

Notices of Meetings.

NEXT WEEK.

Royal Institution of Great Britain.—Tuesday, 22nd May, 3 p.m. Lecture on "Conventions and Conventionality in Art," by Mr. S. Colvin.—Thursday, 24th May, 3 p.m. Lecture on "The Growth and Sculpture of the Alps," by Professor T. G. Bonney.

Society of Telegraph Engineers and Electricians.—Thursday, 24th May, 8 p.m. Extraordinary general meeting. Paper to be read on "His New Standard and Inspectional Electric Measuring Instruments," by Sir Wm. Thomson, LL.D., F.R.S.

Royal United Service Institution.—Friday, 25th May, 3 p.m. Paper to be read on "The Equipment and Transport of Modern Armies," by Colonel H. M. Hozier.

PRICES CURRENT, 17th May.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		30/10½	Cash
Scotch Warrants, m/n		37/10	"
Hematite Warrants, m/n		40/10½	"
Stocks in Stores. Scotch	981,101—Inc. for week,	3188	Tons
Middlesbro'	300,870—Dec. "	4181	"
Hematite	206,611—Dec. "	1475	"

Exclusive of stocks in makers' yards.

Market very dull and little doing.

Scotch shipments 8176 tons, against 8387 tons for same week last year.

	No. 1.	No. 3.	
Coltness	47/6	42/9	f.o.b. Glasgow.
Gartsherrie	44/3	41/3	" "
Dalmellington	39/6	37/9	" Ardrossan
Eglinton	38/-	36/9	" "
Glengarnock	43/-	39/-	" "
*Derbyshire	—	35/-	f.o.t. Works.
*Lincolnshire	—	32/-	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 15 0	5 5 0	f.o.t. wks
" Angles	4 12 6	5 2 6	"
" Plates	4 17 6	5 7 6	"
Staffordshire Bars	5 0 0	6 0 0	Manch'r.
" Angles	5 10 0	6 10 0	"
Crown Sheets	6 10 0	6 15 0	"
" Hoops	5 7 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		8 0 0	"
" Ship and Girder		7 15 0	"

METALS.

Spelter: Ordinary	£16	12	6	to	16	17	6
Copper: British Cakes and Ingots	81	0	0	"		——	
" Chili Bars	83	0	0	"		——	
" Manufactured (strong)	88	0	0	"	90	0	0
Lead: Common Pig	13	15	0	"	13	17	6
" English Sheet	14	12	6	"	14	15	0
Tin: Straits	85	0	0	"	86	0	0
" Australian	86	0	0	"	87	0	0
" English Ingots	97	0	0	"	98	0	0

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Since our last, quotations for Chili spot parcels have ruled from £81 to £83 per ton, and three months from £78. 10s. to £75. 10s., with a fair business at intermediate prices. The increasing difference between spot and three months copper attracts much attention, as it indicates a want of confidence in the ability of the French syndicate. It is probable, however, that there may be steady buying of these forward parcels, and that prices will be maintained for a time, as it is too early to look for a collapse in the great speculation. The copper trade meanwhile continues inactive, the demand being very small, and most of the manufacturers being very short of work.

Spelter continues to droop; warrants quoted £16. 10s. to £16. 15s. per ton.

Tin has been active during the past few days, and prices have somewhat recovered. Straits quoted £85 to £85. 2s. 6d. per ton for sharp cash; £85 to £85. 10s. three months. English is also in good demand at advancing prices, being extremely scarce for early delivery.

Lead is weaker. Spanish quoted £12. 10s. to £12. 15s. per ton. Demand sluggish.

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/-	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	0	0
" Ceylon	"	24	0	0
Cottonseed	"	21	0	0
Cod	"	19	0	0
Lard	"	40	10	0
Linseed	"	18	7	6
Palm, Lagos	"	21	0	0
Rapeseed: English	"	24	0	0
Seal: Pale	"	23	0	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	10	6
Coal	per gal.	0	0	6
Petroleum (Refined)	"	0	0	5⅝
" Spirit	"	0	0	8¼

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	9
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	3	—	0	0	3¼
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6	—	0	1	6¼
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—		.....	
" Muriate (Grey)	ton	23	0	0	—		.....	
" " (White)	"	26	0	0	—		.....	
" Sulphate	"	11	7	6	—	11	12	6
" Liquor	lb.	0	0	3¼	—		.....	
Bleaching Powder	ton	7	7	6	—	7	12	6
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	30	10	0	—	31	10	0
Benzole (90%)	gal.	0	3	0	—	0	3	6
" (50/90%)	"	0	2	4	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—		.....	
Lead: Nitrate	"	23	0	0	—		.....	
" White Sugar	"	26	10	0	—	27	0	0
" Brown "	"	22	5	0	—	23	0	0
Potash: Bichromate	lb.	0	0	4½	—		.....	
" Caustic	ton	22	0	0	—		.....	
" Carbonate	"	17	15	0	—		.....	
" Chlorate	lb.	0	0	5¾	—	0	0	5⅞
" Prussiate (Yellow)	"	0	0	6½	—	0	0	7
" Sulphate (Basis 90%)	ton	8	17	6	—	9	5	0
Precipitate: Red	lb.	0	3	1	—	0	3	2
" White	"	0	3	2	—	0	3	3
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	8	10	0	—	9	0	0
" Recovered	"	4	10	6	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—		.....	
" " (" 60%)	"	5	15	0	—		.....	
" " (Cream, 60%)	"	5	15	0	—		.....	
" Crystals	"	2	10	0	—		.....	
" Bicarbonate	"	5	10	0	—		.....	
" Hyposulphite	"	6	5	0	—		.....	
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	2	6	—	6	5	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

Gloucestershire Engineering Society.—On the 1st inst., the members of the newly formed Gloucestershire Engineering Society met in the theatre of the Science and Art Schools, Gloucester, to hear the first contribution to their Proceedings in the shape of a lecture by Dr. Ryan, of the Bristol University College, delivered by desire of the Council. In a discourse of over two hours duration, the lecturer dealt with some of the more interesting features of modern high speed engines and current marine engineering practice. He showed how electrical engineering had reacted on steam engineering, and given rise to the numerous very ingenious forms of high speed engines. Many of these were illustrated by lantern slide photographs, and particular commendation was given to the rotary engine of Mr. John Fielding, a model of which was on the table. Compassionate reference was made to the confiding people who, without presuming to hamper it by mechanical or other conditions, looked to electricity to fulfil every industrial need, and in some mysterious way to supplant every form of motor. The impulse which electric lighting had given to steam engineering, and the magnificent way in which inventors and manufacturers had responded to it, emphasised the vanity of the hope of those who expected a pan-electrical millennium. The lecturer went on to trace the rise and progress of the triple expansion engine, both for marine and land purposes. He commented on the unparalleled uniformity of opinion amongst marine engineers with regard to its merits. The battle between "simple" and "compound" engines was waged on nearly equal terms for over a decade, and now the triple expansion engine had unmistakably beaten the victor without straining a crank pin or starting a bolt. Curiously enough, all makers alleged an economy of just 25 per cent. for the new over the old type of engine. It was hardly ever more, and seldom less. The lecturer quoted the case of the "Wells City" steamship, formerly belonging to the firm of Chas. Hill & Sons, Bristol. Their consulting engineer, Mr. John Scott, had furnished him with particulars of the performances of the triple expansion engines of the "Wells City" and of the twin cylinder engines of a sister ship, the "Jersey City." The former had certainly realised an economy of 25½ per cent. in the coal bill over the latter. Dr. Ryan attributed 20 per cent. of this to the intrinsic merits of the higher pressure of the steam and the greater expansion, 4 per cent. to accidental advantage in the case of the boilers, and 1½ per cent. to contingent advantage in screw efficiency. Mr. J. J. Seekings, of Gloucester, occupied the chair, in the unavoidable absence of Mr. Jas. Platt, the president.

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HOME INDUSTRIES.

MANCHESTER, 17TH MAY, 1888.

THE IRON TRADE.—The condition of business in all branches of this trade continues to be very dull. The fall in the price of Scotch pig iron, and the increase of public stocks, tend to unsettle the market and to prevent free buying. However, there is probably more iron being used in this district than at any previous time; but it is bought in a number of small lots, instead of in large quantities as formerly. Scotch pig iron is now in store to the extent of 978,000 tons, as against 942,800 tons in the early part of January; Middlesbrough stocks also show an increase of 35,000 tons, while the hematite stored is about 3000 tons less. In twelve months the stock of Scotch pig has increased about 107,000 tons, and of hematite 29,000 tons, while Middlesbrough stocks have decreased 24,000 tons. The total stocks are now close on 1,500,000 tons. There is very little constructional work going on, and wrought iron does not show any improvement; as specifications are being worked off, prices tend to diminish. It appears probable that local bars will again touch the low rates of last year, which will leave no margin of profit. The great difficulty experienced in the bar iron trade is to obtain specifications for iron already sold under contract. Steel bars during the past few weeks have been extensively sold at prices ranging from £6. 12s. 6d. per ton delivered, less 2½ per cent., which is a very indifferent price. Boiler plates of steel are also in good request at prices which are tending downwards, there being already a fall of 7s. 6d. per ton. This business is now an extensive one, but all the orders are keenly competed for.

THE ENGINEERING TRADES.—There is little new to report of this business. Engineers continue to obtain a fair quantity of work, consisting mostly of repairs and replacements. The same remark applies to millwrights, but in both branches business is checked by the prospect of a strike in Oldham. Boiler makers continue to be busy, and bridge builders are also well employed. The improvement which has been recently reported in the locomotive business is hardly maintained, and the number of inquiries has considerably decreased. Tool makers are slowly improving their condition, and there is much more being done than there was a few months back; the orders coming forward are very general in character. Textile machinists are almost without exception actively employed, and in some cases will not give a promise of delivery for some months ahead. Several large foreign orders have been recently placed, and the prospects of this trade are favourable in the extreme. The prices which are being obtained are very closely cut, but it is quite certain that profits are being made; one of the few limited companies engaged in this business has recently paid a very good dividend, besides carrying over a large sum to reserve. Gas engineers are fairly employed, although, from the number of engines now in the market, the competition is becoming severe. Makers of electrical machinery are also well supplied with orders.

LONDON, 17TH MAY, 1888.

THE MONEY MARKET.—The rates for the loan of money began to fall almost as soon as the market felt the effect of the rise in the Bank rate. The action of the Directors of the Bank of England has reassured the outside lenders, who consequently make their rates more easy. Gold will at once begin to come back from the North, and there are shipments on their way which will help to strengthen the depleted reserve. There is no doubt that the delay in raising the Bank rate created a slight panic; for with every Continental centre accumulating gold, it was not very safe to leave the London market at the mercy of the whole world. The Stock Market is again dull, the approach of the Whitsuntide holiday helping to depress business. Home railway stocks, which had begun to move upwards, have come to a standstill again, which is simply due to absence of business in the market. This, in face of the favourable traffic returns, is rather disappointing, as the prospects of nearly all the lines are such as to justify a general rise. Great Western stocks, however, are in favour, as the receipts from the beginning of the year have been exceptionally good. American stocks are lifeless. The most popular form of industrial investment just now is in brewery companies, which are unquestionably profitable.

COMPANIES.—There is no diminution in the number of new companies which are floated, or which are attempted to be floated. The aggregate capital of the companies registered during March amounted to £17,804,400; against this we have in April 416 companies, with the enormous aggregate capital of £121,658,314. The following have been registered since our last report: Bell's Asbestos Company, Limited, with a capital of £200,000; the Engineering and Railway Contracts Syndicate, Limited, with a capital of £1,000,000; the Chandor Petroleum Gas Candle Company, Limited, with a capital of £100,000 (an illustrated description of the petroleum gas candle will be found in *Industries* Vol. III., page 458); the Buenos Ayres and Talcahuano Great Inter-Oceanic Railway Company, Limited, with a capital of £5,000,000; the Inter-Oceanic Railway of Mexico (Acapulco to Vera Cruz), Limited, with a capital of £2,500,000; the Anglo-Continental Aluminium Company, Limited, with a capital of £1,000,000; Leach, Neal, & Co., Limited, with a capital of £60,000, to carry on business as colour manufacturers at the Driffield Works, Derby; the Water Proof Materials Company, Limited, with a capital of £250,000; the Albion Engineering and Contract Company, Limited, with a capital of £50,000; the Miners' Safety Explosives Company, Limited, with a capital of £200,000; the Hercules Dynamite and Explosives Company, Limited, with a capital of £100,000; John Spencer & Sons, Limited, with a capital of £400,000, to carry on business as steel manufacturers, &c.; the Lawrence Light, Heat, and Power Company of London, Limited, with a capital of £250,000; the Cape Copper Company, Limited, with a capital of £600,000; the Crystal Creek Company, Limited, with a capital of £100,000, to acquire mines in Swaziland; the Gwndwn Hill Gold Mining Company, Limited (Wales), with a capital of £60,000; the Anglo-Continental Exploration Company, Limited, with a capital of £41,000; the Great Sheba Gold Mine, Limited (South Africa), with a capital of £120,000; Grinton Mining and Smelting Company, with a capital of £50,000; Mount Wilson Gold Gravels, Limited (United States), with a capital of £120,000; the Empress Mines, Limited (United States), with a capital of £300,000; the Gold Fields of Siam, Limited, with a capital of £250,000; the Storm Cloud Gold Mines, Limited (Arizona), with a capital of £100,000; the Carnarvonshire Freehold Copper Mining Company, Limited, with a capital of £25,000; the Quintera Mining Company, Limited (Mexico), with a capital of £40,000; and the South Green Harth and Nether Harth Lead Mines, Limited (Westmorland), with a capital of £30,000. The Government is unable to state when the Bill for the Amendment of the Law of Limited Liability will be introduced into the House of Lords, but it is in a forward state.

EXHIBITION OF LIFE SAVING APPARATUS.—At the Alexandra Palace, which has been re-opened in spite of the misfortunes which have attended previous efforts, there is a small exhibition of life saving apparatus, and it is announced that additional exhibits will be received until the end of June.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 6th May amounted to £1,240,321 on 15,852 miles, as compared with £1,212,018 in the corresponding period of 1887, when the mileage was 15,728¾ miles. An increase is thus shown in the mileage of 123¼ miles or 0·7 per cent., and in the receipts of £28,303 or 2·3 per cent.—The success of the Westinghouse brake is leading to its increased adoption both on the Continent and at home, and the London, Chatham, and Dover Railway Company have now introduced it upon their system.

THE NAVY.—The Admiralty has sold out of the service the following old and obsolete unarmoured vessels of war in the reserve at Chatham: The "Juno," 3316 tons, 1381 h.p., screw corvette; the "Sappho," 894 tons, 884 h.p., composite sloop; the "Modeste," 1934 tons, 2177 h.p., screw corvette; and two mortar vessels. An unprotected composite sloop, the "Nymphe," has lately been floated out of dock at Portsmouth. This is a sister vessel of the "Buzzard" and "Daphne," and is slightly larger than the gunboats of the "Bird" type, and rather smaller than the protected cruisers of the B class. She will have two sets of horizontal triple expansion engines each of 1000 i.h.p., which are being made by the Greenock Foundry Company. A composite screw gunboat, the "Partridge," has been launched at Devonport. She is 165ft. long by 30ft. broad, and her mean draught when ready for sea will be about 11ft. 4in.

TELEGRAPHS.—In the course of an examination before the Select Committee of the House of Commons on Revenue Department Estimates, Mr. Patey, the Permanent Secretary to the Telegraph Department of the General Post office, stated that the annual cost of the extension of telegraph lines throughout the country was about £100,000. The telegraph lines now occupied nearly all the main roads of the country, and in a few years any extension of the system would have to be effected by means of underground cables, not in substitution of the overhead lines, but in addition to them. He stated that the cost of the underground system was about ten times that of the overground, amounting to between £350 and £400 per mile.

GLASGOW, 17TH MAY, 1888.

THE SUBWAY AND CENTRAL RAILWAY BILLS.—This project has been again defeated, the Select Committee of the House of Lords having found the preamble of the Bill not proved. It is improbable that the scheme will be brought forward again, especially if the Central Railway Bill passes this session. Should the Central Bill not succeed in getting through, the Subway scheme may perhaps come forward under another form. The Central Railway Bill has been before the Lords' Committee for some days, and a large number of witnesses have been examined. It now stands adjourned until the 6th June. The North British Railway Company are among the opponents of the measure. This is very natural, since one of the objects of the Bill is to obtain access for the Caledonian Railway Company to Queen's Dock, in order to communicate with the very large shipping industry there. Hitherto the North British Railway alone has been in the position of serving the docks. Among the points brought out in the evidence, there was the fact that a large number of vessels, after loading general cargo in Queen's Dock, went for coal to the general terminus at the south side, which is largely employed by the Caledonian Railway. It was originally intended that the Central Railway should be promoted by a separate company, consisting of a few responsible individuals, very much in the same way as in the case of the Central District Railway promoted by Messrs. Baird, and then handed over to the North British Railway Company. But after the initial steps had been taken, the Caledonian Railway Company concluded to promote the Bill in their own name, arranged with the original promoters to become responsible for the costs, and then applied to Parliament for suspension of the standing orders, so that their name should appear as promoters of the Bill. This alteration was, however, refused. In addition to this initial trouble, there has been another hitch about the payment of the deposit required by the standing orders, some £61,000. It was announced on Monday that this deposit had been paid into bank in Glasgow, so that probably the technical difficulties of the measure are over, and it may now be discussed on its merits. The progress of the measure is watched with much interest in Glasgow, as, if it passes, the railway will affect many interests, and considerably increase the transit facilities both for passengers and goods.

THE EXHIBITION.—The Exhibition bids fair to become a phenomenal financial success. The demand for season tickets last week was so greatly in excess of anticipation that the supply was entirely exhausted. It is understood that nearly 40,000 season tickets have been sold. The number of entrants also to the Exhibition has exceeded the most sanguine expectations. Excluding the opening day and Saturday, upon which days respectively 47,835 and 57,703 were admitted, the attendance on ordinary days has averaged 32,000 a day.

PIG IRON.—The price of pig iron has again dropped. On Saturday last it reached 37s. 11½d., and on Monday morning touched even 37s. 10½d. The number of furnaces in blast is eighty-seven, as compared with eighty-one last year. Stocks in Connal's stores are still increasing, and shipments are languid; although steel is in request, and the local demand for some classes of iron steady, there is little inclination to buy forward, notwithstanding that the price is now probably below the average cost of production. The shipments last week were 7616 tons, against 8182 tons last week, and against 9156 tons for the corresponding week last year.

(From our own Correspondents.)

LIVERPOOL, 16TH MAY, 1888.

OPENING OF A NEW DOCK FOR LIVERPOOL.—The last of the series of three docks, forming the South Docks Extension Scheme, was opened last Thursday by the entry of one of Messrs. Brocklebank's large sailing vessels, without any ceremony or formality. The "New Toxteth Dock" has a water area of 11¼ acres and a quay space of 1100 square yards, and is therefore one of the largest of the present system. Extensive warehouses and sheds, fitted with all modern appliances for loading and discharging vessels, are in course of construction. The total length of quay space in the whole system of the Liverpool Docks has now been increased to about 22¾ miles.

FIRE EXTINGUISHER FOR STEAMERS' HOLDS.—An interesting and successful experiment was made last Monday with an apparatus designed by Messrs. Coates & Carver, of Manchester, for extinguishing fires in ships' holds, in the presence of a number of the Dock Board officials and the superintendent engineers of the various shipping firms. The principle of the invention is to force the products of combustion of the main or donkey boiler into the burning mass; the carbonic acid gas and carbonic oxide being very effective extinguishers. A large fire of coal and timber, soaked in creosote, was made in the interior of a large pontoon, the manholes being removed to create a current of air. In a very short time after the gases from the combustion chamber of a small donkey boiler had been applied, the fire was extinguished; and to remove the poisonous vapours within the pontoon, the same apparatus forced in sufficient fresh air to enable a boy to enter safely within a few minutes.

SHEFFIELD, 16TH MAY, 1888.

THE HEAVY TRADES.—The condition of local trade continues to be fairly satisfactory. The quotations of both pig iron and Bessemer steel are in favour of the buyer, as the prices are very low. Finished iron is selling 1s. 6d. to 2s. 6d. per ton cheaper. Bars are going at £4. 10s. and £4. 12s. 6d., although the best makes bring from £5 to £5. 10s. Bessemer billets are quoted at yielding prices, and the competition in the steel rail trade is now so keen that sections can be obtained at what seems a remarkably low figure. Nearly all the orders on hand for railway material are now for distant lines, and the output on foreign account is very extensive. Tyres, axles, and springs are in demand for both home and colonial use. The waggon builders are also well engaged, coal trucks and low sided goods vehicles being in better request. At the rolling mills, work has been plentiful during the past six months. There is a good deal of activity in the engineering shops, several extensive orders having recently been received for heavy machinery, both for home customers and for shipment. Sheffield makers are turning their attention particularly to the improvement of labour saving machinery, and are steadily developing their trade. There is also a great deal of experimenting going on with a view to improved steel manufacture. It is felt by some makers that there are still greater possibilities in the steel trade than have yet been grasped, and accordingly experienced workmen are taken into their counsels, as well as analysts; the result may be a still cheaper steel, that will

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supersede iron for more purposes than ever. It is satisfactory to note that there is a growing inquiry for heavy English goods abroad, and Japan, India, and the Argentine Republic are dealing extensively with Sheffield houses; but the United States are depending more and more on their own manufacturing resources.

COAL.—Manufacturing sorts are in excellent demand; but coal for household purposes only finds a quiet market, though it is selling 1s. per ton cheaper. The output for shipment has lately been decreasing, and at some of the South Yorkshire pits the miners have been working short weeks. It is believed that the negotiations between the Midland and the Hull and Barnsley Companies, as to the taking over of the line through the Wolds to Hull, are now at an end. But there is some talk about the probability of the coal owners finding a cheaper mode of transit to the coast by using the inland water ways.

LEEDS, 16TH MAY, 1888.

IRON AND STEEL.—The finished iron trade of Leeds has decidedly improved during the past fortnight, and orders are coming in plentifully. Some makers, too, are obtaining rather higher prices. Locomotive builders are busy. Messrs. Kitson have good orders on hand, and there is great activity at their shops. The demand for locomotive, tram, and stationary engines is improving; and in the engineering trade employment is easier to obtain. There is a more favourable call for agricultural machinery. For engineers' tools the market is satisfactory, and there is a renewed demand for cut nails.

TEXTILES.—There is scarcely a stagnant branch in textiles. Orders are numerous even at stiffening prices in all the branches of the textile trade, and goods for summer wear are urgently called for. Worsteds and serges are selling well for next winter's use, and manufacturers of attractive cloths, either for present or winter wear, are doing well. Trade is very bad, however, at some of the old mills that still employ the old style of machinery; and the makers who are doing the trade are those who have adopted the latest improvements in plant, and introduced new patterns.

THE STRIKE.—The comments about the "sweating" system have led to action on the part of the Jewish tailors. About seven thousand of them have struck at the busiest part of the season, and several of the large clothiers are consequently suffering.

NORTH STAFFORDSHIRE, 16TH MAY, 1888.

THE IRON TRADE.—There is no improvement to report in the various branches of the iron industry, either with regard to prices or demand; and the immediate outlook affords no prospect of improvement. Last year there was a decrease in the production of puddled bars in this district, to the extent of over 11,500 tons, as compared with 1886. At the present time, out of the 390 puddling furnaces in existence, there are 100 inoperative; of the remaining 290, the annual average production per furnace is about 540 tons. In the case of pig iron there was an increase of production in 1887 of nearly 43,000 tons, as compared with the preceding year, which was due to the blowing in of additional furnaces in the latter half of the year. At the present time out of 39 furnaces in existence there are 21 in blast, the annual average production per furnace being about 266 tons.

THE POTTERY TRADE.—There is a decidedly better feeling amongst manufacturers, and a general concurrence of opinion that there is some little improvement in demand. Up to the present time prices have not been affected, but the outlook is regarded from a more favourable point of view. America and the Colonies take the largest proportion of this district's productions, more particularly of cheap lines. The home demand also shows some tendency to expand. Manufacturing fuel is in fair request, prices ranging from 6s. 6d. to 8s. 6d. at the pit, according to quality.

SOUTH WALES, 16TH MAY, 1888.

NEW STATION.—The secretary of the Great Western Railway Company has intimated that plans are being prepared for the construction of a railway station at Roath.

THE CYFARTHFA FURNACES.—The third of the blast furnaces erected at Cyfarthfa, some years ago, and which has remained idle for want of sufficient engine power, has just been put into blast, and is working satisfactorily. Messrs. Davy Brothers, of Sheffield, have supplied the new blowing engine, which has a 44in. steam cylinder and 96in. blast cylinder, with 5ft. stroke.

TIN PLATES.—The recent fluctuations in the price of tin have been of such a character as to completely paralyse manufacturing operations, in so far at least as the booking of orders is concerned. Buyers and sellers remain quite apart; and as the meaning and real cause of the great fall in the price of the metal has yet to be generally understood, uncertainty as to the future is still the prevalent feeling. Makers cannot err, however, in covering their probable requirements for some time to come at the present price.

COLLIERY EXPLOSION.—A few minutes after midnight last Sunday, a terrible explosion occurred at the Aber Colliery, Ogmore Valley, by which five men lost their lives. Mr. Robson, the chief inspector of mines in the district, states that in all probability the explosion was caused by gas ignited by a naked light. As this is not a fire damp colliery, the sad event affords another example of the danger run by the neglect of precautions which long immunity from accident is apt to induce.

BARROW-IN-FURNESS, 16TH MAY, 1888.

WOOD PULP WORKS.—The arrangements which have been in progress for some time for the establishment of wood pulp works at Barrow have at length been completed, and immediately after Whitsuntide the prospectus of a new company will be issued. The chief promoters are Mr. Partington, of Manchester and Glossop, paper maker, who holds the patent right, and Mr. T. Briggs, of Manchester and Barrow, jute manufacturer. By the agreements entered into, Mr. Partington sells his patent right for £43,000, and takes shares to the value of £40,000 in the new company. Only about £50,000 out of a capital of £120,000 will be offered for general subscription, and Mr. Partington guarantees 6 per cent. for ten years on these shares. A suitable site for large works has been secured at the east end of the docks at Barrow. The timber used will be imported, and thus the docks and the railway will benefit by the traffic, while at the same time Barrow will secure another new and important industry.

IRON AND STEEL.—There is nothing new to note in the iron and steel trades except the fact that the demand occupies even less dimensions than of late. There is less inquiry for both pig iron and for steel. Pig iron remains exceptionally dull, and there are no indications of any improvement. On the contrary, it is evident that the large consumption on the part of steel makers is almost alone responsible for the great bulk of the trade now being done. Prices are unchanged at 42s. 6d. per ton net f.o.b. for mixed parcels of Nos. 1, 2, and 3 Bessemer, and 41s. 6d. for No. 3 forge and foundry iron. As stocks have accumulated to a large extent at the works and in the store yards, it is contemplated, in view of the lowering tendency of prices, to restrict the output of the district by blowing out a few furnaces. It is evident that stocks have been allowed to get too large; but that is not entirely the fault of this district, but of all other hematite producing neighbourhoods. Business has been done in hematite warrants at fully 1s. below the prices quoted by makers. In the steel trade there is still great activity, and in all departments makers are very fully employed. Rails still represent the chief feature of the output; but it is also observable that considerable progress is being made in the development of the Siemens-Martin department. Rails are quoted at last week's rates—£3. 17s. 6d. for heavy sections, and £4. 2s. 6d. for light sections net f.o.b. Ship plates are in good demand, and have been largely ordered forward. Prices are steady at £6. 15s., and at £6. 2s. for angles.

MIDDLESBROUGH, 16TH MAY, 1888.

PIG IRON.—There was a very small attendance on 'Change yesterday, and little or no business was done. Prices are much the same as last week, although there are buyers at 1½d. less. Still, the quotation for No. 3 G.M.B. is 31s. 3d. per ton for delivery over the next two months. Warrants are 30s. 11d. per ton cash for Connal's No. 3 G.M.B., and for Connal's hematite 42s. 6d. The stock in Connal's store is decreasing, and amounted on Monday night to 301,391 tons. Makers hold out for more than the quoted price, some insisting upon 31s. 6d., and others 32s.; but no sales are reported.

SHIPMENTS OF PIG IRON.—The shipments of pig iron from the port of Middlesbrough this month promise to exceed even those of last month, which were remarkably good. Up to the 14th, no less than 54,046 tons have been shipped, against 43,218 tons to the same date last month. It is considered, however, that this cannot continue much longer. Scotland is taking more than at the same time of last year, and Germany and Holland have nearly doubled last year's take. Other foreign countries have taken about a third more.

STEEL AND MANUFACTURED IRON.—These are much the same as last week except in manufactured iron, where from 2s. 6d. to 5s. reduction has been made to secure orders. The mills are working full time on old orders, but new ones are few and far between. There is no pressure now from the ship yards, which are quieter than they have been for some time past. At the Darlington Steel and Iron Works there is a lock out, caused at first by the manager objecting to the men joining the Steel Workers' Association, but in the end by a difference as to agreement in the rate of wages.

SUNDERLAND, 16TH MAY, 1888.

SHIPBUILDING.—Shipbuilders continue to be actively employed, and orders recently received exceed the number of vessels launched. It is anticipated that there will be an influx of orders as the time draws near for the enforcement of the increased scantlings for steel steamers which have been agreed upon by the Committee of Lloyd's Register.

SHIPPING TRADE.—The Black Sea and Baltic homeward freights are now of a remunerative character, and a great improvement has taken place in the Bilbao trade. Outward American rates are also firm, but homeward rates are still very low. During the last week, the trade of the port was fairly satisfactory—78,280 tons of coal were shipped, as against 76,173 tons in the previous week, an increase of 2107 tons; 35,022 tons were exported, and 43,258 tons sent coastwise. Other shipments comprised 853 tons of coke, 560 tons of patent fuel, 33 tons of cement, and a general cargo. Foreign imports included 160 tons of scrap iron, 1569 pieces of teak timber, 100 pieces of teak planks, 400 packages of hay, 750 tons of iron ore, moss litter, pit props, sleepers, poles, matches, and paper. Coastwise there were several cargoes received, including iron rails, scrap iron, wheat, chalk, timber, &c.

NEWCASTLE, 16TH MAY, 1888.

IRON.—The circumstance that pig iron shipments from Middlesbrough have been unusually heavy during the first half of the month, tends to strengthen the view that a better demand for the finished commodity is likely to arise ere long. The use of iron for the interior fittings of steamers in cases where the hulls are of steel is gradually extending; and though a structural change of this kind must ultimately have an adverse effect upon the steel trade, it will of course give a proportionate and much needed stimulus to the finished iron trade. The rolling mills at Winlaton, Gateshead, and Jarrow continue to work very steadily, and the output of product is quite double of what it was a year ago. Messrs. Raine & Co., of the first named place, are under a contract to supply a large quantity of heavy chain iron to a firm of Sunderland chain manufacturers during the present year. As announced in *Industries* a few weeks ago, the blast furnaces at Walker, which have stood idle for some years, are being rapidly prepared for re-starting, and will probably be in operation by the end of the present month.

STEEL.—The second of the Siemens-Martin furnaces erected by Messrs. Hawks, Crawshay, & Sons, at their Park Lane works, will be put in operation this week, and, as a consequence, the staff of hands employed will be largely increased. The orders in the hands of the firm for steel plates and angles are very numerous; and it is, therefore, quite certain that unless some brief stoppages for repairs should become necessary, the productive resources of the establishment will be fully utilised for some months to come. At Jarrow and Consett the steel works are exceedingly busy, and the output of plates, angles, &c., is unprecedentedly large. The demand for steel sheets is still satisfactory; but prices show a slightly weakening tendency, a change which is more particularly noticeable in galvanised sheets. Messrs. Cail & Davies, of the Redheugh Steel Works, have lately shipped some large parcels of steel sheets to a Continental destination.

CHAIN AND ANCHOR WORKS.—The demand for anchors, and more especially for those types which are designed to fit into the hawse pipes, is very active; and in some instances the manufacturers are unable to keep pace with customers' requirements. A wages dispute still causes Messrs. Abbot's chain department to be inoperative, a fact the more to be regretted as there is now a good demand for cable chain; and many orders which might have been obtained for these works are being sent elsewhere.

THE "BECK" GAS ENGINE.—Messrs. Black, Hawthorn, and Co., the manufacturers of the "Beck" gas engine, have put down special plant for the production of that specialty, and have now a large number of orders in course of execution. A 16 h.p. engine has lately been supplied to Messrs. Palmer & Co., Jarrow, to drive the machinery in their pattern making department, and one of similar type was delivered to the Wearmouth Coal Company to drive the machines in their fitting shop. The latter has been at work some time, and is found to be a most effective and economical motor.

BELFAST, 16TH MAY, 1888.

RAILWAYS.—The work on the new loop line in Dublin, from Westland Row to George's Quay, is now making rapid progress, all the houses and other property having been cleared away. The contract for the masonry work in connection with the line has been given to Mr. Meade, of Great Brunswick-street, who is bound to have his work finished by November 1st. A meeting was held on the 26th ult., in Cushendall, county Antrim, to promote a tramway scheme between Retreat Station, on the Ballymena and Redbay Railway, and the town of Cushendall, along the new road to Ballymena, now being constructed; the tramway would be about five miles in length, over a hilly country, and the total cost, including plant, would be about £20,000.

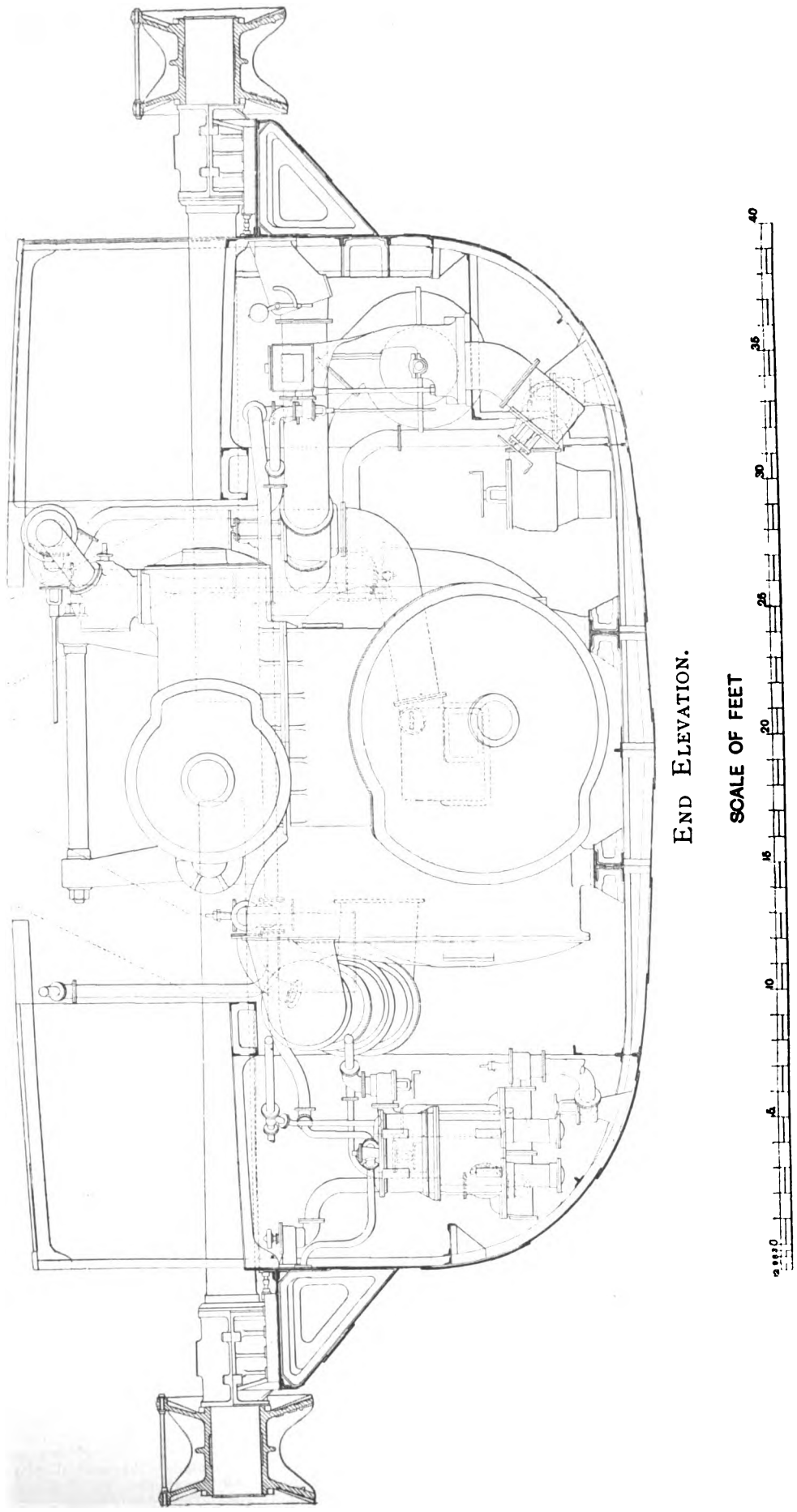
WOOLLEN TRADE.—A large amount of business has been done during the past fortnight in summer goods, and the trade is increasing, as manufacturers are striking out new lines and introducing new patterns of goods. Messrs. Ross, of Bloomfield, Belfast, who have only lately taken up this industry, are at present erecting new wool spinning machinery, and are about to increase the number of their power looms, to keep pace with their rapidly increasing trade. The Irish Woollen Manufacturing and Export Company held its meeting in Dublin, when a dividend of 7 per cent., free of income tax, was declared on the paid up capital. The chairman in his speech pointed out that their goods were to be found now in all the principal towns of the United States and Canada, and also that Berlin and other Continental centres were gradually adopting their goods and writing for samples. They had also made arrangements to send displays to the Irish Exhibition at Olympia and to the Melbourne Exhibition.

LINEN TRADE.—The trade in yarns still continues rather dull, without any sign of speculation, and prices remain steady. Tows also continue quiet, with prices unchanged. Cloths are in good demand, and prices are fully maintained. Brown goods sell freely, and manufacturers are asking slightly higher prices. Finished linens remain unaltered at late prices. Manufacturers of collars, cuffs, &c., are very fully stocked with orders, and in some cases are taxed beyond their powers of production.

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COMPOUND PADDLE ENGINES OF THE S.S. "QUEEN VICTORIA."

CONSTRUCTED BY THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GLASGOW.



END ELEVATION.

SCALE OF FEET

PADDLE ENGINES OF THE MANX LINE STEAMER "QUEEN VICTORIA."

As promised in our last week's issue, we give herewith an end view of the engines of this vessel, and on our two-page supplement this week we give a general plan of the engines and boilers. As will be seen, the engines are of compound diagonal direct acting type. The high pressure cylinder, which is nearly horizontal, is 61in. in diameter, and the low pressure cylinder, which is placed diagonally beneath the high pressure, is 112in. in diameter. The stroke of each is 6½ft. Both cylinders are fitted with slide valves, which are worked by the usual double eccentrics and link motion, and reversed by one of Messrs. Brown Brothers' steam and hydraulic reversing engines. The water for condensing the steam is circulated through the surface condenser by a centrifugal pump driven by a separate engine. The paddle wheels have feathering floats, and, together with the paddle shafts, paddle arms, feathering rods, and all other parts of the machinery, wherever practicable, are made of steel. The boilers are four in number, and are double ended, each 15ft. in diameter, and 19ft. 6in. long. There are six of Fox's patent corrugated furnaces in each boiler. The working pressure is 110lb. per square inch. Forced draught on Laing's closed ash pit system is employed, the fans and engines being of special design. The main feed pumps are separate from the main engines, and are worked by independent engines on the Worthington principle. The main engines indicate upwards of 7000 h.p. It will be remembered that during last season the sister ships made many very rapid runs. On her trial trip the "Prince of Wales" averaged on a six hours' run the extremely high speed for a paddle steamer of twenty-six miles per hour.

COAL, IRON, AND COGNATE INDUSTRIES.

THE Board of Trade returns for the month of April must, on the whole, be considered satisfactory, and are a distinct improvement on those which we had before us to examine last month. The total value of the imports during April was £32,098,693, being an increase of about 3 per cent. over those for the corresponding month in 1887. The total declared value of the exports was £17,735,474, as against £16,411,662 in April last year, being an increase of about 7·4 per cent. The total quantity of iron and steel exported during the month was 327,215 tons, valued at £2,104,163, being an increase of 5937 tons and £186,910 as compared with April, 1887. The exports of iron and steel rails amounted to 47,600 tons, being an increase of 2731 tons as compared with the same month of last year, an improved demand from the Argentine Republic, Japan, and Egypt having more than counterbalanced a falling off in the shipments to Italy and Australasia. We append our usual tabular statement with reference to the trades under review :—

	Month of April.		Four months.	
	1888.	1887.	1888.	1887.
	£	£	£	£
Pig and puddled ...	211,538	257,981	605,155	807,712
Bar, angle, &c.	131,791	88,305	547,176	413,335
Railroad.....	356,054	282,341	1,552,728	1,065,157
Cast and wrought.	371,571	302,284	1,556,524	1,342,065
Hoops, sheets, &c...	326,056	297,206	1,288,988	989,675
Steel, unwrought...	91,875	177,599	429,876	729,420
Tin plates	466,302	384,853	1,779,124	1,432,456
Unwrought copper.	154,261	95,626	749,177	329,190
Coals	787,592	781,263	3,065,095	2,997,210

In each item of the above table the returns must be regarded with satisfaction, excepting those two which relate to the crude metals—iron and steel—in which there is a startling diminution. We have frequently called attention to the necessity for British iron and steel makers to develop markets other than the American Union for the consumption of their products. Having regard to the fact that in 1887 the make of pig iron in the United States was little more than 250,000 tons less than that of the United Kingdom, and the production of Bessemer steel ingots was greater by nearly 900,000 tons, it is apparent that not only will that country be capable of meeting all its home requirements, but that there will some day be a surplus manufacture to compete with us.

With regard to the home market since our last review of these industries, a retrogressive tendency has been in operation. From all sides we hear complaints of prices, which have now reached a lower level than obtained last year, and which are in many instances below cost of production. To low prices is now added a slacker demand, and the outlook for the immediate future is gloomy indeed. Scotch warrants are under 38s., which is, probably, the lowest price on record, and in spite of a considerable reduction in stocks, amounting to above 27,000 tons since the beginning of the year. In the Cleveland district prices in that centre remain low in sympathy with Scotch pig iron. In the Midlands, Northamptonshire, and Lincolnshire, pigs are now quoted 5s. per ton below the ruling rates at the January quarterly meetings; and in all cases the various branches of finished iron participate in the fall, which is still going on.

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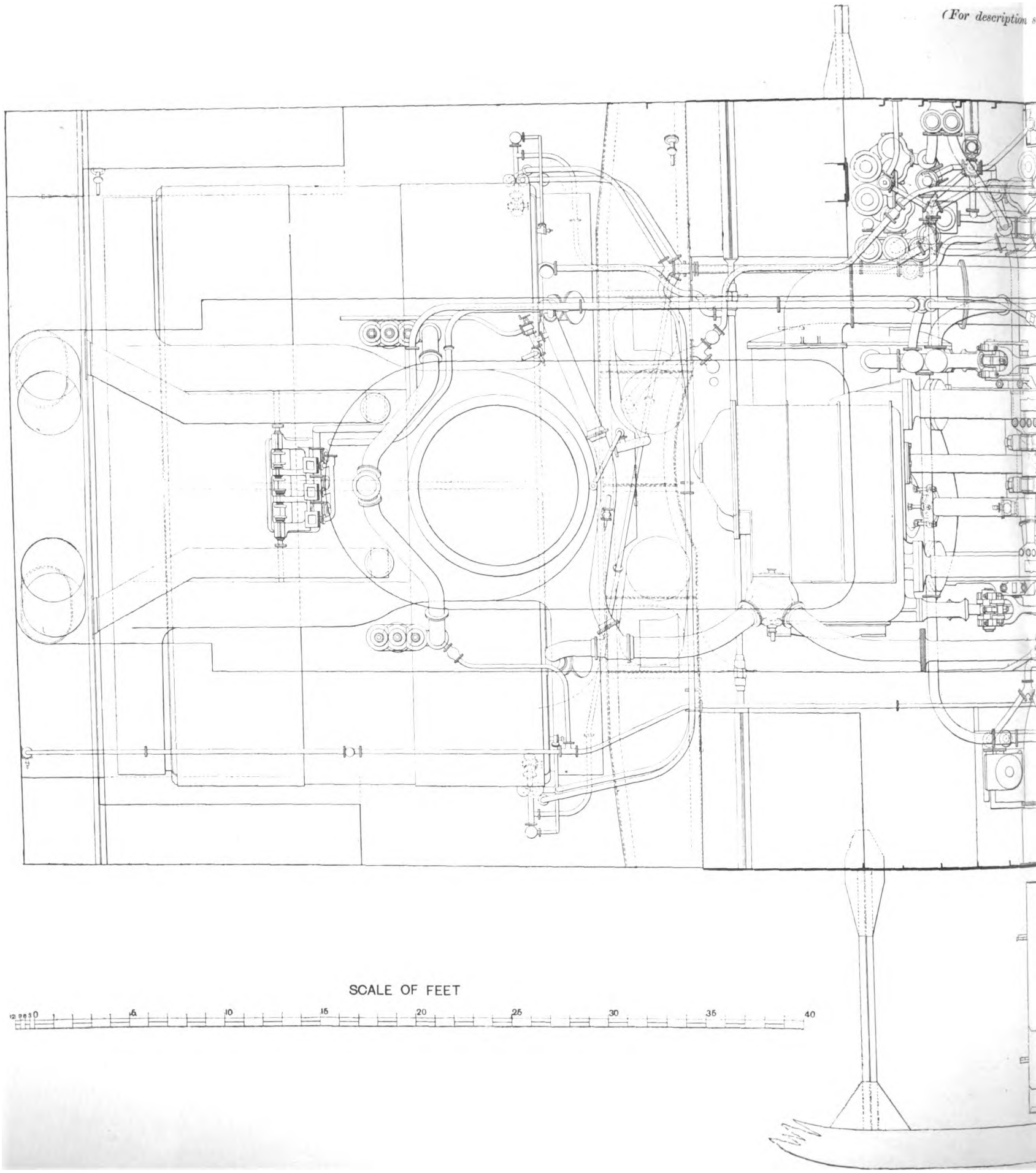
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COMPOUND PADDLE ENGINES AND BOI

CONSTRUCTED FOR THE ISLE OF MAN SERVICE BY THE FAIRFIELD

DIAMETER OF CYLINDERS: HIGH PRESSURE, 61IN.;

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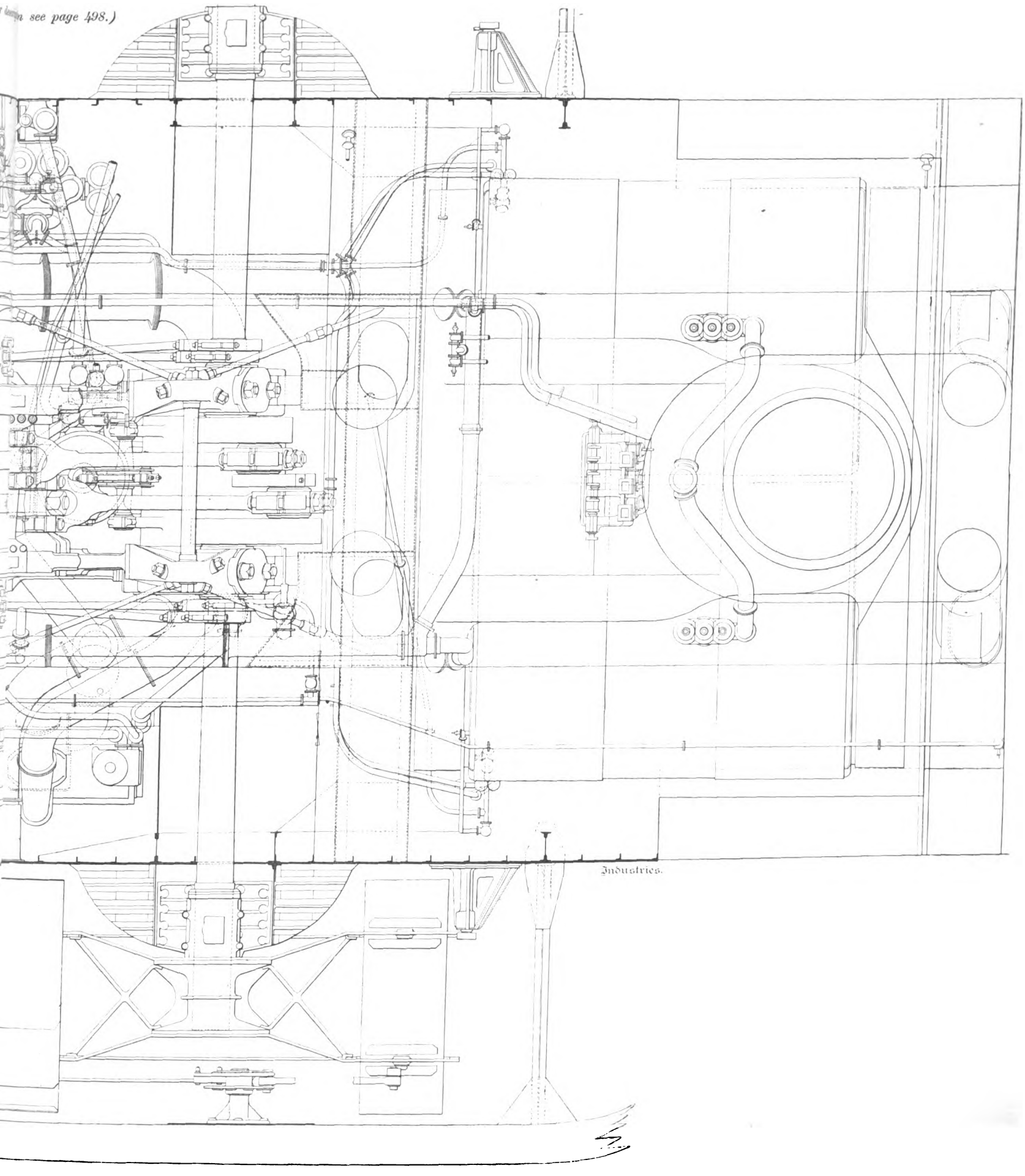
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ELD SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GLASGOW.

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(... see page 498.)



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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 18TH MAY, 1888.

OUR INLAND WATER-WAYS.

THERE never was a time, perhaps, when the cost of transport attained so high a degree of importance as at the present. The keen competition under which trade has now to be carried on has rendered it necessary to keep down all costs, those of distribution as well as those of production, to the lowest possible point; and this necessity has grown more urgent as our difficulties have increased, in consequence of the depression which for a long time past has weighed upon all our staple industries. Manufacturers have come to regard our railway systems, with their high tariffs and wide reaching monopolies, as a serious obstruction to trade, and have in consequence sought to obtain some amelioration of the conditions imposed by those powerful organisations, the railway companies. Hitherto their efforts have been attended with little or no success; and outside the circle of traders interested, their difficulties have attracted no serious attention. But the migration of manufacturing works to the sea coast, which is taking place in consequence of the failure of their owners to obtain relief from the railway companies, has alarmed the whole industrial community, and the question of inland carriage may be truly said to have become a national one. Manifestly our position as an industrial and commercial people is closely bound up with it. Either we must find means of cheaper transport, or the inland country will soon be denuded of all its great manufacturing works. Unfortunately, when this movement has once set in, it does not always end at the sea coast. Emigration has happened in several instances, and we have witnessed the transfer of British capital and British energy to foreign lands. No wonder, then, that the question of inland navigation has come prominently to the front. In this seems to lie our only means of salvation. Such at least is a common opinion, and this view of the matter was strongly represented last week at the Conference held in London under the auspices of the Society of Arts. To one who has not given much thought to the subject, it may appear strange that our water ways should have been so utterly neglected, if they are indeed capable of affording us the means of cheaper carriage than the railways. But the practice of our rivals on the Continent leaves us no room for doubt in this matter. They have put the question to the test of experience, and the result has proved satisfactory in every particular. The Commission of inquiry appointed in 1878 by the French Chamber of Deputies reported that "coal cannot be carried on railways, even for long distances, at a less cost than from 0·54d. to 0·62d. per ton per mile, while on the canal the cost of transport does not exceed 0·22d. per ton." On this point there was but one opinion among the members of the Conference; and as they were all men of extensive practical knowledge, it may be accepted that canal transport as effected in the present day compares very favourably in cost with that of the railway.

Our Continental neighbours and rivals in trade have been more quick to perceive and more ready to avail themselves of the advantages afforded by water carriage than we. They have gradually developed their system of canals, pushing out their extensions under more favourable conditions than those in which the earlier water ways were established. That is to say, the newly constructed or newly projected canals are designed to float large barges or other vessels; they are uniform in the gauge and system of locks; the latter are reduced in number by the adoption, in some places, of hydraulic lifts; and the haulage is effected by steam power. The Germans are especially active in developing their system of inland water ways, and in the most recent projects we see the highest fulfilment of economical conditions yet attained. This progress in canal engineering tends to reduce the cost of transport still further. Hence it is evident that if foreign competition has cost us much in the past, it will become ruinous in the future if we continue on present lines. It was freely admitted at the Conference that we had lost heavily of late in our foreign trade, and the cause was declared to lie chiefly in the cheap water carriage existing abroad. Abundant evidence was adduced in support of this assertion. Some typical examples may be quoted. The iron masters of Liège and Seraing in Belgium get their imported ores brought from Antwerp by water, a distance of over one hundred miles, for 2s. a ton, and their manufactured iron and steel conveyed to Antwerp, for export, at the same low cost. The rate paid on English iron from South Staffordshire to London by railway is 14s. a ton. The corresponding rate under the Belgian canal tariff would be 3s. a ton. Iron is delivered in London from works in the middle of Belgium at a cost of only 5s. a ton of carriage, including canal dues, post dues, sea freight, and insurance. Quite recently, in the case of a large contract for steel rails, the difference as between Sheffield and Belgium was 2s. 11d. per ton. Had the former possessed adequate water communication with the Humber, Sheffield would have gained the contract; but as it was, the extra 2s. 11d. took the whole business to Belgium. Pottery is imported into England from Germany, Belgium, France, and Sweden at a cost of about 7s. a ton for freight, thanks to the inland water carriage. The railway rate to London from the Staffordshire Potteries is 30s. a ton. Maastricht can send ware to Burmah for 10s. a crate less than we can. Plaster and cement is largely imported from Paris and other parts of the Continent, because the land carriage renders it unprofitable to work and manufacture these materials in the Midland Counties. Examples of this sort might be multiplied without number. It is satisfactory to learn that while the members of the Conference were agreed as to the cause of this loss of trade, there was the same unanimity in declaring the remedy to be in the adoption of water carriage.

Geographical conditions and the maritime character of our commerce require, not a network of inland canals, similar to our railway system, but a few main water ways, by which our principal centres of industry would be easily accessible to sea-going vessels. The Manchester Ship Canal will constitute the first of these, and if the success anticipated be achieved, there will be but little difficulty in promoting other undertakings of a similar character. Birmingham certainly will not be long without its ship canal. Ways like these, particularly the latter, will need each its system of feeders. These secondary canals must be designed to fulfil the conditions of cheap transport; that is, they must not be the mere ditches which now exist under the name of canals, but they must be of large and uniform section; regular and uniform, too, in their system of locks, and

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these should be reduced to the smallest practicable number by the adoption of hydraulic lifts. The canals of the future must exhibit in their engineering features the same progress which marks the railway. On this head there was no difference of opinion at the Conference. The same unanimity prevailed relatively to the urgency of the need. Divergence arose only when the means of accomplishing the work were proposed. According to some, State aid is indispensable; and, judging from the resolution passed by a large majority, this view was entertained by the greater number of those present in the Hall of the Society of Arts on Friday last. The resolution, as finally agreed to after long discussion, runs thus: "That the Legislature should seriously consider the necessity of encouraging and assisting the improvement and extension of the canal system by State acquisition or otherwise; and that, meanwhile, this Conference urges the House of Commons to amend the Railway Traffic Bill by authorising local authorities to constitute public trusts for the development of the existing system of canals." This is the outcome of the Conference. It remains to be seen to what practical result it will lead. But the representatives of our great national industries are in no mood to brook delay; and whether or not the aid of the State be granted, they will push on their scheme to completion. This, at least, was to be gathered from the tone of the Conference. Private enterprise can effect much, and, as Mr. Daniel Adamson remarked in the course of the discussion, money will be forthcoming to any amount if the undertaking can be shown to be profitable. Possibly it would be to the advantage of British industry that a work of this character should be left to private enterprise.

THE PRINCIPLE OF ANTAGONISM.

If one cared to run to extreme such ideas as those of Buckle on the influence of climate upon character and opinion, or of Jevons on the influence of sun spots upon commerce, one might indulge in speculation as to the periodicity of certain scientific generalisations. Scientific thinkers, especially those who live apart from the conflict of opinion in the great world, and who work out special problems in isolated state, not infrequently astonish themselves and everybody else by discovering something that has been a commonplace for ages. They are deceived into believing that they have found something new, merely because they have arrived at it by a route which was not open to their scientific ancestors; and the public too readily assume that a new name covers a new principle. Thus there are scientific generalisations which appear with almost undeviating regularity at least twice in every century. That they are re-discovered and re-stated so often, affords a certain presumption of the tentativeness of all such generalisations, and shows the advisability of examining the more carefully the interpretation they give of natural phenomena, the more consonant with common experience these generalisations may at first sight appear to be. Among generalisations whose periodicity it would be interesting to investigate, is that currently known as the "struggle for existence." It would be tedious to recite the list of appearances of this scientific comet. From Heraclitus at Ephesus to Sir William Grove at the Royal Institution is a long stride in point of time, and during its progress the idea of the "struggle for existence" has come and come again in apparently spasmodic, but probably really in regular, periods. Now the influence of Plato, and now that of Hegel, blotted it out of sight, and now the persistence of Malthus and of Darwin thrusts it again into view. Of late it has been noisily pointed out, not so much by the younger groups of scientific thinkers as by men of the older school, who, largely unconsciously, turning their minds upon the ideas of their youth, find among them this generalisation which affects them in their age with the force of a new inspiration. For, however speciously disguised in its new dress, the "principle of antagonism" of Sir William Grove in 1888 is simply the "struggle for existence" of Malthus in 1798 and of Darwin in 1859. While one may admit the advance in science made by the generalisation in its first, and even in its second form, it is open to question whether the mere repetition of it without qualification or addition is to be regarded as of the nature of growth. Sir William Grove prefaces his statement of the "principle of antagonism" by references to ancient metaphysics and mythology, and follows very much the same line as did Professor Huxley in a recent paper. When men of science turn to metaphysics, we may well suppose that they have at least for the moment abandoned serious thinking, and have made up their minds to have some relaxation. Such an Easter holiday amusement is Sir W. Grove's "principle of antagonism." Even if this were the place to discuss the metaphysical problem of the "identity of contradictories," which it is not, we might very well appeal to the precedent of Plato's treatment of Heraclitus and his school, and decline to regard as "serious philosophers" the latter-day Heracliteans who, seizing upon a single and very manifest truism, have made it do duty as a general explanation of the phenomena of nature. Yet such conceptions of the expression "struggle for existence," when applied to industrial life by biologists like Professor Huxley and physicists like Sir William Grove, demand examination and criticism from a practical as distinguished from a metaphysical point of view. In our issue of the 24th February, we offered some criticism of the conclusions of Professor Huxley in his recent article in the *Nineteenth Century*, and now the address by Sir William Grove, at the Royal Institution, seems to demand examination from the same standpoint. It is worth our while then to ask whether Sir William Grove's application of "the principle of antagonism" to the phenomena of commerce affords an adequate explanation of those phenomena. "The principle of antagonism," as stated by Sir William Grove, is that which dominates the play of forces. In his view the universe is pervaded by forces striving against each other; if this strife were to cease, the whole scheme of things would collapse. Antagonism is thus an indispensable condition of existence. This antagonism, pervading as it does the whole universe, "is associated with unorganised matter, with organised matter, and with sentient beings." From this general statement of the principle, Sir William comes down to particulars; he finds individual atom fighting individual atom, white corpuscles fighting *bacteria*, and communities of men fighting communities of men. More, he points out how the combative elements in daily life, games, commercial competition, the war of advertising and the like, are due to this principle of antagonism. All this is very interesting, though it has been said before; but it will be observed that there are involved in these statements two principles of antagonism and not one. There is the larger principle of antagonism, which may be regarded as the playing against each other of the great physical and social forces. In this sense the principle as applied to commerce would include both competition and its opposite monopoly, and as applied to physics would comprise the play of, for example, centrifugal and centripetal forces. In the smaller sense the principle would regard the strife of individual atoms engaged in the competitive strife which in the field of commerce is one side of the larger antagonism, and similarly with physical forces. It is obvious that while the principle is universal and valid in the large sense, it is neither universal nor valid in the small sense. There is always antagonism between the great forces in the universe, but there is not always strife between each individual atom and its neighbour.

That the distinction here drawn between the principle of antagonism in the larger and valid sense, and the principle in the smaller and invalid sense, is an extremely important one, will appear if we note the confusion which exists in the minds of scientific speculators who ignore the distinction. Professor Huxley for example is found defining the history of civilisation as the record of the attempts which the human race has made to escape from a state of strife. In the small sense this is hardly true, in the large sense it is not true at all. It cannot be true if the principle of antagonism is, as Sir William Grove says it is, a necessity of existence. It is futile to attempt to escape from the necessities of existence; and one cannot say that civilisation has been altogether futile.

The confusion between the principle in its larger sense and the principle in its smaller sense really vitiates the bulk of Sir William Grove's conclusions. An illustration will make this comparatively clear. He undertakes to show, as reported, that there are *evils* in the excessive exercise of antagonism. These very expressions suggest a looseness in method. A universal law of nature can hardly be spoken of as being in excess. Antagonism exists, let us say, between two forces, one a centrifugal force, and the other a centripetal force. Should the centrifugal force prevail, and always prevail, should this be regarded as excessive exercise of antagonism? Might it not as justly be called a deficiency of antagonism, and, more accurately, might it not be regarded as showing simply the preponderance of one force over another, the question of excess or otherwise of antagonism not entering into the question in the least? This is not a mere verbal quibble, for the view presented by Sir William Grove was in effect the rough and ready one, that antagonism is carried to excess when the force we want to win does not win.

The fundamental error both of Professor Huxley and of Sir William Grove appears to lie in their regarding the principle of antagonism as an adequate explanation of phenomena much too complex for exposition by so easy and ancient a generalisation. There are other principles at work besides the "principle of antagonism." Howsoever one may admit its pervasiveness even, one may well decline to admit the existence of unremitted strife. There is such a phenomenon as a couple, and Sir William Grove himself has shown in earlier days how there is correlation and continuity of forces. "The principle of antagonism," as a general principle even, is of purely negative value. Assuming an absolute antagonism, or perfect balance of forces, motion, and therefore life, would be impossible. As a theory of dynamics, then, the principle of antagonism is useless. As applied to the phenomena of society, and of industry and commerce, the "principle" does not seem to shed a single streak of fresh light. In social, as in physical phenomena, at one time centrifugal, and at another time centripetal, forces prevail. At one time the tendency is for society to break up into its elements, and at another to concentrate its energies, and as it were mobilise its members. At one time the direction of social progress is towards competition, at another towards its opposite monopoly. At one time it makes for the growth of individual effort, at another time for the growth of its opposite social effort; in all there is a play of forces, a "struggle for existence" of social forces, even an "antagonism" of social forces. But this broad view of antagonism is not that expressed by Sir William Grove, for he speaks of a possible excess of antagonism which shows that what he means is a strife of individual atoms, a strife which sometimes exists and sometimes does not exist, and which is modified and directed by other principles, as for example the love of offspring and the need of combining on occasion for common objects. In this narrow view the principle of antagonism is inadequate to account for the growth of such incidents of modern industrial life as joint stock enterprise, the growth of trade syndicates, of co-operation, of trade unions, or of any of the other numerous instances of the tendency at present abundantly manifest towards the development of associative effort; that is to say, a tendency towards a centripetal as opposed to a centrifugal movement in society. It is quite possible that the next generation may witness a counter movement in the other direction; but however, in the larger sense, social movements are governed by the "principle of antagonism," the evidence is against the conclusion that they are always governed by the principle in the smaller sense.

Letters to the Editor.

THE ELECTRIC LIGHT IN THE SUEZ CANAL.

To the Editor of "Industries."

Sir,—I observed, in the last issue of your valuable paper, a statement made on the authority of Consul Burrell, of Port Said, which is not absolutely correct. This is to the effect that the fastest passage of an ordinary steamer with the electric light was 15 hours and 5 minutes. On January 10th, 1887, I went through the Canal with the Peninsular and Oriental steamer "Rohilla," from Suez to Port Said; passing the Canal Office at Suez at 8-45 a.m.; lighting up the projector at 6 p.m., when the ship was at El Ferdane, and arriving at the moorings at Port Said at 10-55 p.m., exactly 14 hours and 10 minutes; and up till the time I left the Suez Canal (in May, 1887), and also from reports in various papers respecting quick passages, this ship certainly made the fastest on record, with the exception of the "Namouna," quoted by you.

I may mention a few other quick passages of the same company's ships by the electric light: June 18th, 1886, s.s. "Ravenna," 16½ hours' passage, 4 hours' light; November 15th, 1886, s.s. "Ganges," 16½ hours' passage, 10½ hours' light; Nov. 18th, 1886, s.s. "Assam," 16½ hours' passage, 11 hours' light; December 14th, 1886, s.s. "Verona," 15 hours' passage, 4 hours' light; January 27th, 1887, s.s. "Nizam," 15 hours' passage, 7½ hours' light.

The above examples are taken from a copy of my official log, where every detail of the passage by night was duly noted with regard to time, power of light, current used, &c.

Yours, &c.,

Frederick Walker.

4, Little Moorfields, E.C., 14th May, 1888.

THE REPORT OF THE RESEARCH COMMITTEE ON FRICTION.

To the Editor of "Industries."

Sir,—I agree with the remark of Mr. D. Adamson made at the meeting of the Institution of Mechanical Engineers, and reported in your last issue, that the third report of the Research Committee on Friction contained no practical advice. I notice the report publishes certain results as having been obtained on the friction apparatus with the use of "a mineral lubricating oil." As the mineral oils of commerce vary considerably, it would have been useful to know where the oil came from, whether it was pure, whether it had an admixture—as many mineral oils have—and what was its specific gravity, flashing point, &c. This information could easily have been given, and would show to some extent the basis on which the results were obtained. The speeds at which the apparatus was run were very low, viz., from fifty to one hundred and thirty revolutions per minute; and as the experiments are to be continued, it would be interesting if the committee could see their way to increase these speeds up to

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4000 or 5000 revolutions per minute. I am aware that it is generally held that friction is independent of speed, and given perfect lubrication at both high and low speeds this may be so; but given the same pressure in both cases there is little doubt that much more heat is generated and has to be got rid of at high than at low speeds. In spindles where high speed is combined with considerable pressure, such as in wood planing machines, this is particularly noticeable. Some time since I experienced great difficulty in getting two vertical spindles—making some 7500 revolutions per minute—to run cool, and the heat engendered caused them to fire several times. I tried various kinds of oil and methods of lubrication without satisfactory results. The spindles were of mild steel, two inches in diameter, running in gun metal bearings, which were about two diameters in length. Both spindles and bearings soon became torn and abraded, and I replaced them by hard steel spindles and phosphor bronze bearings, increasing the length of the latter to three and a half diameters. Several of these machines have since been constructed, and no further trouble has arisen. This, I think, says something in favour of extended bearings and hard, close grained metal, both for high speed spindles and bearings.

The same oil is often made to do duty for all kinds of work, whereas its specific gravity, rate of application, &c., should be in ratio to the nature of the work to be performed, bearing in mind the pressure on and speed of the parts to which it is applied.

Yours, &c.,

London, 14th May, 1888. M.Inst.M.E.

THE BOILER EXPLOSIONS ACT, 1882.

To the Editor of "Industries."

Sir,—Possibly the Commissioners holding the first formal investigation under the above Act are not so much to blame as your correspondent "Economiser" would seem to imply, when he writes of their not having seen fit to fix the costs upon the culpable persons. The sentence in their report, "No application was made as to costs," is thrown in promiscuously under the heading "Cause of Explosion," as though they were determined to say something on this point, and would gladly have made somebody pay something if only they had been asked to do so. But if this be the real meaning of the Commissioners' remark, it shows very clearly the wilful negligence of the Board of Trade in carrying out an Act which was specially framed to give that department most exceptional powers. It is all very well for Mr. Thomas Gray to assert that this is purely an "Inquiry Act;" but when it was passed the promoters were especially proud of section 7, whereby it was anticipated that the pockets of those who allowed boilers to explode might be touched, even if they themselves could not be proceeded against by criminal prosecutions. This power of making somebody pay the cost of inquiries was undoubtedly one of the chief features of the Act. If Mr. Gray really knew that as the Act reads payment of costs and expenses could not be enforced, why has he never attempted to have the necessary verbal amendment made? If, on the other hand, he only thinks that "payment cannot with certainty be enforced," why has he not tried to obtain a decision on the point by applying for costs in the first formal investigation that has been held? It is much to be feared that "Economiser" supplies the true explanation, when he alludes to an "anxiety to injure boiler inspection as at present carried out, and to elicit evidence to its disparagement . . . . so as to produce a feeling that compulsory inspection is essential, and that it can only be carried out under the care of the Board of Trade." But even assuming that the Board has been actuated by such a desire, might they not fall back on the information that has been supplied to them as their justification. In the recently published Memoranda Mr. Gray calls attention "to certain facts and figures which have been furnished to the Board of Trade by Mr. Lavington Fletcher, chief engineer to the Manchester Steam Users' Association." Now, Mr. Fletcher's feeling against the joint stock insurance companies—who, by his account, only care to make big dividends and neglect inspection, but who, nevertheless, are much more trusted by owners for inspecting their boilers than is the Steam Users' Association—is a matter of notoriety, and that Mr. Gray has been thoroughly imbued with Mr. Fletcher's views on the subject is abundantly clear from his annual reports on the working of the Boiler Explosions Act.

In his earlier reports, one of the chief impressions produced upon Mr. Gray's mind by a consideration of the cases that had been investigated was, that inspection by insurance companies did not prevent explosions—the very thing that Mr. Fletcher had so persistently urged for years. After a time, however, Mr. Gray discovered that even inspection by the Steam Users' Association did not prevent explosions, and the annual allusion to the fallibility of insurance companies was dropped. Later on Mr. Gray—having perhaps gained further insight into the doings of the companies—is constrained to remark (*vide* the report for the year ending June, 1887) that the examinations made under the direction of the companies have in the main been conducted upon a satisfactory system.

Is it, then, too much to surmise that the knowledge of the workings of the insurance companies gained by the Board of Trade, during the six years that the Boiler Explosions Act has been in operation, may have had something to do with the withdrawal of the proposed Boiler Registry and Inspection Bill, and with the hint thrown out in Mr. Gray's Memoranda as to the desirability of inquiring into the way the companies conduct their business? If the Board of Trade is honestly desirous of reducing the number of boiler explosions as far as possible, let it take steps for ascertaining: (1) The number of boilers in use in the United Kingdom, and (2) the number of such boilers under systematic inspection, either by various companies or otherwise. When these have been got, it will be easy to find the annual rate of explosions among inspected and uninspected boilers, and it can then be decided whether it is necessary to legislate for some system of compulsory inspection. When considering the subject, it will be well to bear in mind the second conclusion arrived at by the Select Committee in 1871, which was to the effect that *a great number of explosions arise from causes independent of and apart from anything that could be prevented by periodical inspection.*

Yours, &c.,

Manchester, 16th May, 1888. Flues.

GLASGOW INTERNATIONAL EXHIBITION.

Mechanical Section—General Description.—The mechanical section in the Glasgow Exhibition compares very favourably with such sections in former exhibitions. In certain departments which one might have expected to see well represented, there is an unfortunate deficiency. Notably wanting altogether is the department of locomotive engineering, in which the Paris Exhibition of 1878 was so strong, and in which even the Edinburgh Exhibition of 1886 possessed one of its most attractive features. Deficient also, though not entirely destitute of representation, is the department of marine engineering. Only one full sized marine engine is shown, and that, though an extremely instructive exhibit, is not a large one. There are several models, one of them a working model, and a great number of photographs; but more might have been expected from the city where the most notable improvements upon the marine engine have been effected, and where so many thousands of horse power are annually turned out. The machinery exhibits may, for purposes of convenience, be divided into departments, and to each of these we purpose devoting special attention. Each article following the present one will be written by a specialist in the department referred to, and instead of offering our readers merely descriptive detail, we shall endeavour to treat each department in a manner as fairly critical as possible.

The machinery section, as we have stated, will demand our special attention; but before entering into particulars of some of the chief exhibits, we propose in the meantime to take our readers with us in a general survey of the section. As will be seen from the plan of the Exhibition and grounds which we gave in our issue of the 27th ult., the machinery court is situated at the west of the main building, to which it forms an annexe. It has a floor space of about 160,000 sq. ft., and is divided into nine bays running north and south, the central one of which is wider and higher than the others, and is traversed by a 20-ton overhead crane, made by George Russell & Co., of Motherwell. It has a span of 41ft. 5¾in., and travels on longitudinal girders the whole length of the building, and is driven by a vertical engine at one end by means of an endless rope about 700ft. long, and Russell's patent arrangement of driving pulleys, which all revolve in the same direction, and avoid reverse bends in the rope. This crane has done efficient service in placing the heavy exhibits. Messrs. Russell have also an 8-ton portable steam crane on an ordinary railway gauge, which was used in the goods yard for unloading the general heavy exhibits as they arrived, and will be again in operation after the close of the Exhibition in loading them for removal.

The boilers for supplying the steam for the engines are nine in number, 28ft. long by 7ft. 6in. in diameter, and work at an average pressure of 100lb. per square inch. They are all of the Lancashire type, and are good specimens of substantial work, but present no novel features of construction. They were made and supplied on loan by Messrs. D. Adamson & Co., Manchester; Messrs. A. and W. Smith & Co., Messrs. Wm. Wilson & Co., Messrs. Penman & Co., Glasgow; and Messrs. Sinclair & Co., Leith. Of those by Messrs. Wm. Wilson & Co., one is fitted with Tenby's patent flues, Redgate's patent triplex fire bars, and Schallehu's patent smoke consumer, and the other with Proctor's mechanical stoker and self acting fire bars. The steam pipes have a total length of about 2200ft., and range in diameter from 15in. downwards, and are chiefly run in underground culverts, branches being taken off where the steam pressure is required. The engines for driving the machinery are four in number, and have been supplied by Messrs. Mirrlees, Watson, and Co., Messrs. Alley & Maclellan, both of Glasgow, and Messrs. John Cochrane & Co., Barrhead, and which we shall notice in detail on a future occasion. We have already (see *Industries*, Vol. IV., page 396) given a description of the electric lighting plant and a few particulars of the engines which supply the power, and will give further details later on.

If visitors enter the Exhibition by one of the main entrances under the dome, and proceed along the main avenue till they come to the west side of the machinery court, they will find a flight of steps leading to a gallery, from which a good survey of this section of the Exhibition can be obtained. It passes through the boiler house, along the front of the boilers, into the dynamo shed, and along three sides of the machinery court. Starting then from the boiler house, we look down upon the whole of the boiler arrangements, while from the side gallery we can see at a glance the whole of the electric lighting plant, of which a plan is given at page 396 in the present volume. Entering the gallery on the west side of the court, at its lower end we see a magnificent collection of steel castings and forgings by the Steel Company of Scotland, David Colville & Sons, Hadfield's Steel Foundry Company, Sheffield; Charles Cammell & Co., Sheffield; John Brown & Co., Sheffield; William Beardmore & Co., Parkhead, Glasgow, as well as by other firms; while cast iron work is represented by Walter Macfarlane & Co., of the Saracen Foundry, Glasgow, and George Smith & Co., of the Sun Foundry, Glasgow. On the right of these collections is a working bakery by Robert Thomson & Son, Crossmyloof, Glasgow, in which the manufacture of biscuits by machinery is practically shown. Alongside the gallery is a collection of machines for making confections of all kinds, which receive a considerable amount of attention from the younger visitors. The Pulsometer Engineering Company, London, show a large number of pulsometer steam pumps of various sizes—from No. 1, throwing 900 gallons per hour, to No. 10, throwing 52,000 gallons per hour—as well as a considerable number of other kinds of pumps. Thomas McCulloch & Sons, Kilmarnock, show a high pressure horizontal steam engine, fitted with Pröell's patent variable automatic expansion gear. Napier Brothers show various forms of their well known windlass, and various other ingenious appliances; while Messrs. Brown Brothers & Co., Edinburgh, have their various hydraulic appliances. Different sizes of Rigby's patent double acting steam hammers are exhibited by Messrs. Glen & Ross, who also show a novelty in the way of rotary engines, in a specimen of Ross & McDowell's patent high speed "Rota" engines, of which we hope to give an illustrated description later on. Passing along the north side of the gallery, we see the main exhibits in the centre of the court. The most striking are those by Messrs. Mirrlees, Watson, and Co., Scotland-street, Glasgow. The principal feature of the exhibit is a new form of sugar mill recently designed and patented by the firm. Among the other exhibits of Messrs. Mirrlees, Watson, & Co., are one of their diagonal engines and a steam pump. Messrs. A. & P. Steven, Provanside, have a selection of their hydraulic appliances, all of which exhibit good design and workmanship. Messrs. Alley & Maclellan show several Westinghouse engines, and specimens of their steering and hoisting gear, and of their steam and water valves, which maintain the reputation of the firm for careful work. There are a very large number of specialties, too numerous to mention at present; but the following collections may be indicated as worthy of attention, viz., those by Archibald Baird and Son, J. & G. Weir, Clark, Chapman, Parsons, & Co., Fielding & Platt, Greenwood & Batley, Lancaster and Tonge, and Dempster, Moore, & Co.

Messrs. Ross & Duncan show a set of small triple expansion engines, with Bremmé's valve gear for reversing and varying expansion, and they are the only full sized complete marine engines in the Exhibition. There are several large trophies made up of iron and copper tubes, which illustrate the progress made in these departments during recent years. Then there are very good representations of machine and hand tools by Sharp, Stewart, and Co., Dron & Lawson, A. Mathieson & Son, and others which are well worthy of careful study. Leather manufacture and the industries connected with it are well represented, the most notable examples among the former being those by John Tullis & Son, and Caldwell, Hamilton, and Sons, and the latter by R. & J. Dick and W. & J. Martin. Facing the north end of the court there is a large patent Axminster Brussels power loom for the production of special heavy back carpets, and along the court there are a large number of looms and appliances connected with the textile industries. Passing along the gallery on the east end of the court we see one of the most complete collections of printing machinery ever shown in an exhibition, and all of which is in operation. Along and under the galleries we have traversed there are a very large number of smaller exhibits, which are well worthy of special study.

We have now made a rapid survey of the machinery court proper; but in order to give a little more accommodation, an addition has been made on the other side of the main avenue, which is chiefly devoted to exhibits connected with heating, lighting by gas, and cooking. There is, however, a very good exhibit of gas engines by Messrs. Crossley Brothers, who show fourteen specimens of the "Otto" type. There are also specimens of the "Stockport" and "Sturgeon" engines in the same room, while in other parts of the building are to be found the "Griffin," the "Acme," and other kinds, which we intend to notice more at length shortly. In the meantime we have simply taken a rapid survey of some of the more important features of this part of the Exhibition, and we can say that its leisurely study will be amply repaid.

Telephony.—The subscribers to the Madrid Telephone exchange now number 2500, which is remarkably many, considering that the charge is high, and that it is not a business city. Applications, however, continue to come in, and the company has found it necessary to increase its capital to £64,000. The Spanish Government offers the concession of the telephone system of Carthagena. The latter town is a large business place, and contains a government arsenal.

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SOME RECENT OFFICIAL REPORTS ON BOILER EXPLOSIONS.

Report No. 255 refers to the explosion of a small vertical boiler, 2ft. 7½in. diam., on board the trawl boat "Pilot," 58 tons register, about midnight on the 5th January, at the east end of the Silver Pits, in the North Sea. The boat was owned and sailed by James Tight, Cliff Cottage, Gorleston. The fire box is stated to have been 2ft. 2½in. diam.—height not given—and was connected to the top of the boiler by an uptake 8in. diam. It was provided with the usual mountings, all in good working order; the safety valve being 2in. diam., and loaded to 80lb. per square inch. The plate forming the uptake was corroded through from internal corrosion a little above the water line, and according to the report a small opening, 1in. in length and about ⅛in. wide, was formed, and "through this small aperture" the steam escaped. The skipper stated that "he heard a hissing noise, and found that steam was escaping up the funnel; he had heard a similar noise, though not so loud, on the previous day, but did not notice the escape of steam. He continued to fire the boiler until the engine was no longer able to work the capstan."

Report No. 256, which deals with the bursting of some tubes in the main boiler of the "Gipsy Queen" steamship, of West Hartlepool, calls for no special description, as it simply relates to the giving way from ordinary wear and tear, at different times, of eighteen tubes of an ordinary cylindrical multitubular boiler, causing no unusual inconvenience beyond leakage on one occasion sufficient to lower the water beyond the range of the indication of the gauge glass. It may be doubted whether official inquiries were necessary in the above cases. It does not appear to us requisite to make an inquiry into every case of nominal explosion that may be reported to the Board of Trade under the Boiler Explosions Act, and these would appear to be cases where the Board of Trade might well have used its discretionary power in relation to the holding of such inquiries.

Report No. 257 is interesting for two reasons, first, because it refers to an explosion which only occurred on the 3rd of February last, showing an improvement in the rate of reporting upon these accidents; and, secondly, because it affords some insight with reference to the varied formulæ used by the Board of Trade for the calculation of the strength of vertical boiler fire boxes. The boiler in question was the property of Mr. J. C. Roberts, timber merchant, Dolgelly. It was of the ordinary vertical type, 9ft. 5in. high, 4ft. 6in. diam., with the top dished 2¾in. The fire box was 6ft. 5in. high, 3ft. 11in. diam., with the crown dished and connected to an uptake 11in. diam. All the plates as new were ⅜in. thick, single riveted and lap jointed. Three cross tubes 10in. diam., with flanged ends, were fixed across the upper part of the fire box. The mountings consisted of one open safety valve 2½in. diam., loaded by a lever and movable weight to 107lb. per square inch; one glass water gauge, two test cocks, one steam gauge graduated to 80lb., one steam stop valve, and also a feed valve, blow-off cock, and steam whistle. The boiler was made by Messrs. Barrows and Stewart, Banbury, in 1874 or 1875, and had only once been repaired, by fitting a new crown to the fire box. The fire box was found collapsed on the right hand side nearly the entire height, and a rupture had occurred through the solid plate near the cross seam at half height, forming an opening 18in. in length and 3ft. in width. The boiler was thrown into the air, and fell about thirty yards away, without doing injury to any person. The report states that the explosion happened "because the fire box had been gradually deteriorated by corrosion until it became no longer fit to support the ordinary working load. The plate at the fractured edge is only ¼in. thick, which, taken in conjunction with the diameter and the length of the fire box, is altogether inadequate for a pressure equal to that on the safety valve, viz., 107lb. per square inch. If the thickness of the fire box be taken at ¼in., the collapsing pressure by Sir Wm. Fairbairn's formula is 175lb. per square inch, which is 2·18 times the maximum working pressure according to the evidence, and 1·63 times the pressure per square inch, to which the safety valve was loaded." To the report is appended the following remarks by the Engineer Surveyor in Chief: "This is another explosion brought about by working a boiler at a pressure for which it was unfit. There are still engineers who profess to credit vertical furnaces, such as the one which has collapsed in this instance, with possessing a much greater power to resist collapse than they frequently prove themselves to possess. There appears to have been no efficient inspection made of this boiler, and its explosion, under the circumstances named in the report, is nothing but what might have been expected."

It is somewhat singular, however—particularly in connection with these latter remarks—that no reference is made by the Engineer Inspector or by the Engineer Surveyor in Chief to the collapsing pressure of the fire box by the Board of Trade formula, as used for a similar type of boiler in Report 145. It appears that, taking the thickness of the plates at ⅜in.—the thickness when the boiler was new—the collapsing pressure by that formula would only be 107lb.; and, assuming the plates to be only ¼in. thick—as taken by the Board of Trade Inspector—only 48lb. per square inch! In view of the boiler having safely worked for thirteen or fourteen years with the safety valve loaded to 107lb. per square inch, some explanation should, we think, be given of this bewildering discrepancy between actual practice and the results obtained by this formula.

THE LATE SIR CHARLES BRIGHT.

At the meeting of the Society of Telegraph Engineers and Electricians on the 10th inst., the President, Mr. Graves, referred in sympathetic terms to the death of Sir Charles Bright. He pointed out that while Mr. Crampton, whose death was announced at the previous meeting, had designed the first submarine cable, Sir Charles Bright had designed the first Atlantic cable. This cable had, it was true, but a short life, owing to faults of construction and other circumstances; but it showed what could be done, and the experience gained was of the greatest value to all who subsequently laid submarine cables. Sir Charles had also invented the bell telegraph and other apparatus, and he had greatly assisted in the development of submarine telegraphy. The President concluded by moving that the Society should express its sympathy with Lady Bright and the other members of his family, and the resolution was carried unanimously.

SHIPBUILDING NOTES.

The s.s. "Athenian," belonging to Messrs. Leyland, Liverpool, has recently been fitted with new machinery, so as to enable much higher pressure to be used than formerly. The cylinders have been reduced from 34in. and 68in. diam. to 22½in. and 60in. diam. respectively; but the boiler pressure has been increased to 150lb. per square inch. A trial trip was made last week, when, with a piston speed of 402ft. per minute, or 67 revolutions, 980 i.h.p. was developed. The vessel obtained an average speed of 11 knots per hour.

On the 4th inst., the new steel steamer "Engineer" had a successful trial trip. The vessel was loaded with full cargo, and attained an average speed of 11½ knots per hour. The "Engineer" was built by Mr. James Laing, Deptford Ship Yard, Sunderland, to the order of Messrs. Tatham, Bromage, & Co., London, and is specially designed for carrying machinery, having exceptionally large hatches, and appliances for lifting great weights. The dimensions are: Length between perpendiculars, 200ft.; breadth moulded, 28ft.; depth moulded, 15ft. The engines and boilers are by Mr. George Clark, Southwick Engine Works, Sunderland. The cylinders are 18in., 38in., and 53in. diam., with 24in. length of stroke.

Messrs. C. S. Swan & Hunter launched from their shipbuilding yard at Wallsend-on-Tyne, on the 7th inst., the screw steamer "Gellwara," which has been built to the order of the Anglo-Scandinavian Steamship Company. The vessel is of the following dimensions: Length between perpendiculars, 330ft.; breadth moulded, 45ft.; depth moulded, 24ft. 3in.; and is built of Siemens-Martin steel on the spar deck principle, with cellular double bottom, with extra strength beyond the requirements of Lloyd's Register for the 100 A class. The vessel has a cargo capacity of 4000 tons, and will be able to carry 3300 tons on the exceptionally light draught of 17ft., and attain a speed of 11½ knots per hour. The "Gellwara" is provided with twin screws, and has two sets of triple expansion engines, 18in., 28½in., 46in. diam. of cylinders, 33in. length of stroke, indicating 2000 h.p. The boilers and engines have been constructed by the Wallsend Slipway and Engineering Company, Limited, Wallsend-on-Tyne. The deck machinery consists of four double horizontal steam winches, and two special 20-ton derricks to facilitate loading and discharging, steam steering gear, and direct steam windlass. In addition to the usual oil lamps, the vessel will have a complete electric light installation, including large deck lamps, to expedite loading and discharging at night time, as well as a powerful arc search light.

CONVERSAZIONE AT THE ROYAL SOCIETY.

The first Royal Society conversazione of the season was held at Burlington House on the 9th inst., and was largely attended. Amongst the more remarkable exhibits we noticed a new instrument, by Captain Abney and Major-General Festing, for the measurement of light reflected by coloured pigments. The object of this instrument is to define, in a scientific and accurate way, the shade and depth of any colour, so that it may be reproduced at any future time. The colour to be defined is compared with that portion of a spectrum with which it coincides, and for this purpose a beam of light from an arc lamp, after passing through a narrow slot, is split up into two spectra, one of which falls upon a white screen, whilst the other falls upon a screen painted with the pigment to be investigated. By a suitable slide, the position of which can be read off on a scale, only those rays of the spectra are utilised which correspond with the colour of the pigment. To match the depth of colour there is interposed in one of the rays a metallic disc, with openings which can be more or less closed. This disc is revolved at a constant speed by means of an electromotor, and the size of the openings is varied whilst the disc is in motion until the colour has been matched. The proportion of the openings to the total circumference of the disc and the position of the slide before mentioned, give together an exact indication of the colour of the pigment, and a diagram can then be prepared for future use. In the same room Professor Rücker and Mr. Boys exhibited their beautiful experiments on electrical stress, which we have already noticed in our issue of the 30th March. There was also exhibited a large Wimshurst machine containing twelve discs of 2ft. 6in. diam., each disc carrying sixteen metal sectors. It was used to show a perfect brush discharge at its terminals, and when used with Leyden jars produced a spark 13½in. long. A very beautiful display of flashes could be seen on the outside of the Leyden jar, which was only partly coated. Mr. Boys showed a radio-micrometer, which is a very delicate instrument for measuring radiant heat. It consists of a circuit made of antimony, bismuth, and copper, hung by an exceedingly fine fibre of quartz in a strong magnetic field. The fibre is so fine that, when magnified twenty times, it appears only to have the same thickness as spun glass. The same gentleman also exhibited some interesting experiments with soap bubbles, most of them intended to show that there is a strong force of repulsion between the thin films of soap bubbles owing to which it is impossible to bring them into actual contact. The outer of two bubbles may be pulled out until it squeezes the inner one into a long oval without real contact taking place, and an inner bubble filled with hydrogen will carry up the outer one to which is attached a weight; yet the surfaces of the two bubbles do not touch.

In the reception room there was exhibited a series of maps and diagrams illustrating the recent work of the Geological Survey in the North-West Highlands of Scotland, and Mr. Caddel, of Grange, a member of the Survey, showed some interesting photographs, illustrating experiments made with a view to account for the remarkable dislocations found in that district. Most geologists have hitherto supposed that the earth's crust, when locally subjected to horizontal pressure, behaves like a plastic mass, and bends into great folds like a piece of carpet. The recent survey shows, however, that this is not necessarily the case. The crust seems to have behaved more like a rigid and brittle mass yielding to pressure by snapping asunder, the broken pieces being thrust one upon the other. Mr. Caddel has reproduced this phenomenon in the laboratory by putting pressure on brittle stiff strata composed of damp sand and plaster of paris. The artificial rock thus produced solidified *in situ* by the plaster absorbing moisture from the sand, and formed stiff lamina between the softer sandy base. When pressure was applied by means of a screw, the strata snapped, and parts of the mass slid over other parts in thrust planes, producing structures exactly like those found in the western borders of Sutherland and Ross. There were some thirty or forty photographs of these experiments exhibited. Mr. Caddel also showed how the so-called fan structure found in the Alps might be imitated in the laboratory.

In the principal library we noticed an apparatus by Mr. Thomas Turner for the determination of the hardness of metals or other substances. This consists of a balance arm, to the longer end of which is attached a diamond. A sliding weight on the arm determines the pressure exerted by the diamond upon the specimen under test when the surface of it be scratched. A series of scratches is made with varying pressure, and that scratch which can just be felt is compared with certain standard scratches, and thus the degree of hardness is determined. Professor George Forbes exhibited his coulomb meters, which were worked by a secondary battery. As we have already described these delicate instruments when reporting the last meeting of the British Association, we need not give a detailed description in this place beyond mentioning that a ring of india-rubber has been inserted into the glass bell near the bottom of the instrument for the purpose of eliminating the disturbing influence of convection currents. Mr. Eric Stuart Bruce exhibited a model of his translucent balloon for military signalling at night. Within the balloon is fixed a ladder containing about half a dozen glow lamps, and in addition to the cable by which the balloon is kept captive there is a twin conductor joining these lamps with a battery and a switch on the ground by which Morse signals are transmitted. Messrs. Johnson, Matthey, & Co. exhibited some incandescent gas burners, the mantle of which is made of iridium-platinum gauze. The light from these

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lamps is not so white as from the Welsbach burner; but the makers claim that the difficulty of very fragile mantles is entirely overcome by their invention. Mr. Shelford Bidwell exhibited his apparatus for measuring the change produced in the length of rods and rings by magnetisation, a detailed account of which will be found on page 377 in our issue of the 13th April. Messrs. Woodhouse & Rawson showed Vernon Harcourt's new pentane standard lamp, which has a naked flame, and is, therefore, free from the objection of the varying absorption of light by a glass cylinder. There was also a photometer arranged for the rapid determination of the light given out by a glow lamp in all directions. The new microphone carbon button, and the filaments of adamantine carbon exhibited were interesting, as showing how carbon can be artificially manufactured to a degree of hardness which brings it very near to that of black diamonds. The Edison & Swan United Electric Light Company showed some of the most recent forms of Swan's safety lamp for miners, which weighs 7lb., and is 7in. high by 4¼in. diam. These lamps, which are intended for use by the overseers, are provided with a new fire damp detector, consisting of a circular metal box, with a glass cover attached to the side of the lamp. Within this box is stretched a platinum spiral, and when turning the outer rim of the box into a certain position communication is established with the atmosphere. Upon further turning, the communication is interrupted, and the current from the four storage cells is switched on. The platinum wire begins to glow, and if there be fire damp in the atmosphere, the characteristic blue light appears. There were also some Schanschieff safety lamps exhibited.

On the ground floor Professor Kennedy exhibited for Mr. Baker some lantern views, illustrating the progress made in the erection of the great cantilevers spanning the 1700ft. wide openings of the Forth Bridge. Mr. Arthur Sopwith exhibited lantern views of the interior workings of a colliery. These were the same views which Mr. Preece recently showed at the Royal Institution. Dr. Mariet showed the image of electric sparks on a screen magnified by a camera lens, in illustration of flashes of lightning.

THE PHYSICAL SOCIETY.

At the last meeting of this Society, Professor S. P. Thompson read two notes, one dealing with the condition of self excitation of a dynamo machine, and the other with that of self regulation for constant potential difference. The author, after referring to a previous paper read by him before the Society, in which he had dealt with the question of dead turns on the basis of the Lamont-Fröhlich formula, said that in the present investigation he made no assumption whatever about the law connecting magnetising force and induction. The electromotive force developed in the armature is proportional to NCu, where N represents the total induction, C the number of armature conductors, and u the number of revolutions per second. The current is given by the expression $\frac{NCu}{a+x}$ where a is the internal resistance of the machine, and x the resistance of the external circuit. If the field magnets are wound with S turns of wire which are traversed by the current i the induction is represented by the formula

$$N=\frac{4\pi Si}{R}$$

where R, the magnetic resistance, consists of a portion α due to the air gap, and ξ due to the iron. By inserting this value for N into the formula for the e.m.f. we obtain

$$4\pi uCS=(\alpha+\xi)(a+x)$$

as the condition of self excitation for a series machine. A similar formula was given for the shunt machine. From the above formula it will be seen that for every given speed there is a limiting value x_1 of the external resistance x, beyond which the machine will refuse to excite itself. Neglecting ξ, which is very small for the initial stages of magnetisation, this limiting value is

$$x_1=\frac{4\pi uCS}{\alpha}-a.$$

In the discussion which followed, Mr. Kapp pointed out that the subject so clearly put forward by the author was not new, the critical conditions of dynamos being well known to the makers of these machines. His own practice, after the usual test, was to run his machines on the shunt only at the minimum speed at which they would excite, and noting the ratio of speed to voltage, which remained constant over a certain range of speed. This gave him the minimum value of $(\alpha+\xi)$, which he called the critical magnetic resistance, and which he invariably found to be lower than the theoretical value α of the air resistance only. The theoretical value of the air resistance was obtained by multiplying the co-efficient 1860 with double the air gap, and dividing by the polar area, the latter increased by a fringe equal to half the air gap. Experiment, however, showed that the co-efficient should be taken at 1440, and not at 1860, and this the speaker attributed to the permeability of copper being slightly greater than that of air, an explanation first suggested to him by Professor Ewing. A modification was also introduced by a certain tendency dynamo machines have to continue in their condition of excitation, or non-excitation, as the case may be. Although a machine may not start on a high resistance, it might be ultimately made to work through that resistance if started with a lower resistance, which would gradually be increased.

Professor Perry suggested that this might possibly explain why the air resistance, instead of being represented, as is done in Dr. Hopkinson's curves, by a straight line through the origin tangential to the characteristic curve, was really represented by a straight line through the origin intersecting the characteristic.

Professor Ayrton said that the author's formulæ could not be directly applied to determine the critical speed and resistance: first, because no account was taken of residual magnetism, which produces an e.m.f. of 3 or 4 volts at ordinary speeds; and secondly, because a, the internal resistance of the machine, is not a constant, as was assumed. The variation is due to the self induction of the armature, which is considerable for small currents, and to a kind of spurious resistance between the brushes and the commutator, which may possibly be due to jumping. He had often found that a dynamo could be made to excite itself at a lower speed than it otherwise would by pressing the brushes against the commutator, showing the existence of the resistance to which he had referred.

Lord Rayleigh pointed out that the fact that no current was produced below a certain speed had been very simply explained by Sir William Thomson many years ago. His reasoning was based on Faraday's dynamo, a revolving copper disc touched by conducting wires at its centre and circumference, and he also showed that above a certain speed a state of instability ensues. The reason that no definite speed can be determined is that the work done against e.m.f. is proportional to the square of the current, and so is the work spent in the circuit, so that the two balance each other. He did not like the term "magnetic resistance," as this term was generally used where there was work absorbed. In the case of magnetic resistance there was no work absorbed.

Professor Thompson, in reply, stated that he was not oblivious of Sir William Thomson's paper, which formed the foundation for the study of critical velocity. He had noticed that a machine could often be started by taking off and putting on the brushes. He agreed with Professor Ayrton that the internal resistance of the machine was not a constant, and had only treated it as more or less approximately so. The reason that α was not constant was due to the great variation in the magnetic resistance of iron in its lower stages of magnetisation. He thought that the difference observed by Mr. Kapp was due to an insufficient allowance made for the fringing of the magnetic field. The slight residual magnetism would make no practical difference.

The other note by Professor S. P. Thompson, on the condition of self regulation in a constant potential dynamo machine, was an attempt to make a certain formula, published by the author some time ago, agree with practical results. This formula was originally given as follows:—

$$\frac{Z}{S}=\frac{r_a}{r_a+r_m}$$

in which Z and S signify turns of wire in the shunt and main coils respectively, and r_s, r_a, and r_m are respectively the resistances in the shunt, armature, and main coils.

In a machine tested by Fröhlich, he had found $\frac{Z}{S}=17{\cdot}7$ and $\frac{r_a}{r_a+r_m}=64$. This was clearly a very badly constructed machine. The formula could, however, be made to fit any moderately well designed machine by writing it thus:—

$$\frac{Z}{S}=\frac{r_a}{r_a+r_m}\frac{q_0}{q_1}$$

where q_0 and q_1 represented certain co-efficients depending on the configuration of the magnetic circuit.

There was no discussion.

Mr. Blakesley then brought forward his views on

Magnetic Lag,

and the loss of power accompanying the reversal of polarity in an iron core subject to the influence of harmonic currents. On other occasions Mr. Blakesley has given formulæ for determining the lag in transformers, and for calculating the loss of work incidental to it; but in this paper the methods of calculation were for the first time given. A dynamometer is placed in each circuit, and a third has one of its coils in each circuit. These furnish without difficulty the current, and therefore the magnetising stress produced thereby in each coil, and the angle of phase difference between them. The resultant magnetising stress is therefore known, and the phase relatively to each component. If this resultant is in quadrature with the current in the secondary, there can be no magnetic lag, for the magnetism must be in quadrature with that current. But experiment shows that the magnetic stress is in advance of the magnetism from 5° to 6°. If this angle of advance be represented by φ, then—

$$\tan\varphi=\frac{\frac{m}{n}C\alpha_3-B\alpha_2}{\frac{m}{n}\sqrt{AB\alpha_1\alpha_2-C^2\alpha_3^2}}$$

where m=the number of turns of wire on the primary coil; n=the number of turns of wire on the secondary coil; A B C are the dynamometer constants; and α_1 α_2 α_3 are the dynamometer readings.

The dynamometer constant is that number which, multiplied by the reading, will give half the square of the maximum value of the current. Thus the existence of a magnetic lag may be detected by the use of the second and third dynamometers alone, and measured by means of the three together. Further, as the current induced in the secondary coil is known, the e.m.f. of this induction can be easily calculated if the resistance r_2 in that coil is also known. This e.m.f. per turn is $\frac{I_2r_2}{n}$, I_2 being the secondary current. But this must also apply to the coils of the primary. Therefore, $\frac{m}{n}I_2r_2$ is the whole induced e.m.f. in the primary, and $\frac{m}{n}\frac{I_2r_2}{r_1}$ must be the induced component of the current in the primary coil; and consequently $\frac{m^2}{n}\frac{I_2r_2}{r_1}$ is the magnetic stress arising from it, and forms one of the components of the whole magnetic stress due to the current in the primary coil. Their difference of phase being known, the remaining component due to the e.m.f. (E) of the machine itself, viz., $\frac{E}{r_1}m$, becomes known.

All these vectorial quantities can be plotted geometrically in a way with which Mr. Blakesley has endeavoured in other papers to make electricians familiar, so that the work done and other matters become functions of a simple triangulation, the sides of which merely involve dynamometer readings and constants, the resistances in the circuits, and the number of turns of wire in the two coils. The whole work done by the machine takes the simple form:—

$$r_1A\alpha_1+r_2\frac{m}{n}C\alpha_3.$$

The first term is obviously the power heating the primary coil. The second term is the sum of the power heating the secondary coil r_2 $B\alpha_2$, and the power involved in the magnetic reversals; it follows that the latter is equal to

$$r_2\left(\frac{m}{n}C\alpha_3-B\alpha_2\right)$$

which contains as a factor the numerator of the expression for the tangent of the lag, and showing that one is the result of the other.

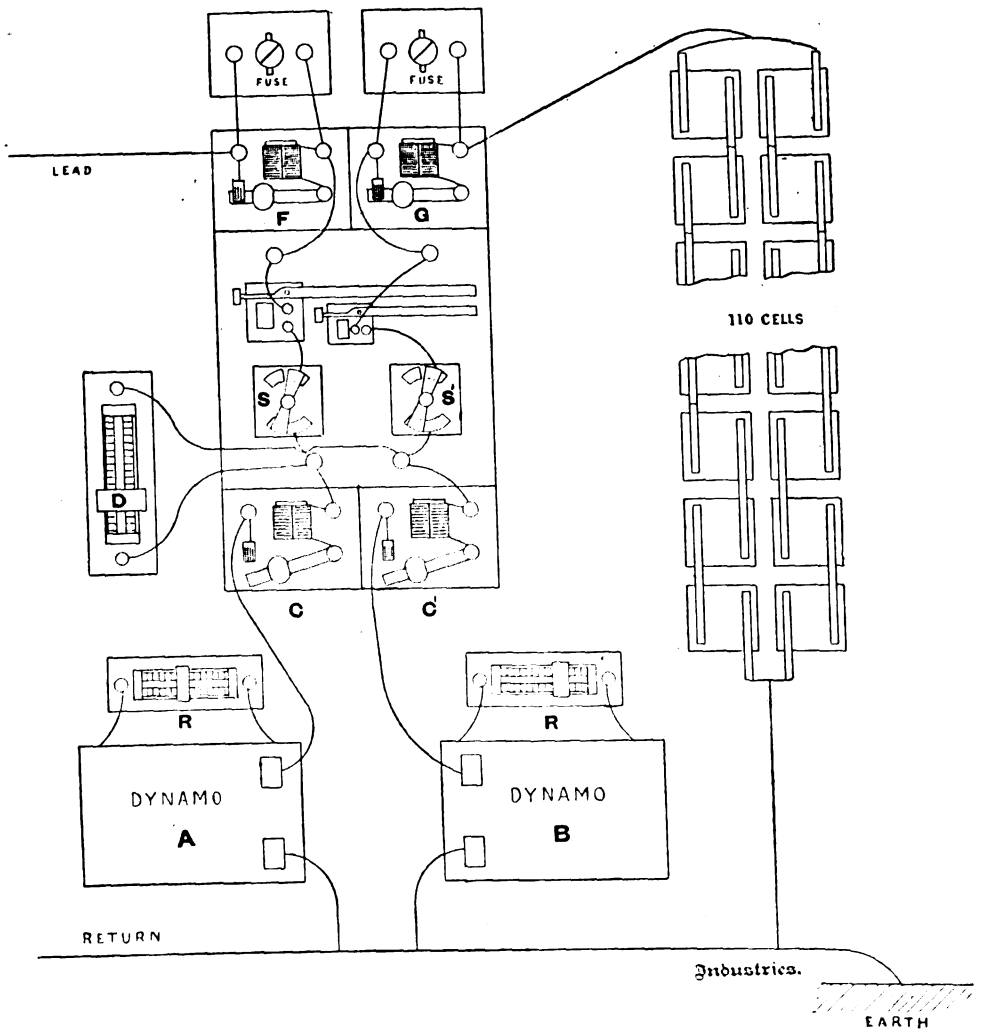
In speculating upon the cause of the lag, Mr. Blakesley believes that the increasing magnetisation calls into being an opposing magnetic stress, as motion in a medium calls into being an opposing friction. This induced magnetic stress must be compounded with those impressed by the currents to obtain the effective magnetic stress which is in phase with the magnetism. This involves the conception of magnetic self induction, and a corresponding co-efficient symbolised by N, to which Mr. Blakesley is careful not to attribute constancy, though he points out that its constancy is a necessary condition to the maintenance of the harmonic character of the changes. These views were illustrated by experimental results.

After the reading of this paper,

Professors Ayrton and Perry showed some interesting applications of their magnifying spring. The first of these was a lecture apparatus designed to exhibit the expansion of metals by heat, and consisted essentially of a magnifying spring, with one end fixed and the other attached to the free end of the expanding bar, the spring carrying a pointer, which rotated over a dial as the bar expanded. An aneroid barometer was also exhibited, in which the expansion of the metal chamber was shown by a magnifying spring carrying a pointer, in place of the ordinary somewhat complex mechanism of wheels and pinions. An arrangement was also exhibited in which, by a combination of two portions of a spring wound on a large mandrel with one wound on a small one, a small rotation could be magnified into a large rotary movement.

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ELECTRIC LIGHTING AT THE "SCOTSMAN" OFFICES.



ELECTRIC LIGHT INSTALLATION AT THE "SCOTSMAN" OFFICES.

THE proprietors of the leading Scotch newspaper, fully appreciating the advantages of electric lighting, began about eighteen months ago to introduce glow lamps in some portions of their establishment; and since then they have gradually extended the installation, until now nearly the whole of their offices and printing works are lighted electrically. The installation comprises about 370 glow lamps, of 16, 32, and 50 c.p., current being supplied by two 300-light dynamos, driven by belting from an ordinary horizontal engine, and in conjunction with the dynamos there is installed a storage battery of 110 cells, capable of supplying upwards of two hundred lamps. The installation is interesting on account of its having been carried out on the single wire or earth return system, and also because of the ingenious manner in which the dynamos, cells, and line are coupled up. Referring to our diagram, the dynamo A supplies current at 110 volts direct to the lamps, whilst dynamo B supplies a charging current of 137 volts to the cells, and it may at the same time assist the other dynamo in lighting. The pressure at the terminals of both dynamos is adjusted separately by the shunt rheostats R, shown in our sketch. The current from dynamo A passes through a differential magnetic cut-out C, then through the switch S and a steelyard ampère meter to a second magnetic cut-out F, and then to the line. Parallel with the magnetic cut-out, is coupled a fuse containing a high resistance, so that if, owing to a heavy leak, the magnetic cut-out F should come into action, the current to the lamps is not completely interrupted, but is reduced by that resistance to such an extent as to avoid danger. The resistance is, however, so adjusted that should the magnetic cut-out F act on account of an absolute short circuit, then the fuse itself will also melt. The connections from dynamo B are similar. The current passes first through the differential magnetic cut-out C^1, then through the switch S^1, through a steelyard ampère meter, through a second magnetic cut-out G, to which is connected in parallel a second fuse with resistance, and then to the positive terminal of the cells. The negative terminal of the cells is in connection with the earth return. Between the switches S and S^1 is inserted a variable resistance D of sufficiently stout wire to take that portion of the current from dynamo B which it is intended to send direct to the line. The quantity of current thus supplied to the lamps from dynamo B depends upon that portion of the contact D. The more current is to be sent directly to the lamps from dynamo B, the less must be the resistance of this rheostat. By its means it is also possible to stop dynamo A, and to charge and light simultaneously, from dynamo B, the rheostat, serving to reduce the pressure from 137 volts at the dynamo to 110 volts at the lamps. Usually the cells are charged at night, when the maximum number of lamps is on, and both dynamos are at work. In this case the current from dynamo B is mainly used for charging, and that from dynamo A exclusively for lighting; but by the interposition of the rheostat D, the lighting circuit gets the advantage of the steadying influence of the batteries, so as to tone down the effect of any irregularity which might exist in the speed of the dynamo. In the daytime there are seldom more than about forty lamps on, and these are usually supplied from the batteries, the dynamos being at rest. If it should be desired to charge the batteries in the daytime whilst lighting, only dynamo B is used, and the resistance of the rheostat D is suitably increased; but the loss of energy occasioned thereby is small, on account of the small current passing to the line. The construction of the magnetic cut-out is indicated in our diagram. When the current and pressure are within proper limits, the switch lever is held closed by a catch controlled by the armature of a differential electromagnet, which in this case is not energised sufficiently to attract its armature. Should the current or the pressure increase, the armature is, however, attracted, the catch is released, and the lever falls by its own weight, thus breaking the circuit. The same result occurs if the main current ceases to flow through the magnet, because in this case the magnetising power of the shunt current, acting alone, is sufficient to attract the armature, and thus cause the cut-out to act. In this way a back flow of current from the batteries to the dynamo is avoided, in case the latter should accidentally stop.

As we have already mentioned, this installation is carried out on the earth wire system. The positive wire is well insulated, but the return wire is connected to the brass work of all the fittings, and to the main water and gas pipes. All the switches and fuses are placed in the positive circuit. A switch and fuse are fitted in a box to control each sub-main which lights a department, and a fuse is placed in the base block, and a switch in the brass work of each fitting. The installation has been erected under the superintendence of Mr. J. D. F. Andrews, partner in the firm of Messrs. Muir, Mavor, and Coulson, of Glasgow.

FIRE RISKS IN ELECTRIC LIGHTING.

AT the meeting of the Society of Telegraph Engineers and Electricians, held on the 10th inst., Mr. W. H. Preece, F.R.S., read a paper on "The Risks of Fire Incidental to Electric Lighting." The author began by pointing out that the practical applications of electricity involved serious danger when proper precautions were neglected. These dangers, however, could all be avoided. All artificial illuminants gave rise to danger, but of these the electric light could most easily be rendered perfectly safe. In the year 1880 the author had sounded the note of alarm in a letter to the *Times*, in which some of these dangers were pointed out, and for this he was fiercely attacked by many of the promoters of electric lighting. It was, however, important to know the danger, as this knowledge led to suitable precautions being taken. The question then arose, whether rules and regulations for carrying out electric light installations were necessary. Such rules were not drawn up by the fire insurance companies with regard to other illuminants, because the precautions to be taken were self evident. As regards electric lighting, the author considered, however, such rules desirable, owing to the novelty of the subject, and the mysterious character of the agent used. Electricity could not be perceived either by sight or smell. It was also specially liable to fraud, as it was so easy to deceive the ignorant, and on this account afforded an extensive field for what Americans called "Cheap-Jackism." Rules and regulations were therefore also required to protect consumers from the rapacity of those who contracted to supply the light.

In the year 1881, the Edison Company of New York brought out a set of rules, and these were followed by a set drawn up by the fire insurance companies. In 1882 a set of rules founded upon these were drawn up by Mr. Heaphy for the Phœnix Fire Office, and in the same year another set had been drawn up by the Society of Telegraph Engineers and Electricians, and this example was followed by the Franklin Institute in America. The rules issued by the Society were simply assertions of general principles, and with respect to points of detail the majority of electrical engineers had been guided by the Phœnix rules, which were drawn up in the interest of the fire insurance companies. Last year it was suggested that the Society should revise the original rules, and since then fresh rules had been issued by three independent fire offices, whilst there was every prospect of other offices following suit. In the United States matters were still worse. The requirements of New York were met by the rules issued by the New York Board of Fire Underwriters, and revised from time to time. The rules of the Franklin Institute were in use at Philadelphia. At Boston at least two rival sets of rules were in force, and almost every town had a distinct set of rules in operation.

The original rules of the Society were in great demand, and with the exception of London installations, which were almost entirely carried out under the Phœnix rules, they were in use in the majority of electric lighting installations in this country Owing to this fact, and the desirability to revise these rules so as to bring them into accordance with modern requirements, the committee of the Society on the subject was re-appointed last May. The author did not approve of the matter being re-opened, as he was satisfied with the Phœnix rules: but ultimately he agreed to accept the chairmanship of the committee to which he had been elected, as he was in the case of the former committee. It was decided that in the first place the secretary of the Society should ascertain how far their action would meet with the support of the insurance companies, at the same time pointing out to them that the Society had no wish to take any action in the matter except in so far as they considered this desirable in their own interests. The companies expressed themselves in favour of some alterations being made in the rules, and of having, if possible, only one set of rules in use. The author considered that the committee ought to have the benefit of Mr. Heaphy's assistance, and accordingly Mr. Heaphy became a member of the Society and joined the committee. It was, however, found impossible to get the representatives of the different fire offices to agree among themselves. It was decided that the rules drawn up by the Society should be revised, and should, as before, deal only with general principles, and that they should be supplemented by detailed rules drawn up by Mr. Heaphy, and to be known as Fire Office Rules. Some objections were made by the author and others, chiefly to the phraseology of

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the rules, as leaving too much to be decided by the fire insurance inspector. They came to an agreement regarding the abolition of these permissive clauses, and they also agreed to recommend, after due consideration and revision, the detail rules drawn up by the Phœnix Fire Office. Mr. Heaphy, however, wished them to adopt these rules *en bloc* before they had examined them, and upon their refusal he withdrew from the committee. The committee subsequently brought out their rules. The question was really one between the insurers and the insured, and all that the Society of Telegraph Engineers could do was to act the part of friendly guides. The committee was exceptionally strong. Among the leaders of science it included Professor W. G. Adams, Sir William Thomson, Professor Ayrton, Professor Cary Foster, Mr. Crookes, Dr. Hopkinson, and Professor Hughes. Among consulting electrical engineers it included Sir Charles Bright, Professor Forbes, Mr. Z. E. H. Gordon, and Mr. Massey, and among contractors Mr. Crompton and Mr. Alexander Siemens; the names of Professor Fleming and General Webber were also added.

The author pointed out that, in the interest of electric lighting, it was important to prevent such alarms of fire as occurred—for example, in Lord Brassey's house, where a transformer which had recently been fixed in position in an iron fire proof case, heated the case, and gave rise to an alarm, though no fire actually occurred. He also instanced the fire occurring at the Temple Theatre at Boston, by which that theatre was destroyed, and which originated in a short circuit in cotton covered wires insulated by paraffin. He also mentioned a fire which occurred at the Midland Works at Derby, due to a short circuit heating, and setting fire to one of the old wooden lamp holders. The author pointed out that while in 1887 the number of theatres destroyed by fires arising from the lighting system in use, averaged about two a month, the total number of fires arising from the use of the electric light during the same period was, after all, exceedingly small. Many of the sources of danger in electric lighting were of a nature which had never been anticipated—for example, in stables, the corrosive action of the ammonia upon the metal staples, and in houses, short circuits, arising from washing floors and the ravages of rats and mice, were all sources of danger which had to be provided against. It was a common practice, but one which could not be too strongly deprecated, to bury electric conductors in cement when houses were being built. Moisture was a great source of danger. In underground work water was a safeguard, as gutta-percha insulation is protected from decay when under water; but in the air both gutta-percha and india-rubber, when exposed to moisture and to changes of temperature, were very liable to deterioration. The wires were then attacked by electrolytic action until they became eaten away so much in some places as to be unable to carry the currents without undue heating. The practice of encasing wires in wood was an extremely dangerous one, and several fires in ships had arisen from this cause. Mercury contacts were most objectionable, except in positions where the mercury could be frequently renewed. Where the electric light was used in houses, the luxury and convenience of the light often led to additional lamps being placed on the original leads until the latter were unable to safely carry the current required, which led to their becoming heated, and forming a source of danger.

The greatest danger of all arose, however, from bad joints. All the older engineers would agree in maintaining that all joints should be soldered; yet the rules in force at Boston declared that "joints should be wrapped in tape, and though soldering is desirable it is not essential." Such a statement as this was, in the author's opinion, absolutely fatal to the value of the rules. According to the New England rules, resin should not be used as a flux in soldering joints, whereas Mr. Heaphy's rules advocated its use. The rules issued by the Society stated that where soldering fluids were used the joints should be carefully washed and dried before the insulator was applied. He preferred fluid to resin, except for submarine cable work, and considered Baker's fluid, which was generally used by the Post Office, a very good one. Loose connections of any kind were a great source of trouble, and joints should always be soldered where possible. Owing to defective joints, cut-outs, if not carefully looked after, were often a source of danger rather than of safety. Switches were often a source of danger owing to loose connections, and the author exhibited a switch which had been fixed against some oak carving in the House of Commons, and had very nearly caused a fire from heating, due to a loose connection. A great source of danger lay in the inflammable nature of the insulators in general use, and a good non-inflammable insulator was a great desideratum. The author stated that the Westinghouse Company were using Waring wires, which were insulated with a substance obtained as a distillate from petroleum after the naphtha and illuminating and lubricating oils had been given off. This substance was not so inflammable as other insulating compounds, and experiments were exhibited to show this.

ELECTRO-DYNAMIC ROTATION.

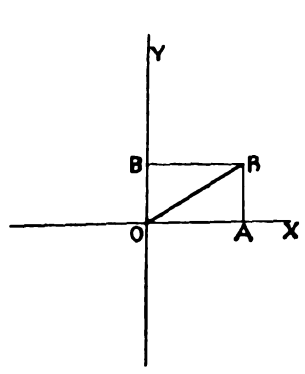


Fig. 1.

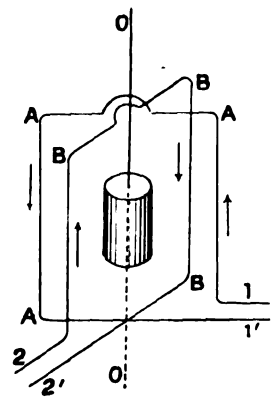


Fig. 2.

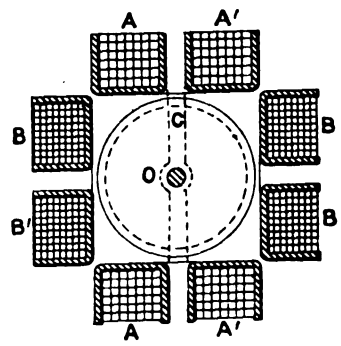


Fig. 3.

The author considers that the Phoenix Company had shown great pluck in accepting the risks on transformers before the majority of electricians had come to any conclusion on the matter. The Phoenix rules were extremely good, but not perfect, and he would like to see Mr. Heaphy join again in carrying on the work of revision from the point at which he had withdrawn his co-operation. One of the most effectual means of guarding against fire risks from electric lighting lay in the proper education of the rising generation of electrical engineers. It was essential to frame rules to exclude the cheap contractors who offered tenders at a price that could not pay for good work, relying on extras for their profits. Mr. Heaphy had stated that there had not been a single accident from fire arising from the electric light in installations carried out under his inspection and in accordance with the Phoenix rules, and the author believed this statement to be perfectly correct.

The discussion was opened by Mr. Heaphy, who thanked the author for the kind manner in which he had spoken of him, but took exception to the statement with respect to his reasons for withdrawing from the committee. He would give his account of the matter at the next meeting of the Society. He pointed out that when transformers were first introduced, and but little was known about them, the insurance companies were very chary about accepting risks upon them. The Phoenix Company decided to take the risks of admitting both transformers and high tension currents, under certain regulations, into buildings without any extra charge. Several electricians had told him, when he advised the company to this effect, that they would be sorry to be in his place, and that he was imperilling his professional reputation. These prophecies had, however, been falsified, as they had hitherto not had any accident either from high tension currents or transformers installed in compliance with their regulations. The speaker complained that after the Phœnix Company had taken all the risk the other fire insurance companies now wished to bring out their own rules. He stated that the Phœnix Company would be ready to meet the others in every reasonable way. The only real point of difference between himself and the committee had been his insistance on the retaining of the name "Phœnix" in conjunction with the rules.

Mr. Killingworth Hedges objected to the insertion of the word "copyright" after the Phœnix rules, as he maintained that they were practically identical with the rules previously published by Mr. Woodbury in America.

Mr. Human, surveyor of the Guardian Insurance Company, stated that they had issued a set of rules because they objected to send out lists of rules to their customers bearing the name of a rival company, thus advertising it at their expense. He hoped the action of the Society would ultimately lead to the adoption of one uniform set of rules, which would be accepted by all the insurance companies.

Mr. Swan called attention to cases of short circuiting arising from the trickling of water. He thought the earlier installations ought all to be overhauled, in order to detect bad joints and other defects. He agreed with Mr. Preece with respect to the importance of having all joints soldered, and thought this should apply even to the case of cut-outs.

Mr. John Verity made an appeal both to the Phœnix and to the other companies to endeavour to come to some definite arrangement, so that a single set of rules might be adopted. He pointed out that Mr. Heaphy had done great service to electric lighting, both by preventing fire scares, and by doing away with cutting competition by the stringency of the rules made by him.

Mr. Manville thought a few more contractors might have been added to the committee in addition to Mr. Crompton and Mr. Siemens.

Mr. Crompton considered that Mr. Heaphy's hard work, and the position which he had taken up from the beginning, gave him a moral, if not a legal, copyright in the rules. He was of opinion, based on the result of inquiries, that 95 per cent. of electrical contractors would be in favour of adopting Mr. Heaphy's rules. He thought it a pity that the Society should have to play the part of a buffer between the jealousies of rival insurance companies. The Phœnix Company were always ready to meet the wishes of contractors in a reasonable spirit, and as the great majority of the fire insurance offices were now using the Phœnix rules, he appealed to the other fire offices to lay aside their jealousy, and accept these rules.

Mr. Alexander Siemens considered that the principal defect of Mr. Heaphy's rules lay in the saving clauses occurring in nearly every rule, and which, he thought, left too much to the discretion of the fire insurance inspector, and this latitude might leave the way open for a less conscientious inspector than Mr. Heaphy to pass what might ultimately lead to danger. His own recollection of the point of difference between Mr. Heaphy and the committee of the Society coincided with the account given by Mr. Preece.

The discussion was adjourned to an extraordinary meeting on the 17th inst.

ELECTRO-DYNAMIC ROTATION BY MEANS OF ALTERNATING CURRENTS.

Professor Galileo Ferraris, of Turin, who, as will be remembered, was one of the first to make a strictly scientific investigation of transformers, and who has since then continued to devote attention to alternating currents, has just published the results of some experiments made with a view to produce continuous rotation by their means. The experiments are interesting, because the apparatus used was based upon an entirely new principle, which may be capable of further development. The question how to produce continuous rotation by means of alternating currents is just now occupying the minds of many electricians, because the production of an alternating current motor would greatly increase the earning capacity of central electric light stations supplying alternating currents. Whether the apparatus devised by Professor Ferraris, and which we are about to describe, will lead to the discovery of an alternating current motor, is a question on which we do not pretend to prophesy; but as the principle involved may also have other applications, notably in the construction of meters for measuring the supply of electricity, we think it of sufficient importance to lay a short abstract of the investigation before our readers. The principle on which the apparatus is based is exceedingly simple, and will be understood by reference to the accompanying sketches. Let in Fig. 1 the lines O A and O B represent in direction and magnitude the strength of two magnetic fields. The combined action of these fields on a unit pole, placed in the point O, would then be represented by the resultant O R. Instead of having two distinct fields, we have one resultant field, represented in direction and magnitude by this line. If both fields undergo periodic variations of the same period, the resultant field O R will also undergo a periodic variation, and the point R will traverse a curve, the form of which depends upon the precise manner in which the lines O A and O B change with the time. The fields O A and O B can be produced by two coils, having the lines O X and O Y respectively for their axes, and which coils are traversed by alternating currents of the same period. If the alternating currents may be expressed as sine functions of the time, and if there is an appreciable lag between the currents in the two coils, the point R describes an ellipse round O as centre. In

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this case the line O R representing the resultant field revolves round the centre O, the direction and magnitude of the resultant field changing at every instant. If, however, there is no lag between the two currents, that is to say, if they pass through zero simultaneously, the direction of the resultant field O R remains stationary, and the point R performs harmonic oscillation over the line R O and its prolongation with O as centre. This may be considered as a special case of the ellipse where the latter has been flattened down to a mathematical line. Another special case occurs when the ellipse becomes a circle, and this must evidently take place when the lag between the two currents is 90°, when the coils are at right angles to each other, and when the component fields are equally strong. A metallic body suspended in the centre of the two fields, and free to revolve, must evidently have a tendency to participate in the rotation of the resultant field.

The application of this very simple principle will be clear from Fig. 2, in which the two coils are indicated by the rectangles A and B, the connections being made by the wires 1 1^1 and 2 2^1 respectively. When alternating currents are sent through these coils a resultant field is produced, which revolves round the line O O. In the centre between the coils is suspended a small hollow cylinder of copper, and as the lines of the resultant field cut the metal Foucault currents are induced, and by the interaction of these induced currents and the revolving field the cylinder is set in rotation. The action is exactly the reverse of that occurring in the well known experiment in which a copper disc is rapidly revolved below a compass needle, with the result that the compass needle is deflected on account of the induced currents in the copper disc, and ultimately caused to rotate with the copper disc.

Up to the present we have spoken of two distinct currents being required in the coils A and B, one lagging behind the other by a quarter period; and to perform the experiment we might employ an alternating current dynamo with two circuits in the armature, so arranged with regard to each other as to produce the desired lag. It is, however, possible to perform the experiment by using an ordinary alternating current machine with only one circuit on the armature, and to produce the second current by means of a transformer. The current from the machine is sent through the primary of the transformer and then through the coil A, whilst the secondary current obtained from the transformer is sent through the coil B. It is then possible, by the interposition of a suitable inert resistance into the secondary circuit, to obtain very nearly the desired lag of 90° between the currents in the two coils. As the strength of the secondary current will, by the insertion of the resistance, be considerably reduced, it is necessary, in order to obtain approximately equal fields from the two coils, to employ a larger number of turns in the coil B than in A. Another method of producing the desired result consists in using a transformer with one primary and two secondary coils, and to insert into the circuit of one of the secondary coils a large self induction, and into that of the other a large inert resistance, by which means the desired lag between the two secondary currents can also be obtained. It will be seen that in either of these ways it is possible, by means of a simple alternating current and a transformer, the coils of which are abreast, to obtain a revolving magnetic field of approximately uniform intensity, by which phenomena can be produced in every respect similar to those obtainable from a revolving permanent steel magnet.

In the first experiment made by Professor Ferraris, a Gaulard & Gibbs transformer, with an equal number of turns in the primary and secondary coils, was used. In the primary circuit was included the coil A, consisting of a few turns of stout wire, whilst in the secondary circuit were included an adjustable and non-inductive resistance and the coil B, the latter consisting of many turns of fine wire. A small hollow copper cylinder was suspended on a thread in the centre of the two coils, as shown in Fig. 2. If the current was sent through only one of the coils, the cylinder remained at rest; but if currents were sent through both coils, the cylinder immediately started to revolve, twisting the thread on which it was suspended. A reversing switch was inserted in the secondary circuit, and if the current through this circuit was inverted, the cylinder was immediately brought to rest, and started in the opposite direction. Professor Ferraris next substituted a small iron cylinder for the copper one, and found equal results; but when using an iron cylinder sufficiently large to nearly fill the place within the coils, the experiment did not succeed so well. He attributes this to the greater self induction which the presence of iron in a large mass necessarily introduces into both circuits. Another experiment was made with a small iron cylinder, composed of a number of thin discs insulated from each other, and this experiment also succeeded. Foucault currents could not in this case be the cause of rotation, and Professor Ferraris thinks that the rotation is due to hysteresis. A larger apparatus was then constructed, which is indicated in our sketch Fig. 3. In this case the copper cylinder, which was mounted upon a horizontal axis in bearings, had a diameter of 3½in., and was 7in. long, its weight being 11lb. This cylinder was closely surrounded by the primary and secondary coils wound upon wooden bobbins. To make room for the shaft each coil was in halves, the primary consisting of ninety-six turns of seventy-seven mils. wire, both coupled in series, so as to produce the effect of a coil of 192 turns; the secondary consisting of 504 turns of thirty-eight mils. wire, both being coupled in parallel, so as to produce the effect of 504 turns. The resistance of the primary coils was 7·12 and 6·63 ohms respectively, and that of the two secondary coils coupled in parallel was 3·43 ohms. In the secondary circuit was also inserted a rheostat without self induction, and the best results were obtained when the rheostat was set to between 15 and 18 ohms. A Gaulard & Gibbs transformer was used, giving eighty reversals per second. The copper cylinder began to revolve when the primary current was 5 ampères, and with higher currents the velocity could be increased to nine hundred revolutions per minute, and might have been still further increased but for the somewhat imperfect mechanical arrangements, which occasioned considerable vibrations. To the shaft was applied a small friction dynamometer, and the following table gives the work obtained on the brake by a primary current of 9 ampères at different speeds:—

Revolutions per minute....	262	400	546	653	722	770	772	900
Watts obtained on brake...	1·32	2·12	2·65	2·77	2·55	2·40	2·04	0

The maximum energy was obtained at 650 revolutions. Beyond that speed the energy decreased, which is attributed by Professor Ferraris to the imperfect mechanical arrangement of the apparatus, causing a considerable waste of power in vibrations. If it were not for this, the maximum energy would have been obtained at about 1200 revolutions, whilst at 2400 revolutions, which is the speed of the revolving resultant field, no energy at all could be obtained. Professor Ferraris suggests that this apparatus may be used for lecture purposes, and as a motor when the power required is small, and it may also be used as an electricity meter. The torque exerted by the revolving field upon the copper cylinder is proportional to the square of the current, and in order that the total number of revolutions performed in a given time may be an indication of the number of coulombs supplied, it is necessary to introduce some opposing force which varies with the square of the velocity. If this can be done, and if the friction of the journals can be sufficiently reduced, an ordinary counter attached to the axis would indicate the quantity of electricity supplied.

Notes.

DEVELOPMENT OF COSTA RICA.

The British Consul at San José states that a concession of 7000 acres of land has been granted to Marco Soto, ex-President of Honduras, in order that he may form syndicates in the United States and Europe to develop the mines of the country, and establish agricultural and other industries. Special privileges will be granted for a term of ten years, and all machinery and agricultural implements destined for the purposes of these industries will be admitted duty free.

METEOROLOGY.

M. Cruls, the director of the observatory at Rio de Janeiro, is engaged on the compilation of a universal climatological dictionary which promises to be of special value. The publication is under the auspices of the Emperor of Brazil, who has recently written to the President of the Academy of Science in Paris, asking the assistance of the French meteorologists in the undertaking. His Imperial Majesty hopes that the meteorological observatories in France will furnish the editor with details of the work which they are conducting, in order that the volume may be complete in the French methods of investigation.

MINES IN ECUADOR.

The British Consul at Guayaquil reports that the works on the Zarama gold mines continue. New machinery has been put up by the Quebrada Mining Company, which is to commence milling shortly. The Compañia Esplorada de Minas has sent its representative to Europe to make arrangements to raise capital for working about eighteen mines. A new English company has undertaken the exploration of another group of mines in Zarama, and has sent out an engineer and materials for the purpose. The Consul states that so far no decisive results have been obtained sufficient to warrant an opinion being given as to the ultimate success of these new enterprises.

STEAMERS FOR BRAZIL.

The British Consul at Santos states that a native steamship company is in course of formation at that port, and which promises to have commercial success. The scheme has been set on foot by Baron de Jacequay, who intends shortly to proceed to Europe to superintend the building of the steamers, and British shipbuilders should consequently be on the alert to obtain the orders.

PHOSPHATES IN SOUTH CAROLINA.

The British Consul at Charleston states, that whereas in 1867 the quantity of phosphate rock mined in Charleston County was only 6 tons, it amounted last year to 285,000 tons. This industry has materially improved the trade of the port of Charleston, and valuable works have been established on the Ashley and Cooper rivers. The prices ruling for some time past have, however, been unremunerative. The total production in South Carolina in 1887 amounted to 432,757 tons.

COAL IN ALGERIA.

The imports of coal and patent fuel into Algeria amounted to 150,767 tons in 1885, to 115,778 tons in 1886, and to 132,392 tons in 1887. Consul-General Playfair, of Algiers, states that some time ago great pressure was brought to bear upon the railway companies to induce them to use patent fuel of French manufacture. The result of this was that in 1886 the quantity imported from England decreased. After a short trial, however, the railways again purchased their supplies from England, as the French fuel cost 20 per cent. more. The Consul-General says that the consumption of English patent fuel in Algeria amounts to over 20,000 tons per annum; he also states that the consumption of coal in Algiers is likely to increase, as that port is becoming an important coaling station for vessels engaged in the Eastern trades.

COTTON IN RUSSIA.

About 360,000,000lb. weight of cotton are annually imported into Russia, being mainly derived from America and Egypt. The territory acquired in Central Asia by Russia is said to be well suited for the cultivation of cotton, and some Asiatic cotton from Khiva and Bokhara has already been sold on the Russian market. The prospect from the new plantations on the Murghab is very promising, and experiments have been made there by General Paucker and M. Poklevsky Kozell. The latter believes that after the restoration of the Sultan Bekdyke, this tract alone will be sufficient to supply the whole of the Russian Empire. The preliminary essential to these operations is the completion of the irrigation works now in hand, and as these will occupy the next two years it is uncertain, until they are achieved, whether cotton or some other crop will be the most remunerative.

ANCIENT MATERIALS FOR PAPER MAKING.

Dr. Julius Wresner, from a microscopical examination of the paper from El-Faijûne, preserved in the Austrian museum at Vienna, in the collection known as "Papyrus Erzherzog Rainer," has conclusively proved that linen rags were used in the manufacture of paper as early as the eighth and ninth centuries. The fibre is chiefly linen, but there are also traces of cotton, hemp, and animal fibres present. The manufacture of paper out of rags is, therefore, an Eastern and not a German or an Italian invention, as has hitherto been supposed. Out of five hundred Oriental and Eastern specimens, not a single one was a raw cotton paper. All those that were examined had likewise been "clayed" like modern papers. The material used for this purpose was starch paste, manufactured from wheat, and in some cases from buckwheat. Animal substances do not appear to have been employed for "claying" before the fourteenth or fifteenth century.

IODIDE OF MERCURY IN TANNING.

The addition of a small quantity of iodide of mercury to skins is found to effectually prevent fermentation setting in, and at the same time to produce no injurious effects in the subsequent tanning operations. It is said that the mercury salt acts as a preservative of the constituents of the tannin liquors, and that leather produced from skins that have been previously treated in this manner is superior to that tanned in the ordinary way. Messrs. Collin & Benoist, the French chemists, who have experimented with this anti-ferment, state that it completely prevents the liquefaction of the gelatine which takes place in putrefying hides, and thus saves them from this loss. A saving is also effected by its use in the prevention of the decomposition of the tannin in the tanning liquid, which is usually hastened by the introduction of the hides when in a state of decomposition. The amount of iodide of mercury required is so small that there is no possible danger from poisoning, either to the workmen or to those subsequently using the leather, in its use.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

18043. Thomson, J. ..... Dwell cams. (Received 5th May, 1888. Ante-dated 12th October, 1887. Under International Convention.)
18044. Thomson, J. ..... Apparatus for combined rotary and reciprocating movement. (Received 5th May, 1888. Ante-dated 12th October, 1887. Under International Convention.)

4th May, 1888.

6640. Craven, F., & others.... Injectors.
6641. Manier, A. F. A. ..... Utilising tidal power.
6644. Roberts, H. ..... Manufacture of wire rods.
6646. Dawson, J. B. ..... Two wheeled vehicles.
6647. Knowles, J. ..... Picking motions for power looms.
6648. Gregson, W. ..... Warping or beaming machines.
6649. Heywood, C. ..... Grinding of the flats for carding engines.
6653. Hateley, T. ..... Tapping holes in metal.
6656. Platt, J. E. ..... Securing the cards in carding engines.
6660. Siviter, J. ..... Axle boxes.
6668. Beaven & Co. ..... Machine mouldings.
6670. McKenzie, S., & others.. Anchoring boats in deep seas.
6674. Addis, J. B. ..... Bosses for forging.
6677. Hewitt, J. ..... Manufacture of lace.
6679. Brasier, E. ..... Decorticating fibrous materials.
6683. Cleminson, J. J. D..... Submarine vessels and torpedoes.
6684. Hill, W. ..... Rudder line ends.
6689. Daverio, G. ..... Sifting machines.
6690. Buignet, H. ..... Testing the strength of cements.
6693. Boulton, M. P. W. ..... Engines worked by elastic fluid with use of combustion at high pressure.
6698. Forster & Dawson..... Boilers.

5th May, 1888.

6700. Donovan, J. W. ..... Reversing valves.
6704. Bailey, W. H. ..... Wool combing machines.
6705. Williams, W. J. ..... Fire and damp proof cylinders for explosives.
6708. Louks, A. ..... Gas engines.
6711. Seidenberg, B. ..... Cleaning breech loading rifles.
6718. Johnson, J. Y. ..... Looms for weaving ribands (*Moraes*).
6736. Howes, J. ..... Float and valve mechanism for tanks.
6739. Vaughan, G. E. ..... Steering apparatus for twin screw ships (*Trott*).
6742. Wise, W. L. ..... Steam engines (*Maschinenfabrik Oerlikon*).
6744. Edwards, E. ..... Iron floors (*Hahn*).
6750. Turner, G. H. ..... Drilling and tapping holes in pipes.
6754. Key & Gales ..... Tube stopper and scraper for steam boilers.

7th May, 1888.

6756. Nelson & Nelson ..... Dyeing and sizing yarns.
6763. Walker, W. ..... Lace machines.
6766. Lang & Dannfield ... Rotary engines.
6774. Holt & Holt ..... Manufacture of figured cloth.
6788. Walter & Edmeston... Mangles for treating textile fabrics.
6794. Stitt, J. C. ..... Mechanically propelled lifeboats.
6795. Pooley & Pooley..... Weighing machines.
6799. Stevenson & Marshall Motors and apparatus for raising and forcing fluids.
6808. Stuart, G. ..... Machine for filling the feeders of Gatling guns.

8th May, 1888.

6816. Newall, G. W. ..... Pistons and valves.
6619. Nash & Lacassagne..... Couplings for railway carriages.
6821. Berry, J. H. ..... Valve motion for steam pumps.
6825. Fairweather, W. ..... Apportioning furnace draft for batteries of steam boilers (*The Babcock & Wilcox Co.*).
6830. Shackleton, R. ..... Injectors.
6832. Hopwood, J. ..... Shaft bearings.
6835. Green, E. C. ..... Breech loading small arms.
6847. Farmer, J. S. ..... Washing textile fabrics.
6852. Balls & Hudson ..... Governors for steam engines.
6854. Snedeker, E. W. ..... Sawing machines.
6856. Backeljau, F., & others Pneumatic elevator.
6863. Hutinel, H. ..... A novel apparatus applied to steam boilers.
6864. Goodfellow, J. T. ..... Metallic platforms for railway cars.
6870. Servettaz, J. ..... Working points and signals of railways.
6879. Chamberlain, E. G. ... Compound railway rail.
6884. Barker, W. B. ..... Air valve, applicable to mechanism for signalling.
6885. Barker, W. B. ..... Sound signalling apparatus.

9th May, 1888.

6886. Bookwalter, J. W..... Iron and steel (*Robert*).
6890. Fasham & Pyle ..... Using the action of the tides.
6894. Brampton & Brampton Driving chains.
6895. Mills, E. C. ..... Self acting stop motions applied to speed regulators for steam engines.
6897. Hutchinson & Younghusband ..... Securing connecting rod straps to connecting rod ends.
6898. Pearson, H. ..... Pickers of looms.
6904. Pilley & Darnbrough. Apparatus for making flake yarn.
6911. Poole & Poole..... Mules.
6912. Wrigley, E. W., & ors. Doubling and twisting machinery
6913. Penn & Deeley ..... Ejecting mechanism of drop-down small arms.
6914. Mudgemarchant and Abbott ..... Application of steam to engine power.
6918. Hall & Verity ..... Anchors.
6919. Atkinson, E. S. ..... Discharging projectiles from guns.
6922. Johnston, J. ..... Production of moulded castings (*The Société du Familisteri de Guise Vve Godin et Cie*).
6930. Vaughan, G. E. ..... Twin screw ships (*Trott*).
6936. Blachon & Mimard ... Sporting guns.
6942. Offen, F. ..... Coupling.
6951-2. Bookwalter, J. W.... Iron and steel.

10th May, 1888.

6959. White, H., & others..... Corrugated girder fire bar for furnaces.
6962. Cryer, J. M. ..... Drag motions for flyer doubling and spinning frames.
6969. Kiddier, J. W., & others Straight bar knitting machines.
6970. Huck, G. ..... Tension bar for looms.
6971. Annandale, J. H. ..... Boiler furnaces.
6976. Farini, G. A. ..... Magazine attachment to the Martini rifle.
6980. Lazenby, G. ..... Muffle kilns for bending and firing stained glass.
6981. Cocker & Cocker ..... Mules.
6984. Henderson, A. C. ..... Steam boilers (*Desgoffe and De Georges*).
6986. Lowth, T. ..... Centrifugal apparatus for extracting honey from honey comb.
6987. Ellis, O. J. ..... Steam generators.
6989. Wade, J. ..... Looms for weaving pile fabrics.
6990. Thompson, W. P. ..... Two wheeled vehicles (*Vandenplas*).
6994. Romanel, R. C., & ors.. Magazine repeating fire arms.
6998. Whitehead, R. ..... Valve for torpedo engines.
7000. Richmond & Whiting.. Printing presses.
7009. Haddan, R. ..... Pumps (*Mosser & Chiari*).
7011. Wells & Hitton..... Hot air motor.
7012. Wells, C. ..... Apparatus for recording the degree of accuracy in aiming with ordnance guns.
7013. Wells & Paynter ..... New method of using steam as a motive power.
7014. Goodwin & Goodwin... Travellers for carrying suspended loads.
7015. Casson, R. S. ..... Manufacture of metallic tubes.

ELECTRICITY.

4th May, 1888.

6657. Williams, B. D. ..... Secondary batteries.
6680. Vaughan, G. E. ..... Electric railways (*Trott*).

5th May, 1888.

6740. Armstrong & Serrailler ..... Portable electric lamp.
6751. O'Leary, C. M. ..... Automatic alarm bells.

7th May, 1888.

6772. Calliphronas, T. ..... Electrical measuring apparatus.

8th May, 1888.

6828. Tolehard, F. J. ..... Automatic telautograph.
6834. Chattock, A. P. ..... Measurement of the co-efficients of electro-magnetic induction.
6836. Ayrton, W. E., & others Electro-dynamic relay for constant or varying currents.
6876. Aron, H. ..... Measuring electric currents.

9th May, 1888.

6889. Firth & Crabtree..... Dynamos and motors.
6893. Walker, E. C. ..... Electro-magnetic and magneto-electric generators.
6907. Immisch, M. ..... Storage batteries.
6909. Houghton, E. J. ..... Dynamo machines.
6910. Houghton, E. J. ..... Electric lighting.
6927. Ward, M. R. ..... Electrically propelled vehicles.
6928. Andersen & Tafe ..... Electric switches.
6953. Southern, W. ..... Electric gas lighters.

10th May, 1888.

6961. Nussbaum, G. A. ..... Electric batteries.
6985. Immisch, M. ..... Switch for electrical tram cars.
6988. Ward, M. R. ..... Supplying electrically worked vehicles with fresh sets of accumulators.

CHEMISTRY.

4th May, 1888.

6694-5-6. Hake & Heenan ... Ammonium nitrate.

5th May, 1888.

6725. Card, W. L. ..... Eliminating metals from their matrices.
6743. Leigh, H. H. ..... Colouring matters (*Williams*).

7th May, 1888.

6778. Kiel & Stoltenhoff... Manufacture of starch.
6812. Rose, T. K. ..... Recovery and regeneration of bromine, chlorine, and other chemicals employed in the extraction of gold.

8th May, 1888.

6869. Johnson, J. Y. ..... Purifying alcohol and obtaining aldehydes and acetones (*La Société Française de Alcools purs of Paris*).

9th May, 1888.

6899. Limpach, L. ..... Separation of isometric xylidines.
6949. Mitchell & Hagemann Purification of oils and fats (*Von Schmidt*).
6956. Greenway, A. G. ..... Manufacture of zinc.

10th May, 1888.

6972. Hannay, J. B. ..... White pigment of lead.

MISCELLANEOUS.

1851A. Johnson, J. Y. ..... A sound conveying tube (*The Volta Graphophone Company*). (This Application having been originally included in No. 1851, dated 7th February, 1888, takes, under Patents Rule 23, that date.)

4th May, 1888.

6639. Ambler, W., & others... Glass bottles.
6643. Pickup, J., & others..... Shuttles.
6652. Tunks, D. ..... Watches.
6654. King, F. W. ..... Brush with removable cover.
6663. Mowll, C. H. ..... Artificial fuel.
6667. Ingrey, C. ..... Apparatus for producing sonorous and flashing signals.
6669-71. Boult, A. J. ..... Extracting wool oil (*Korschelt*).
6675. Bill & Taylor..... Silk warp threads.
6676. Holdsworth, G. ..... Securing top rollers upon their spindles.
6681. Clarke, A. B. ..... Automatic washing apparatus.
6686. Williams, S. de la G... Lock bolts and nuts.

5th May, 1888.

6701. Battye, A. ..... Oil lamp.
6712. Craven & Craven ..... Pressing bricks.
6714. Ingram, G. ..... Extinguishing lamps.
6716. Garnett & Sawley..... Screws of gill boxes
6722. Bergh, W. ..... Milking machines.
6724. Brand, C. ..... Manufacture of paving blocks.
6727. Waddington, J. ..... Railway brake pipe coupling (*Massey*).
6728. Sturm & Schrader ... Wiring bottles.
6733. Haggenmacher, C..... Middlings purifiers.
6734. Imray, O. ..... Drying organic substances (*Richter*).
6745. Sutcliffe, T. ..... Stoppers for bottles.
6746. Lighbody, W. ..... Oil lamps.
6748. Steinbrenner, D. C. E. Anemometers.
6753. Atkins & Atkins ... .. Filtering apparatus.

7th May, 1888.

6757. Graetz & Kiesow ..... Lamp burners.
6759. Lucas, P. ..... Step ladders.
6760. Bell, J. H. ..... Preventing accidents and facilitating traffic in thoroughfares.
6762. Kay, T. ..... Tyres.
6764. Tucker, E. ..... Evaporating and concentrating liquids.
6770. Brown, J. ..... Handle for screw drivers.
6771. Cadman, C. W. ..... Packing for stuffing boxes.
6773. Calliphronas, T. ..... Clocks.
6776. Wagstaffe, Baron W. de..... Sight for fire arms.
6780. Williamson, J. C. ..... Cleansing the bottoms of navigable vessels.
6781. Michaud, J. ..... Damping apparatus for lithographic and zincographic presses.
6782. Battye, A. ..... Oil lamps.
6785. Johnson, S. A. ..... Lamps.
6790. Buck, T. ..... Cutting and loading bricks.
6807. Stuart, P. ..... Pavements.
6809. Edwards, E. ..... Sickles and scythes (*Von Löbbecke*).

8th May, 1888.

6813. Tennant, W. J. ..... Door checks.
6817. Turner, J. S. ..... Manufacture of boots.
6818. Jagger, E. ..... Stoves for heating soldering irons.
6826. Denniston, P. ..... Chimney cowls.
6827. Storrar, J. M. ..... Manufacture of candles.
6829. McLelland, T. G. ..... Lifting and loading earth.
6851. Hagemann, O. C. ..... Extracting moisture.
6853. Payne & Burstow ..... Burners for oil lamps.
6855. Crastin & de Pass..... Lamps.
6857. Westbrook, F. A. ..... Fire escapes.
6859. Utzon, M. L. ..... Mill stones.
6862. Defries & Feeny ..... Feeding oil for lighting and heating.
6865. Jones, E. ..... Thermometers.
6866. Blackstone, E. C. ..... Horse rakes.
6872. Thompson, W. P. ..... Rustless coating on iron and steel surfaces (*Wells*).
6874. Delf, F. D. ..... Retort stands.
6875. Favier, A. ..... Cartridges and detonators.
6877. Thompson, W. P. ..... Metallic wheels' rims (*The Warwick Cycle Manufacturing Company*).
6881. Macneill, T. ..... Uniform supply of oil in lamps and lubricators.

9th May, 1888.

6887. Holme, J. W. ..... Weavers' loom shuttle tongues.
6892. Crisp, W. ..... Rim and mortise lock.
6896. Pullon, J. T. ..... Drying and mixing cement.
6900. Spencer, G. S. ..... Bottles.
6905. Day, J. M. ..... Glass bottles.
6920. McIntosh-Valon and Brin's Oxygen Co.... Purification of coal gas.

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6923. Methven, J. ..... Lamps.
6925. Cousins, C. ..... Screens for cleaning corn.
6929. Challenger, G., & ors. Machines for striking cycloidal curves.
6931. Gibson, W. A. ..... Operating the valves of hydraulic elevators.
6932. Thomson, J. ..... Meters for water.
6933. Davies, E. A. ..... Manhole covers for metal tanks.
6935. Harmer, H. A. ..... Tightening wires.
6938. Neal, E. ..... Wedge joint for steel or iron rails.
6944. Lake, H. H. ..... Manufacture of blocks for building purposes (*Van Berkel*).
6947. Simon, H. ..... Mounting and driving of sieves.
6948. Macneill, T. ..... Oil lamps.

10th May, 1888.

6965. Brindley, J. ..... Gulley traps.
6973. Fallows, F. ..... Shuttle tongue for cops used in weaving calico.
6974. Hunt, J. J. ..... Stoppering bottles.
6975. Waser & Davonport ... Lamps.
6983. Armstrong & Armstrong ..... Locks.
7002. Mills, B. J. B. ..... Brakes (*Guetton-Danyon & Des Georyes*).
7003. Otway, G. ..... Cutting bricks.
7007. Royer, C. L. ..... Treatment of hides for belting.
7010. Matton, J. ..... Automatically extinguishing lamps.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

12th May, 1888.

1524. Mantle, A. W. ..... Thrashing machines.
6485. Bureau & Hendlé ..... Steam motors.
7033. Vosper, C. W. ..... Sewing machines.
7346. Smith, H. ..... Breech loading small arms.
7628. Walker, H. ..... Boiler and smelting furnaces.
7708. Foster, N. R. ..... Kilns and drying floors for the manufacture of cements and limes.
7729. Benton, C. H. ..... High speed steam engines.
7844. Michaelis, E., & others. Gig mills.
8128. Fabre, A. J. ..... Shuttle pickers for looms.
8161. Horrocks & Horrocks Pickers employed in looms.
8172. Ambler & Blackburn.. Steam boilers.
8331. Spencer, G. ..... Steam pressure reducing valves.
8417. Lister, H., & others ... Pickers for looms.
8450. Low, R. ..... Dovetailing machine.
8518. Garrett & Webster... Self feeding punching and eyeletting machine.
9447. Bansen, W. ..... Manufacture of hoop iron.
9531. Webb, E. ..... Apparatus for printing floor cloths.
9555. Quick, G. ..... Ordnance.
9581. Clark, E. S. ..... Manufacture of nails.
9603. Reynolds, O. ..... Friction clutches.
9615. Johnys, W. E. ..... Temples employed in looms.
9661. Ness, A. ..... Lubricating journals.
9664. Pearson, J. J. ..... Apparatus for drying sand (*McDonald*).
9671. Trelease, E. H. ..... Pneumatic brakes for railways.
9687. Christie, R. C., & others Gun carriages (*Canet*).
9860. Molyneux-Seel, E. H... Brake appliances for road vehicles
9928. Lang, J. ..... Slide valves.
9932. Finch, T. F. N. ..... Axles and axle boxes.
9969. Morton, R. G. ..... Crushing and grinding grain.
9989. Holden, I. ..... Apparatus for drawing of fibres in combing machinery.
10070. Kay, T. B. ..... Carding engines.
10151. Orton, R. H. ..... Combined brakes, buffers, and draw gear.
10230. Brayshaw, G. ..... Brake for the cylinders of lithographic and letterpress printing machines.
10398. Lloyd, F. H. ..... Crossings of railways.
10672. Barlow, H. B. ..... Manufacture of woven belting.
11187. Holroyd & Thompson.. Pressing woven fabrics.
11395. Clifford, I. E. ..... Shaft for screw propellers.
13436. Lea, H. ..... Gas engines.
15077. Chambers & Liddell... Lifeboats.
16420. Heenan, R. H. ..... Spherical engines.
16710. Edison, T. A. ..... Prime motors.
17561. Schneider & Werth ... Converting reciprocating into rotary motion.
192. Berry, H. ..... Applying varying degrees of pressure to hydraulic cylinders.
385. Bolton, J. ..... Sewing machines.
579. Walkden, S. ..... Eccentric.
3154. Binns, L. ..... Spinning and twisting machines.
3339. Evans & Hall ..... Generating steam.
3751. Imray, O. ..... Fish plates for railway rails (*Lee*).
4173. Swartzbaugh, J. H., and others ..... Spark arrester.
4431. Henderson, F. J. ..... Ball valves.
4696. Schenck, U. H. W. ..... Belt holders and shifters.
4925. Smith & Smith ..... Jacquard machines.
4973. Dowling, P. ..... Presses for hay, straw, wool, &c.
5213. Cox, R. ..... Machine for polishing glass, marble, stone, &c.
5240. Hague, W. ..... Protecting boiler tubes.
5244. Mauser, P. ..... Breech loading fire arms.
5325. Lake, H. H. ..... Manufacture of cut nails (*McKay*)
5326. Lake, H. H. ..... Washing machines (*Schumpe and Hammelrath*).
5335. Binns, L. ..... Spinning and twisting machines.
5338. Abel, C. D. ..... Treating textile fabrics with steam (*Koethe*).
5402. Mills, B. J. B. ..... Ships' propellers (*Bidauld*).

ELECTRICITY.

12th May, 1888.

6400. Schiller & Meyer..... Electromagnetic apparatus for the automatic lighting and extinguishing of gas lamps.
7189. Akester, W. H. ..... Secondary batteries.
8495. Clark, A. M. ..... Electric lamps (*Bertou*).
9598. Timmis, I. A. ..... Electrical apparatus for working railway signals.
2369. Orme, J. ..... Electrical signalling between driver and guard.
3246. Walker, F. ..... Electric lamp.
3303. Leigh, H. H. ..... Registering the consumption of electric energy (*Clerc*).

CHEMISTRY.

12th May, 1888.

6417. Marx, J. ..... Alkalies.
9227. Wigg, C. ..... Bicarbonate of soda.
9706. Clark & The Panther Lead Company..... Condensing and separating lead fume.
17625. Mitchell, C. ..... Gold washing machines.

MISCELLANEOUS.

12th May, 1888.

1816. Boult, A. J. ..... Bleaching vegetable tissues.
6555. Blackburn & Mori ... Lamps.
7046. Thorne & Burr ..... Lenses and reflectors for lamps.
8176. Eastwood, G. ..... Manufacture of moulds for stereotype plates.
8266. Cliff & Peto ..... Building block.
8306. Boult, A. J. ..... Velocipedes (*Renz*).
8949. Palmer, E. J. ..... Lamps.
9148. Cormack, J. H. ..... Doors for flues.
9199. Boult, A. J. ..... Cooling, heating, or purifying liquids, gases, and vapours (*Fischer*).
9280. Spencer, G. S. ..... Bottle stoppering.
9617. Harrison, J. ..... Metallic grit for cutting stone.
9711. Crastin, C. ..... Lamps.
9957. Trassl & Lindner ..... Manufacture of thin plates of glass.
11274. Rigby, J. S. ..... Whiting and cement.
13699. Singer & Judell..... Cleansing wool.
17130. Shelley, T. R. ..... Glazing roofs.
17853. Upsdale, J. ..... Manufacture of gloves.
17928. Chapman, G. J. ..... Cycles.
738. Smart, H. R. ..... Hydrodynamic ventilating apparatus.
2533. Hovde, A. G. ..... Lamp extinguisher.
3673. Rowatt, J. M. ..... Lamp burners.
3674. Lighbody, W. ..... Lamp burners.
4289. Dunn, B. S. ..... Gas and air comminglers.
4771. Hill, E. C. H. ..... Bottle.
4831. Nickels, B. ..... Filtering funnels.
4953. Westphal, C. ..... Production of water gas.
5001. Fahie, A. ..... Apparatus for counting boards (*Nielsen*).
5089. Campbell & Campbell Masts of ships.
5090. Heimsoeth, B. ..... Locks.
5203. Pontois, L. J. le..... Transmitting sounds to a distance by means of light.
5305. Petri & Hausmann..... Syphons.
5337. Abel, C. D. ..... Supplying cooled air to rooms (*Koethe*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(*To the 5th February, 1888, inclusive*).

Year 1884.

2289, 2291, 2292, 2294, 2298, 2301, 2302, 2308, 2311, 2313, 2316, 2317, 2318, 2320, 2324, 2327, 2330, 2332, 2337, 2338, 2339, 2340, 2351, 2352, 2353, 2355, 2357, 2358, 2361, 2364, 2365, 2366, 2368, 2370, 2372, 2374, 2377, 2379, 2382, 2383, 2389, 2392, 2393, 2395, 2398, 2399, 2400, 2403, 2404, 2405, 2406, 2408, 2410, 2413, 2419, 2420, 2423, 2428, 2432, 2433, 2434, 2435, 2437, 2440, 2441, 2445, 2446, 2447, 2448, 2451, 2454, 2455, 2458, 2459, 2461, 2465, 2469, 2474, 2475, 2477, 2485, 2487, 2491, 2495, 2498, 2499, 2500, 2501, 2512, 2513, 2515, 2517, 2519, 2522, 2523, 2524, 2527, 2528, 2530, 2531, 2532, 2533, 2535, 2536, 2540, 2542, 2544, 2551, 2554, 2557, 2559, 2562, 2564, 2565, 2568, 2571, 2576, 2577, 2578, 2581, 2582, 2585, 2589, 2593, 2601, 2603, 2604, 2609, 2612, 2614, 2615, 2616, 2618, 2621, 2622, 2624, 2626, 2627, 2628, 2630, 2632, 2633, 2634, 2638, 2639, 2640, 2641, 2642, 2643, 2645, 2648, 2650, 2651, 2652, 2656, 2662, 2666, 2674, 2676, 2678, 2685, 2686, 2687, 2692, 2694, 2695, 2696, 2697, 2698, 2699, 2704, 2705, 2706, 2707, 2708, 2713, 2715, 2716, 2720, 2722, 2724, 2725, 2726, 2728, 2729, 2732, 2736, 2738, 2741, 2743, 2744, 2748, 2750, 2755, 2758, 2764, 2767, 2769, 2773, 2774, 2779, 2780, 2782, 2784, 2787, 4760, 5152, 5567, 8800.

Year 1883.

469, 473, 493, 502, 563, 566, 585, 606.

Year 1882.

491, 496, 499, 524.

Year 1881.

411, 459, 489.

Year 1880.

486.

Year 1879.

369.

Year 1878.

397, 414, 415, 437.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Fuel Economisers.—*Sir E. Green, Wakefield*.—The object of this invention is to cause a rapid and more positive action of the reversing gear of the scrapers of fuel economisers, by arranging the upper part of the trip lever with a race, in which a rolling body has a free action to either end as the trip lever is lifted to a position just beyond the vertical, the rolling body suddenly moving to the outer end of the race to throw the

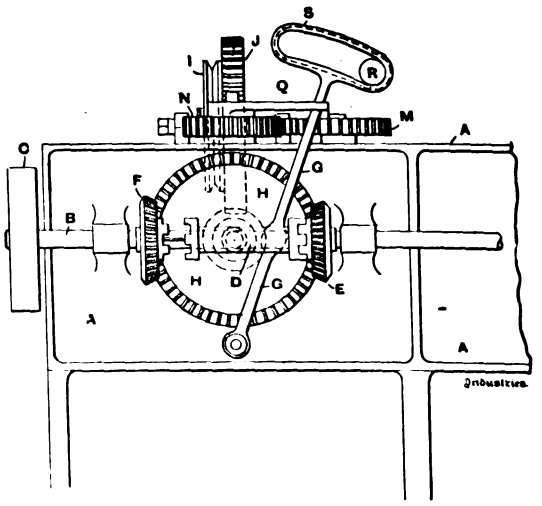


Fig. 1.

reversing gear over and so reverse the travel of the scrapers. In the figures, A is the upper frame carrying the shaft B, which is driven by a belt passing round the wheel C. A double clutch tube D is free to slide on the shaft B, and can engage with either of the clutch wheels E F when shifted over by the trip lever G. The clutch wheels E F both gear with a wheel H. The shaft on which the wheel H is mounted also carries a wheel gearing with the toothed wheel J. The scraper chain pulley is fastened to the wheel J by means of a bolt. The wheel J operates a pinion K which is fixed on the same shaft as the worm L, and the combination worm and spur wheel M communicates the motion to the wheel N, whose axis carries the

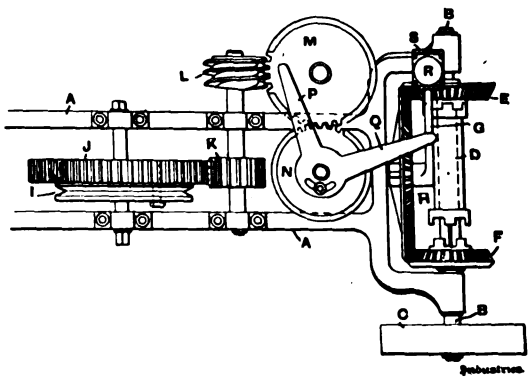


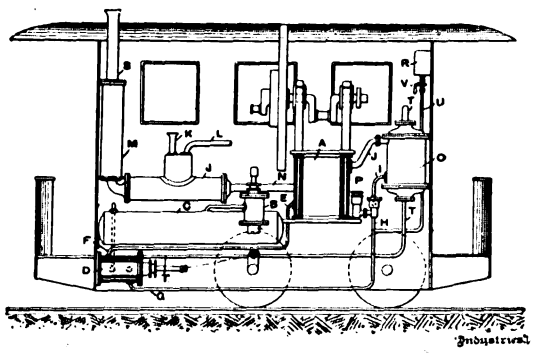
Fig. 2.

two arms P Q. These arms extend within reach of the trip lever G, and alternately move the lever back and forward; when the lever arrives at a position just beyond the vertical, the ball R suddenly moves to the other end of the race S, and causes the lever to move rapidly and to shift the clutch from one gear wheel to the other. These motions are arranged to take place when the scrapers have arrived at the end of their travel. The inventor claims: Providing the upper part of the trip lever of the reversing gear of a fuel economiser with a ball or other rolling or sliding body, which has a free action to either end for carrying the trip lever suddenly over, and for reversing the travel of the scrapers.—No. 7623. May 25th, 1887. 8*d*.

Shipping Coal.—*P. G. B. Westmacott, Newcastle-on-Tyne.*—The apparatus here described is designed for the purpose of transferring coal and other materials from railway waggons to the hold of a ship, with as little breakage as possible. A frame is pivoted at one end, and when horizontal it receives the shipping box on its pivoted side and the railway truck at the other end; a hopper is interposed between the box and the truck, and the box is carried upon a secondary frame which is pivoted to the main shipping frame. When a full truck has been run on to the frame its end flap is unfastened; the frame, with the hopper box and truck, is then raised and turned round its pivot, and the coal gradually runs down from the truck through the hopper into the box. After the truck has been emptied, the main frame is lowered to its former position, while the tilting of the secondary frame is continued until the box is in a vertical position, when it can be removed by a crane and emptied. These movements of the frames are generated by hydraulic power. For raising the main frame two cylinders are employed, a large one for giving the first part of the lift, and a smaller one for the latter part of the lift, which requires less power, on account of most of the coal having flowed towards the pivoted end. The inventor makes seven claims.—No. 8447. June 10th, 1887. 11*d*.

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COMBINED GAS AND COMPRESSED AIR ENGINES.—*E. Stevens, Brussels.*—These improvements are applicable to locomotives which are used on tramways. The gas engine is combined with the compressed air engine in such a way that the cylinders of each engine are covered with water jackets communicating with one another; the water is caused to circulate between them by means of a pump, for the purpose of cooling the gas cylinder and heating the air cylinder. The general arrangement is shown in the accompanying figure. The gas motor A serves two purposes, viz., to actuate the air compressing pump B, and to drive the pump P, which is employed to set the water in circulation. The pump B compresses the air into the receptacle C, whence the air passes through the air motor D and into the receptacle O. The gaseous fuel is composed of compressed air and the vapour of naphtha, petroleum, or other hydrocarbons. The exhaust gases from the gas motor A pass through a series of tubes inside the vessel J, in which is contained the hydrocarbon; the air enters at K, and the gaseous mixture leaves at L for the induction valve of the motor A. The products of combustion, after having evaporated the fuel, pass through the vessel M and pipe S into the atmosphere, and an asbestos lining is fixed inside the vessel M, for the purpose of deadening the puff of the engine. The air motor D is provided with a jacket in the same manner



as the gas motor A, and the tube E F connects the interior of the two jackets. The jacket of the motor D is connected by means of the tubes G H with the pump P, whose pressure tube I is led to the cooling apparatus O. The water of the two jackets is sucked into the apparatus O by the cooling action of the exhaust air from D. The air leaving the cylinder of the air motor enters through the tube T^1 into the interior of O, and escapes through the tube T^2, and the water sucked by the pump P through the pipe G H from the cylinder jacket enters through the pipe I into the space in O surrounding the pipes through which the cold air passes, and flows off through the pipe J to the jacket of the gas motor. To compensate for the gradual loss of cooling water, and to supplement the cooling effect of the vessel O, a small cold water reservoir R is arranged, from which the water can be let direct into the pipe G H through the pipe U. Three claims are made for the combination of the double walled cylinders D A with the chamber O and the pump P for the purpose of keeping up a constant circulation of the cooling water, for the carburetter, and for the silent exhaust apparatus M, as described.—No. 4843. March 31st, 1887. 8*d.*

GAS ENGINE.—*C. Davy, Sheffield.*—The object of this invention is to obtain a ratio of expansion of the ignited gases greater than that of their previous compression, and to effect the complete expulsion of the waste gases from the cylinder. These results are accomplished by causing the piston to make strokes of unequal length and at different positions in the cylinder, the length of the inhaling and working strokes being normal, and the compression stroke less and the exhaust stroke greater than the normal. Two cylinders are employed, and their pistons are coupled to the same crank; the four cycle principle on which the engine works is so timed as to make the first and third and second and fourth strokes take place at the same time in the different cylinders. The connecting rods are coupled to the crank through the medium of an equal armed tumbler or elbow lever, whereby at certain points of the revolution the positions of the pistons relatively to each other and to their cylinders are changed so as to cause them to make strokes of different lengths at different stages of the cycle. Four claims are made for this method, and for its applications.—No. 7677. May 26th, 1887. 8*d.*

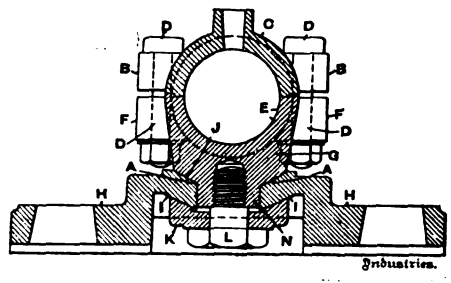
CHAFF CUTTER.—*J. Keeble & C. E. Mumford, Bury St. Edmunds.*—This chaff cutter is intended to be attached to a thrashing machine immediately behind the shakers, and an arrangement is made for throwing it in and out of gear as required. The cutter consists of a set of knives secured to a spindle, upon which they can be adjusted by means of screws, springs, or collars. The spindle is carried on two bearings which are also made adjustable to make up for wear. To a finger bar, consisting of an iron rod or tube, are attached a series of clips of iron corresponding in number to the knives; these clips surround the cutting edges of the knives, and come up close against the flat edges. A clearer bar is fastened to the back of the knives, in order to remove the chaff as it is cut; it consists of a rod or tube fitted with spikes, which can be adjusted by a screw to suit the position of the knives. At the top of the knives is a slotted bar which carries some material for sharpening the knives as they revolve, and a set of rakes driven by a crank serve to bring the straw up to the knives. Three claims are made.—No. 5217. April 9th, 1887. 8*d.*

PAPER PULP STRAINERS.—*R. Wood, Leith, Midlothian.*—In the machines to which this invention is applicable, a pulsating motion is imparted to the pulp, so as to draw it through strainer plates, which are fixed in a horizontal position in a shallow vat. In improving these parts, the inventor forms one or more openings in the bottom of the vat. In the ordinary pulp straining apparatus there are preferably two openings about 2ft. long by 18in. broad. On the edges of each opening is fixed a band of rubber of semi-circular section, with the convexity outwards, so as to act like a spring. The lower lip of the band is fixed to the edge of the bottom opening by means of an inner flat ring and screw bolts, and the upper lip is similarly fixed to a plate of the same shape as but larger than the bottom opening; this plate is connected by a rod to a crank on the rotating shaft below. The inventor claims the method of imparting a pulsating action to the pulp by plates moved by rotating cranks, and placed over openings in the bottom of the box, the plates being connected to the bottom of the box by rubber bands, as described.—No. 8591. June 15th, 1887. 8*d.*

MULES.—*W. Taylor, Oldham.*—The object of this invention is to prevent the snarls ordinarily occurring in yarn which is spun on the spindles near the headstock. When the carriage is being drawn in, the part of the carriage near the headstock springs and bends, and, in consequence, the yarn on this part of the mule becomes slack, and the cops are not wound tightly. This defect is obviated in the present invention by giving the spindles near the headstock a slightly greater speed than the rest. One or more lengths of the tin rollers on each side of the headstock are made of a slightly greater diameter than the others, or the wharves of the same spindles may be reduced in diameter; the desired result will be obtained by either of these two methods. Three claims are made, for giving these spindles a greater speed, and for the two ways of effecting it.—No. 9136. June 28th, 1887. 8*d.*

PRINTING MACHINES.—*A. H. Marinoni & J. Michaud, Paris.*—The machine is arranged to print on both sides, or on one side only with a single feed, or on one side only with a double feed; the special arrangements for printing in one or other of these methods have been described in Patent No. 11393 of 1885. In the machine for printing on one side only with a double feed, the cam carrier described in that patent is modified according to this invention; its two ends carry the cams which act on the rollers of the grippers of the delivery cylinders. These cylinders carry toothed wheels which gear with the wheels on the printing cylinders, and are of such a diameter that they make exactly a given number of revolutions while the printing cylinders revolve twice; the meeting of their grippers with those of the printing cylinders thus takes place every time the latter have a sheet to deliver to them. The sheets taken by the grippers of the delivery cylinders are either conveyed to the delivery by a set of tapes to be directed to the mechanical receiver, or are delivered by tapes above the receiving table and placed upon the table by hand. In order to enable the top of the type table to be easily uncovered, the rollers round which the tapes pass may be fixed to the feed table, so that in raising the latter the set of tapes will be raised at the same time. The tapes, which hold the sheets when they have been released by the grippers, may be replaced by balls of india-rubber. The inventors make three claims.—No. 8485. June 13th, 1887. 8*d.*

PEDESTALS FOR ROTATING SHAFTS.—*W. Hargreaves & R. Harwood, Bolton.*—The object of this invention is to allow for the self adjustment of pedestals in order to reduce the strain and friction due to errors of level or alignment. The body E of the pedestal is provided with a vertical stem G; the under side of the stem

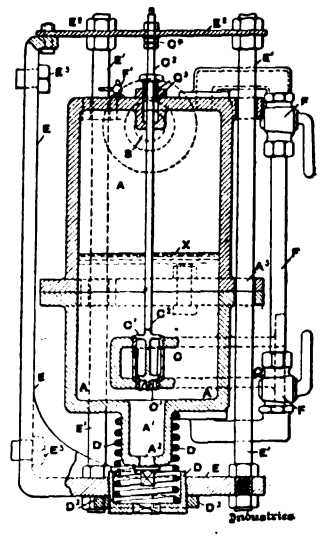


takes the form of a spherical surface, whose centre coincides with that of the bearing. The upper side of the base plate H is constructed with a concave surface A, which receives the convex end of the stem G. The under side of the base plate H is formed with a spherical surface I struck with a radius from the centre of the pedestal. This surface bears upon the disc K, which is secured to the pedestal and to the base plate. The base plate has a slot which admits the projection N; the slot allows the adjustable part of the pedestal to swivel longitudinally, but prevents it tilting laterally. The snugs F are cast on the body E of the pedestal, and receive the bolts D by which the cap C is secured. The base plate H can be provided with an oil dish if desired. This arrangement of the bearing and its supports allows of the self adjustment of the bearing. Two claims are made for this bearing and for another modification.—No. 6329. April 30th, 1887. 8*d.*

EXCAVATORS.—*J. H. Morgan, Liverpool.*—This invention relates to the grabs which are used in dredging and excavating. The jaws of the grab are pivoted to the shaft which carries the opening and closing gear, and also to a raising and lowering cross head. The jaws are made of one piece of metal, and their sides are shaped so as to overlap one another when closed. The arms pivoting the jaws to the raising and lowering cross head, and the outline of the lower edges of the jaws, are so regulated that the distance between the surface on which the opened jaws rest and the cross head decreases as the jaws close. The opening and closing gear consists of snail-shaped cams, which are connected to the cross head and to the raising and lowering chain by suitable flexible agents. For excavating, the grab is made of a number of blades threaded on shafts, to which the raising and lowering arms are pivoted; the blades are bound together by other shafts passing through eyes, and the whole is hinged to the opening and closing shaft by means of stay pieces. Seven claims are made.—No. 8328. June 10th, 1887. 8*d.*

COAL MINING.—*T. C. R. Horsfield & R. Porter, London.*—In cutting and boring the blast holes, the inventors make use of a specially designed hydraulic press, which consists of a metal cylinder, divided longitudinally into two parts. In the larger of these two portions there is a cavity passing through its length; and a series of holes, fitted with rams, are arranged transversely to this cavity, and in communication with it. The ends of the rams touch the other portion of the cylinder, and are provided with hydraulic leathers, in order to secure an air tight joint. On the admission of water to the cavity, the pressure is applied on the ends of the rods, which are consequently forced outwards. Three claims are made for the construction of the hydraulic press, with the cavity and the separate access for the fluid to each hydraulic ram.—No. 14344. October 21st, 1887. 8*d.*

STEAM TRAP.—*A. D. Marshall, Sydney, New South Wales.*—This improved automatic steam trap consists essentially of a receiver, which elastically retains its discharge valve in a tightly closed position, and is allowed a movement to discharge itself when a certain weight of water has accumulated. In the accompanying figure, A is the container or receiver, B is the inlet, and C the outlet; A^1 is a mud well, A^2 a plug, D a supporting spring, C^1 an equilibrium valve, C^2 its spindle, and F^1 the pet cock. The guide rods E^1 are firmly held in the saddle E and by the top plate E^2. The level of the water in the container having been determined, the saddle E is firmly bolted in position, and



the valve spindle is jambed to the plate E^2 by the nuts C^4, and the spring D is adjusted by means of the screwed socket D^1 until the water, which it is desirable should remain in the container, will retain the valve C^1 tight upon its seat. When the water rises above the desired level marked X in the figure, the extra weight will cause a depression of the spring D, and the container A will slide downwards on the rods E, and its seat will fall away from the valve C^1. The water will thus be discharged through the outlet C; when sufficient water has escaped the upward pressure of the spring D will cause the valve to close again. If desired, the equilibrium discharge valve may be constructed in a separate box fastened to the outside of the container; or the discharge may be regulated by means of a cock actuated by levers receiving their motion from the movement of the container. Four claims are made.—No. 12878. September 22nd, 1887. 6*d.*

ELECTRICITY.

ELECTROMOTORS.—*C. Coerper, Cologne, Germany.*—The armature and the field magnets are mounted on the same shaft, the field magnet being rigidly connected, and the armature loose. The two elements are fixed on the circumference of two equal wheels, which are placed side by side on the shaft. The driving wheels of the machine are also mounted upon the same shaft, and by the application of a brake to the loose armature the speed of revolution may be varied while the potential of the current remains the same. This invention is more particularly applicable to tram engines. Four claims are made.—No. 633. January 14th, 1887. 8*d.*

DYNAMOS.—*J. Swinburne, Chelmsford.*—This invention consists of an induction apparatus for studying dynamos, and for developing new types. It is at present almost impossible to calculate the results which will be obtained from a particular arrangement of the parts. According to this invention, a model is made to scale, which consists of the ordinary field magnets and armature. There is no commutator needed, and the terminals of the wire are used instead of brushes. The armature is not rotated, but is held in position in the field so that it can be moved round into any angular position representing a desired lead of the brushes. The induction through any part of the model is then measured by means of a pilot wire and a ballistic galvanometer. The galvanometer is calibrated by means of a pair of coils whose co-efficient of mutual induction is known. To find the "no load" curve of the machine, gradually increasing currents are passed round the fields, and the armature induction is noted by observing the motion of the galvanometer on the reversal of the exciting current. To take "full load" readings, a current is also passed through the armature wire; when both the armature and field circuits are reversed the induction is measured by means of a pilot wire, as the armature circuit alone is no longer convenient for the purpose. The distribution of the induction in the air space at different loads is measured by means of a pilot wire circuit. The change of induction through a section of armature conductor corresponding to one pair of commutator sections is taken by reversing the current in a model section without reversing the armature and field magnets. In the case of the alternating current machines, the "no load" curve is not obtained directly from the total induction through the armature circuit; but as the e.m.f. at any instant depends on the rate of change of the total induction, the curve is readily found. To obtain full data, a pilot wire is used, and the induction is determined at each armature position. As the models are apt to get very hot, the currents are manipulated

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by a switch, and the heating thus lasts only a short time. The inventor claims: (1) An induction apparatus consisting of a scale model and apparatus for measuring the induction in parts of the model, and (2) dynamos or motors constructed from data obtained from such a scale model.—No. 6219. April 28th, 1887. 6*d*.

Dynamos.—*H. Watt, London.*—One feature of this invention is the employment of a single core of circular form and of large sectional area, which is wound on the longshunt system. This core is placed at right angles to the armature spindle, and is provided with polar extensions. The armature coils are wound upon a flanged former of gun metal in such a way that the point of magnetic saturation shall only be attained when the machine is giving off a greater current than it is designed to produce. The periphery of the flanges of the gun metal former are provided with slots, into which are fixed pieces of insulating material for the reception of lateral copper bars. In another modification, the field magnet has a small iron core, round which is wound a highly insulated copper wire of such a length that it will have a very high resistance. A hollow cylinder of wrought iron of any convenient thickness is placed over the core and coil, and is afterwards wound with the same sort of wire as before. Over this cylinder and its coil is placed another cylinder, and any desired number of concentric cylinders and coils may be added, according to requirements. Three claims are made for the two forms of electromagnet, and for the armature.—No. 9853. July 13th, 1887. 8*d*.

CHEMISTRY.

Carbonate of Iron.—*T. Thompson, Edinburgh.*—This invention involves a method of preventing the reaction of sulphate of iron and carbonate of potassium until the medicinally prepared mixture of these two salts has been introduced into the stomach. Their water of crystallisation is first driven off, and dehydrated salts are mixed with either almond oil, vaseline, or gum, in order to prevent any moisture coming in contact with them. The mass is then made up into pills, which may be covered with gelatine. The salts are thus prevented from absorbing any moisture until introduced into the stomach, and the reaction of the two salts which is required in producing the carbonate of iron is delayed. One claim is made for keeping the moisture out by means of the medium mentioned.—No. 5419. April 14th, 1887. 6*d*.

Oxides of Iron.—*E. A. Jones, Middlesbrough, and F. F. Jones, London.*—This invention relates to the production of red and brown pigments, consisting of oxide of iron, from the scale which falls from the surface of iron when subjected to the operations of hammering and rolling. The scale is first pulverised, and then converted into sulphate by the action of oil of vitriol. The further treatment consists of calcining the sulphate in a furnace in order to drive off the sulphur. The furnace employed is of considerable height, and the powdered sulphate is fed from the top, so that it falls through the entire height. A pipe is provided at the lower end for the introduction of heated air, the supply and escape of which is regulated so that the pressure in the interior of the furnace shall be greater than that of the atmosphere. Cross bars are arranged in the inside to retard the fall of the sulphate, and a grate at the bottom serves to maintain the furnace at a suitable temperature. In a modification of this process, the pulverised scale is subjected to the action of a stream of heated air charged with acid or surcharged with oxygen, without the previous application of sulphuric acid. Three claims are made.—No. 7761. May 27th, 1887. 6*d*.

Glue.—*T. P. Milligan, South Orange, New Jersey, U.S.A.*—The glue stock is first washed in cold water, and afterwards with hot water. During these processes the wet stock is placed in a basket made of wire or rattan, or of any porous material. The receiver and the stock are then plunged in a tank of boiling water, and the stock almost instantly contracts and hardens, and loses about 40 per cent. of water. The shrinking of the stock can also be effected by directing a jet of steam over a thin layer of stock placed on a slanting floor. The shrunk stock is conveyed to a loft which is heated by steam. The temperature of the air is regulated between 125°F. and 170°F., as this is sufficient to melt the tallow and extract it from the body of the stock. When the stock is bone dry it is subjected to a bath of boiling alkali in order to remove the grease and tallow; and after the alkali has been rinsed off by cold water, the stock is ready for a final bath in a solution of alum. When the glue has remained in the alum for twenty minutes it becomes hard and ready for use. Seven claims are made.—No. 3393. March 6th, 1888. 6*d*.

Separation of Fusel Oil.—*I. Trauber & G. Bodländer, Hanover.*—In separating the fusel oil from aqueous wood spirit or ordinary alcohol, the inventors saturate the liquids with sodium carbonate, ammonium sulphate, or other salts. This mixture separates out into two strata, the upper one containing the fusel oil, and the lower one being a mixture of spirit and salts. Two claims are made.—No. 8387. June 10th, 1887. 6*d*.

MISCELLANEOUS.

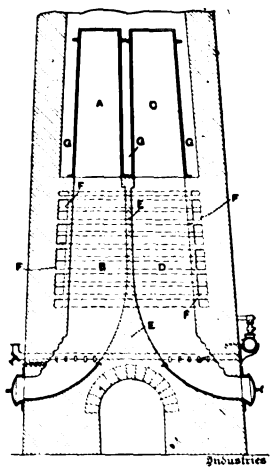
Guillotine Machines.—*H. H. Leigh, London. (P. J. Timoulin, Paris.)*—The inventor discards the use of wood and compressed paper for the tables of guillotine machines, and substitutes celluloid for them. The wood and paper tables become worn too rapidly; the celluloid also becomes worn, but it can be readily repaired by a composition specially invented. This composition is prepared by dissolving celluloid in a solution of collodion, pyro-acetic acid, or alcohol. Two claims are made, for the employment of celluloid, and for the composition for repairing it.—No. 9910. July 14th, 1887. 6*d*.

Metal and Asphalt Structures.—*W. Gürtler, St. Petersburg.*—A pattern of the structure is made of wood, and by its aid a frame work of iron and wire is woven in such a manner that the pattern forms a core; between the core and the frame work, sufficient space is left for forming the inner coating of asphalt on the frame work. The hot asphalt is applied on both the inner and the outer surface of the frame work, and it is pressed between the interstices. When the asphalt is cool the cores are removed and the surfaces smoothed. The metal frame work for tanks, pipes, or railway sleepers may consist of two helices of wire wound in opposite directions, and of vertical or longitudinal bars, which are arranged at distances apart between the helices, and securely attached to the wire. One claim is made for the manufacture of structures of metal frame work and asphalt, as described.—No. 7134. May 16th, 1887. 8*d*.

Utilisation of the Waste of Grain Mills.—*L. Rappaport, Breslau, Germany.*—The waste of flour and other mills, which consists of poisonous and useless seeds, has been found to contain a certain amount of oil and wax. These products can be extracted by means of mechanical pressure, or by the application of certain chemicals such as benzine, naphtha, ether, and the like. Four claims are made for the utilisation of the waste by these two methods.—No. 5270. April 9th, 1887. 6*d*.

Weaving Pile Fabrics.—*G. Burtscheidt, Dülken, Prussia.*—The object of this invention is to produce a pile fabric in a power loom, which shall have as firm and erect a pile as the hand made fabrics. For this purpose the inventor makes use of a binding in which the pile thread in the upper and lower grounds is bound between the two upper and lower warp threads. One claim is made.—No. 3587. March 8th, 1888. 6*d*.

Distilling Shale.—*R. M. Fraser & J. Snodgrass, Pumpherston, Midlothian.*—In the retorts used for distilling shale, the shale is passed down through them in a continuous stream; the oil is driven off principally in the upper parts, while in the lower end of the retort the shale is more highly heated, in order to extract the ammonia. The lower part is made of fire brick, and is heated by gas which traverses the flues in the walls of the



retort. In the figure A B C D represent a pair of retorts, the parts A C being made of cast iron, and the lower parts B D of fire brick. The retorts are separated from one another by a thin partition E. The flues F are formed round the lower parts B D for the passage of ignited gas, which afterwards passes into the oven space G surrounding the retorts A C. By this arrangement any overheating of the middle parts of the lower parts is avoided, and the heating of the two retorts is made more equal. The inventors claim in primary shale distilling apparatus constructing the heating flues of each pair of retorts on three sides, and separating the retorts by a partition which does not contain any flues.—No. 7867. May 31st, 1887. 8*d*.

Carding Cloth.—*H. Gerdes, Aachen, Germany.*—The ordinary cloth soon becomes useless by the carding teeth becoming bent outwards at their ends. The inventor has designed a new form of teeth, which will be more durable. The teeth are given a backward curve underneath in the joint piece of the two limbs; the bend is so great that the curve of one row meets the curve of the other row, and, consequently, the joint piece of one limb is held by the joint piece of two other limbs. Hence the joint piece of the limb lies with one surface on the drum, and the teeth stand free; the cloth or leather only serves the purpose of keeping the teeth upright in their proper position. The curve also prevents the teeth from bending outwards, because they are curved in two different planes. The giving way of the teeth is thus entirely prevented, even if the cards are drawn up loose. Two claims are made for the arrangement of the backward curve.—No. 2669. February 22nd, 1888. 6*d*.

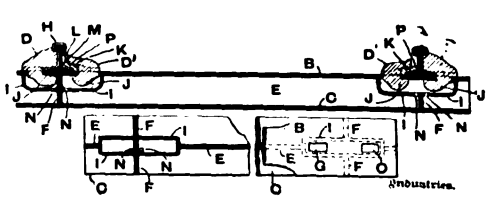
UNITED STATES PATENT ABSTRACTS.

Obtaining Alumina from Clay.—*F. J. Seymour, Findlay, Ohio.*—The process for separating alumina from clay described in this invention consists in first mixing the clay with a deoxidising agent and a flux and with copper, or some other metal of greater specific and atomic weight than aluminium, and in heating the mixture in a furnace. The mingled oxides which come off from the heating chamber are cooled and separately condensed. The silicia is first collected, and afterwards the alumina, together with the oxide of the other metal. Two claims are made.—No. 382197, dated 1st May, 1888.

Removing Fibre from the Seed.—*W. F. Corne, Cambridge, Massachusetts.*—A current of air is employed to blow the material against a rotating toothed surface inside the machine, and the same current of air is used for removing the resulting fibre from the machine. The casing over the rotating toothed surface is divided into a series of communicating pockets, each provided with a worm; the material passes successively through the pockets in its course through the machine. The pockets are separated from one another by check bars which have fingers protruding between the saws, in order to assist the latter in supporting the material and to prevent it from being carried beyond the check bars by the saws. Five claims are made.—No. 381616, dated 24th April, 1888.

Automatically Controlling the Supply of Water or Gas.—*L. Weil, New York.*—This invention relates to a method of automatically cutting off the supply of water or gas in a building or room when the doors are closed. An electric circuit and electromagnet are so arranged that when a certain mechanical movement such as the closing of the door takes place, the circuit is completed, a bell is rung, and the stem of the controlling valve is attracted by the magnet. There are seven claims for this arrangement.—No. 381866, dated 24th April, 1888.

Metallic Sleeper for Railways.—*H. L. de Zeng, Geneva, New York.*—The upper figure shows a vertical longitudinal section of the sleeper, and the lower figure a plan and a horizontal section of its ends. The sleeper consists of an upright central web E and a top and bottom flange B and C; and underneath the rails are two cross flanges F and the box enclosures I, the whole being cast in one piece. The mortises G O are made

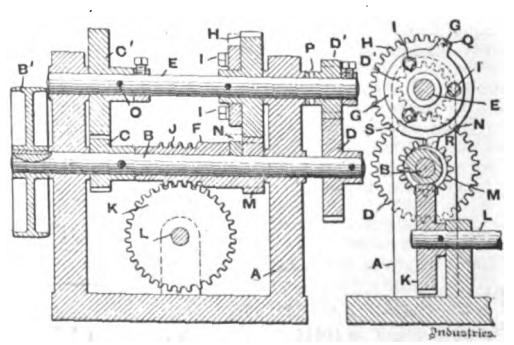


in the upper flange for the reception of the clips D D¹. In securing the rails to the sleepers, the clips D D¹ are inserted through the mortises, and a wedge P is placed as shown in the upper figure; the flange L intervenes between the rail and the clip D¹, and a headed key K, sliding in a groove in the wedge, keeps the clip D¹ firmly fixed in its place. Nine claims are made for the sleeper and for the fastening.—No. 380623, dated 3rd April, 1888.

Softening and Renovating Leather.—*L. C. de Villiers, Brooklyn.*—The present invention relates to a process for softening and renovating all kinds of leather. The articles to be treated are immersed in a mixture of soft water and salts of sorrel, with a definite proportion of oil, ammonia, and castile soap which is quite free from potash. After remaining in this solution for some time the leather becomes soft and pliable. One claim is made for the composition of this solution and for its application.—No. 381680, dated 24th April, 1888.

Knitting Machine.—*C. J. Appleton, Elizabeth, New Jersey.*—The improved machine is intended for straight knitting, and includes a set of horizontal and a set of vertical needles, with a yarn guide for each. The cams which operate the needles are so constructed and arranged as to cause the needles of each set to form the yarn supplied to them into rows of plain loops, and to interlock these loops with the corresponding loops formed by the other set; the loops of one yarn are made to lie wholly upon one face of the fabric, and the loops of the other yarn wholly upon the other face. Three claims are made.—No. 381898, dated 1st May, 1888.

Wire Netting Machine.—*B. Scarles, Clinton, Massachusetts.*—The present invention relates to a mechanical movement which is more particularly applicable to wire netting machines, and its object is to impart to the shaft L an intermittent rotation from the driving pulley B¹. The spur wheels C and D are fixed on the shaft B, and the pinion H on the shaft E. The pinions C¹ and D¹ are loose upon the latter shaft, and either of them may be fastened to the shaft by means of screws, according to whether the shaft E is to be rotated slower or



faster than the shaft B. The sleeve F fits over the shaft B, and carries a spur wheel M, a worm J, and a finger N. The wheel H carries a mutilated gear, as shown, and a projection G¹ to catch against the finger N. The worm J gears with a worm wheel on the shaft L. By the mechanism as described, an intermittent rotating motion is imparted to the shaft L. Two claims are made for the combination of the pinions C D C¹ D¹, the mutilated gear, and the projections G¹ and N, with the sleeve and worm gear.—No. 380666, dated 3rd April, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE IRON AND STEEL INSTITUTE.

In our previous issue we brought the report of the last meeting of this Institute down to the conclusion of Wednesday's proceedings. The first paper read on Thursday morning was by Mr. James Johnston, on

Continuous Moulding Machinery at the Works of M. Godin, at Guise, France.

This paper was prefaced by a short history of the works and an account of the economical and social conditions under which they are carried on. The paper itself contained a minute description of the machinery used in the moulding and casting of iron ranges for cooking stoves and other domestic purposes. Some diagrams were placed upon the wall, but these were drawn to so small a scale that it was impossible to distinguish the details, and consequently much of the value of the paper was lost to the hearers. We shall not attempt to abstract or reprint the paper at the present time, but shall do so when we have obtained a copy of the diagrams. There was hardly any discussion on the paper itself, most of the speakers pointing out that it was impossible to discuss the paper in the absence of specimen castings, or of sufficiently large wall diagrams to be seen by everybody in the room. In this connection Mr. Jeremiah Head suggested to the Council of the Institute that the means at the command of the Institute would be quite adequate for the appointment of a competent staff of draughtsmen organised in a similar manner to that of the Institution of Mechanical Engineers. These draughtsmen would assist authors by preparing wall diagrams for their papers; or if authors preferred to make their own diagrams, the staff of the Institute would give them such directions that these diagrams might be of a suitable nature for their proceedings. It was finally resolved to defer the discussion on Mr. Johnston's paper until the next meeting, when the author promised to exhibit specimen castings, and by which time the diagrams will have been published in the Proceedings of the Institute.

The next paper read was by Major L. Cubillo, of the Spanish Artillery Ordnance Works, Trubia, on

The Manufacture and Treatment of Steel for Field Guns.

A reprint of this paper will be found in another part of the present issue. The discussion was opened by Mr. Walker, of Leeds, who spoke in strong terms against the present practice pursued by the Government in testing guns. In his opinion the strains which were put on our guns in testing were so great as to permanently injure them, and he pointed out that the Germans do not test their guns in the same barbarous manner. It was, no doubt, very gratifying to the manufacturer of a gun to find that it would throw a shot to a distance of twelve miles, and produce a muzzle velocity exceeding anything which had been done before; but the ultimate object of our guns was not to perform extraordinary feats, but to protect the country, and the guns after having been tested in this manner were not reliable. He did not agree with the author regarding pot steel, and thought that if they wished to make steel of the very highest quality it was necessary to make it in the crucible and start with the very best materials they could obtain, carrying out the process of steel making step by step, and in the most careful manner. If they had to deal with very large ingots the steel should never be allowed to cool down, but must be worked with the least possible delay. It was only in this way that they could avoid the variations of carbon in different parts of the piece, which variations greatly impaired the strength of the gun. His firm had made some very large steel castings, and to get uniformity they had found it necessary to run the metal in at the bottom of the mould, and to use large heads so as to put the whole of the metal under considerable pressure. The results obtained with this method were very satisfactory. He had no doubt that the most perfect steel castings could be obtained by the method suggested by Sir Henry Bessemer, and so ably carried out by Sir Joseph Whitworth, of compressing the steel whilst still in the liquid form, or even when in a semi-liquid form. This was much preferable to letting the casting get cold and re-heating it afterwards. The process of cooling the inside of the ingot, referred to in the paper, was not a good one, and they would not improve the quality of the steel by running cold water through the hot tube. He preferred to improve the quality of the metal by giving it plenty of work, and the time was not far distant when, instead of the noisy and rattling steam hammer, which shakes the inside of the steel to pieces, the metal would be quietly kneaded into compact and solid masses by the hydraulic press. His firm had made a press for Sir John Brown, which was used in the manufacture of some large ingots, which were ultimately worked into shafts, and even the workmen who turned these shafts on the lathe noticed the difference between the material thus produced and that usually obtained when the steam hammer was used. In point of cost the press has also a great advantage, and the speaker thought the same work could be done for one-fourth of the expense as compared with that of the steam hammer.

Mr. Edmonds, of the Woolwich Arsenal, regretted that General Maitland was not present to discuss the subject of testing the guns by heavy charges. The speaker, however, did not agree with Mr. Walker in his criticism, and pointed out that it was the usual practice amongst engineers to test machinery beyond its working load. Opinions might differ as to the amount of the test, but they were all agreed that such testing was a safeguard. When guns were properly made they were in the tests never strained beyond what they were able to stand. The object of proving the gun was to ascertain that all its parts were of reliable material, and had been properly made. In his opinion it would not be fair to the gunners and to the country to test a gun only with the usual charge of powder and then send it out for service. He noticed that the paper simply dealt with crucible steel, and with only very small guns. No difficulty was experienced in making steel for small guns, and he considered that almost any kind of steel would do for that purpose. The steam hammer would at no very distant date be superseded by the hydraulic press, and it would only be by using the latter that they would obtain good work. He did not altogether agree with Mr. Walker that a very large amount of work must be put upon the steel. If that were done, and if the forging were drawn out into a long piece and then tested both longitudinally and transversely they would find a great difference, not only in the strength of the material, but also in the elongation. He contended that this was due to the hammer, and that if the hydraulic press were employed instead a much more homogeneous material would be obtained. With reference to the tempering of the steel, he was of opinion, until recently, that this improved the metal; but from a few recent trials which he had made he was not now so sure that this was the case, and in this connection he was about to make an exhaustive series of experiments.

Mr. E. H. Carbutt said that he had for the last eighteen months had great doubts as to the efficiency of oil tempering, and he thought that when more experiments had been made it would be found to be rather a question of annealing. He had been a member of the committee appointed by the Government, and in this capacity he had visited all the works in this country where forging presses were employed, and he could confirm all that Mr. Walker had said regarding the superiority of the press over the steam hammer. The first press put up by Sir Joseph Whitworth owed its existence to what at the time seemed a misfortune. The speaker had made a large steam hammer for Sir Joseph Whitworth, but some neighbours complained of the noise and vibration, and this led Sir Joseph Whitworth to turn his attention to the question of using a press instead. The advantage of the press was that the centre of the ingot was not wasted, as the tube could be worked on a large mandrel, and thus there would be pressure inside as well as outside. He had recently ascertained from a Russian officer that at the Russian Government Works they used a Whitworth press for compressing steel in the fluid state. Anybody who had seen the beautiful exhibits of Sir Joseph Whitworth & Co. at the Manchester Exhibition must have come to the conclusion that the press is the instrument of the future. The speaker could not agree with Mr. Walker regarding the advantages of pot steel over Siemens-Martin or open hearth steel. When they came to deal with masses up to 50 tons, they could not make as good an ingot with pot steel as they could with the other material, and it was well known that every tube with which difficulties had been experienced at Woolwich was made of pot steel. He also took an entirely different view from Mr. Walker on the question of testing guns. He himself had blamed the Government for not having tested sufficiently, and he contended that it was far better to occasionally over-test and destroy a gun with a view to ascertain exactly what their guns would stand than to go on spending enormous sums, and remain in ignorance of the real nature of these weapons. If the country was to maintain its position, it could only do so by continually improving the guns, and this was impossible without experiments.

Sir Henry Bessemer said that his attention was first directed to the manufacture of iron and steel when he endeavoured to find a suitable metal for guns. He had come to the conclusion that a sound steel casting could not be made without pressure. In an ordinary iron casting they had a pressure of at least 15lb. per square inch, being that of the atmosphere; and if they attempted to cast in a vacuum, the casting would be extremely spongy. His first idea was to force a ram into the liquid metal, and thus put pressure upon it; but there were obviously conditions under which this method could not be applied. For instance, a locomotive crank could not be made in this way, as the webs would simply close up under the pressure of the ram. The method was also inapplicable to the casting of a cylinder, and he therefore suggested another method, under which the whole mould would be put into a closed steel cylinder, and after casting the cylinder would be put into communication with vessels containing gases under high pressure. By this means they would get a uniform pressure over the whole area of the casting, precisely as they now get a pressure of 15lb. over the area of ordinary iron castings. He had ascertained by experiment that if an inch cube of steel were laid upon a steel ingot heated to the usual forging heat, and if a pressure of 3 or 3½ tons were applied, the cube would be forced bodily into the mass of the ingot, and would disappear. He therefore came to the conclusion that a pressure of 4, or, at the outside, of 5 tons to the square inch would be ample to compress the steel to as great an extent as it was compressed by the steam hammer. The steam hammer, although an excellent instrument for small forgings, had the great defect when applied to large forgings of compressing only the outer portions, since the inertia of the large mass underneath would prevent the pressure from being transmitted to the interior. With the hydraulic press this difficulty vanished, and they could operate on the mass equally in all directions. He believed that if the casting while still fluid were subjected to a pressure of 5 tons, or even more if desired, it would when solidified be so dense that no forging or other method of subsequent compression would be required.

Mr. J. W. Spencer, who has had great experience with both crucible and Siemens steel, thought that better results could be obtained with the latter than with the former. He admitted that the press might be a better instrument than the hammer for large masses; but he thought that the best way to get over the difficulties connected with the treatment of large masses would be to cast them, not in the form of an ingot, but more nearly in the shape in which they were ultimately required. He agreed with the President in considering tempering an objectionable practice, and in all probability the material was rather injured than improved by it. The speaker next referred to Major Williamson's plan of building up guns in layers which contained different amounts of carbon. The hard steel would be put into the centre, and protected by milder steel on the outside, and the whole would be heated together to a welding heat, and then treated with the steam hammer, the press, or the roll. The presence of the mild steel on the outside would protect the inner layers of hard steel from the action of the air.

Mr. J. Y. Hall thought that heavy guns could be made in the form of plain steel castings equally as well as in their present built up form. It would, however, be necessary to apply a judicious system of tempering and annealing, so as to distribute the strains equally throughout the mass of the metal.

The President thought that steel makers had yet something to learn, both as regards uniformity of material and economy in manufacture. When they considered that 35 per cent. of the ingot had to be cut off at the top, and 5 per cent. at the bottom, they would agree with him that improvements in their method of producing steel were desirable. He agreed with Sir Henry Bessemer's suggestion to consolidate the casting by gaseous pressure, after which no subsequent working could give the metal greater strength or endurance. The records of strength and elongation in the paper were obtained by using a testing machine of only 60 tons, and on this account they were not so reliable as might be wished. The results obtained with a small test piece of about half a square inch area could not be taken as an indication of what would be found if test pieces 4in. or 5in. in diameter were pulled asunder. In the smaller test pieces, the outside and inside were affected almost equally; but with large test pieces the stresses would not reach the interior so quickly as they reached the exterior. If they had a machine sufficiently powerful for testing large pieces, they could arrive at a definite conclusion whether oil hardening was advantageous or not. It had been stated that a large amount of work put on to the metal would increase its strength and endurance, and they all knew that a 30-ton metal when drawn into wire might easily have a breaking resistance of 60 tons; but they should remember that this work took place when the metal was cold, and was, therefore, different from the work usually put on forgings. Moreover, the increase of strength was only attained with comparatively small masses, and if the results were applied to large masses they might be misleading. He could not agree with Sir Henry Bessemer's objection to the use of a ram for producing the pressure in the casting, for if the pressure were applied whilst the metal was still fluid, it would be transmitted to all parts of the casting equally. He had no doubt that the press would ultimately replace the steam hammer for large work. It was not only quicker in action, and produced a better forging, but it also minimised waste. He had seen a magnificent steel shaft, 17in. diam., and of great length, made by Sir Joseph Whitworth under a press, and the work was turned out so true that it required only $\frac{1}{16}$th of an inch to be turned off the surface to finish it. Referring to the question of testing guns, he deprecated the method of putting abnormal strains upon the material,

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because of the permanent injury which may result from it. The test strains should not greatly exceed the greatest strain which could by any chance come upon the metal in actual service. The Admiralty had already abandoned the old method of testing boilers to twice their working pressure, and were now satisfied with a test pressure equal to the working pressure plus 90lb. per square inch. This was obviously a step in the right direction, and he thought that a similar system might be adopted in testing guns. It was out of the range of possibility that a gun which in regular service had to stand a pressure of 20 tons to the square inch could at any time be strained to double that amount. It would therefore be sufficient to simply test the gun with such a charge as to increase the working pressure by a moderate and definite amount, which would serve to show that the material was sound and that the gun was properly designed and made. He had for some time held the opinion that tempering in oil was not only undesirable, but absolutely injurious. A paper was read on the subject by Professor Akerman at their Düsseldorf meeting, and afterwards that gentleman sent him specimens the tests of which he had intended to publish in a paper at the Institution of Civil Engineers, but pressure of other work had prevented him from writing this paper. He had, however, made 180 tests, and had found, almost without exception, that oil tempering when applied to large masses proved injurious. They must remember that in a gun there were concussive strains, and for this reason it was undesirable to employ a material in which there already existed internal strains. Some years ago it was considered satisfactory if a gun tube had a strength of 20 tons circumferentially and of 12 tons longitudinally, whilst now they could obtain a metal carrying from 28 to 30 tons in both directions. He, however, did not think it wise to push the increase of strength too far; they might get a lighter gun with a higher carbon metal, but if he had to work a gun in a turret he would prefer the gun to be made of a somewhat lower and more ductile metal, because if it came to grief it would do less damage than the stronger metal.

The next paper read was by the same author on

Steel Castings for the Manufacture of Guns.

In this paper the author pointed out that the high price of steel forgings for the manufacture of guns and the expensive plant required in the process had induced many artillerists and engineers to consider whether it would be possible to produce reliable artillery from steel castings. If at the end of a heat of the Martin-Siemens process ferro-silicon-manganese be added to the bath, a casting can be produced containing ·28 per cent. of carbon, of 29 tons strength and 5 per cent. elongation. This metal differed widely from forged steel tempered in oil of the same percentage of carbon, it being most deficient in ductility; yet this cast steel was very superior to cast iron, having twice the tenacity and eight times the ductility. Its point of fusion being higher, it was also more adapted to resist the high temperature produced in the bore of the gun when fired. It would thus appear that although cast steel guns could not compete with forged guns, they had yet a great advantage over iron guns, which were still used in some countries for reasons of economy. In the manufacture of howitzers, which are subjected to relatively small pressures on firing, steel castings could be employed without inconvenience.

In the casting, during the process of cooling, crystals were formed, and it was well known that their size depends not only on the rapidity of cooling, but also on the greater or lesser mobility of the molecules when cooling. If the casting be heated to a temperature greater than the point B of Tchernoff's scale, and then immersed in a refrigerating medium, the amorphous texture acquired by the steel at that temperature was preserved, and was practically the same as that of forged and tempered steel. When an ingot was heated to a temperature superior to the point B, and then worked by the steam hammer or the hydraulic press, the continuous mobility imparted to the molecules prevented crystallisation, and the texture of the metal was amorphous and fine grained. They would remember the paper read by M. Pourcell at the Vienna meeting, which demonstrated that it was possible by tempering steel castings at different temperatures to manufacture a metal which could compete with forged and tempered steel. The Terre-Noire Company, at the Paris Exhibition of 1878, also showed a cast tube which had fired one hundred rounds, and in which the deformations were smaller than those occurring in a forged tube equally tested; but the most practical and severe trials of tempered steel castings have been made in Sweden, at the Böfors Works. The materials charged in the Siemens furnace for the castings were the following:—

Swedish pig iron of superior quality	26
Spiegeleisen, 12 per cent. manganese	6
Swedish iron scrap	63
Ferro-silicon-manganese	5
	100

The percentage of carbon was ·37 in the first experimental gun, and the tubes and breech pieces were cast solid. After firing 322 rounds with extraordinary charges in this gun, five new guns were constructed, and the test pieces taken from the heads of the castings gave the following results:—

Percentage of carbon.	Elastic limit. Tons per square inch.	Tensile resistance. Tons per square inch.	Elongation. Per cent.
0·30	21·5	38·9	21·0
0·30	22·3	40·5	20·0
0·35	24·3	38·4	21·2
0·37	29·9	50·7	14·8
0·38	24·3	45·4	19·0
0·38	33·3	54·9	9·0
0·39	25·3	43·0	14·0
0·35	15·2	38·63	15·0

Four of these guns, three of which were 3ft. 2in. and one 4ft. 6in., were submitted to trials. One of them burst at the round 2152, another had its breech piece cracked at the round 2154, whilst the third only showed a small expansion in the most advanced part of the powder chamber. These results seemed to indicate that castings properly tempered could be employed without any risk in the construction of field guns, and the reason they were not employed for larger guns seemed to be the fear that notwithstanding all precautions observed in the casting process, there might be left in the inner parts of the tubes and breech pieces some cavities which would weaken them.

Recently, in the United States, a 6in. Bessemer steel gun had been cast with complete success; but the author did not know if this gun would be built up or made of a single tube, nor whether it would be tempered at different temperatures. He did not consider that the Rodman process would present any inconvenience when applied to cast steel guns; but owing to the difficulty of establishing the ratio between the water passed through the bore in a certain time, and the initial tension required by the different films, he considered the built up system the only method of producing guns so powerful as the physical qualities of the steel permit. When a built up gun bursts, the accident was not necessarily the fault of the system, but might be due to bad shrinkage, or defective design, or to the bad quality of the steel.

The discussion on this paper was opened by

M. Gautier, who referred to a paper he had read on the same subject at a previous meeting. He had seen the first gun made by M. Pouriel, at the Terre-Noire works. Rodman's process of cooling the metal by a stream of water sent through the bore of the gun had been found of great advantage in cast iron guns, but he did not know whether it would be equally valuable in steel guns. It would be remembered that the first wrought iron armour plates were made in France. They were only 4in. thick, and to avoid crystalline structure, they were brought to a red heat, and hardened in water. When they used mild steel, they were still troubled by the crystalline structure, and to avoid this they hardened in oil; but this was liable to produce cracks. Recently, the method of hardening in lead by dipping the plate into a bath of molten lead was introduced, and this would give the steel, with a high percentage of carbon, an intermediate condition between hardening and annealing.

Mr. J. A. Pease, as an advocate of steel castings, felt himself disappointed at the concluding sentence of the paper, which was to the effect that forged metal must be exclusively used in the construction of guns. This statement, which was perhaps made unintentionally, was completely at variance with the rest of the paper, which was evidently written to show that steel castings could be used for artillery purposes. The facts reported in the paper ought to outweigh the antipathy which many persons had to cast steel guns, and the speaker thought there was a good prospect for such guns.

Mr. J. W. Spencer was pleased with the results recorded in the paper. Some eight years ago a conference was held at Elswick, when he suggested to make a gun in the form of a steel casting, but Lord Armstrong laughed at the idea. At that time he was doubtless right; but since then events had shown that his original suggestion was feasible, and that it would ultimately come into use. At the last Newcastle Exhibition he had a cast tube for a 10in. gun, and tests made showed that the material was superior to the forged steel employed by the Woolwich authorities. He felt certain that cast guns could be made equally as strong as forged ones. They could cast very nearly to the size of the finished gun, and obtain a perfectly homogeneous material throughout the piece. He was totally opposed to oil hardening, and thought it moreover unnecessary, as another method had been invented which would produce the right molecular condition of the casting. He was, however, not at liberty to disclose that method.

Mr. J. D. Ellis also commented on the contradictory language of the paper, and confirmed the previous speaker's statement that steel castings could be made to stand almost as severe tests as forgings; but he would remind them that, notwithstanding all improvements, they would sometimes find at the bottom of the casting a few cavities which would weaken the piece, and might lead to a serious disaster. By the present method of making guns they could ascertain that the metal used was sound throughout, and for this reason he would not advocate a departure from the built up gun. He objected to the word tempering being used in the sense in which it was used in that discussion, as the process was not tempering, but simply one of hardening.

Mr. Edmonds, of the Royal Arsenal, drew the attention of the meeting to the fact that they were in reality discussing two questions, the first whether they should substitute cast for forged guns, and secondly, whether their guns should be all in one piece or built up. If they had a cast gun it need not necessarily be in one piece, and if steel makers could furnish them with castings of as good a material as the present forgings, he saw no reason why guns should not be made of this material, on the built up principle.

Mr. James Riley from his own experience felt satisfied that steel castings could be made equally as strong as forgings, and considering the heavy tests to which the guns were subjected, the presence of cavities in the casting and of weak spots would be immediately detected, so that the guns when they had passed the tests would be perfectly safe for service. He also directed attention to the fact that cast guns would be much cheaper.

Mr. E. H. Carbutt referred to the difficulty which the Government had in obtaining guns. They had now nine ships built, engined, and ready to go to sea, but no guns for them, and therefore he believed the authorities would be quite ready to adopt any improvements which would facilitate and accelerate the manufacture of guns. The reason they were behind with the guns was, that although they had sufficient forging power they were short of lathes where these heavy pieces could be turned, and if they could cast some of the outer rings it would greatly lessen the labour in turning, so that guns could be produced more quickly.

After a few words from Mr. Walker and the President, the discussion was concluded, and a paper was read by Messrs. Pattinson and Stead on

The Behaviour of Arsenic in Ore and Metal During Smelting and Purification Processes.

In this paper the authors pointed out that the literature on the subject was extremely meagre. They had made a special study of it for some time, and they now laid the results of their investigations before the Institute. It was well known to many analysts that arsenic in small quantities was widely distributed, traces of it being found in most ores, especially those of a sulphurous nature, and a table was given of various ores in which the arsenic varied from nothing to over 1 per cent. In pig iron the average quantity of arsenic is about ·03 per cent., but may occasionally rise to ·15 per cent. It was a prevalent idea that arsenic might be expelled from the ores when they were smelted, and in order to test this point experiments were made with arsenical pyrites calcined in open hearth vessels with free access of air, with and without the presence of lime, and in closed vessels in a reducing atmosphere. These experiments showed that the greater part of the arsenic was rapidly removed in the absence of lime by open calcination, but that it was difficult to expel the last traces, and that practically no arsenic was removed from iron and manganese ores when only small quantities were present to begin with. Lime was found to have an important influence in preventing or retarding the volatilisation of arsenic. A further series of experiments was made to ascertain the behaviour of arsenic in ores during the process of smelting in the crucible and in the blast furnace, and the majority of these experiments showed that nearly all the arsenic introduced with the ore was also found in the pig. Careful examination of the flues of blast furnaces had not revealed more than the presence of traces of arsenic in the dust. The authors had analysed some of the iron ore deposits in the neighbourhood of Civita Vecchia, which contained a large percentage of arsenic. Near a disused charcoal blast furnace they found several small pigs of metal, which were carefully analysed, and from the results of these analyses they had come to the conclusion that practically speaking the whole of the arsenic introduced into the blast furnace in iron ores was concentrated in the pig produced, and did not go off with the escaping gases, as was often supposed.

The next point dealt with was the behaviour of arsenic in the process of converting pig iron into steel. The authors showed that no arsenic was removed by the acid Bessemer process, and a similar result was found with the acid open hearth process. With the basic Bessemer process the blown metal contained a slight increase of arsenic, which was obviously only a relative increase due to the removal of other substances, and with the basic open hearth process similar results were obtained, a metal containing 3·21 per cent. of arsenic before treatment containing 3·39 per cent. after treatment.

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Regarding the physical effects of arsenic, the authors pointed out that hematite pig made in the Cumberland district, although containing ·04 per cent. of arsenic, was exceptionally suitable for making steel, and that therefore this quantity of arsenic would not have a deleterious influence. They had also met with very good mild steel containing as much as ·2 per cent. of arsenic, and they concluded therefore that this element had not the same injurious properties as phosphorus. On the whole the presence of arsenic in larger percentages must, however, render the material brittle. The paper concluded with a description of the method of determining the percentage of arsenic in iron and iron ores.

The discussion of this paper was taken together with that on a note by Messrs. F. W. Harbord and Alexander E. Tucker on

THE EFFECTS OF ARSENIC ON MILD STEEL,

in which the authors pointed out that no systematic experiments had as yet been made to determine the effect of arsenic on wrought iron or mild steel. They had investigated this question, and adopted the following method in their researches: A rich alloy of arsenic and iron, practically free from other metalloids, was first made by heating drillings of mild basic steel to redness, and then dropping metallic arsenic into the pot. The alloy was fusible at a full red heat, and was re-melted to insure uniformity, and poured out on to an iron plate. Varying quantities of this alloy were melted in an ordinary 56lb. clay pot, and mild steel, taken from a Bessemer converter, was teemed into the pot from an ordinary casting ladle, and in this way a series of twelve alloys of basic steel varying from ·07 to 1·2 per cent. was obtained. Some samples were also made with blown metal; but on account of red shortness these were discarded. The small sample ingots were rolled down to 1⅛in. round bars, and the behaviour of each was as shown in the following table:—

EFFECT ON ROLLING.

No.	As.	Effect.
0	nil.	Rolled perfectly.
1	0·070	„ „
2	0·093	„ „
3	0·171	Rolled fairly.
4	0·191	„ „
5	0·233	Rolled poorly.
6	0·350	Rolled fairly.
7	0·460	„ „
8	0·497	„ „
9	0·531	„ „
10	0·662	„ „
11	0·921	„ „
12	1·184	„ „
	From blown metal.	
13	0·05	Rolled very badly.
14	0·083	„ „
15	0·148	„ „

The bars were cut into suitable lengths for tensile tests, cold bending, plating, and welding, and by these tests the authors found that a percentage of arsenic not exceeding ·170 did not appear to affect the bending properties of steel at ordinary temperatures. Above this percentage cold shortness began to appear, and rapidly increased until with a percentage of 1 per cent. the metal became exceedingly brittle. If ·350 per cent. of arsenic was present it was found impossible to make a sound weld. Below that quantity the metal could be welded and easily plated out at full red heat. A percentage of arsenic not exceeding ·66 per cent. raised the tensile strength in a marked degree, but above this percentage the strength again diminished. Arsenic lowers the elastic limit of steel in a marked degree. On the whole, the authors considered the effect of arsenic on iron and steel as the reverse of beneficial.

In the discussion which followed the reading of these papers, Mr. Blair, of Stockton, read a long statement in which he referred to previous investigations made by chemists on the effect of the rarer minerals on iron and steel, and pointed out that the effect of those elements which hitherto had not been usually taken into account might at times be of great importance. English metallurgists were generally satisfied when they had determined the quantity of carbon, phosphorus, sulphur, silicon, and manganese; but they did not, as a rule, test their samples for the presence of arsenic, copper, and other elements. German and Swedish chemists, on the contrary, were very careful to search for almost every element which might possibly be contained in the sample, and if they followed that example they would not hear so much of the mysterious behaviour of steel or the treachery of this material: terms which were really applied to hide our ignorance. The more closely English chemists would push their inquiries regarding all the elements which might be contained in steel, the more perfectly would they understand the behaviour of this metal.

Mr. E. Riley had taken great interest in tracing phosphorus and arsenic in connection with steel and spiegel for the last twelve months. He would give the credit of having first obtained arsenic out of pyrites over thirty years ago to Dugald Campbell, who had also discovered the presence of this element in hematite ores. Some ten or twelve years ago there was found a large quantity of watery deposit in a pocket in a hematite district, from which he had made some steel, which contained a large quantity of arsenic. He made the steel into drills, but found it very brittle. The speaker pointed out that arsenic occurred very frequently in spiegel and ferro-manganese, and many of the differences found in analyses might be due to the fact that arsenic was occasionally estimated as phosphorus. In their present method of determining phosphorus the whole of the arsenic was eliminated as chloride of arsenic, provided they boiled the solution for a sufficient time; but if they neglected this precaution part of the arsenic present would be estimated as phosphorus, and thus they might get in a certain sample ·055 per cent of phosphorus, whereas, in reality, more careful analysis would have shown ·013 per cent. The practical bearing of this question was of great importance, since it had become a common practice to guarantee the phosphorus to be below a certain point when selling cargoes of iron and iron ore, and it was therefore important that the phosphorus should be ascertained separately from the arsenic. He had recently a cargo of iron ore submitted to him and he made the phosphorus ·037 per cent. The same cargo was also submitted to Messrs. Pattinson & Stead, who made the phosphorus ·044 per cent., and this discrepancy he considered was not too great for practical purposes. They all knew that they could not determine phosphorus to a $\frac{1}{1000}$th per cent., and they would be quite satisfied if they could determine it to $1\frac{1}{00}$th per cent.

Mr. E. Tosh confirmed the statement of the previous speaker, that arsenic was often mistaken for phosphorus in the usual chemical analyses applied to samples of iron and steel; but the investigations of Mr. Stead and of the authors showed that arsenic was not nearly so injurious an element from an engineer's point of view. Now, if iron or steel contained ·04 per cent. of phosphorus and ·04 of arsenic, it would be considered a good material; but if the arsenic were mistaken for the phosphorus, its percentage would be returned as ·08, and this material would be rejected. Sellers of pig iron had often to guarantee the percentage of phosphorus when exporting to the United States, and then it was a matter of great importance that the analysis should be so conducted as to show the percentages of phosphorus and arsenic separately.

The authors of these two papers did not reply to the discussion, and the last paper read at this meeting was by Mr. H. le Neve Foster, and descriptive of

A NEW INSTRUMENT FOR THE MEASUREMENT OF COLOUR, MORE ESPECIALLY AS APPLIED TO THE ESTIMATION OF CARBON IN STEEL.

This instrument is the invention of Mr. F. W. Lovibond, of Salisbury, and is intended for the accurate measurement or matching of colours. One of its applications is to obtain a permanent standard for the matching of carbons in steel by the well known Eggertz colour method or by Stead's alkali method. The instrument consists of a tube divided by a central partition which terminated at the eye piece in a knife edge; at the other end are two apertures alterable in size or shape by means of diaphragms. The two apertures are divided by the thick end of the central partition, which together with the sides is recessed by grooves into which can be placed standard glasses, each of a distinct colour and shade. Into one of the partitions is placed the trough containing the liquid which requires to be matched. Behind the apparatus is a white surface, and the whole is so arranged that the only light which can meet the eye of the observer must first pass in equal limits through the liquid in the gauge glass vessel in the one tube and the standard glasses in the other tube.

Found by Eggertz Method. Carbon per cent.	Found by Tintometer. Carbon per cent.
No. 1. ·17	·182
„ 2. ·18	·180
„ 3. ·15	·163
„ 4. ·17	·175
„ 5. ·19	·195
„ 6. ·21	·216
„ 7. ·25	·272
„ 8. ·24	·23
„ 9. ·21	·20
„ 10. ·23	·22
„ 11. ·20	·187
„ 12. ·21	·205

The observer inserts standard glasses until he sees exactly the same colour and the same shade of colour through both tubes, and after the observation he has only to read the figures on the standard glasses which he had to insert in order to find the percentage of carbon present. The author had worked with the tintometer, and gave various tables to show the degree of accuracy which can be obtained by its use. The best results as regards accuracy were obtained by dissolving half a gramme of steel in 10cc. of nitric acid of 1·20 sp. gr., boiling for twenty minutes, and then diluting with 50cc. of water. This liquid is put into a 1in. cell. For mild steel, this gave a colour which was easy to match. The figures obtained with various samples of steel by the Eggertz method and by the tintometer respectively, are shown in the accompanying table.

The author concluded his paper by an appeal to chemists to unite with a view to form a reliable standard for which in his opinion coloured glasses were eminently suitable.

There was no discussion on the paper, and after the usual formal proceedings, the meeting terminated. The next meeting of the Institute will be held in Edinburgh, on the 21st, 22nd, and 23rd August next.

THE "CLOSE GRIP" SASH FASTENER.

THE accompanying illustrations show an improved form of sash and casement lock, invented by Mr. W. K. Booth, 21A, Exchange Buildings, St. Mary's Gate, Manchester. The apparatus consists of a catch secured to the inner sash, and a pivoted lever fitted with a screw and attached to the outer sash. In fastening the window the lever is turned into the position shown in Fig. 2, and the screw

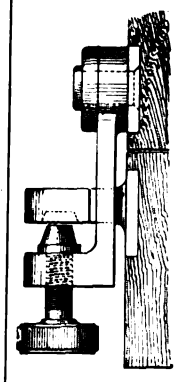


FIG. 1.

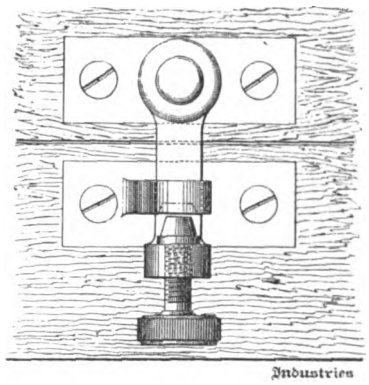


FIG. 2.

is made to engage with a conical recess provided in the catch on the inner sash, thereby forcing the sashes against each other. The advantages claimed for this arrangement are that the loose sashes may be tightened up in such a manner that the insertion of a tool for burglarious purposes is almost impossible, and that therefore the window cannot be opened from the outside without cutting the glass, and further that the upper and lower sashes are so firmly bound together that the objectionable clatter and noise often produced by the wind is altogether prevented.

MODERN HEAVY ARTILLERY.

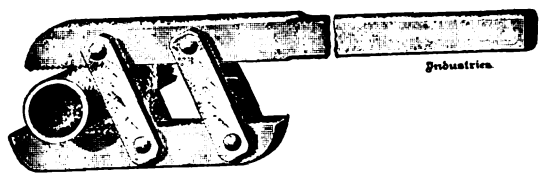
No limit can be fixed to the possibility of science, and with increasing mechanical ingenuity and improvements on existing types of ordnance we may expect that larger and more destructive weapons than have yet been constructed will be called into existence. Thirty years ago it was considered that no gun exceeding 5 tons in weight could be worked on the deck of a ship. To-day guns weighing 110 tons are loaded and manipulated on shipboard through hydraulic agencies with the greatest ease. Muzzle loaders have been superseded by breech loaders, and power and range are ever increasing. The 80-ton muzzle loading guns of the "Inflexible" are already considered obsolete, and are exceeded both in range and power by the newer type of breech loading 67-ton guns carried by the "Trafalgar." The "Inflexible" 80-ton gun is built of iron coiled around a steel tube, and is 27ft. long. The new 67-ton gun is built wholly of steel, and has a length of 36ft., with a calibre of 13·5in. The charge of powder used in the latter gun weighs 630lb., and provides the projectile, which weighs 1250lb., with as much energy at a range of 1000 yards as the projectile from the 80-ton gun possesses at the moment it leaves the muzzle. At a range of 1000 yards the projectile from the 80-ton gun is capable of penetrating 23in. of unbacked wrought iron, while the projectile from the 67-ton gun will penetrate rather more than 27in. The "Trafalgar's" guns are somewhat insignificant when compared with the 110-ton guns of the "Benbow." The projectile fired from the guns of the latter ship weighs 1800lb., and is capable of penetrating 35in. of wrought iron at a range of 1000 yards, the charge of powder used weighing 900lb. Our 110-ton guns have already been surpassed by the Krupp 118-ton guns, which were supplied to the Italian Government a short time ago. With these guns a wrought iron plate of 41in. in thickness can be penetrated near the muzzle, and 39in. at a distance of 1000 yards. Their length is about 46ft., and weight, including breech mechanism, 118 tons. They are made entirely of crucible steel, and are without trunnions,

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the connection with the carriage being made by means of ring projections. During experiments with these weapons results were obtained which are stated to be the highest realised with any existing cannon. These achievements, however, are soon likely to be surpassed by the production of other monster weapons by Krupp of Essen. Designs for a 139-ton gun already exist, the projectile from which would be capable of piercing a wrought iron plate 45in. thick; and report says that a piece of ordnance to weigh 150 tons is in contemplation at Essen. What is the limit of weight of gun to be carried on shipboard? And when is all this rivalry in heavy guns to cease? A few months pass away, and what was new and startling becomes old. Reasoning from the past, it would seem that even our 100-ton guns may soon fall into comparative disrepute, and others more powerful may hold supremacy.

A NEW PIPE WRENCH.

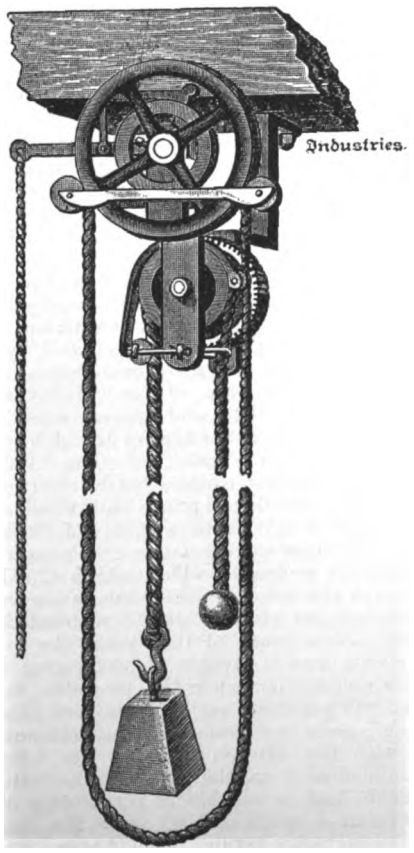
The accompanying illustration, which is taken from our American contemporary the *Iron Age*, represents a new pipe wrench, constructed by the Ellrich Hardware Manufacturing Company, Plantsville, Connecticut. This wrench is made of the best tool steel, and is self adjusting within a limited range. It consists of one long bar of



steel as a handle and a short steel bar connected to it by means of two short bars, which freely swing round the four rivets shown. The advantages claimed for this tool are its simplicity of construction and the firmness of grip on the piece operated upon. This wrench is likely to prove a useful tool, especially in places where only a limited space for working is available, as it may be used in the same manner as a ratchet brace.

IMPROVED HOIST.

The accompanying illustration, for which we are also indebted to our American contemporary the *Iron Age*, represents an improved rope hoist constructed by the Energy Manufacturing Company, Philadelphia, Pa., which



is specially designed to work in hatchways for raising and lowering goods from floor to floor. This contrivance appears to meet the demand for a cheap hoisting arrangement in places where limited space or the heavy initial outlay forbids the use of more complicated elevators. The gearing is arranged in a cast iron frame bolted to the ceiling, and an automatic brake is provided, by means of which the load may be held at any required height, and the rate of lowering the same regulated to suit requirements. The hoist can be easily worked by one man. The advantages claimed are: that the hoist is very compact, its length not exceeding 22in.; that the parts subject to wear may be easily replaced, and that the rope cannot slip or leave the wheels. The hoists are at present constructed in two sizes, for raising loads of 500lb. and 1000lb.

PONTOON AND FLOATING DOCKS.*

In this paper, any floating structure having open ends, and sides of equal and uniform section throughout, by which ships are lifted out of the water, will be called a "floating dock;" but structures having sides varying in height and of less displacement than the bottom tanks will be called "pontoon docks." The sides are supposed to commence at and rise above the deck. The deck is the platform on which the keel blocks rest. In designing an open ended floating or pontoon dock to lift a ship of given maximum size and weight it is necessary: (1) For the under deck displacement of the dock to be greater than the combined weight of ship and dock; (2) the dock should be sufficiently strong not only to support the intended maximum ship, but so strong that it will not be injured if the ship has been built or damaged in such a way that a great part of the ship's weight rests either amidships or at the ends; (3) the sides should be made as low and narrow as efficiency will permit, so that a wide working platform may be secured and light and air have access to the ship, and that the top weight and displacement be a minimum; (4) the water should only have a limited cross range in the tanks; (5) if the dock is emptied by pumps, the pumps should be close to the bottom of the dock, so that the water may as far as possible run into the pumps without having to be drawn in. The pontoon built under the writer's Letters Patent for the Tyne Pontoons and Dry Docks Company, Limited, Wallsend, fairly fulfils the above conditions. Fig. 1 is a longitudinal view of the pontoon, Fig. 2 is a plan, Fig. 3 is a half midship section and half cross section through sill, showing the keel blocks supported on three longitudinal girders G, F, and G¹. These girders are stiffened by intercostal plates A on every third frame. Stanchions are fitted to the intermediate frames. The frames throughout are 31in. from centre to centre. The transverse gusset plates in tank C are on every third frame, but in tanks D and E are only on every sixth frame. The frames between the gusset plates are fitted with stanchions. The longitudinal water tight girders are shown by F, G, H, I, and K. Three transverse bulkheads divide the pontoon tanks into four longitudinal parts, as shown on the plan (Fig. 2), forming altogether twenty-eight separate tanks. The plan also shows that the main tanks terminate some distance within the ends and sides of the pontoon. This arrangement permits of an all round internal examination and free communication between the two engine rooms when the pontoon is sunk. The outside shell plates, up to and a little above the tank top, are $\frac{7}{16}$in. thick. They and the tank top plates are double riveted in seams and butts throughout. Two centrifugal pumps, engines, and boilers are placed in the forward end. The pumps are placed, and draw from the main cross drain M (Fig. 2), which forms part of the structure, and is in communication with the various tanks adjoining. The pumps appear to be well placed, for they have pumped freely. There is a sluice valve in the cross drain in the longitudinal centre line, so that usually the port pump only pumps from the port tanks, and the starboard pump from the starboard tanks. Before sinking the dock the distributing valves shown on Fig. 2 are opened, and remain open until the dock is completely raised again. In fact, it would be better not to have these distributing valves, but to draw direct from the end of each tank, and thus each longitudinal set of tanks would be entirely independent of its neighbours. The water coming in or going out is entirely controlled by the admission or exclusion of air from the various tanks; *i.e.*, if in lifting the dock it was considered necessary to keep the water in any particular tank, the air pipe for that tank would be kept shut, and this gives the necessary control over the water. The pumps are run full speed during the lifting of a ship, and the man in charge is on the dock or ship, and controls the air pipes, as above described. There are two donkey pumps and a range of piping, by which the tanks can be drained or the dock washed, or ships supplied with water to test tanks, fill boilers, &c. The pontoon was successfully launched, broadside on, in a nearly finished condition, into a space little wider than twice its breadth. The launching ways were an arc of a circle. A ship was docked and lifted within a week after the launch. It has been in constant use for three years, and has lifted 170 steamers in that time. The largest ship lifted measured 300ft. long, 37·3ft. beam, and 27·3ft. depth of hold to upper deck; the ship overhung the pontoon 25ft. at one end and 15ft. at the other. A ship carrying 1000 tons can be lifted and sighted in about an hour. To show its adaptability, and the ease with which it can be worked, it may be stated that a steamer was undocked and the pontoon lifted, and all the keel blocks moved and set in two rows to suit a centre ladder steam hopper dredger, and again sunk and the dredger lifted, all in one tide. The pontoon is lighted by gas throughout. Some such reasoning as the following led to the sides being made in form as shown by Fig. 1. A ship to be moved into a dry dock or on to a slip must have sufficient stability in herself, or ballast must be added to give the necessary stability before she can be moved; therefore, in this condition she requires no external aid. A pontoon when sunk, ready to receive a ship, must, in virtue of its construction, have the combined centre of gravity of the structure and contained water some distance below its centre of buoyancy, and consequently it must remain upright, even if totally submerged. Now, as it has been shown that the ship must be stable, and the pontoon has enormous stability, it is evident the pontoon requires no sides above the water to give it stability at the time when it and the ship are combined; but while the water is being pumped out of the pontoon, the combined centre of gravity of the ship, pontoon, and its contained water, will rise, and the combined centre of buoyancy will fall; and, therefore, the dock must have sides to give stability as it rises, until ultimately the sides are made the full length, and the maximum stability is secured with a minimum of top weight and displacement. The sides, being low, allow light and air free access to the ship, and the ship's bottom is thus easily seen and rapidly dried.

Fig. 4 is a cross section of the Rotterdam Harbour Authority's two floating docks. They have been in use about four and a half years, the work upon them is excellent, and I believe the docks are strong. Fig. 5 is a cross section of a dock built, or building, by the Dutch Government for the East Indies. It appears to be exceptionally strong. Figs. 6 and 7 show a design the writer proposes to employ for making a self docking pontoon where desirable. It will be noticed that the centre part can be taken out and lifted by the two side pieces, as shown on Fig. 6, *b*; or one side can be lifted by the centre and one side piece, as on Fig. 6, *a*. This plan has many advantages, the longitudinal strength of a solid dock is maintained, and its cross strength is easily provided for. The design is convenient for transport, or for placing in ordinary dry or wet docks. The writer is quite sure the connections of the three parts can be arranged to be thrown adrift, and one part lifted by the other two in one tide. It would be interesting to compare in detail these docks, both in strength and stability; but this of course cannot be done here. The lifting power of the various docks may be taken to vary roughly as the under deck displacement. Sir Frederick Bramwell, in his paper on "Floating Docks," read before the Institution of Mechanical Engineers in 1867, pointed out that their stability varied as the square of the number of tanks in the cross section of the dock. If this is true, then all floating docks should be built with numerous water tight longitudinal bulkheads, so that the water may have comparatively little transverse motion. Figs. 8, 9, and 10 illustrate the above. Fig. 8 shows a dock and ship listed to 5°. The water is allowed to travel from side to side. The positions of the centre of gravity and centre of buoyancy show the dock to be unstable, and that it will go further over before coming to rest. The same applies to Fig. 9, only in a less degree, as the water can only travel between the centre and the side. Fig. 10 shows the dock and centre of buoyancy in the same position as Figs. 8 and 9; but the centre of gravity is on the stable side, and if any internal or external force was able to list the dock so far over, it would right itself. The relative initial stability of the three docks, exclusive of the ships' stability, and purely because of their internal construction, would therefore be 1, 14, and 49. In 1869, Mr. G. B. Rennie read a paper before the Institution of Naval Architects, in which he describes the Carthagena floating dock, and gave its righting moment at 10° list when the dock is out of the water, and at the same time supporting a Spanish war vessel. This, of course, is a most stable condition for the dock when supporting the steamer. As far as the writer can learn from the paper, he does not take into account the effect of the contained water travelling over as the dock lists.

The diagram he gives is purely one point in the metacentric diagram. This seems to be the usual way of showing a floating dock's stability, but it is, in my opinion, extremely misleading. The metacentric curve for docks is only useful as a means of comparison when the docks are of similar design and uniformly proportioned. I will endeavour to explain this fully from calculations made for a pontoon dock which has not yet been built, so that no one can object to their publication, and it will be called the model pontoon. Let the displacement curve D, on Fig. 11, represent the pontoon's displacement curve, M its metacentric curve, and B its centre of buoyancy curve. Fig. 11 also shows the displacement *d*, centre of buoyancy curve *b*, and metacentric curve *m*, of a deep, narrow, tender proportioned steamer, which is supposed to be the heaviest ship this particular dock will lift. The figure also shows the before mentioned curves combined in M^2 B^2, and also the combined centre of gravity curve G^2, as if the vessel and pontoon were one structure, and to be raised as one. In making such calculations, it is necessary to be perfectly sure that, if there is an error, it shall be on the safe side; and having this in view, the steamer's centre of gravity is supposed to coincide with its light draught metacentre G on diagram 11; and we may take it that the steamer could not be moved into the dock if the centre of gravity had been higher. The centre of gravity of the pontoon is supposed to coincide with its centre of total displacement. This is also well on the safe side (Mr. G. B. Rennie places the centre of gravity of the Carthagena dock one-fourth lower). The centre of gravity of the water in the tanks is supposed to remain constantly at half the height of the bottom or under deck tanks. It is possible, under extraordinary circumstances, that the water might remain so high; but it is not possible for it to be higher. Along with this explanation, it is necessary to say the calculations have been carefully made on the actual form of a ship and the model pontoon, having tanks arranged as shown in Fig. 10. You will notice the result shown by Fig. 11 is, that at a pontoon draught of 23ft., there is 4½ft. metacentric height, with the combined centre of gravity 18in. above the combined centre of buoyancy. And at a draught of 17½ft. we have the least metacentric height, viz., 3¼ft. when the combined centre of gravity is 6ft. above the combined centre of buoyancy. At 11ft. draught, when only the keel of the ship is in the water, we have 9ft. metacentric height with the combined centre of gravity nearly 12ft. above the combined centre of buoyancy. And at 7ft. draught we have 33ft. metacentric height when the combined centre of gravity is 14½ft. above the combined centre of buoyancy.

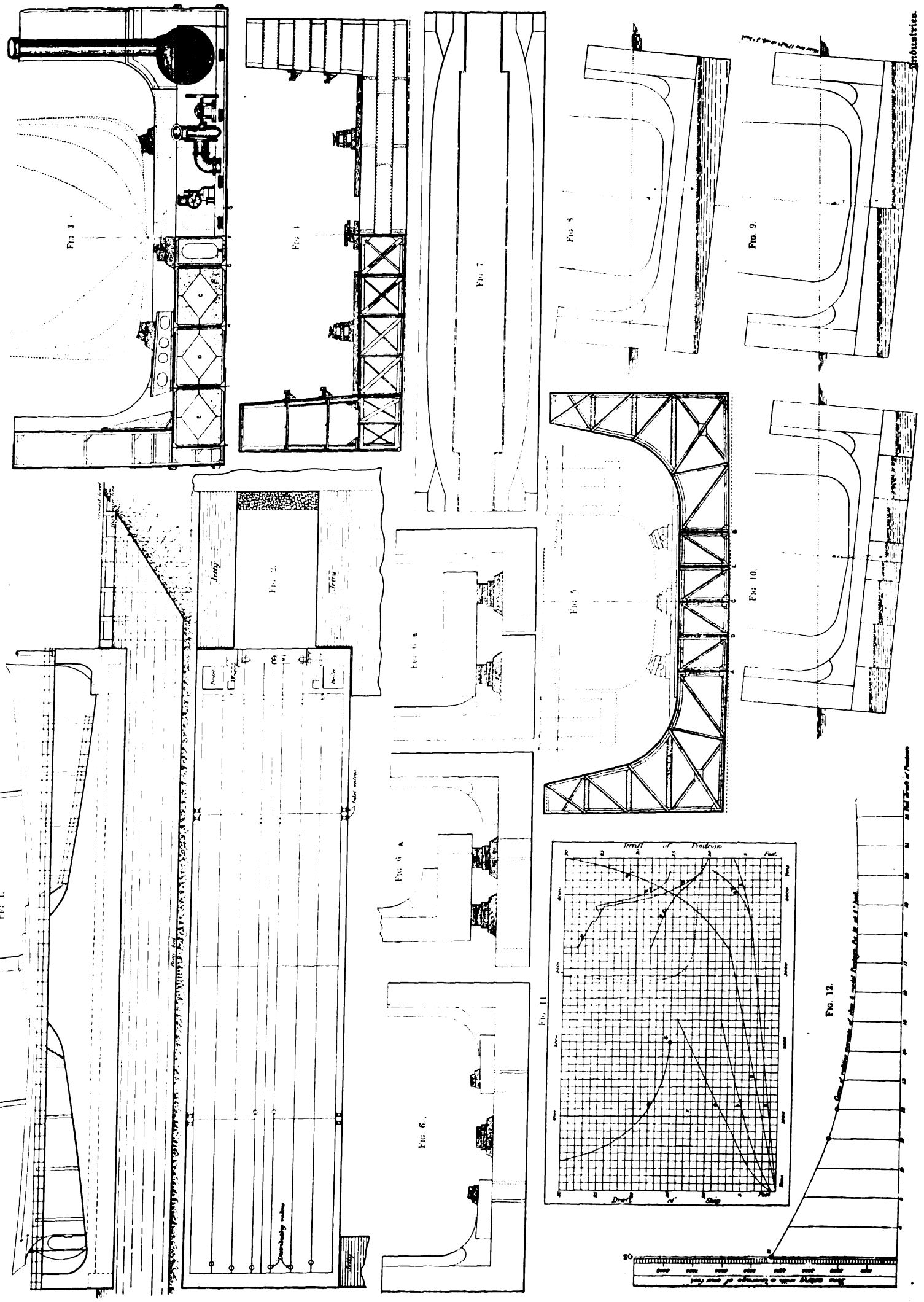
Diagram 12 shows the combined righting moment for the said ship and pontoon at 5° list during the whole process of lifting the vessel, from the time the ship touches the blocks to the time the dock is pumped dry. Where the curve of moments runs into the vertical ordinate at N, representing 7ft. draught, the righting moment is calculated for the water being over one-half the pontoon deck, while the moment M on the same ordinate is calculated for the deck entirely free from water, in which position the dock invariably is when supporting a ship out of water. Of course it must be clearly understood that these diagrams, &c., give the model dock's stability under the most unfavourable conditions possible to conceive.

* Paper read by Mr. Alexander Taylor, before the North-east Coast Institution of Engineers and Shipbuilders, on the 11th April, 1888.

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PONTOON AND FLOATING DOCKS.

(For description see opposite page.)



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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 22ND MAY, 1888.

THE IRON MARKET.—The issue of circulars by the Paris iron merchants announcing an advance in prices is beginning to be looked upon as a farce; but in whose interests or for whose entertainment the farce is played does not appear. I announced a fresh issue last week, and I have now to report the fact that though the official quotations are thereby raised, buying and selling goes on under former conditions. Thus no progress has been made, and the situation has rather been weakened by the declaration of a rise which cannot be maintained. This state of things appears to be the result of efforts on the part of the merchants to render themselves independent of the manufacturers of the North by buying in other markets. How long this will last depends on the progress made in syndicating the trade. A perfect understanding has been come to between the manufacturers of the North and those of the Centre. If the agreement be extended to the Eastern departments, the merchants will find themselves isolated, and this is likely to happen. I quote these facts to show, first, that the ordinary newspaper reports do not accurately represent the state of the Paris markets; and second, that the true state of the latter is not typical of the iron trade generally. Business in the provinces is being transacted on a firmer basis, and there is no "cutting" trade being carried on. The demand is fairly active all round, and sellers neither offer nor grant concessions. That prices are more likely to advance than to recede may be judged from the fact that the time is at hand when manufacturers of finished iron and steel will have to renew their contracts for pig, and at current rates these contracts would be considerably above those on which they are now working. It is announced that the Danish naval authorities have decided, as the result of a series of comparative experiments, to use Creusot steel plates for the armour of the new cruiser "Walkyrie." This is considered another triumph for French industry.

THE METAL MARKET.—The copper market is still firmly upheld by the syndicate notwithstanding the constant accumulation of stocks or the prospect of a further restriction of the consumption in consequence of the abnormally high prices now prevailing. Meanwhile, production is steadily if not rapidly increasing. The collapse may yet be distant; but when it comes it will be, like that in tin, sudden and complete. Tin has further receded, and is now quoted at £100 a ton—a fair price, below which it is not likely to drop. Lead is being pressed for sale; the price has dropped slightly since the beginning of the week, and is likely to go lower, production being in excess of consumption. Spelter continues its retrograde movement.

STRIKE IN THE GLASS TRADE.—The strike in the glass works of the Seine and Seine-et-Oise, by which about 2500 hands are thrown out of work, continues. The dispute arose from an attempt on the part of the trades union, or what is here the equivalent of an English trades union, to force their will upon the masters in the matter of dismissing one of their managing clerks. The masters seem to be determined to resist this encroachment on their rights. On the other side the men are encouraged to persevere in their attempt by the sympathy and material aid of the municipal authorities of Paris, who have voted £400 for the relief of the men on strike. The works effected are for the better class of glass goods. The agents of Belgian and German firms are endeavouring to turn the opportunity to account.

TELEPHONIC EXPERIMENTS.—Last week an attempt was made to communicate by telephone with Marseilles from Dijon, a distance of 480 miles. The experiment was entirely successful. A further trial to extend the communication to Troyes, a distance of some 600 miles from Marseilles, was but partially successful, owing, it is said, to defects in the line from Marseilles to Troyes. As soon as these defects have been remedied the trial will be repeated.

BERLIN, 21ST MAY, 1888.

THE IRON MARKET.—On the whole the condition of the iron trade has been satisfactory during the past week. In the Upper Silesian district there are at present twenty-seven blast furnaces in action, and prices rule as follow: Forge pig, 50s.; and foundry pig, 58s. to 60s. The demand for foundry pig is at the present moment on the increase, as iron founders and engineering works are well supplied with orders, and in some cases even work overtime. Business in rolled iron has remained normal. The question of the supply of steel rails to the Bromberg railway adminstration is at present exciting the attention of rail makers. The administration not wishing to pay the high prices imposed by the syndicate, have approached them with a request to reduce their prices; but the negotiations have not yet had the desired result. If the syndicate will make reductions, the order will probably go to the Bochum Works for 3200 tons, and to two Silesian works for 1600 tons each. German steel rail makers are, however, afraid that they will lose these contracts, on account of the low offers received from England.

UTILISATION OF BLAST FURNACE SLAG.—Herr G. Hoffmann has, in conjunction with the Tarnowitz iron works, introduced the manufacture of artificial stones, flags, stair treads, &c., for which purpose the slag from the blast furnace is utilised. This industry, which has now been established for some time, has been so successful that depôts for the sale of these artificial stones have been opened in various towns of Upper Silesia. Herr Hoffmann has agreed with the Tarnowitz works to take all the slag he requires from them, to the exclusion of any other works; and as the stocks of slag on hand amount to about 500,000 tons, there will be no lack of raw material for this industry for many years to come. In addition to the price paid for the slag, Herr Hoffmann pays to the works a yearly rent of £750 for permission to carry on his manufacture on the premises.

INDUSTRIAL IMPORTANCE OF INLAND WATER WAYS.—Herr Natorp, who represents the coal mining interests, in a speech made last week in the Landtag, in support of a measure for the improvement and extension of the inland water ways in Germany, said: "If the projects for canalising the Oder and deepening the Spree be carried into effect, a new district will be opened up to the manufacturers and other producers of Upper Silesia. Coal may then be sent to Stettin at a low cost, and German colliery owners will be enabled to gradually drive back British coal from those districts of North Germany where hitherto we have failed, in consequence of the cost of railway carriage, to do more than gain an insecure foothold."

CENTRAL STATION LIGHTING.—The Town Council of Hamburg are erecting an electric light central station, independently of the installation on the bonded warehouses which you recently described. The capacity of the station is to be for 10,000 lamps at present, but with provision to increase it to 20,000 lamps next year. The generating plant will be erected on the site of the old and disused town mill, and a district of 13,000ft. radius is to be supplied. The glow lamps will be of 16 c.p., and the arc lamps of 8 ampères. The cables are designed to carry 20 per cent. more current than corresponds to the 10,000 16 c.p. lamps, and in December next a portion of this installation is to be in working order. Of the ten boilers projected, six are already installed, each with 2700 sq. ft. heating surface, and working at a pressure of 100lb. The grates are arranged for coke firing, and there are two chimneys each 130ft. high. Motive power will be supplied by four steam engines of together 1100 h.p., viz.: One of 100 h.p., one of 200 h.p., and two of 400 h.p. There will be six dynamos, one of 1000 and five of 2000 lights capacity. For street lighting there will be fixed sixty-four arc lamps, each of 8 ampères. The loss of pressure in the feeders is estimated at 13 per cent., and in the network mains at 1·3 per cent.—The Helios Company of Cologne are erecting in Amsterdam a central station for an output of 2000 ampères at 65 volts. The cables are designed for a loss of 2 per cent. only. Current will be supplied by two steam dynamos, each driven by a twin engine, the fly wheel of which carries the armature. A central station with storage batteries has been projected for Barmen. The distribution is to be on the three-wire system from four parallel series of Tudor accumulators, each series containing 136 cells. The accumulators are to be charged in parallel by five shunt dynamos working at 250 volts.

VIENNA, 21ST MAY, 1888.

THE IRON MARKET.—Business in most branches of the iron trade has remained normal during last week. Crude iron is now firmer than it was during the winter, and the demand for forge pig is on the increase. Bar iron and sheets continue fairly active, but in tinned sheets a fall in price is expected, owing to the drop in tin. Engineering works, with few exceptions, are well supplied with orders. The Austrian State Railway administration recently invited nineteen Austrian firms to tender for plant required for the water supply on some new lines now in course of construction. The successful tenderers were E. Skoda, of Pilsen, Bohemia, for seven complete plants for water supply, including boilers, engines, pumps, piping, and reservoirs, and an engineering works in Prague for five plants for water supply, and five locomotive turntables. Messrs. L. Lang, of Buda-Pesth, have just booked an order for a 420 h.p. triple expansion engine, for a large jute spinning and weaving mill in the same town. This engine will work with a pressure of 160lb. per sq. in. They have also in hand a 450 h.p. engine for the new small arms factory, and a 600 h.p. rolling mill engine for the Rima iron works. In the engineering works of the Austro-Hungarian State Railway, there was completed at the beginning of this month the two thousandth locomotive, an event which was celebrated by some festivities. This locomotive is an express engine, intended for the Sicilian railways. Out of a total of 2000 engines built by the works up to the present time, 1640 have been supplied to railways within the Empire, and 360 to foreign lines.

THE JUBILEE EXHIBITION.—Although this Exhibition, which was opened on the 14th inst., has been organised by the Niederoesterreichische Gewerbeverein, that is to say by a society distinctly local to Lower Austria, considerable support has been received from other parts of the Empire, and the list of exhibitors includes nearly all the important manufacturers in the various Austrian provinces, and even Hungary is represented to a certain extent. The exhibits are divided into twenty-one groups, of which I only mention a few as likely to be interesting to your readers: I., Mining and metallurgy; II., Chemical industries; IV., Leather and india-rubber; V., Textiles; VII., Wood work; VIII., Paper; XII., Engineering and means of communication; XIII., Electrotechnic; XIX., Civil engineering and architecture; and XX., Safety appliances.

TEXTILES.—Since my last report the situation in cotton has improved considerably, both as regards volume of trade and prices. In linen goods, however, there has been no change. The greatest activity in the textile industries is displayed in the north-west of Bohemia, where the present tendency is to increase works and manufacture on a large scale. Textile industries are also well developed in the Reichenberg district, where it was shown in a recent census that out of a total of 4278 industrial establishments, the majority are textile factories. The total number of steam engines required for industrial purposes throughout the district is 1736, representing a total of 46,897 h.p., whilst there are in addition 3115 water motors representing 28,048 h.p. The total number of hands employed is 147,378.

ELECTRIC LIGHTING OF THE JUBILEE EXHIBITION.—The steam and dynamo plant for the lighting of this Exhibition is as follow: There are fifteen boilers having an aggregate of 16,000 sq. ft. heating surface. The boilers are divided into three groups. The first, representing about 8500 sq. ft. heating surface, is required for the lighting of the Rotunda and adjoining galleries; the second of 6000 sq. ft. for the external lighting and that of the machinery hall; whilst the third will be required for the lighting of various annexes. The boilers are of different types, but all work at a pressure of 105lb. per square inch, the feed water being supplied by the high pressure town mains. The first group of boilers supplies in all seven steam engines of an aggregate of 800 h.p. Of these there are three compound engines, of 200 h.p., 200 h.p., and 120 h.p. respectively; two single cylinder engines of 100 h.p. and 170 h.p. respectively; and two high speed engines of 60 h.p. and 50 h.p. respectively. There is also one vertical engine of 60 h.p. of the ship lighting type, and a vertical engine and boiler, semi-portable, for driving a dynamo supplying two arc lamps of 25 ampères each. The boilers of the second and third groups supply four steam engines of together 500 h.p., one high speed engine of 50 h.p., and one Colman engine of 80 h.p., also two ship lighting engines. There are the following dynamos: Five Gülcher machines for combined arc and incandescent lighting, five Krizik machines, four of which are for arc lights and one for three hundred incandescent lamps; eight Ganz dynamos, of which six are for arc lighting and two for incandescent lighting; three dynamos of Egger & Co., of which two are for arc lighting and one for incandescent lighting; four dynamos of Kremenezky, Meyer, & Co., of which two are for arc lights and two for incandescent lights; four dynamos of Siemens & Halske, of which two are for arc lighting and two for incandescent lighting; and six Edison-Hopkinson dynamos built by Messrs. Siemens and Halske. With the exception of the three ship lighting dynamos, all the machines are driven by belting from counter shafts.

BRUSSELS, 22ND MAY, 1888.

THE COAL MARKET.—The situation of the coal market at the present moment is very favourable, and a rise of about 3d. a ton has taken place in all qualities of coal. The Strepy-Bracquegnies Colliery has sold 200 tons of coke for export at 13s. 5d. A contract will shortly be made on the Brussels Exchange for the supply of 2000 tons of coal for the State railways. The imports during the first three months of the present year were as follow, the quantities being given in tons:—

	Coal.	Coke.
Germany	93,783	3220
England	59,772	1028
France	38,813	832
Holland	36,539	1294
Other countries	60	—
Total	228,967	6374

The exports during the same period were:—

	Coal.	Coke.
France	902,317	201,118
Luxembourg	24,191	44,364
Holland	36,205	—
Other countries	23,612	6,311
Total	986,325	251,793

There has been a considerable diminution in the imports of coal; but, on the other hand, those of coke have increased. As regards the exports, coal shows a falling off as compared with the same period of 1887, whilst coke shows an increase. In addition to the exports given above, there were exported 72,562 tons of briquettes. The quantity of coal at present carried on the Belgian State railways is greatly in excess of that transported at this time last year.

THE ENGLISH SECTION AT THE BRUSSELS EXHIBITION.—The efforts put forth by Mr. S. Lee Bapty to push on his portion of the Exhibition have been so successful that the British section was opened to the public on Saturday last. Lord Vivian, the English minister, the Comte d'Oultremont, the Commissioner General of the Belgian Government, and M. Somzee, the president of the Exhibition, took part in the proceedings. A very good representative display of English manufactures is made, this being the most important of the foreign sections of the Exhibition.

THE METAL MARKET.—Many iron masters are of opinion that in view of the scarcity of pig and the rise in the price of coal, the base price of merchant iron for home consumption should be advanced. Forged iron is in good demand, and engineering establishments are receiving larger orders.

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La Metallurgique works have obtained the order for the iron work for the covered market at Buenos Ayres. Contracts will be made to-morrow for the supply of sixty-three 5-ton coal waggons for the State railways. Two lots, each for fourteen complete engine tenders, will also be contracted for shortly. The Esperance works of Liège intend to start a second blast furnace at their Seraing works in addition to that which I mentioned in my last letter. The imports and exports of iron and steel during the first quarter of this year were as follow, the quantities being given in tons:—

	Imports.	Exports.
Steel ingots	424	2413
Steel rails	88	10,154
Other rolled steel	683	7508
Pig iron	52,734	3185
Old iron	5769	268
Iron wire	922	1009
Iron rails	68	3170
Sheets	450	9837
Other rolled iron	1833	47,926
Nails	135	2629
Wrought iron	948	4722
Malleable castings	172	2938
Wrought steel	67	516

The imports of pig show an increase of 24,518 tons as compared with the same quarter of last year. The principal event during the past week has been the opening of the tenders for the supply of 8000 tons of Goliath rails for the State railways. The Cockerill Company tendered for 3400 tons, the Ougrée works for 2200 tons, and the Angleur works for 2400 tons, all at 91s. 8d. per ton, these three firms having formed a ring; G. Boël for 1500 tons at 95s.; the Acieries de France for 6000 tons at 93s. 6d., and for 2000 tons at 87s. 7d.; and Caramin & Cie. for 4000 tons at 94s. 5d. It will be seen from the above that the average Belgian price was lower than that of the French company.

Electric Lighting at the Exhibition.—Contracts have at last been signed with the firms who are to undertake the electric lighting of this Exhibition, and these companies can now commence operations. As I have already stated, the original scheme has been greatly modified, and the lighting of the buildings and annexes has been given to the following seven firms: The Thomson-Houston Co.; La Société Industrielle; Messrs. Bouckaert and Cie.; La Compagnie Electrique; M. Dulait; M. Khotinsky; and Herr Zipernowsky. The Thomson-Houston Co. will supply seventy-six arc lamps of ten ampères, of which twenty-four will be in the machinery department, eighteen in the foreign annexes, twenty in the horseshoe building, six in front of the main buildings, and eight in the central pavilion. La Société Industrielle will furnish fifty seven-ampère arc lamps, thirty of which will be placed in the Salle des Fêtes, and twenty in the working breweries. Messrs. Bouckaert & Cie. will supply sixty arc lamps of eight-sixteen ampères, fourteen of which (ten ampères) will be in the machinery department, eighteen in the Belgian section, and the remainder in the restaurants of Mr. Mackenzie Ross. La Compagnie Electrique will furnish twenty-two twelve-ampère arc lamps for the machinery department and seventy-five glow lamps. M. Khotinsky will provide 250 glow lamps, which will be fed from accumulators, and Herr Zipernowsky will supply 200 glow lamps. Special contracts have been made with the Anglo-American Brush Corporation for forty arc lamps of ten ampères, and with M. Pieper for the same number, for lighting the gardens. It will be seen that the larger share of the electric lighting has fallen to foreign firms.

DÜSSELDORF, 21st May, 1888.

The Iron Market.—The general aspect of the iron market is, on the whole, satisfactory. There is a lack of activity in some classes of goods, notably in bars, sheets, and wire; but in others there is a strong and steady current of business. The improved state of the Belgian and French markets has had a strengthening influence here. The supply of ore to the blast furnaces is now scarcely equal to the demand, and high prices have in consequence to be paid for immediate delivery. This fact, and the scarcity of coke, points to the maintenance of the current rates for pig iron for some time to come. The crude iron market remains unaltered since last week, the demand for home consumption continuing brisk, while the export business grows more and more languid. The export market has been unfavourably influenced this week by the announcement of the abolition, from July 1st next, of the special export tariffs for pig iron from Dutch ports. The latest Cologne prices are: Spiegel of 10 to 12 per cent., 59s. to 60s.; German Bessemer pig, 54s. to 55s.; white forge pig, 51s. to 52s.; Luxemburg white forge, 38s. 6d. to 40s.; and German foundry, No. 1, 57s. 6d. a ton. The tone of the finished iron market has become more confident since the announcement, a few days ago, of an agreement formally entered into between the German finished iron syndicate and the Austrian iron syndicate, with a view to prevent excessive competition in the frontier districts. The home demand for bars has become slack again except in a few localities, and foreign business is almost at a standstill. The activity is now chiefly in plates. Sheets are neglected, and manufacturers have begun, in some instances, to work for stock. Hoop iron is quiet, and wire remains very dull. The wire nail syndicate lately established seems to be on the point of collapsing, in consequence of the evident gravitation of the trade towards those makers who have remained outside the association.

The Tin Plate Trade.—The manufacture of tin plates in Germany, though not yet one of great magnitude, is steadily growing in importance. The production amounted in 1883 to 11,238 tons; since that year it has increased as follows: 12,149 tons in 1884, 11,786 tons in 1885 (a falling off from the previous year), 13,570 tons in 1886, and 17,808 tons in 1887. The net imports in the last named year amounted to 20,808 tons, against 32,901 tons in 1886. Nearly the whole of the tin plates imported are derived from England. The constant growth of the native industry points to the annihilation of this import trade. The greater consumption now going on has, however, occasioned heavier purchases of English tin plates in the first quarter of the current year, the total net imports of that period being 7501 tons, against 6170 tons in the corresponding quarter of 1886.

Chain Testing Works at Lübeck.—There will shortly be established at Lübeck complete and very important works for testing chains. The design originated with Herr von Baggessen, the proprietor of testing works at Hamburg, and is being carried out by him in conjunction with several influential commercial men connected with the shipping trade. These works, the first of the kind in Germany, are likely to operate beneficially to the Westphalian iron and engineering industries, by causing much of the trade which now goes to England to be transferred to them. At present the German ship owners get practically all their chains and anchors from England, the reason given being that they prefer goods of English make, because hitherto there have been no means of testing these chains in Germany. As this want is now on the point of being supplied, an effort will be made by the Westphalian chain makers to induce ship owners to buy in the home market. The scheme provides that manufacturers shall send the goods to Lübeck to be tested, and there stored till sold, so that the purchaser who obtains his chains from the Lübeck store will have a guarantee of their having been properly tested.

LILLE, 22nd May, 1888.

Textile Manufactures.—As the weeks roll on it becomes more and more certain that the hopes freely indulged in at the beginning of the year, that we were entering on a period of life and activity in the textile trades, are doomed to be disappointed. Business is everywhere languid and declining, and the prospect affords but little ground for encouragement, owing to the insecurity of the political situation. No one has any confidence in the permanency of existing institutions, and there exists that vague, indefinable fear which, more than a certain knowledge of imminent and clearly perceivable danger, stifles the spirit of enterprise, and keeps all commercial transactions within the narrowest possible limits. Until we have a strong and settled Government, we shall look in vain for commercial activity. This week the market reports from all our great centres of the textile goods trade are characterised by a gloomy tone. Business is becoming more and more restricted. Nowhere is there anything approaching to healthy, vigorous life, and, what is more discouraging, there are no symptoms of improvement.

Flax and Yarn Markets.—A little more has been done this week in home grown flax at firm prices. In Russian, business is at a standstill. Yarns, too, are quiet. Consumers have now considerable stocks in hand or contracted for, and as the woven goods trade is slack, they are unwilling to commit themselves further. The Ghent markets are dull both for raw flax and for yarns.

The Iron Market.—There is no new feature in the iron market calling for special notice. Business is fairly active in all the principal classes of iron goods, and prices are very firm. It is worthy of notice, as bearing on the question of prices, that the coal owners in renewing their contracts with the iron masters stipulate for an advance of 1fr. a ton for all coal and coke delivered in the next three months, and 2fr. a ton for all deliveries of a later date.

WINTERTHUR, 21st May, 1888.

Textiles.—Constant complaints are made as to the depressed condition of the cotton spinning trade, and only those mills which are favourably situated and which have the most improved machinery are able to work at a profit. No one is inclined to take the initiative in reducing the production. The contrary is the case, for manufacturers are endeavouring to reduce the proportion of their permanent expenses by increasing the output of the machines. Self acting spindles which were formerly run at 6000 revolutions per minute are now being worked at from 8000 to 9000 revolutions, and so on. The workpeople employed in the industry are paid according to the quantity of work turned out, and the earnings of spinners now average 3s. 6d. to 3s. 8d., and those of flyer hands from 2s. 2d. to 2s. 7d. The fine weaving and newly introduced tulle industries are in a very unsatisfactory condition. Many looms are standing, and weavers earn only 1s. 8d. per day. The weaving of coloured goods is even in a worse condition, as printed cotton goods are supplanting this branch of manufacture. The earnings of weavers seldom reach 1s. 8d. per day. The condition of the silk trade is, however, more favourable. Some of the silk weaving mills are being enlarged, and dye works are well supplied with orders. The continual complaints regarding the low wages ruling in the silk trades have induced the Government Inspector of Factories to collect statistics, from which it appears that, in large factories, the average fortnightly earnings of weavers are 26s. 6d., and of warpers 25s. In smaller factories the wages are somewhat lower.

MADRID, 21st May, 1888.

Almaden Quicksilver Mines.—A rumour is current that the Government is thinking of selling these mines, or that some influential persons are desirous of acquiring them. This belief has been caused by the fact that changes have been made in the administration of the mines which are not justified either by their technical or economical requirements.

Wood Pavement.—A contract has been made by the municipal authorities for paving the principal streets of Madrid with wood. This system of paving has already been found to work well at Bilbao.

Electric Lighting of Theatres.—The first theatre in Madrid which has complied with the new regulations enforcing the exclusive use of the electric light in theatres is La Comedia Theatre, a very well appointed and fashionable house of medium size. The installation consists of a Collet tubular boiler, a Daevel vertical high speed engine, and two Schuckert's dynamos of 75 ampères and 105 volts. There are fitted 450 glow lamps, made by Messrs. Siemens and Halske, of Berlin.

NEW YORK, 12th May, 1888.

The Coal Market.—There is now a better feeling in the anthracite coal trade, and dealers report an increased demand. Production has decreased. Bituminous coal is considered to have touched bottom, and a better demand with higher prices is expected.

The Iron and Steel Market.—The pig iron market has shown a fair degree of activity during the past week, with a little weakening in prices of the better qualities. Consumers are not willing to pay over $20·50 per ton for the very best brands of No. 1 foundry, and $16·50 for grey forge. Buyers do not care to take more than a few weeks' supply. In the lower grades, prices are steadier, as the parcels offered are light, and with anything like a fair demand it is probable that prices would advance. There is great dulness in manufactured iron; the demand is small, and the prices ruinously low. The worst competition comes from the Carnegie Mills, Pittsburg, and other Western Pennsylvania firms. Their policy is to run full, and as they have a line of specialties which yield a good profit, these are made to pay for losses elsewhere. Prices are irregular, but average about 1·85c. and 1·9c. per lb. for best refined bars, 2c. and 2·15c. for angles and plates, and 3·3c. for beams and channels. Steel rails are extremely dull, with prices at $31·50 and $32 per ton at mill. Western advices are not encouraging, and buyers are in no hurry to place orders. There is, however, no cutting, and prices may remain as they now are for some time to come.

The Metal Market.—The copper market has been well sustained, and business has been done at about 16·70 cents per lb. The collapse of the tin corner has had no influence on the price of copper, but has slightly affected the volume of business. There have been no failures in connection with the fall in tin, although some of the operators are badly crippled. As the market is now down to consumers, prices there have been numerous inquiries, with indications of a fair amount of business in the near future. Tin plates have been steady, the decline in pig tin having already been discounted in the plate trade. Prices are likely to remain steady, although the market has been unsettled. Lead has been very quiet. Sales to consumers and dealers have amounted to about 400 tons, at 4·60 cents per lb. for spot. Spelter is dull, but with rather a firmer tone than it has had for some time past. Prices for common domestic range from 4·65 cents to 4·75 cents per lb.

Bridge Building.—The key plates of the great steel arch of the new Harlem Bridge at 181st-street have been swung into position, and if the work continues at the present rate it is believed that the bridge will be open for traffic in December next. There are two steel arches, each 510ft. long, and the entire length of the bridge is 2373ft. The roadway will be 50ft. wide, with 15ft. footpaths on each side, making the bridge over 80ft. wide. The arch will be 133½ft. above the river, and the roadway 151ft. The work was commenced in September, 1887, and the cost will be £520,000.

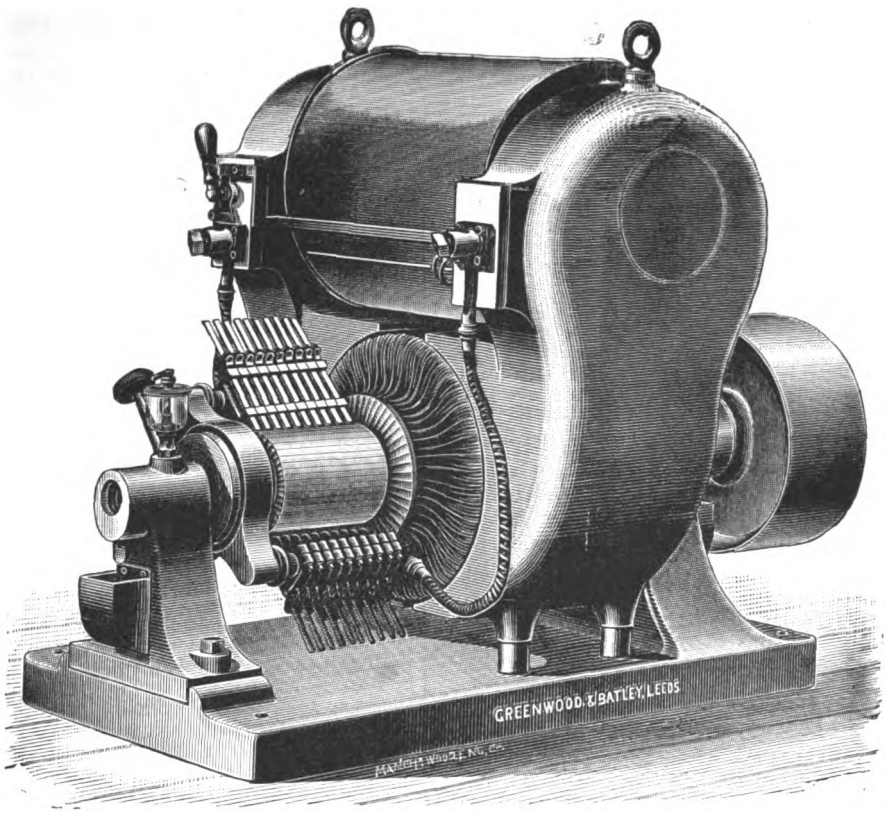
PHILADELPHIA, 12th May, 1888.

The Iron Market.—There is abundant proof that the contest between Pennsylvania irons and Southern and Western is only just beginning. The transportation companies have been called on to take their share in the reduction of prices that have been and are still being made, and if furnaces and mills cannot get their materials carried at much lower cost many will have to close. As a matter of fact, iron from Ohio is being carried direct to points in New England at lower rates of freight than are being paid from points in the Schuylkill and Lehigh Valleys. The railroads are beginning to realise the necessity of lower freights, and one road has already offered reductions of 30 per cent. as an inducement to one concern which is now idle to resume work.

Steel Gun.—The Standard Steel Company, of Chester, Pa., have cast a 6in. gun of Siemens-Martin steel, which they propose to offer to the Government for the same tests to which the gun lately cast at Pittsburg will be subjected.

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THE "LEEDS" DYNAMO.



THE "LEEDS" DYNAMO.

The above illustration represents an 18 kilo-watt dynamo, of the "Leeds" type, manufactured by Messrs. Greenwood & Batley, of Leeds. The core of the field magnet is of annealed wrought iron, and is provided with soft cast iron poles. The armature is of the Gramme pattern, the core consisting of thin annealed charcoal iron discs, insulated from each other in the usual way, and the winding of a single layer of copper wire. The armature shaft is of Bessemer steel, and is supported in Babbitt metal bearings. The current is taken off by a large number of small brushes, which are self lubricating. The machine is intended for an output of 180 ampères, at a pressure of 100 volts when driven at 750 revolutions per minute. We are informed by the makers that a machine of this type has now been successfully at work for two years at the Union Oil Mills, Rotherhithe.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

In a certain sense the meeting of this Society, held on the 17th inst., was unique. Generally speaking, the papers read and discussed at the Society of Telegraph Engineers are primarily of a scientific or technical and only secondarily of a commercial character, whilst the advertising element and personal reference have happily hitherto not been more prominent than in any of the other leading scientific societies. If the proceedings were at times somewhat dull, this was not so much the fault of the speakers as it was due to the nature of the subjects under discussion, which did not lend themselves to nor call for oratorical and histrionic displays; but, on the whole, the meetings were decorous, and yet of sufficient interest to attract large audiences. Those members who had the welfare of the Society at heart could feel when they went home from the meetings that the evening had been spent in a way creditable to the Society, and that although the amusement it provided was certainly limited, this drawback was amply compensated by the scientific and technical interest of the proceedings. To such members the meeting of the 17th inst. must have come as a revelation, and let us hasten to say a disagreeable one. There was this time a maximum of amusement, but this was not accompanied by a corresponding amount of decorum or scientific instruction. To hear one eminent electric light engineer tell an equally eminent professor that he knows nothing practically about a certain subject, or to find the carefully rehearsed and grandiloquently delivered peroration of one member received with peals of laughter by the other members may be highly amusing, but it is not the kind of thing we are used to in English scientific assemblies, nor is it the kind of thing which will improve the status of the Society of Telegraph Engineers and Electricians.

The Society has been attacked from various quarters for having issued a new set of fire rules, and at the meeting alluded to above a kind of three-cornered duel took place between the Fire Rules Committee of the Society, Mr. Heaphy, and other gentlemen interested in fire insurance offices, the general body of members taking mostly part against the committee of their own Society. This feeling of opposition is difficult to understand. By issuing a new edition of their 1882 rules, the Telegraph Engineers have done what was obviously a necessity in this age of rapid progress. Mr. Preece told the members that thousands of copies of the original rules have been sold to all parts of England, and that the demand is still maintained. Should the Society continue to supply antiquated rules, should it refuse to supply any rules at all, or should it supply rules amended in accordance with modern requirements? The Council have determined upon the latter course, which would commend itself to most business men, but when it be considered that they could only in this way prevent or restrict the indefinite multiplication of rules, that they were encouraged by several fire offices to take the lead, and that they had even the assistance and approval of Mr. Heaphy up to nearly the time of publication of the new rules, it is almost impossible to understand on what reasonable grounds the Society is now censured for the publication of these rules. It must be borne in mind that the rules are merely general recommendations, and not intended to supersede any other detailed rules which fire offices may issue.

Having made these few introductory remarks regarding the meeting on the 17th we proceed to give our report of it; but in doing so we shall omit all matters constituting the amusing and personal element, limiting ourselves to the points which are technical. As the personal element greatly predominated over the scientific element our report will be necessarily very short.

After the formal business of opening the meeting had been gone through, Mr. Crompton was called upon to reply to the discussion which has taken place on his paper on "Central Station Lighting." In the course of his remarks he reminded the members that his paper did not pretend to deal generally with the question of "Transformers *versus* Accumulators," but only with the particular phase of this question which presents itself when applied to London districts of moderate size, in which case overhead wires could not be used, and consequently the battery system would be the cheaper of the two. He had particularly in mind the lighting of residential districts, and there the load diagram would not admit of a greater sale than 2100 units per day, though in business districts the sale might reach a higher figure. He did not include the sale of motive power, as this would unfairly prejudice the alternating current system where motors could not be used; but it must be remembered that the cost of the central station would be somewhat in proportion to the peak of the load diagram, whilst the income would be proportional to the area, and since the sale of electricity for motive power increases the area without raising the peak, the use of motors would give an enormous advantage to the B.T. system. His tables of the cost of conductors were taken from actual commercial experience and were therefore correct. His bare conductor supported on insulators—not suspended from the roof of the culvert—would have an insulation resistance equally as high as the best cable, and where space could not be obtained for a culvert 18in. square, he could manage with a culvert 5in. deep by 18in. wide for an ordinary twin main or 24in. wide if a charging main were to be laid in addition. It must be remembered that there was no difficulty in getting width under the footway, but they were sometimes restricted in depth. He did not refer to the Colchester installation, because that was of a totally different character to his own. In Colchester the batteries were charged in the daytime and discharged at night, and acted as reservoirs of electricity. In his own plan the batteries and the dynamos would work together, and the efficiency of the batteries came only into question in so far as they acted as reservoirs; but since the maximum supply would be direct from the dynamo, the presence of the battery could have no appreciable effect upon the efficiency of the whole distribution. He fixed the potential at 400 or 450 volts, because he was certain that with that pressure he could do the work. It might in future be possible to raise the potential and go to a longer distance. At Vienna he had now 13,000 lights installed, the charging main being 1500 yards long. If a potential of 400 volts be considered too high, it would be quite practicable in London to work on the three-wire system with two batteries, and thus keep the potential within the limits allowed by the Board of Trade. As regards the depreciation of accumulators, the Vienna Company had received an offer to maintain them at an annual cost of 10 per cent., but they had refused this offer because they were satisfied that the depreciation will come to less. After the usual vote of thanks was recorded to the author, the adjourned discussion on the paper by Mr. Preece on Fire Risks and Fire Risk Rules was opened by Mr. Musgrave Heaphy, who gave a history of the labours of the committee at which he assisted up to the time when he left it.

Mr. Human criticised the clause of the new fire office rules referring to the insulation resistance. According to this clause the insulation resistance is not to be specified as so many megohms or ohms, but by the amount of leakage which could be allowed, the limit being $\frac{1}{3000}$th part of the working current. Mr. Human said that in most installations the working current was comparatively small, say from 15 to 20 ampères, and he did not see how so small a current as $\frac{1}{3000}$th part of 15 ampères could be measured.

The Earl of Crawford deprecated the multiplication of rules, because each rule contained some weak points, and unscrupulous contractors would choose that rule which would best suit them for doing the work cheaply. He and his friends at the Grosvenor Gallery installation have found the Phœnix rules perfectly satisfactory, and owing to the great trouble they had had with installations put up under other rules they had now come to the determination that before turning the current on to any installation they would require proof that it had been fitted up under the Phœnix rules, or that it had been inspected and passed under those rules. Referring to Mr. Crompton's statement that at the Grosvenor Gallery the consumption of coal was 18lb. per electrical h.p., he thought that Mr. Crompton must have displaced the decimal point, and must have meant 1·8lb.

Mr. Wharton considered the fire offices and the contractors the only parties who had to be consulted in the matter of fire rules, and, as far as he knew, neither party wished to have any alteration in the existing Phœnix rules, or any new set of rules imposed upon them.

Mr. Shoolbred asked the author about the relative heating effect in different sized wires, and he pointed out to the meeting that the new rules issued by the Committee of the Society were not in any way antagonistic to the existing Phœnix rules, which could still be retained as detailed rules.

Mr. Prior denied the statement that the Phœnix rules had been adopted by all the leading offices. The office with which he was connected had not adopted these rules, and did not intend to adopt any rules of this character, as it was not the business of the fire insurance company to protect the contractor or the customer from possible losses by leakage, &c. His office did not consider inspection necessary, and would not accept any rules which would necessitate the sending of inspectors to electric light installations before accepting the risk. They wanted some simple rules under which inspection would be unnecessary, and for this reason he considered the Phœnix rules totally inadmissible.

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Mr. Preece, in his reply, regretted the turn which the discussion had taken, and limited himself to the scientific and technical points only. Referring to Mr. Human's question, he said that any telegraph engineer and any budding electrician in the room would be perfectly competent to measure a current of three milliampères which would be the permissible leakage with an installation using a 15 ampères working current. Regarding the question of Mr. Shoolbred, he had for some considerable time been carrying out experiments to determine the heating of wires of different sizes when traversed by currents of different intensities. In this connection he would refer to the investigation made by Professor Forbes some years ago, which, however, was based upon Macfarlane Gray's co-efficient of emissivity, which was determined in the laboratory of Sir William Thomson by means of metal spheres both polished and blackened. His own experiments showed him that the co-efficient was different for cylinders, and that the formula of Professor Forbes required correction.

CLYDE SHIPBUILDING FOR APRIL.

THE tonnage launched during April was not above, though it was up to, the average. There were in all fourteen steamers and six sailing vessels launched, and the aggregate tonnage was 15,777 tons. Included in this total is yacht tonnage amounting to 860 tons. The bulk of this comparatively large tonnage is composed of the 735 tons of the "Lady Torfrida," which Sir William Pearce has had built by his firm for his own use. The only large steamship launched was the "Spindrift," built by Messrs. Russell & Co., Greenock. One notable feature of the launching of the month is the comparatively large proportion of sailing tonnage. Four large sailing vessels, averaging nearly 2000 tons each, make up the respectable total of about 7000 tons, or nearly 50 per cent. of the whole. The new orders of the month are not significantly large, though somewhere about 4000 tons of new contracts have been booked. About ten vessels are included in this estimate, so that the average size is small. Among the orders is one for a caisson for docks in Nova Scotia, which has been entrusted to Messrs. D. J. Dunlop & Co., Port Glasgow.

	Steamers. No.	Tonnage.	Sailing vessels. No.	Tonnage.
United Kingdom	8	6,371	6	6,897
Colonies	2	1,209	—	—
France	1	250	—	—
Italy	1	250	—	—
Egypt	2	800	—	—
April, 1888	14	8,880	6	6,897
April, 1887	11	5,820	5	3,900

Steamers: "Aid," 250 tons, patent hopper dredger, built by Messrs. Simons & Co., Renfrew, for a French firm; "Campbill," steel screw steamer, 1026 tons net register, built by Messrs. Russell & Co., Port Glasgow, for Messrs. Macbeth & Gray, Glasgow; "Cygnet," steel steam yacht, 30 tons, built by Messrs. T. B. Seath & Co., Rutherglen, to the order of Sir John Lawes; "Fusileer," paddle steamer, 250 tons, built by Messrs. J. Macarthur and Co., Paisley, for Mr. David MacBrayne; "Lady Torfrida," steel steam yacht, 735 tons, built by the Fairfield Shipbuilding Company, Limited, for Sir William Pearce, Bart.; "Luath," steel steam yacht, built by W. S. Cumming, Glasgow, for Mr. John Henry, Glasgow; "Macassa," steel twin screw, 459 tons, built by Messrs. W. Hamilton & Co., Port Glasgow, for service on Lake Ontario; "Ramleh" and "Rosette," hopper barges, each 400 tons, built by Messrs. Lobnitz & Co., for the Suez Canal Company; "Rouen," steel paddle steamer, 800 tons, built by the Fairfield Shipbuilding Company, for the London, Brighton, and South Coast Railway, for the Newhaven and Dieppe route; "Ruby," 500 tons, built by Messrs. Scott & Co., Bowling, for Mr. William Robertson, Great Clyde-street, Glasgow; "Spindrift," steel, 3000 tons, built by Messrs. Russell & Co., Greenock, for Mr. S. Y. Barwick, Sunderland; "Triette C.," steel, 250 tons, built by Messrs. W. Simons & Co., for passenger service in the Adriatic; "Volunteer," composite, 750 tons, built by Messrs. A. Macmillan & Son, for service on the Newfoundland coast.

Sailing Vessels: "Adderley," steel, 1237 tons, built by Messrs. John Reid & Co., Port Glasgow, for Messrs. C. W. Kellock & Co., Liverpool; "Harold," steel, 1360 tons, built by Messrs. Robert Duncan & Co., Port Glasgow, for Messrs. Thomas Stephens & Son, London; "Madagascar," steel, four-masted barque, 2080 tons, built by Messrs. Russell & Co., Port Glasgow, for Mr. J. W. Boyd, Helensburgh; "Marion Lightbody," steel, four-masted ship, 2155 tons, built by Messrs. D. & W. Henderson and Co., for Messrs. Rogers & Co., Glasgow and Valparaiso; "Oriel," yacht, 5 tons, built by Mr. De Fyfe, Millport, for Mr G. H. Pentland, Drogheda; "Yanara," composite racing yacht, 60 tons, built by Messrs. D. & W. Henderson & Co., Partick, for Mr. Paul Ralli, London.

Notices of Meetings.

THIS WEEK.

THE DYNAMICABLES.—Friday, 25th May, 7-30 p.m. Dinner at the Holborn Restaurant.

PHYSICAL SOCIETY.—Saturday, 26th May, 3 p.m. Papers to be read: "Note on the Governing of Electromotors," by Professors Ayrton and Perry; on "The Formulæ of Bernouilli and Haecker for the Lifting Power of Magnets," by Professor S. P. Thompson; "Experiments on Electrolysis. Part II. Irreciprocal Conduction," by Messrs. W. W. Haldane Gee and H. Holden.

NEXT WEEK.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday, 28th May. Ordinary meeting. Nomination of candidates for membership. Paper and discussion.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, 29th May, 8 p.m. Annual general meeting, to consider the Report of the Council on the state of the Institution, and to elect the Council and officers for the ensuing year.

SOCIETY OF ARTS.—Tuesday, 29th May, 8 p.m. Applied Art Section. Paper to be read on "Persian Textiles," by Mr. Cecil Smith.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, 29th May, 3 p.m. Lecture on "Conventions and Conventionality in Art," by Mr. S. Colvin.—Thursday, 31st May, 3 p.m. Lecture on "The Growth and Sculpture of the Alps," by Professor T. G. Bonney.—Friday, 1st June, 9 p.m. Lecture on "Earthquakes, and How to Measure Them," by Professor J. A. Ewing.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, 31st May, 8 p.m. Paper to be read on "The Influence Machine from 1788 to 1888," by Professor Silvanus P. Thompson.

GEOLOGISTS' ASSOCIATION.—Friday, 1st June, 8 p.m. Paper to be read on "The Natural History of Gypsum," by Mr. J. G. Goodchild, F.G.S.

PRICES CURRENT, 24TH MAY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3	30/11	Cash
Scotch Warrants, m/n	37/8½	"
Hematite Warrants, m/n	40/10½	"
Stocks in Stores. Scotch	983,651—Inc. for week,	2550 Tons
Middlesbro'	296,336—Dec. "	4534 "
Hematite	205,674—Dec. "	937 "

Exclusive of stocks in makers' yards.

Market very dull.

	No. 1.	No. 3.		
Coltness	47/6	42/9	f.o.b.	Glasgow.
Gartsherrie	44/3	41/3	"	"
Dalmellington	39/6	37/9	"	Ardrossan
Eglinton	38/-	36/9	"	"
Glengarnock	43/-	39/-	"	"
*Derbyshire	—	35/-	f.o.t.	Works.
*Lincolnshire	—	32/-	"	"
*Lancashire	—	37/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 15 0	5 5 0	f.o.t. wks
" Angles	4 12 6	5 2 6	"
" Plates	4 17 6	5 7 6	"
Staffordshire Bars	5 0 0	6 0 0	Manch'r.
" Angles	5 10 0	6 10 0	"
Crown Sheets	6 10 0	6 15 0	"
" Hoops	5 7 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		8 0 0	"
" Ship and Girder		7 15 0	"

METALS.

Spelter: Ordinary	£16	12	6	to	16	17	6
Copper: British Cakes and Ingots	81	0	0	"			
" Chili Bars	82	0	0	"	82	10	0
" Manufactured (strong)	88	0	0	"	90	0	0
Lead: Common Pig	13	15	0	"	13	17	6
" English Sheet	14	12	6	"	14	15	0
Tin: Straits	86	10	0	"	87	0	0
" Australian	87	0	0	"	87	10	0
" English Ingots	96	10	0	"	97	0	0

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/-	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—Being Whitsuntide holidays, our market is virtually closed. Quotations for Chili spot parcels firm, about £82 per ton; three months, £75. 10s. per ton. Manufactured is still without demand.

TIN.—Straits, £86 to £87 per ton for cash; £87. 5s. three months, with a steadier market.

LEAD.—Spanish, £12 to £12. 5s. per ton. English quiet.

SPELTER dull, and quotations about same as last week. Warrants, £16. 10s. to £16. 15s. per ton.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	0	0
" Ceylon	"	23	10	0
Cottonseed	"	20	15	0
Cod	"	18	10	0
Lard	"	43	10	0
Linseed	"	18	12	6
Palm, Lagos	"	21	0	0
Rapeseed: English	"	24	10	0
Seal: Pale	"	22	10	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	11	6
Coal	per gal.	0	0	5½
Petroleum (Refined)	"	0	0	5 7/8
" Spirit	"	0	0	7½

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	9
" Citric	lb.	0	1	7½	—	0	1	8
" Oxalic	"	0	0	3	—	0	0	3½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6	—	0	1	6½
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	7	6	—	11	12	6
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	7	6	—	7	12	6
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	30	10	0	—	31	10	0
Benzole (90%)	gal.	0	3	0	—	0	3	6
" (50/90%)	"	0	2	3	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	.....		
" White Sugar	"	26	10	0	—	27	0	0
" Brown "	"	22	5	0	—	23	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5½	—	0	0	5 7/8
" Prussiate (Yellow)	"	0	0	6½	—	0	0	7
" Sulphate (Basis 90%)	ton	8	17	6	—	9	5	0
Precipitate: Red	lb.	0	3	1	—	0	3	2
" White	"	0	3	2	—	0	3	3
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	8	10	0	—	9	0	0
" Recovered	"	4	10	6	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	15	0	—	.....		
" " " 60%)	"	5	15	0	—	.....		
" " (Cream, 60%)	"	5	15	0	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	2	6	—	6	5	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

AGRICULTURAL IMPLEMENTS IN SPAIN.

THE British Vice-Consul at Jerez de la Frontera states that, nothwithstanding want of capital and heavy taxation, land owners and farmers in his district have made an effort of late years to import ploughs, thrashing, reaping, binding, and sowing machines from England, Messrs. Ransome's being the principal firm from which they have been obtained. Latterly, however, agents for German and American manufacturers have established themselves at Seville, and are obtaining a large share of the trade. They keep considerable stocks not only of various classes of agricultural implements, but also of the separate parts, thus enabling the farmer to immediately replace any damaged part of his machine. This bears out the advice given some time ago by our Madrid correspondent, that English agricultural engineers would find it good policy to establish repairing shops in Spain if they desired to do business there. Those farmers who cannot afford the outlay necessary for the purchase of agricultural machinery continue to reap by hand and to thrash in a primitive fashion. In the Cordoba district, according to the local British Vice-Consul, foreign enterprise in agricultural implements meets with little encouragement; but he points out that American and German houses are doing their best to promote trade by giving long terms for payment, and adds that he thinks there is every possibility of good results.

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HOME INDUSTRIES.

MANCHESTER, 24TH MAY, 1888.

THE COTTON TRADE.—This week being the popular holiday time in Lancashire, the state of the market is somewhat disorganised, and there are no special features to note. The general tone and tendency are unmistakably in favour of buyers, and this is largely helped by the extremely low price of silver, and a somewhat drooping condition of the cotton market. Silver has touched during the past week a price of 41⅛d. per oz., a quotation which we believe is without precedent. The lack of confidence which is caused by this state of the silver market immediately tells on the chief Eastern buyers, and the result is that a very slack demand exists at present prices. So far as cotton is concerned, it is now tolerably clear that the largest estimate of the extent of the American crop which was made in the early part of the season will be very materially exceeded, and the immediate result is seen in a fall in the price of all American staples. Thus there are two factors tending to produce lower prices—cheap silver and cotton—the combined effect of which is very strong. On the other hand there is no disposition on the part of spinners to yield, as they now have to face an immediate advance of wages. The replies received from the various spinning firms in the Oldham district were considered at a meeting held on the 17th inst., and were of such a nature that it became absolutely necessary to concede the advance in wages asked by the operatives. As this amounts to 5 per cent. on the wages of spinners and 10 per cent. on those of blowing room hands, there is a powerful counterpoise provided to any declining tendency in quotations. At present also there are a large number of concerns well bought in cotton and well sold in yarns, and under these circumstances a stiff opposition will be made to any attempt to lower the rates. Besides this there is a much larger home demand for all classes of yarn than ever existed before, so that, all round, the pessimists of the trade are likely to be disappointed. The cloth trade is quiet generally, more especially so in Eastern varieties. A fair quantity of contracts are running out, and there is a little pressure to replace them; but it is almost always the case when this happens that lower prices are offered and accepted. The peculiar mode in which manufacturing operations are now carried on, and the large number of small masters who now weave for the market, enable the large distributing agents and merchants to keep rates down and to make remunerative bargains. It is somewhat singular and very significant that the spinning trade tends to larger establishments and weaving to smaller ones. In the better class of cloth, such as printing varieties, there is less demand than ever, and makers are complaining a good deal. The dispute to which we have previously referred between the loomers and drawers and their employers at Blackburn appears likely to lead to a strike, which, if it occurs, will affect a body of workpeople altogether out of proportion to the number directly concerned.

STEAM IN WEAVING SHEDS.—A memorandum has been issued by the Blackburn and District Weavers' Association complaining of the emission of steam into sheds where weaving is conducted. This practice, it is claimed, is very detrimental to health, however beneficial it may be in preventing breakages. It is very likely that, if any well authenticated case was brought to the knowledge of the authorities, steps would be taken to prevent the practice, the benefits arising from which have been shown by American experience to be very slight.

THE FLANNEL TRADE.—This trade, the head centre of which in this district is Rochdale, is gradually recovering from the extreme depression of the past few years. Flannel goods have not been much worn latterly, and the revival in their employment has been accompanied by a demand for fancy and mixed goods. These flannelettes, which are a mixture of cotton and wool, are now produced in tasteful designs, and are being largely adopted. Those manufacturers who have been wise enough to keep abreast of the times, and who endeavour to make goods which take the public fancy, are fairly employed, and generally speaking there is a very decidedly better state of things existing in Rochdale than there was a short time ago. A steady business is also being done in all wool goods, and with the greater knowledge of hygienic science, these will be still further called for.

LONDON, 24TH MAY, 1888.

THE MONEY MARKET.—The money market has been comparatively easy in the absence of any strong demand for accommodation in the way of loans, and rates have consequently continued at a comparatively low figure. In the stock markets a more hopeful tone has begun to manifest itself since the "House" resumed after the holiday. Business had been absolutely dead for some days before, and as soon as work was begun again an endeavour was made to infuse a little more life into the markets. Naturally, the movement was led by home railway stocks, as the lovely weather during Whitsuntide insured a good traffic. There is still room for improvement in the markets, which are not so buoyant as might be expected. The absence of life and energy in the Stock Exchange this year is almost unprecedented, and is quite inexplicable.

COMPANIES.—The following new companies have been registered since our last report: Richard Goodair, Ld., with a capital of £100,000, to acquire the business of a merchant and cotton manufacturer carried on at Preston and Manchester; Oldham & Booth, Ld., with a capital of £20,000, to acquire the engineering business carried on at the Central Foundry, Hull; the Water Works, Gas, and General Lighting Corporation, Ld., with a capital of £1,000,000; the Monmer Lane Iron Company, Ld., with a capital of £20,000; the Marsden Chemical Company, Ld., with a capital of £25,000; the Wenham Company, Ld., with a capital of £250,000; the Pacific and Oriental Petroleum Company, Ld., with a capital of £400,000; the Schülke Gas Lamp Company, Ld., with a capital of £50,000; the Parana Water Works Company, Ld., with a capital of £100,000, to supply water to the town of Parana, Argentine Republic; the Rosario Drainage Company, Ld. (Argentine Republic), with a capital of £800,000; the San Juan and Rioja Railway Company, Ld. (Argentine Republic), with a capital of £2,000,000; the Universal Patent Fuel Machine and Manufacturing Company, Ld., with a capital of £75,000; the Great Northern, Lincoln, and East Coast Railway Company, Ld., with a capital of £75,000; the Morgan Gold Mining Company, Ld., with a capital of £210,000; the Groot Paardekraal Gold Mining Company, Ld., with a capital of £250,000; the Leadville Mines Company, Ld. (United States), with a capital of £210,000; the Rich Knob Copper Mining Company, Ld. (United States), with a capital of £200,000; the Libiola Copper Mining Company, Ld. (Italy), with a capital of £252,000; the Golden Crown Company, Ld. (Brazil), with a capital of £175,000; the Deep Navigation Collieries Company, Ld., with a capital of £215,000; Luipaards Vlei Estate and Gold Mining Company, Ld., with a capital of £250,000; and the Kadur-Mysore Gold Mines Company, Ld., with a capital of £100,000.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 13th May, amounted to £1,219,233 on 15,852 miles, as compared with £1,188,010 in the corresponding period of 1887, when the mileage was 15,728½ miles. An increase is thus shown in the mileage of 123½ miles or 0·7 per cent., and in the receipts of £31,223 or 2·6 per cent. A Blue Book has been issued containing a return of the accidents on the railways in the United Kingdom during last year. Under the heading of accidents to trains, rolling stock, and permanent way, it appears that twenty-five passengers were killed and 538 injured, as compared with eight killed and 615 injured in 1886; eight servants of companies were killed and 109 injured, as compared with four killed and eighty-one injured in the previous year. The number of deaths of passengers from collisions was thirty-three, and the number of injured 647, as compared with twelve and 696 respectively in the previous year. By accidents from other causes ninety-six passengers were killed and 759 injured, as against eighty-seven and 727 respectively in 1886. The total number of personal accidents reported to the Board of Trade during last year amounted to 977 persons killed and 7747 injured.

PARIS EXHIBITION, 1889.—The Executive Council of the British Section announce that they are prepared to receive applications from intending exhibitors up to the 9th of next month, at which date it will be absolutely necessary to commence the allotment of space. It appears that very little, if any, more space can be given to this country, which already has a large proportion of the amount allotted to foreigners, the demands made by native exhibitors having been unexpectedly large.

SANITARY INSTITUTE OF GREAT BRITAIN.—At the annual general meeting, held at the Parkes Museum last week, Professor W. H. Corfield, M.A., M.D. (chairman of Council), in the chair, a report was presented by the Council on the work of the Institute during the last year, and on the Congress at Bolton in the autumn of 1887. The chairman gave an address, and the officers for the ensuing year were elected: President, the Duke of Northumberland, K.G., and trustees, Sir John Lubbock, Dr. B. W. Richardson, and Mr. Thomas Salt, M.P.

GLASGOW, 24TH MAY, 1888.

GENERAL BUSINESS.—There is a considerable want of life in general business; prices both in the metal markets and in stocks are not exhibiting any signs of expansion. There is a slight increase in shipments of pig iron, but no corresponding increase in price. Shipbuilding and engineering orders are neither numerous nor important. The retail trade of the shops, which ought at this season to be brisk, has been affected both favourably and prejudicially by the Exhibition. The influx of strangers has brought brisk trade to some classes of shopkeepers, but others complain that their customers are entertaining themselves otherwise than by purchasing, and that except in dress goods, printing, and a few trades specially affected by demands for the Exhibition, there is little being done.

GLASGOW EXHIBITION.—In point of attendance, the Exhibition is a phenomenal success. The numbers are much greater even than the Indian and Colonial Exhibition in 1886. The average daily attendance during the first twelve days reached the large total of 35,994. The corresponding figures for the Indian and Colonial Exhibition were 21,833, for Manchester 21,720, for Edinburgh 19,122. The building, large as it is, is inconveniently crowded when upwards of 30,000 are within its gates at one time. It is found that the Grand Hall, which is seated for about two thousand, is altogether too small. The Whitsuntide holidays have brought into town a large number of English visitors. There can be no doubt that the financial success of the Exhibition is already assured. A singular economic result from a banking point of view is the direction into the hands of a single bank—the Clydesdale—which has an office in the building, and which finances for the Executive, of the relatively large sum of from £500 to £1,000 in small silver coins per day. A careful watch has to be kept at the turnstiles for foreign and counterfeit coins, of which already a considerable quantity has been passed, the pressure at every entrance in the evening rendering detection difficult.

PIG IRON.—A hematite furnace has been put in blast at Gartsherrie, bringing the number of furnaces now in operation in the district up to eighty-eight. This is an increase of seven furnaces over the same week last year. A fairly large quantity in warrants has changed hands, but the price has not yet made any upward movement.

(From our own Correspondents.)

LIVERPOOL, 23RD MAY, 1888.

THE PACIFIC STEAM NAVIGATION COMPANY.—On account of the prevalence of cholera during the last year in Chili and Peru, many of the ports had to be closed, and for the same reason vessels ceased calling at Monte Video and the Brazilian ports. Although these ports were not actually closed against vessels sailing from Chili, the rigorous and expensive quarantine enforced practically made them so. This has reduced the coasting traffic of the company to an unprofitable limit, and several of the steamers had to be temporarily withdrawn. Excessive competition on the West Coast, Straits, and the Australian line, has compelled the adoption of reduced fares in order to compete with the inducements offered by foreign companies. From the report of the directors it appears that the profits on the working account last year was £171,684. The profit and loss account, after the usual debits were made, including £159,648 for depreciation, &c., shows a credit balance of £5,940 for the year 1887. An interim dividend of eight shillings per share was paid in November last from the balance of £28,935 brought forward from 1886. The final credit balance for last year being only £11,658, the directors have decided to carry it forward to the 1888 account.

PASSENGER TRAFFIC TO THE VARIOUS WATERING PLACES.—The summer excursion season has now fairly commenced, all the boats to the Isle of Man, Llandudno, and other places being well patronised; what with last Monday being a Bank Holiday, and the exceptionally fine weather, the traffic to the Isle of Man was enormous and quite unprecedented; all the steamers of the two companies were brought into requisition, and no less than eight left the stage during the day with about six thousand persons on board. Forced draught has been applied to the "Mona's Isle" and others of the Old Manx Line with satisfactory results, and some interesting races have since taken place between the boats of the competing companies; the "Queen Victoria" of the new company is, however, still able to give her opponents fully half an hour's start.

SHEFFIELD, 23RD MAY, 1888.

THE HEAVY INDUSTRIES.—During the early part of the week there was a general holiday, but a vast amount of work was done in forwarding and completing orders in order to prepare for the holiday, and all the houses making heavy material have still a good number of orders on their books. Bars, hoops, angles, indeed all kinds of iron, can now be bought so cheaply, and the quotations for Bessemer steel are so easy, that manufacturers are not making a great profit even on urgent contracts; still the low prices are tempting buyers, and not only makers but merchants have turned over a vast amount of material during the past month. The fall in the price of coal has also tended in some quarters to a better demand, especially with houses that find it absolutely necessary to cheapen production. It is encouraging to find in the midst of complaints about the unremunerative condition of the iron trade that the Parkgate Iron Company, near Sheffield, has made a profit of nearly £7,000 on the year. Work is plentiful there, and its blast furnaces, plate and sheet mills, and puddling fires are kept going steadily. When the new plant for steel manufacture by the Siemens-Martin process is put down, the firm hopes to develop a very extensive steel trade. There is all round a tendency to extend steel manufacture, and additions both to crucible and Bessemer steel making plant are being put up by local firms. The talk about national defences has revived hope in Sheffield, but that is all it has led to at present. The special machinery built in the new shops of some of the great Sheffield firms on the expectation of Government orders is for the most part lying idle, and an enormous amount of capital has been, so far, practically wasted. Railway material continues in good request. Tyres, axles, and springs are on extensive order, both for the home and colonial markets. One or two good orders for rails have been placed during the week. At the rolling mills there has been considerable activity up to Whitsuntide, and in the engineering shops employment has been by no means scarce. A great deal of heavy machinery is on order, and in the boiler shops work is not so difficult to obtain. The crisis in the shipbuilding trade of the North will benefit one or two local firms, but it is to be regretted that the difficulty has arisen. The trade in edge tools is brisk. Makers contrive to keep opening new markets, and all kinds of articles, handy, useful, and cheap, are being

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shipped to the Colonies, and to more remote markets. The intention of the Government to keep open the passage of the Zambesi has given much satisfaction here. Sheffield already does an extensive African trade, chiefly in kind. Before long another advantage may be derived, on account of the cost of the transit of ivory being much decreased. Colliery plant, such as machinery, hauling wire, and pit rails, is in fairly good demand.

NORTH STAFFORDSHIRE, 23rd May, 1888.

The Iron Trade.—This week the works are all closed for the Whitsuntide holidays, and the market is quiet. The outlook is unfavourable both with regard to prices and demand. Manufacturers are interesting themselves in the question of railway and canal carriage, as owing to its landlocked position the maintenance of trade in this district much depends upon the prospect of reduced charges for transit to the coast.

The Coal Trade.—Now that summer weather is really upon us, there is a great falling off in the coal trade for domestic consumption, and in consequence of the keen competition prices are being reduced. The demand for manufacturing fuel for the pottery industry is fairly good. Messrs. Johnson Brothers are building a new manufactory at Hanley, and hope to have it completed before the autumn.

Engineering.—Founders still complain of low prices and poor demand, and there is little margin for profit in the rates at which orders have to be booked. Foundry coke is in but poor request, and most of that used locally comes from the Durham ovens.

BIRMINGHAM, 23rd May, 1888.

The Iron and Hardware Trades.—The markets in the iron trade are dull, but pig iron remains fairly steady. Buyers, as usual at this season, are unwilling to purchase, and probably little activity will be manifested until the holidays are over. Staffordshire all mine hot blast pig is firm at 52s. 6d. to 57s. 6d. per ton, and marked bar iron brings £7, although with some difficulty. Black sheets are selling freely, the reduction in the price of galvanised iron having stimulated this branch of business. Several offers for thick sheets have been refused by makers at £6. 5s. for 24-gauge. Steel is in good request, and sheets up to 20-gauge are worth £7. 5s. In the hardware trade production is almost at a standstill, and many firms have closed until Thursday. The continued high price of copper continues to harass the copper and brass trades. Standard brass wire is quoted at 8½d. per lb., but brass tubes find only a limited demand. In the jewellery trade matters are a little better; the demand for silver goods has somewhat subsided, and gold articles, ornamented with jewels, have taken their place. Travellers report that fashion appears to be again returning towards the wearing of jewellery, and the fine weather is opportune to the revival. Electro-platers and manufacturers of white metal goods report great quietness in trade; the orders for home requirements are very meagre, and the only activity appears to lie in the direction of Colonial markets. Makers of common white metal spoons, coffee house appliances, bar fittings, cork drawers, and general pewter ware are busy. Iron wire drawers continue to feel the German competition very keenly, particularly in foreign markets; in the home markets English manufacturers are steadily regaining their predominance. The action of the Government in deciding to remove to Enfield the plant of the local ammunition and small arms concern, which they recently bought, is giving much dissatisfaction; it is considered in this district that not only will their action result in injury to the local gun trade, but will tend to weaken the national defences in case of a crisis.

LEICESTER, 23rd May, 1888.

Wool Spinning and Yarn Trades.—The condition of the wool market remains almost unaltered so far as prices are concerned, whilst the turnover has been very restricted. Staplers who are not heavily stocked stand out for the late prices, and as a rule sales are not pressed. Users content themselves with buying as small quantities as possible. An uncertain element in the market at present is the new clip, and until this has been seen and judged for quantity and quality, prices cannot be fixed. As a rule the heavier sorts are best in demand, and fine wools are very slow. Spinners have not been any better employed, and the present state of the industry is very discouraging. The incidence of the holidays this week has enabled them to let the machinery stand for the week, and it is likely that much of it will be run short time on the commencement of work next week. Sales are only effected at most unremunerative prices, and it is deemed better to let the machinery stand than take orders at rates offered. Yarn merchants are doing anything but a satisfactory business, the unstable state of the market making itself much felt in their department. The demand is best for cashmeres. Cotton yarns are in very quiet demand.

Hosiery Trade.—Somewhat better business is now being done in this industry, and some of the houses are very busy. Those manufacturers who produce specialties are busy and on full time. Medium goods are most in demand, the chief inquiries in the plain department being for cashmere hose and underwear. Fancy hosiers, too, are much better employed, and the trade generally is quite up to its usual average.

Boot and Shoe Trade.—Last week was a busy one, and a heavy turnover was made, mainly in goods ordered for the holiday trade. Orders are more plentiful, and on the resumption of business after the holidays, the workpeople will be more fully employed. The leather trade remains rather quiet, consumers only ordering for immediate wants. The rates rule very low, and the market generally is depressed; and though it is so much in favour of purchasers, yet very little trade is done of a speculative character.

BARROW-IN-FURNESS, 23rd May, 1888.

Iron and Steel.—There is a quiet tone in the hematite pig iron trade, and makers are not in receipt of many new contracts. They are certainly not pressing for orders, and users of iron are not in want of early deliveries of large parcels of metal. There is a large delivery of Bessemer pig iron to steel makers, and as the latter are sure to be busy throughout the year, the mainstay of the hematite pig iron trade is assured; but there is not much hope of any improvement in the prices of pig iron so long as stocks remain as large as at present. As those stocks are for the most part held by second hand dealers, it is easy to see that in times of depression or inactive demand their sale will be frequently effected. Last week's rates are still quoted—Nos. 1, 2, and 3 Bessemer at 42s. 6d. per ton net f.o.b., and No. 3 forge at 41s. 6d. per ton. Hematite warrants have changed hands at fully 1s. and 1s. 6d. per ton below these figures. In the steel trade there is much activity, and the works are very fully employed, and makers are well sold forward. Rails are in good demand; but makers find it impossible to raise the prices, which remain at £3. 17s. per ton net at works or f.o.b. for heavy sections. The mills are very busily employed. Every effort is being made to increase the output of Siemens-Martin steel in the district. In fact, the plant is being doubled, and it is probable that before two or three months the output of plates, angles, and other classes of light goods in mild steel will be fully 1000 tons per week in Barrow alone. Ship plates are in good demand at £6. 15s. per ton net f.o.b., and angles at £6. 2s. per ton. Makers have plenty of orders on their books, and others of some importance are offering. In billets, tin bars, hoops, wire, &c., there is a good trade being done, and all round there are signs of a long continuance of activity in this trade. In shipbuilding a much brisker trade is talked of after Whitsuntide, and there is reason to believe this anticipation will be realised, as also in the engineering, boiler making, and forge trades. The output of iron ore is steadily maintained, but the trade is quiet; prices show no improvement from old rates, which are 8s. 6d. to 11s. 6d. per ton net at mines.

The Import Timber Trade.—There is every prospect of a large import timber trade at Barrow this season, for not only have the Naval Construction and Armaments Company arranged for heavy deliveries of teak wood, pitch pine, and other classes of wood used in shipbuilding, but timber merchants and others have had consigned to them many heavy cargoes of all classes of timber.

Barrow and the Petroleum Trade.—Mr. David Caird has already commenced his contract for the erection of a large storage for petroleum on the docks at Barrow. It is expected that this new trade with Barrow will be opened in a month or two.

MIDDLESBROUGH, 23rd May, 1888.

Pig Iron.—The holidays have prevented any business being transacted during this week. At the weekly meeting held on 'Change yesterday, there were not a couple of dozen persons present. There is no change in price, which is merely nominal at 31s. 3d. for No. 3 G.M.B. for early delivery, and 31s. 6d. for delivery over the third quarter Warrants are 31s. per ton cash for Connal's No. 3 G.M.B., and 42s. 6d. for hematite Nos. 1, 2, and 3.

Shipments of Pig Iron.—Contrary to expectation, the shipments of pig iron continue unabated. No doubt the low price has had its due effect, so that Continental stocks are being more than replenished in all probability. Germany and Holland still lead the way, almost equalling Scotland between them in their demands.

Shipbuilding.—The wage difficulty is again threatening to disturb the trade. The masters have decided to resist. It is considered very unwise on the part of the men to raise the question at all at this time.

Salt.—This industry is growing apace, and very little stock is allowed to accumulate, the demand is so constant and steady. It chiefly goes for chemical and agricultural purposes, but there will also shortly be a demand for fish curing as well.

NEWCASTLE, 23rd May, 1888.

Rope Works.—The demands of shipbuilders for wire rigging and other descriptions of rope required on shipboard are now becoming very pressing, and rope making firms which make that class of work a specialty, are exceedingly busy. The proprietors of several Northumberland collieries have lately placed important orders for wire rope in the district, and considerable quantities have also been ordered for exportation. On the whole, the rope trade may be said to be in a very healthy condition, and so long as business is maintained at its present level manufacturers will have little cause to complain.

Glass Works.—Flint glass manufacturers at Gateshead, Teams, South Shields, and Lemington are able, through the pressure of orders now existing, to keep their establishments actively going, and this somewhat unusual briskness is likely to last for some weeks to come. The lamp chimney trade is becoming busier, and in the bottle making trade a very decided improvement has taken place since the beginning of the year. Very remarkable success has attended the efforts of the Gateshead Stained Glass Company in developing their business, a circumstance which is fully attested by the fact that orders are now coming in from all parts of the country.

Potteries.—Manufacturers of the various descriptions of white ware are generally well supplied with orders, and at most of the local establishments a satisfactory output is maintained. In the matter of values, however, no perceptible improvement is to be noted.

Fire Brick Works.—The demand for fire bricks and sanitary pipes has greatly strengthened within the past few weeks, and the output from the works has greatly increased. Large quantities of these classes of goods are being shipped to foreign destinations.

The Timber Trade.—The number of arrivals of timber laden vessels at Tyne Dock is increasing each week, and in a short time the season of activity in this trade will be at its height. There is much more work for the saw mills than at this time last year, the main cause of the improvement being the increased requirements in connection with ship construction.

The Coal Trade.—The demand for gas and household coals has slackened very much since the beginning of the month, and many of the pits which produce these qualities are now on short time. In the steam coal trade, however, business is daily becoming more animated. The united exports of coal and coke from Tyne Dock during the week ending May 19th, amounted to 91,391 tons. This is a decrease of 3961 tons as compared with the corresponding week of last year.

The Tyne Shipbuilding Trade.—A very serious obstruction to business has just occurred in the Tyne shipbuilding trade. The platers' helpers at Messrs. C. M. Palmer & Co.'s Jarrow yard having been refused an advance of wages, struck work early in the month, thereby practically putting a stop to the operations of the establishment. The Jarrow helpers showing no disposition to return to work without the advance, which, in present circumstances, the employers found it impossible to concede, retaliatory steps by the latter became necessary, and as soon as such measures were decided on, they were very quickly carried out. Towards the close of last week a number of new hands were obtained to supply the places of those on strike at Jarrow, and it was decided at a meeting of the shipbuilders that the helpers employed in the other yards should be discharged. This was done on Saturday last, excepting in two or three establishments whose proprietors do not belong to the Shipbuilders' Association. It was expected that this action of the employers would cause the Jarrow helpers to withdraw their demand for an advance, but as yet they have not done so.

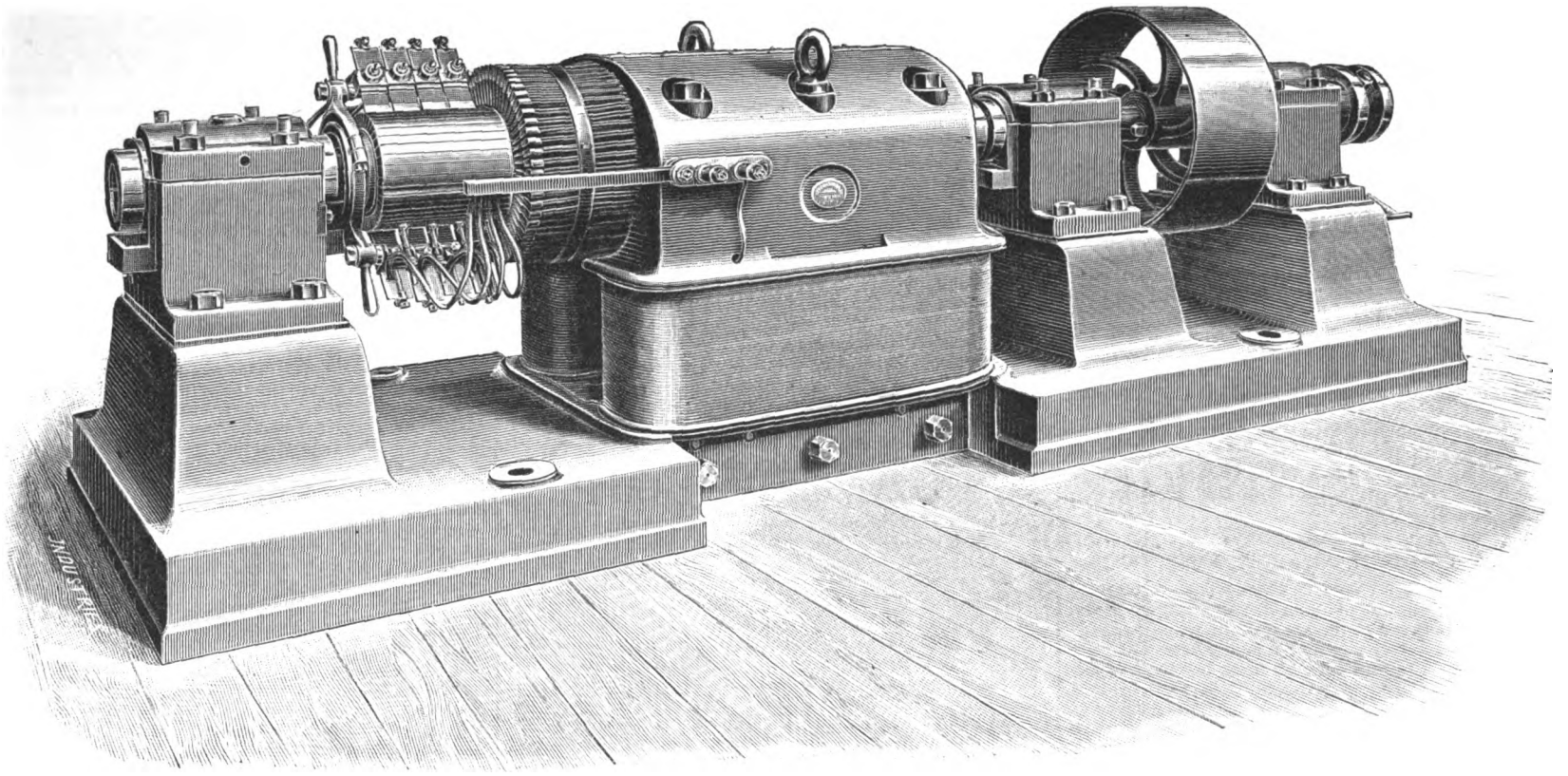
The Sunderland Gas Engine.—Messrs. Ridealgh and Fairman's Sunderland gas engine is now a recognised success, and the demand for it is extending at a rate almost beyond the capabilities of the manufacturers to cope with. They will shortly receive in their shops, however, some new and extensive machinery, and the productive capacity will consequently be largely increased. The firm have now about a score of engines in progress, besides one which is finished, and will at the end of this week be forwarded to the London firm by whom it was ordered. A Newcastle firm of printers, who were among the first to adopt this engine as the motive power in their works, have just received from Messrs. Ridealgh & Fairman a second engine, and have now entirely dispensed with steam as an actuating power for their machinery.

DUNDEE, 23rd May, 1888.

Flax and Jute Trades.—The staple industries of the town and district are moderately active. In the linen branch sellers are more anxious than buyers, and prices are barely maintained; in the jute branch, however, the tendency is in favour of sellers. Flax is coming forward in sufficient quantity to keep spinners fully employed, and there is consequently only a limited spot business, and prices tend rather in favour of buyers. There is more doing for shipment, both in Riga and Petersburg flaxes. Flax and tow yarns command a moderate sale, but prices show no actual improvement. Foreign wet spun yarns are offering at cheap rates. Orders for linens are coming in freely, and manufacturers, more especially in Fife, are well foresold, and holding for rather higher rates. In the heavier classes of goods, such as sail cloth, only a moderate business is passing at late quotations. There has been more inquiry for jute on the spot at about late prices, and there is more disposition to operate on the new crop. For jute yarns the demand continues to be active, and a considerable business has been transacted at firm prices. Spinners are fully engaged, but fresh orders are not abundant at the full advance asked. In jute fabrics Hessians are in good request, and prices are rather higher. The prospects are in the seller's favour, and the tendency is towards increased firmness rather than towards any concession. A moderate business has been done in sacking, and bagging and tarpaulin are very saleable, with an upward tendency in prices.

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THE GOOLDEN-RAVENSHAW DYNAMO.



General View.

FIFTY KILO.-WATT GOOLDEN-RAVENSHAW DYNAMO.

The present tendency in dynamo building is in the direction of increased size. Some five or six years ago, when the manufacture of dynamos was with most firms but an infant industry, machines capable of running 100 or 200 glow lamps were considered fairly large, and constituted productions of which the manufacturer was justly proud. Compared with the original Gramme machines, a 200-lighter was undoubtedly a great achievement; but at the present time such a machine is considered almost a toy as compared with the powerful dynamos which are now made as regular articles of commerce. The three machines required for the Bradford installation, for instance, will each have an output of 85 kilo.-watts, and we recently saw in a Continental works two machines in course of construction, each for an output of 120 kilo.-watts; and 100 kilo.-watt Edison machines for central station lighting are by no means unusual at the present time, to say nothing of alternating current machines, the power of which is expressed by thousands of glow lamps. In most cases large dynamos are direct driven by special engines; but occasionally belt driving is resorted to, and we illustrate above a belt driven machine made by Messrs. Goolden & Co., of Halifax, to the design of Mr. W. H. Ravenshaw. This machine is interesting, not only on account of its size, but also because it contains several contrivances which the increase of size rendered necessary.

As will be seen from the illustration, the machine is of the "over" type, with the yoke in the bed plate and the armature above. It has an output of 500 ampères at 102 volts pressure when driven at 375 revolutions per minute. The armature is of the drum pattern, with internal ventilation, and the conductor consists of six 192 mil. wires in parallel, there being 120 conductors counted all round the armature. Its resistance is ·0066 ohms, and the resistance of the field magnets, which are plain shunt wound, is 6·3 ohms. The total useful induction through the armature core is about 2300 English lines. The armature core consists of the usual iron discs, which, however, do not fill the whole interior, but are of the same dimensions as used by Messrs. Goolden & Co. for Gramme armatures, and are mounted upon the spindle in the same manner. There is thus gained an internal space for ventilation, and a sleeve is fixed over the shaft on the pulley side, leaving an annular space for the admission of air, which is drawn through the armature by means of a fan placed between the commutator and the armature core. By an ingenious method of winding, the ends of the armature are left flat, and not bulging out as in the Hefner Altenek winding, thus economising in length of wire. The magnet cores are of wrought iron, bolted to the bed plate, and the pole pieces are of cast iron, fastened to the magnets by strong bolts, as shown in our illustration. The exciting coils are made with their long sides slightly bulged, so as to cause the wire to lie tightly, and at the same time provide ventilation between the surfaces of the magnets and the internal surfaces of the exciting coils, a suitable slot being left in the flange of the pole piece, as shown.

In this machine a special device has been introduced for giving to the armature a definite to and fro motion lengthwise, in order to keep the bearing surfaces and the surface of the commutator in good condition. It will be remembered that in some of the early Edison machines a similar rocking motion was introduced by means of a spring pressing against the end of the shaft, and several dynamo makers have adopted the rule to allow the shaft a little play endways between the bearings, relying on the side motion of the belt to keep the armature rocking to and fro. This plan, although it works fairly well in certain cases, is not always satisfactory. The armature is often found to rock too violently, and thus produces knocking between the collars on the shaft and the ends of the bearings. To overcome this difficulty and yet obtain the advantage of a variable position of contact between the brushes and the commutator, Mr. D. Halpin has devised a special brush holder and gear by which the brushes are slowly shifted backwards and forwards in a direction parallel to the spindle; but a more simple plan is to make the clearance between the collars and bearings larger than the distance through which the armature rocks. The field magnets exert an attraction upon the armature in the direction of the spindle if the centre of the core of the armature does not exactly coincide with the centre of the pole pieces. If the armature be shifted out of this position of symmetry, the field magnets will pull it back, and the force thus exerted is quite sufficient to limit the oscillation to either side of this normal position. This plan answers well in small and medium sized machines, but for very large machines it is obviously better to prescribe the path through which the armature shall rock, and this is done in the present design in the following way: To the end of the shaft outside the bearing is fixed a cast iron disc, and between this and the bearing there is loose on the shaft a second cast iron disc, with an inclined face. On a spindle at right angles to the shaft and secured to the fast disc is a loose roller touching the opposed surfaces of the two discs. The external diameter of these discs is slightly different, and against their periphery is pressed, by means of a spring, a paper roller running loose on a stud. The centre of the armature core is set slightly back as compared to the centre of the field magnets, so that the magnetic attraction tends to pull the whole armature forward towards the commutator bearing, thus keeping a certain pressure between the two discs and the roller. It will now readily be seen that, as the armature revolves, motion is imparted to the paper roller by the fixed disc, and the paper roller in turn causes the loose disc to revolve at a speed which is slightly different from that of the shaft and fixed disc. The diameters of the two discs are so chosen that the relative movement of the loose disc against the fixed disc is two complete revolutions per minute, and the whole armature receives therefore two complete out and in motions per minute, by which means the position of the brushes on the commutator is continually varied lengthwise, and scoring is entirely prevented. The longitudinal motion has also the advantage of preserving the bearing surfaces in perfect condition. The total weight of the machine is 6 tons.

H.M.S. "MAGICIENNE."

It will be remembered that the Government have now in course of construction five fast cruisers. These vessels are to be of a new type, their leading feature being a combination of high speed, quick-firing guns, protective deck, and moderately heavy armour. Three of the vessels of this new class are being built in royal dockyards at Chatham and Portsmouth, and two of them are being built by the Fairfield Shipbuilding Company, Glasgow. The first of the fleet to be launched was the "Magicienne," which left the ways at Fairfield on Saturday, the 12th inst. The vessels are of a displacement of 3000 tons, and their engines are of 9000 h.p. The speed expected to be obtained is 20 knots. The engines are being made by Messrs. Hawthorne, Leslie, & Co., Newcastle-on-Tyne. The hull is 265ft. long, 42ft. broad, and the moulded depth is 23ft. It is divided into seventy-five water tight compartments, the engine and boiler space consisting of four of these. The steel protective deck is 1in. thick in the centre, and is 2in. thick in the angles. There are two complete decks running fore and aft. The vital parts are all below the water line. The stem consists of a casting of phosphor bronze, the stern post being made of the same material. The armament will consist of nine 6-pounder Hotchkiss guns, a number of Nordenfelt guns, and six 6-inch 5-ton Armstrong guns. The engines will consist of a pair of horizontal surface condensing engines, the dimensions of the cylinders being respectively 34½in., 51in., and 76½in. diam.; stroke 36in. There are four double ended cylindrical boilers to work at a pressure of 155lb., with a grate surface of 456 sq. ft. There are twenty-four corrugated furnaces. The second vessel of the new class is the "Marathon," which will soon be ready for launching.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
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Telephone number: 684, MANCHESTER.
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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 25TH MAY, 1888.

THE NATIONAL DEFENCES.

THE members of Her Majesty's Government must for some time past have had a difficult task in attempting to please those who were urging upon them the necessity for greater economy in the expenditure of the national finances, and at the same time those who were pointing out the inadequacy of our national defences. On this latter subject there can be no doubt but that we have been passing through one of those periodical scares which are largely got up by one-sided politicians, or by interested parties. While, of course, we strongly advocate the necessity for keeping ourselves well prepared for any probable emergency, we strongly deprecate the hysterical style which is indulged in by many journals, and we think the Lord Mayor was quite right in his remarks when he refused the use of the Mansion House for a public meeting for the discussion of the subject, as he was of opinion that it was highly unpatriotic to raise and keep up panics which were quite unjustifiable. It is not the sign of strength, but, on the contrary, of weakness, to get into a state of nervous excitement over a clever article which has been written by a man who may be suffering from indigestion or disappointment, or over a speech by an able general who has failed to obtain all he asked for from the Government of the day. The now celebrated speech which Lord Wolseley delivered on the occasion of the banquet to Sir John Pender, seems to have been an escape of passion engendered by the failure of urgent professional representations to bring about needed reforms, although he seems to have used much stronger language at the banquet than ever he did in his official correspondence. He strongly disclaimed, however, all intention of making an attack on the Government, and said he was convinced that no unprejudiced person, no matter who he might be, whose mind was not warped by the habitual contemplation of party politics, could calmly have read what he said, and have construed his remarks into an attack on Her Majesty's Government. His chief object was to show that the subject of the national defences has suffered from being made the convenient instrument of party intrigues, instead of being elevated into a plane above all such considerations. If in the speech referred to, Lord Wolseley had maintained the dignity he displayed in the House of Lords, when referring to the personal remarks of the Marquis of Salisbury, he would have had more sympathy from all classes of men who love their country more than their party. On that occasion he repeated part of the evidence he gave before the Royal Commission eighteen months ago, and some of his statements are certainly grave enough. He complained that we never take the English people into our confidence, we never tell them what are our shortcomings, and consequently they have no means of ascertaining the military views of the highest military officers they employ. He was still of opinion that the position of England at the present moment, as regards its army, is very unsatisfactory, and that if a hostile force of say 100,000 men were to land upon our shores, there is no reason why that force, if properly led, should not take possession of London. We have in a previous article considered the defence of London, and in view of the importance of the subject, and of the gravity of the opinion expressed by Lord Wolseley, we may soon return to the subject again; but in the meantime we may say that if such a force were to effect a landing, our defenders will be culpable in the highest degree. We venture to predict, however, notwithstanding our shortcomings, that should such a force land, few would ever return except as prisoners of war.

At the same time we agree with Lord Wolseley when he says that people are too prone to care little for the organisation of the army, and take it as a matter of course. Everyone tells us at public dinners, and in speeches delivered from both sides in either House of Parliament, that the army and navy have always done their duty and will do it in the future, and as a rule we take these views as correct, carry them home with us, and think we can sleep quietly in our beds because the army and navy are strong enough. We forget, however, that circumstances have changed much since we last took part in a great war, that our possessions and consequent responsibilities have much increased, and that the armaments of our probable antagonists have been growing at an immense rate. While giving the present Government every credit for having keenly and ardently at heart the efficiency of both the army and navy, and for having introduced many and beneficent changes into their organisation, during the time they have been in power, still, in view of our increasing responsibilities, he held it was absurd to say that these had been kept up in proportion to these responsibilities. Taking the army for instance, it has been found necessary by the Administration of India to increase their military force by ten thousand men. We have had within the past few years to maintain a force in Egypt, where we have accepted greatly increased responsibility, which may entail at any moment the necessity of sending out large reinforcements. We have also very recently become aware, thanks to a commission which sat and reported on the subject, of the condition of things abroad in our fortresses and coaling stations throughout the world, and also to our home defences. We are obliged to send considerable reinforcements to our foreign stations, so that when it is said that since 1884 there has been an increase of nearly twenty thousand men to the army, the information is altogether misleading. Moreover, as a matter of fact, the army is at present 23,000 less than it was in 1860, 16,000 less than it was in 1862, 8000 less than it was in 1863, and 7000 less than it was in 1864. Lord Wolseley concluded his speech in the House of Lords with what he called an exposition of his faith on the subject. He said: As long as the navy is as weak as it is at this moment, Her Majesty's army, dispersed as it is, cannot hold its own all over the world. Our defences at home and abroad at the present moment are in an unsatisfactory condition, and our military forces are not organised or equipped as they should be to guarantee even the safety of the capital in which they were at the present moment. He said he quite felt the responsibility incurred in making this statement; but, at the same time, there was no need whatever for panic. He appealed to reason to show that there is no imminent danger pending over the country, and that therefore there is plenty of time to do all that is necessary to place at least the army in a state of efficiency before its services are required. Panic is the offspring of

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ignorance. For the people to realise their danger, and the power of meeting it, is the first step towards doing all that is required.

The Prime Minister, in the course of his reply, referred to Lord Wolseley's confession of faith, but said that he could not remember having heard it before. It surely cannot therefore have been often repeated in Ministerial ears. He admitted that it was a very grave statement, and that it would receive the most serious consideration. Alluding, however, to Lord Wolseley's remarks on the present weakness of the navy, he said that weakness and strength are relative terms, and lest a wrong impression should be created regarding the exertions this country has made, now for several years, to place its navy in a condition fit for the great duties it is called upon to perform, he wished to state what had been done since the year 1880, the beginning of the last Administration. In 1881-2 the total was £2,100,000; in 1882-3, £2,447,000; in 1883-4, £2,592,000; in 1884-5, £2,927,000; in 1885-6, £4,895,000; in 1886-7, £5,095,000; in 1887-8, £5,358,000; and in 1888-9, £5,467,000. The annual expenditure on the construction of new ships and armaments has risen since 1880 from £2,100,000 to £5,467,000. He further pointed out that in considering strength or weakness we must always take into account our probable allies, and he protested with vigour against the statement made by Lord Wolseley that public men, for the sake of making a good Budget and winning a party advantage, would consciously risk the interests of the Empire. Lord Granville, with his usual quiet banter, reminded the House of Lords of the old story of Dean Swift, who, in his "Instructions to Servants," advised the servant in a particular department to ascertain the gross amount of his master's income, and to endeavour to apply the whole of that income to his own particular department. No doubt the difficulty is largely a financial one, and the problem before the Government is to make the most of its resources, by apportioning them according to the just demands of its various interests; and in view of the great importance of the subject and its bearing on the industries of the country, we intend to keep our readers informed regarding some of its most important bearings.

TECHNICAL EDUCATION IN NEW SOUTH WALES.

Some time ago we gave a short account of the progress which was being made in technical education in New South Wales (see *Industries*, Vol. II., page 564), and we did so, not only because of the interest which the work was likely to excite on its own account, but also because we felt that the action of our Colonies in this matter was likely to have a most important bearing on the future of the trade and industry of this country. Further, we hoped to impress on our readers the fact that if new countries found it necessary to attend to the organisation of their scientific and technical education, in order that they might be able to develop their resources, it is still more necessary in a country like our own, where in many cases the materials of construction or manufacture are beginning to be somewhat scarce. Moreover, with us manufactures are absolutely necessary for our existence, whereas in the Colonies land is still abundant and sufficient for the population.

The Colonies do not by any means rush into any ill considered scheme of education which is placed before them; but before taking any decided steps, they make inquiries in all quarters in which they are likely to receive useful information, and these inquiries are generally conducted by special commissioners. Although New South Wales has made a good start in organising scientific and technical education, it was felt that more direct information was wanted on the subject, and the Government commissioned Mr. Edward Combes, C.M.G., M.P., President of the Board of Technical Education, to make inquiry with reference to technical schools and other matters connected with the systems of technical instruction in operation in Great Britain, and on the Continents of Europe and America. Mr. Combes' report was issued last year, and is a most comprehensive document. It is divided into two parts, the first of which treats of industrial art schools, and the second of technical training, and moreover has a number of appendices giving a considerable amount of useful information relating to technical education, both in this country and on the Continent. That on art is most complete, and enters very fully into the reasons why it should be taught, and the methods by which it ought to be taught. The different systems of art education are fully discussed, and the weak points in each pointed out. He gives credit to the various schools in England for having effected a very great change for the better in art designs, and points out to those who would disparage the work of the schools the fact that French monopoly of designing is at an end so far as British manufacture is concerned. Instead of going abroad for designs, foreigners, becoming familiarised with our advance in the industrial arts, are now continually coming to examine our system of teaching, to study our methods, and to avail themselves of the examples placed before the pupils at South Kensington and elsewhere. As an illustration of the altered relations between England and France, it may be stated that about five years ago one of the first manufacturers in Paris sent over to England for a collection of English designs in paper hangings, in order that his designers might avail themselves of them. For evidence of our advance in artistic culture, it is but necessary to consult those who are old enough to remember the changes of the last thirty years, and to hear what they say of the improved appearance of our shops and shop fittings, our warehouses and wares, our furniture and table appointments, our wall papers and carpets, our books and book bindings, our illustrated periodicals, and our children's toys and picture books. There is scarcely a household in the country that is not the better for the change, not a manufacture in which design has a place that has not felt its influences; and it would be altogether idle to deny that this advance, to be seen on every side, is greatly attributable to the schools of arts. The report gives a very good account of the different systems of art training in Britain and on the Continent, and especially of that followed out under the directions of the South Kensington authorities; and the evidence of Mr. Walter Smith, who was from 1871 to 1882 Director of Art Education in the State of Massachusetts, United States of America, is interesting, not only for the account it gives of the progress of American art teaching, but also for its criticism on the South Kensington methods. Mr. Smith is an Englishman, trained at South Kensington, and is likely to know the good and the bad points of the system there pursued; and we observe that he has the same objections that we have urged, viz., that the methods pursued are too mechanical, and do not train to originality. Mr. Smith said "he thought they begun in England upon a wrong basis—a very unphilosophical principle—and that they had been entirely misled by choosing that wrong principle. He had been misled himself, and until recently had made as many mistakes as anybody. He had only reproduced in his public work and teaching that which he had been taught, and there was not, in his opinion, one man who could be described as a thinker, or even as a great teacher, amongst all the men who started the schools of design. He did not think a single man amongst them would ever live in history as an educator." He then goes on to advocate a more intellectual system, and illustrates it by the work which is now being done in the Conservatory School of Fine Arts in Boston, of which he is now principal. We cannot enter into details of that, but we may say that the first part of the report gives one of the most interesting historical and descriptive accounts of art training which we have seen.

The part of the report on technical training is also most valuable, and gives an interesting record of opinions from different points of view, although we must confess that Mr. Combes is, in our opinion, too much inclined to rely on Government support, and he strengthens his position with statements like the following: "It is always asked how the State is to be paid for her expenditure in providing for this class of instruction. If the application of the saying that it is better to pay for a boy's education than to pay for his keep in prison is clear as regards general education, then much more is it apparent as regards technical instruction. The apprentices' municipal school costs Paris a large sum a year, and the working expenses also reach a considerable amount. The return to the city is made in the beauty of her fabrics, and has proved a good investment. The art and taste developed and applied in these schools give the city wealth and magnificence. Her workmen can design and decorate, carve and engrave, model and paint, in a way superior to others, and this has been obtained by means of art schools. It could not possibly be effected without them. Therefore the French are wise in their endeavours to keep the position Paris so long ago acquired—the mistress of the world as regards all kinds of art industry." But the report also points out that the professional schools of France resolve themselves into three types, the first of which is municipal, and is represented by the school of La Villette, the second by the school of Horologerie (clock and watch making) created and maintained by the trade or guild, and the third, that represented by the printing works of M. Chaix, and which is entirely maintained by those immediately interested, viz., the proprietors of the works and manufactories. It seems to us that we ought to observe a similar distinction in this country, but with greater strictness than is done in France. The subjects which are of common interest should be supported by public funds, either imperial or local; special trades schools should be undertaken by the employers and the employed conjointly through their organisations; while others should be undertaken largely by the masters as a means for educating their apprentices.

Our space will not allow us to enter into further details regarding the report, but we may say that it is one of the most complete and satisfactory which has yet been published; while if the recommendations which are made are fully carried out, New South Wales will soon be able to set an example to the mother country in the organisation of art and technical education.

FIRE AND LIFE RISKS IN AMERICAN ELECTRIC LIGHT INSTALLATIONS.

Fire risks in connection with electric lighting have been discussed by the Society of Telegraph Engineers and Electricians at their last two meetings, and in view of the general importance of the subject it will be interesting to our readers to learn the condition of affairs prevailing in this respect in the United States, as set forth in a communication we have received from an occasional correspondent in New York. Our correspondent writes:—

"In New York city the overhead wires of the arc lighting companies are rapidly deteriorating, and many of them should have been renewed at least three years ago. In most cases the leads used are of the kind popularly known as underwriters' wire, in which the covering consists of two or more layers of cotton braid, thoroughly impregnated with white lead paint. This wire has been so largely used on account of its low price, and the fact that the insurance companies' inspectors have approved it. The insulation, inferior from the first, is now becoming worse than useless. It has decayed, under the influence of sun and rain, until thousands of places may be found where the wires are actually bare of all covering. When the lines were first constructed, the joints were covered with so-called insulating tape. This article, while originally good, has been gradually cheapened under the stress of competition, until it has become worthless for the purpose for which it was originally intended. When new, it has sufficient adhesiveness to apparently insulate a joint; but the compound with which the fabric is saturated soon disappears through the action of the weather, and it hangs loosely from the wire, swaying in the wind, and giving a decidedly objectionable appearance to the lines. Perhaps the most serious phase of this state of affairs is the fact that the wires of other companies, harmless in themselves, come occasionally into contact with the arc light circuits, and are thus made the mediums of conveying destructive currents into locations where they are not looked for. Any repairer engaged in his ordinary line of duty may, therefore, be exposed to sudden and unlooked for dangers. When the agitation first began which finally led to the organisation of the Board of Electrical Control, a vast amount of nonsense appeared in the dally papers regarding the dangers of overhead wires. It was published in the interests of various underground schemes, but in a certain sense it was effectual. A large number of conduits have been laid, but so far there have been no means discovered by which electric companies can be legally compelled to place their wires into them. Although with the wires underground all danger will not be removed, it will certainly be diminished if the work is well done. Whether through ignorance or parsimony, there is, however, small prospect that electrical plant will be in future so erected as to be absolutely safe. Even with the best material, poor workmanship will nullify such intentions if they exist. Cases of careless work are very frequent. In one case a stranded conductor with an insulation of a rubber compound was twisted round a nail or hook, so damaging the covering that it was practically worthless. There are hundreds of 'wire butchers' engaged in this character of work who should be suppressed. The growth of the business has perhaps been too rapid to permit of the proper mechanical training of employés, and there are few competent instructors. Whatever control has been exercised over electric light installations may be traced to the authority of the underwriters, and yet their regulations are so exceedingly crude that the construction which complies with the rules of the Board in one city, would not be tolerated in another which happens to be under the jurisdiction of a separate organisation in the same line of business. Of course the laws of electricity are the same in New York, Boston, or Chicago, and the rules which are good in one city should be equally effective in another. An effort to rectify this condition of affairs in Boston has been made by the establishment of the New England Electric Exchange, the membership being made up jointly of insurance and electrical representatives. It is the intention of this exchange

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to issue licenses to workmen engaged in wiring, and it remains to be seen if the organisation will effect the contemplated reforms. In New York city the underwriters claim to be satisfied with the existing conditions, yet there take place electrical fires in sufficient number to prove that the system of inspection is defective."

"The electric light companies here are not pursuing a sound policy. The loss of property by fire, personal injuries, and death, all tend to create a prejudice against electric lighting which should never have been allowed to gain a foothold. Now that cases of this kind are not only established facts, but appear to be increasing from week to week, instead of taking steps to prevent them, the companies endeavour, by statements before coroners' juries, and through certain electrical journals, to create the impression that the blame does not rest with them."

THE EDISON GLOW LAMP PATENTS.

Our last report on this case, in our issue of the 11th inst., terminated with the examination of Mr. J. Swinburne. Before his cross-examination was proceeded with, the Attorney-General stated that he was willing to admit that the carbon conductor in Swan's stick lamp had been made by Mr. Carré, in Paris, and that it had received its present form before carbonisation. It will be in the recollection of our readers that, in the former trial against Messrs. Woodhouse & Rawson, Sir Frederick Bramwell stated that, to the best of his belief, this carbon had been worked down from a thicker piece of carbon, and had not been carbonised in its present form, and in this opinion he was corroborated by the other witnesses for the plaintiffs. Mr. Swinburne was then further cross-examined by Mr. Moulton, with a view to show that if the material used in carbonising contained such a large quantity of sand as he had spoken of, the steam would have driven all the air out of the crucible before the temperature had been reached at which the air would begin to combine with the carbon.

Mr. Alexander Bernstein was then examined by Sir Horace Davey. He stated that he had sold large numbers of lamps in which the carbon was $\frac{1}{25}$th of an inch in diameter and from $\frac{3}{4}$in. to $2\frac{1}{2}$in. long, and that they were used in series with perfect success, both in this country and abroad, especially in the United States. When he went to America in December, 1880, he could find no Edison lamps on the market; but on visiting Mr. Edison at Menlo Park he found him making lamps with filaments of bamboo. On being cross-examined by Mr. Aston the witness mentioned one or two places where his lamps could be seen in use in this country, but declined to name any others. Mr. Justice Kay intimated that the witness's objection to do so was natural, as he was possibly afraid that Mr. Aston was laying the foundation for a case against him, and the matter was then dropped. This was the last witness called by the defendants on the scientific aspect of the case, the next witnesses giving evidence as to what they had seen in Newcastle at Mr. Swan's place of business during the years 1878 and 1879.

Mr. Proctor, a well known scientific gentleman, residing in Newcastle, who had been very intimate with Mr. Swan throughout that period, remembered Mr. Swan exhibiting a broken lamp to the Chemical Society of Newcastle on the 19th of December, 1878. This lamp was a good deal blackened on the inner surface; it had contained a small straight pencil of carbon, which had been ruptured. Mr. Proctor had analysed the black coating on the glass, and subsequently read a paper on his investigations. Mr. Proctor was also present at Mr. Swan's celebrated lecture on the 3rd of February, 1879, on which occasion the stick lamp was exhibited and incandesced for some time. It was worked from a dynamo and burnt steadily, giving a comparatively good light. Several hundred persons were present, and Mr. Swan explained the construction of the lamp. The witness then stated that during the summer of 1879 he had seen many lamps of various constructions at Mr. Swan's works in Moseley-street, some being made of paper and some of thread; and that he had seen some of these of an arched or horseshoe form, which must have been carbonised after they had received that form. These lamps were incandesced in Mr. Swan's works, and gave out 10 to 14 c.p. Mr. Proctor was cross-examined at some length by the Attorney-General for the purpose of showing that his memory was in fault, and that he saw these lamps in 1880 and not in 1879.

The next gentleman was Mr. Arthur Heaviside, the superintending engineer of the postal telegraphs at Newcastle. He had known Mr. Swan very intimately during the years 1878 and 1879, and had tested a number of lamps for Mr. Swan in the summer and autumn of 1879 for the purpose of ascertaining their resistance. The lamps contained thread-like burners in some instances, and in others flat strips of carbonised material bent into an arched form. The witness was able to fix the date of his tests by his notes of lectures delivered to a scientific class about that time. Mr. Heaviside was cross-examined at considerable length as to the accuracy of his dates, and stated that he had not only seen threads in a horseshoe form, but also with a double twist at the end of the horseshoe.

Mr. Patterson, who carries on business at Gateshead as an earthenware manufacturer, was then called, and stated that he had on several occasions before November, 1879, taken strips of paper, packed in powdered carbon, to be carbonised in his father's pottery furnaces; and he remembered Mr. Swan exhibiting his lamps in the workshop, and at the lectures, where he on one occasion assisted in fitting up the batteries. He left Mr. Swan's employment in January, 1880.

The next witness was Mr. Mayfield, of Queen Victoria-street, London, who had been the manager of Mr. Swan's scientific department until October, 1879. He corroborated the three preceding witnesses as to the experiments made by Mr. Swan in the autumn of 1879 with slender carbon burners. Several witnesses of minor importance were also called to speak to the same point, and this brought the defendants' case to its close.

Professor Dewar was then examined by Mr. Moulton, for the purpose of giving rebutting evidence on behalf of the plaintiffs. He stated that directions to enclose the filaments in powdered charcoal when carbonising were wholly unnecessary, inasmuch as persons with an ordinary amount of skill would know that this was desirable. He produced carbon filaments which he had made by carbonising in sand inside one crucible which he had placed in the carbonising chamber in the inside of another crucible, and stated that none of the filaments had been attacked by oxygen, and that he had actually made a lamp from a filament of broom carbonised in that way. Professor Dewar stated that there was no difficulty in rolling out a filament of lampblack tar, and he proceeded to roll one in Court to a very considerable fineness. He had mounted a filament so prepared in a lamp, and run it for a couple of hours. He had also rolled out filaments of lampblack, containing camphor and oxide of zinc, and carbonised them; but he had not mounted them. The witness also produced lamps in which the filament had been coated with silicate of soda and alumina. He had conducted several experiments with Despretz's process, the result being to completely disintegrate the carbon, owing to the very powerful currents used by Despretz; and he distinguished Despretz from Cheesbrough, because the latter pointed out that it was necessary to gradually increase the current during the flashing, which point Despretz did not mention. The witness stated that Cheesbrough's directions as to his alternative process, viz., impregnating lime with carbon, were not misleading, inasmuch as, if the carbon pencil surrounded with lime were put into the lamp, the lime cylinder would not crack off, and would do no harm. This witness was cross-examined at great length by Sir Horace Davey, and admitted that in his experiments on Despretz he had used secondary batteries, and obtained from them more powerful currents than Despretz used, and that the gradual increase of current was not essential in Cheesbrough, but only highly advantageous.

Dr. Hopkinson and Dr. Fleming were recalled to add to the evidence already given by them, the latter admitting that the plaintiffs had never made any lampblack and tar filaments except for the purposes of litigation.

The next witness was Mr. Joseph William Swan, who deposed that he had never made any thread lamps before November, 1879. He gave an extremely interesting account of his early experiments and failures. Upon cross-examination by Sir Horace Davey, he said his chief means of fixing any dates as far back as 1879 were letters which he had received from Mr. Stearn. He was then asked to explain how it was that he had been present during the trial against Messrs. Woodhouse & Rawson, in which the witnesses for the plaintiffs had repeatedly stated that, in their opinion, his stick lamp had been made by rubbing it down from a larger piece of carbon, and that he had never corrected them or mentioned the matter to the solicitors. Mr. Swan explained that he was not there as a party to the action, but merely as a person who had been subpœnaed by the defendants, and he did not then know that it was a matter of extreme importance in the action. Reports of many lectures delivered by Mr. Swan in the years 1880-1-2 were then read, in which Mr. Swan was reported to have stated that after a perfect vacuum, such as Mr. Crookes had produced, was created in the lamp, there was nothing more to be done except to perfect the details of the lamp. An affidavit was then read which had been sworn by Mr. Swan soon after the Edison Company attacked the Swan Company about the year 1882, and shortly before the two companies amalgamated and became the present plaintiff company. The words of one paragraph of that affidavit were as follow: "I believe that the said Letters Patent of the said Thomas Alva Edison are void, not only by reason of the prior publication of the invention claimed, but also on account of insufficient description." And finally two specifications of patents taken out by Mr. Swan in 1880 were put to him. In the first, he described the preparation of cotton thread by treating it with acid and carbonising it; in the second, dated five days later, he described and claimed precisely the same invention with this difference, that he used powdered charcoal in carbonising the filaments.

This brought the case to the end of the eighteenth day, when the Court rose for the Whitsuntide recess. It is understood that the plaintiffs propose to call further evidence, which will probably occupy another two days.

Letters to the Editor.

THE VALUE OF BOARD OF TRADE FORMULÆ.

To the Editor of "Industries."

Sir,—I have read with great interest your remarks upon the official report of Preliminary Inquiry No. 257 in your last week's issue. They are most opportune for my purpose, and singularly confirmatory of the position I took up in my letter of the 13th February with regard to the Board of Trade formula for the calculation of the collapsing pressure of fire boxes of vertical boilers, published in their "Instructions to Surveyors," and used in Report No. 145. In the letter to which I refer, published in your issue of the 17th February last, I drew attention to this formula, with special reference to its use in calculating the collapsing pressure of the fire box of a boiler of a steam crane that exploded at the West India Docks. This explosion formed the subject of Preliminary Inquiry No. 145—already mentioned—held by Mr. Peter Samson, and the result of the inquiry was to decide that the fire box, which was 4ft. high and $38\frac{1}{4}$in. and $40\frac{3}{4}$in. diam. respectively at the top and bottom, strengthened by two cross pipes 8in. diam., welded and flanged, placed at right angles to each other, made originally of $\frac{3}{8}$in. plate, reduced by corrosion on the fire side to $\frac{1}{4}$in. thick in places, but still with a remaining mean thickness of $\frac{5}{16}$in., collapsed from weakness, under a safety valve load of 49lb. per square inch.

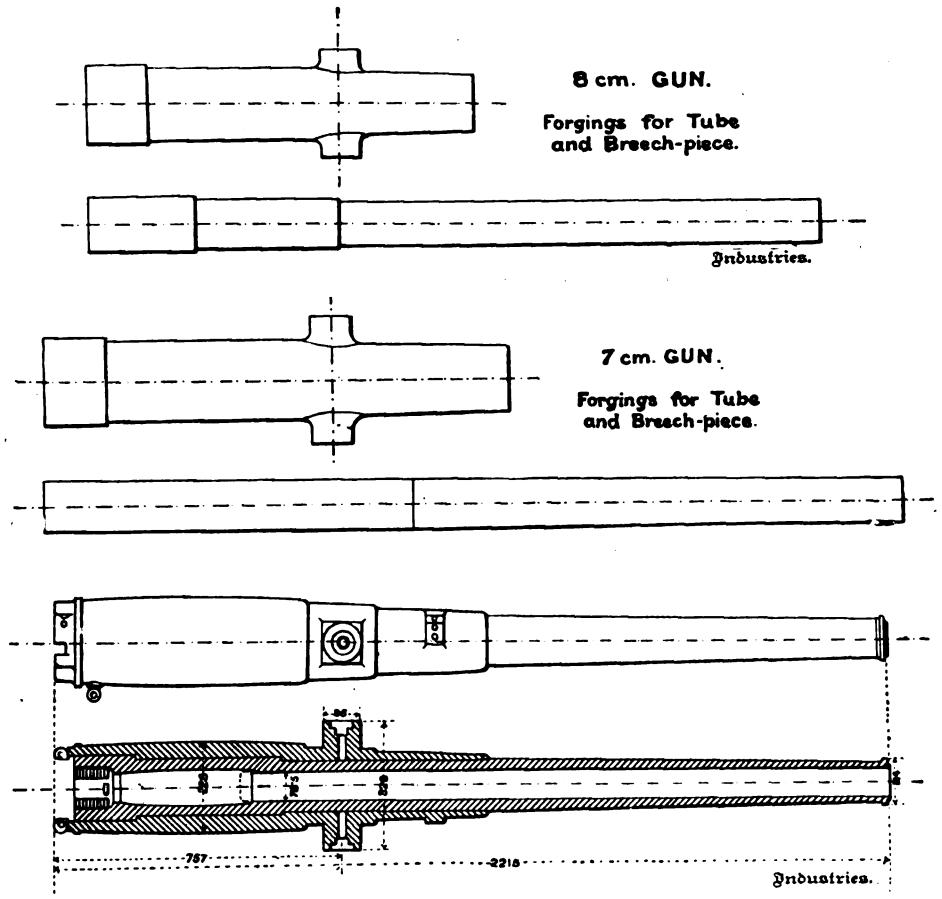
By the Board of Trade rule Mr. Samson calculated the collapsing pressure of this fire box, taking the thickness of plate as $\frac{5}{32}$in., to be 106lb. per square inch, or 2·16 the normal pressure upon the safety valve. By the same formula, the collapsing pressure when new, taking the plates as $\frac{3}{8}$in., would be 141lb. per square inch. Mr. Traill remarked that "the strength of such fire boxes ought to be known by this time." I asked, "Would any competent engineer hesitate for one moment to subject a fire box of similar construction and dimensions to a test of that amount (141lb.) by hydraulic pressure?" and pointed out that if this formula was to be relied and acted upon, it would render a large reduction of pressure necessary. In fact, assuming the total number of boilers in the kingdom to be 150,000, upwards of 25,000—or taking the number of boilers at 140,000, as assumed by Mr. Thos. Gray, in his recent Memoranda to the President of the Board of Trade, about 23,300 boilers—would require alteration.

My object in now recalling these facts is to show from Report No. 257 that the remarks and statements I then made can be substantiated by the testimony and evidence provided by another Board of Trade inspector, Mr. James Ramsay. One or two curious inquiries also arise from the consideration of this report which are deserving of notice. It will be necessary to recapitulate a few only of the facts, as your summary of last week gave all the leading and necessary points. Suffice it to say that the fire box of the "Dolgelly" boiler was 6ft. 5in. high, 3ft. 11in. diam., made of $\frac{3}{8}$in. plates, single riveted and lap jointed, provided with three cross tubes, each 10in. diam., and that it was found collapsed on the right hand side nearly the entire height, with a rupture through the solid plate, 18in. in length and 3ft. wide. The Engineer Inspector states the collapse occurred because the fire box had suffered by corrosion, the plate at the fractured part being only $\frac{1}{4}$in. thick; and taking that thickness, "the collapsing pressure by Sir William Fairbairn's formula would be 175lb. per square inch, 2·18 times the working pressure, and 1·63 times the pressure per square inch to which the safety valve was loaded." With this remark, Mr. Ramsay dismisses the whole matter; no inquiry seems to have been made as to whether the boiler had been short of water, or the plates overheated in any way; and as you very pertinently observe, no reference is made either by the Engineer Inspector or the Engineer Surveyor in Chief to the collapsing pressure of the fire box by the Board of Trade formula. The Board of Trade formula did not suit the occasion, and it was not brought out and applied in this case. The inquiry naturally follows, Why? Simply because that to have done so would have been to show in the most conclusive manner its utterly worthless character, and how unreliable are conclusions based upon its use. As pointed out by you, the collapsing pressure of the fire box when new, and the plates of their full thickness of $\frac{3}{8}$in., would only be 107lb.; it ought therefore to have collapsed—if the Board of Trade formula was correct—the first time after it was set to work, and the steam pressure equalled the load on the safety valve of 107lb. per square inch. It was given in evidence that the ordinary observed working pressure was 80lb. per square inch; yet, as you also show, the collapsing pressure of the fire box by this formula was only 48lb.! Surely such an important fact ought not to have escaped the attention and notice of the Board of Trade inspector.

But there is still another singular feature to be noted. The collapsing pressure, by Sir William Fairbairn's formula, is not correctly given. The inspector's words are: "If the thickness of the fire box be taken at $\frac{1}{4}$in., the collapsing pressure by Sir William Fairbairn's formula is 175lb. per square inch," whereas the fact is that by that formula it is only 128lb. per square inch! How can such an error, if error it be, have crept into the report? It would have been awkward, to say the least, for Mr. Ramsay to have given correct particulars in face of his colleague's report No. 145. Mr. Traill's remarks are so ponderous and weighty that I almost fear to touch upon them, still I cannot help suggesting that if he had bestowed a little more care and thought upon the matter his "observations" might have had more value to the public, although possibly they might have lost their didactic and Tupperian flavour. For instance, it would have been most

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STEEL FOR FIELD GUNS.



interesting if he had explained satisfactorily the cause of the absurd discrepancy which has been pointed out. Instead of mildly sneering at those not sufficiently informed engineers who have for so many years been making vertical furnace boilers according to the best and only information at their command, it would have been more useful and re-assuring if he had pointed out, what I think is almost self evident, that Messrs. Barrows and Stewart never intended this boiler to work at 107lb. per square inch.

The boiler was made according to the best practice and information available, and was well designed and proportioned, the bursting pressure of the shell and the collapsing pressure of the fire box being 268lb. and 313lb. respectively. Taking the usual factor of safety of 4, it would appear that the boiler had been originally constructed to work at about 65lb. per square inch, and that the owner and user, or some one acting for him, had ignorantly increased the load to 107lb., for which it was, there is little doubt, never intended. Had the boiler been worked at the pressure for which it was made, no explosion would have occurred. It would be well to have heard what Messrs. Barrows & Stewart had to say on this point, and it would have added to the value, as well as the fairness of the inquiry, if they had been asked and allowed to speak on their own behalf. By the ordinary formula, the collapsing pressure at the time of the accident, ignoring the presence of the cross tubes, would be, as I have said, about 128lb. There was, it is plain, therefore, no necessity to drag the special weakness of vertical fire boxes, as discovered by the officers of the Board of Trade, into the question of this explosion. It is a case of the simplest character, and is due to working a boiler that was made for 65lb. at a pressure of 107lb. It is, to say the least, disingenuous upon the part of the Board of Trade officials to omit all reference to the signal failure of their formula in this instance, and to suppress the fact that the boiler was being worked at one and three-quarter times the pressure for which it had, there is little doubt, been made. Rules made to affect the working pressure of from 23,000 to 25,000 boilers should be based on somewhat better and more extensive experiments than have led to the promulgation of the one under notice. Let us hope more care and prudence will be exercised in future. It would be well also if some careful revision of the official reports were practised before they are submitted to the public, as errors both of fact and judgment, such as appear in No. 257 alone, tend to shake confidence in their accuracy and usefulness, and certainly seriously reduce their importance and value in the eyes of well informed men.

Yours, &c.,

ECONOMISER.

Manchester, 19th May, 1888.

INSPECTION OF BOILERS.

A PAPER has been issued—containing memoranda prepared by one of the assistant secretaries to the Board of Trade on the subject of the registry and inspection of land boilers—which contains materials for the evidence to be collected and laid before the Select Committee on the Boiler Bill, which was to have been moved for by Lord Stanley of Preston in the House of Lords. In collecting and digesting the facts as regards boiler inspection in other countries, a distinction has been made between direct Governmental inspection and indirect inspection by societies whose guarantees are accepted by Government, and also purely voluntary inspection not prompted or accepted by Government at all, but originating in the necessity of a guarantee for purposes of insurance or in the desire of owners to omit no reasonable precautions for the security of their employés and their plant. Attention has also been directed to the degree of responsibility for accidents attached by the laws of the different States to boiler owners or attendants, and to the methods (if any) by means of which the efficiency of boiler attendants is secured. Some statistics are appended with a view to comparing the results of the different systems in use, and the method of inspection adopted by each country is shortly set out.

STEEL FOR FIELD GUNS.*

THE wonderful improvements that have taken place in metallurgy during the last thirty years having permitted great masses of steel to be produced with economy, artillerists and engineers now declare it to be the most suitable metal for the construction of guns. There are, indeed, some countries in which guns are still constructed of cast iron or of compressed gun metal, but this is due to economical rather than to technical considerations. In other countries the labours of distinguished artillerists have been directed to obtain from cast iron, wrought iron, and bronze, properties which have not been reached, and have delayed the universal adoption of steel for the construction of ordnance. This metal, the most admirable of all hitherto employed, is produced of so many descriptions, that it is necessary to fix the conditions it must fulfil when destined for ordnance purposes. Tenacity, ductility, a very high point of fusion, and a great resistance to the corrosive action of the products of the combustion of gunpowder, are the principal properties of a metal suitable for guns. The hard steels can satisfy the first condition; the milder steels the other requisites. Besides, it is of the utmost importance to know, by the deformations caused in the guns, when the destruction of the metal is approaching; and taking into consideration that certain elements of the gun, by the action of the powder gases, pass alternately from compression to tension, it is very easy to perceive why mild steel of mean tenacity has been adopted for the construction of ordnance. In the commencement of its use for this purpose, the quality of the material was only tested by its tenacity or breaking strain, without any definite standard for elongation. This was the practice followed in England, at least, until the year 1881, as stated in a paper read by Colonel Maitland at the autumn meeting of the Institute in that year. But the increasing requirements of the naval constructors and artillerists compelled the metallurgical engineers to improve the manufacture of steel, and they have accordingly undertaken the production of those enormous masses in the form of crank shafts for the powerful engines of Transatlantic steamers, or in the form of inner tubes for 110-ton guns; and if, in these enormous masses, the uniformity is not so great as in the small ingots, it is still probably sufficient. The steel for guns must be not only good, but of a superior quality, because the very great strains to which guns are subjected compel the constructors of ordnance to use a very high factor of safety, 12 tons per square inch being approximately the working stress of the metal. An eminent English engineer, Mr. Anderson, has proposed to use a factor of safety of $\frac{1}{4}$, in order to employ in the construction of guns a material of a more ordinary description; but I think it is better to have a superior steel, and to use a high factor of safety.

Having made these preliminary remarks, I am about to describe the manufacture and treatment of steel for field guns, as practised at the royal arsenal of Trubia. It is now our constant practice to define the steel for a certain purpose by its physical qualities, and more especially by its tenacity and ductility. Nearly all artillerists, in their specifications for steel, require, besides the tests of tenacity and ductility, that of bending by impact; but this test is not necessary, because, being only required in order to determine the presence of phosphorus, it can be suppressed without inconvenience, when there is security that the percentage of that metalloid is not capable of injuring the steel. At Trubia the characteristics of tension in the three states of the steel are the following, in tons per square inch:—

	Elastic Limit. Minimum.	Breaking Strain. Minimum.	Elongation. Minimum.
Annealed after forging	10·0	29·6	23 per cent.
High tempered	17·0	36·	16 ,,
Low tempered	14·0	32·8	21 ,,

The steel must be of a very superior quality in order to fulfil these conditions. Its manufacture takes place in the manner which I am now about to describe. The casting is made in crucibles, heated in the old well known furnaces. In my opinion the Siemens furnace is the best apparatus for casting steel intended for ordnance. Supposing the materials used in both processes to be of the same purity, it is possible to obtain more uniformity in large castings by the Siemens-Martin than by the crucible process; because, as is well known, the crucible does not improve the quality of the metal fused in it. The only advantage of this process is, perhaps, that there is no waste; but its great cost has led to the almost universal adoption of the Siemens-Martin process instead. Certainly the casting of a 60-ton ingot by the crucible process must be a wonderful spectacle if carried out with the marvellous and military precision of the celebrated Krupp firm; but this magnificent spectacle of course proves nothing in favour of the process. Its disadvantages are not so great in the casting of small ingots; and at Trubia we use it until the large steel foundry hydraulic presses for forging, and all the modern appliances, have been established. The materials introduced in the crucibles are the following: bar iron, worked three times; manganese ore, and charcoal—these two latter substances being introduced in the form of powder. The bar iron used is produced by the puddling of charcoal pig iron, made with the best ores of the Pyrenees and of Bilbao, which are only surpassed in purity by the finest Swedish ores. This pig iron, puddled in a Boetius furnace, gives iron bars of the greatest purity; because, as is well known, the hand puddling furnace removes 80 per cent. of the phosphorus, which goes into the slag; and as the pig iron has only 0·025 to 0·035 per cent. of phosphorus to begin with, we obtain bar iron with only 0·005 to 0·007 of that metalloid. The bars are subjected to careful selection; those which present a fibrous fracture at both ends are applied to the manufacture of steel. We are thus sure that the bars do not contain more than 0·35 of carbon. The selected bars are cut, piled, and rolled twice over, and at last a bar of $\frac{3}{8}$in. by $\frac{1}{2}$in. is obtained, which is cut in small pieces in order to be introduced into the crucibles. In this state the carbon of the bars is between 0·2 and 0·3 per cent. I think that the great ductility demanded in steel for guns, allied to corresponding tenacity, cannot be obtained with a simply carburetted steel, and that, in consequence, a manganese steel must be employed. At Trubia, manganese is not introduced as an addition of a certain quantity of ferro-manganese, but, as I have said, in the form of the ore of this metal, which is obtained as a very rich and pure peroxide from the mines of Covadongia, forty miles from Trubia. Its chemical analysis is as follows:—

Silica	1·30
Peroxide of iron	5·30
Red oxide of manganese	72·60
(Corresponds to the peroxide 82·76)	
Lime	3·60
Magnesia	0·80

The charcoal is employed for the reduction of the manganese ore, and the quantity introduced is no more than is necessary for making that reduction. The furnaces admit four crucibles; two with a charge of 72lb. of iron, the other two with 60lb. We have employed at Trubia, with much success, the Morgan crucibles; but now, as the system of public auction is adopted in Spain for the acquisition of materials, the Germans always offer crucibles more cheaply than the English, although English crucibles are certainly better than German. The crucibles employed in the melting of steel for guns must have made one fusion, because in this first fusion the plumbago contained in the crucibles is removed, and there is then no risk that any quantity can be incorporated into the steel. English condensed coke of the highest quality is the fuel employed in the furnaces, and 3·2 tons are required for the production of one ton of steel. The time of melting varies from four and a half to five hours. When the steel is completely fused, the crucibles are carefully excoriated before removal. The slag, which is a very acid one, is a double silicate of manganese and iron. I will not describe the process of casting the ingots, which would be very tedious. I need only say that the jet is always proportional to the section

*Paper read by Captain L. Cubillo, Spanish Artillery, Ordnance Works' Trubia, before the Iron and Steel Institute, on the 10th May, 1888.

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of the mould. Ninety men are necessary for the casting of the 3-ton or 2-ton ingots. The moulds employed have a circular section, and we have given the preference to this form in order to avoid the plans of less resistance originated by the crystallisation of steel in the polygonal moulds. These have a quadruple section like that of the forgings, a relation which permits of sufficient work under the hammer for obtaining a fine and amorphous texture. I think, however, that with the work put upon the metal by the forging process, the mild steels for ordnance purposes do not acquire the best molecular conditions; and that this best condition is only possible after two or three temperings at different temperatures. I intend to develop this idea when speaking of the tempering process; but at present I will follow the order of the operations. The cold ingot is taken out of the mould and carried to the mechanical shops, where both its ends are cut; the top with a weight of 35 per cent. of the whole ingot, the bottom with 5 per cent. Besides, its outer part is rough turned until the cavities situated in the periphery may have entirely disappeared. With these operations two very important objects are attained, viz.: First, by the previous cutting of both ends of the ingot, the distribution of the cavities is ascertained; because sometimes, when the casting has been badly carried out, there is a great number of them in the inner part of the ingot, and then this is rejected. Second, by the total disappearance of the cavities, the ingots are forged as sound as it is possible to obtain them, taking into consideration the methods of melting and casting employed, and the actual state of metallurgical science. In the new steel works to be erected at Trubia, a powerful hydraulic press for the compression of the metal while in a fluid state will be installed, it having been ascertained that the cavities of the ingots are due to the absence of pressure. It has been my good fortune to witness this process at Sir Joseph Whitworth's works, and I am convinced of its beneficial results. The chief object to be attained by the forging process is the change of texture of the ingot, making it to pass from the crystalline to the amorphous condition. At Trubia, the rules given by Tchernoff for the heating and hammering of the ingots are carefully followed. These are heated to a temperature of 1980 degrees, and returned to the furnace when the temperature has fallen to 1260 degrees. The ingots hitherto forged having been of relatively small dimensions, and the re-heating furnaces being very large, it has been possible in each heat to have within the furnace the whole of the ingots; and by this means we have entirely avoided the dark lines which separate the heated parts of the ingot from that which is out of the furnace. It is evident that this system cannot be practised with large ingots, because it would be necessary to employ furnaces of colossal dimensions. The ingots are at present forged under the steam hammer; but as I have said, in the projected new steel works large hydraulic forging presses are to be installed. The ingots are heated in a Boetius gas furnace, to which I have applied, as far as possible, the principles of heating by radiation, as described by Mr. Frederick Siemens in his admirable paper read before this Institute at the Chester meeting—that is, the roof of the furnace has been elevated, free space has been allowed for the perfect combustion of the gases, and the contact of the flame with the walls and roof of the furnace has been prevented. In conducting the heating of the ingots in this way, the advantages attributed by Mr. Frederick Siemens to this process, viz., less waste, and the greater duration of the furnace, are fully confirmed. Sometimes it has been necessary, during the forging process, to "scarf" some ingots which presented cracks due to the steel being harder than usual, and having been heated to the same temperature as mild steel. The first heat for the 16in. ingots lasts for four hours, and that for the 20in. and 24in. ingots for five or six hours. When the forging is completed, the ingots are covered with ashes until they become completely cold.

The steel, the manufacture of which I have now described, has a chemical composition varying within the limits of the two following analyses:—

	Mn.	C.	Si.	S.	Ph.
First.....	0·32	0·23	0·05	traces	0·005
Second.....	0·38	0·33	0·06	nil	0·007

The cold ingots are carried to the mechanical shops, where they are rough bored and turned; and when these processes are ended the mechanical tests are applied. At first the test pieces were cut lengthwise of the ingot; but taking into consideration that the most convenient course was to know the state of the metal in the cross section of the ingots (because in these sections the two most important forces originated by the powder gases exist), the test pieces are now cut crosswise of the ingots. At Trubia, in each condition of the metal—*i.e.*, when annealed after the forging, and when high and low tempered—one slice is taken from both ends of the tubes, and in each slice three test pieces in the direction of the sides of an equilateral triangle are cut. In order always to obtain comparable results, the dimensions of the test pieces obey a law, which is expressed by the following equation: $L^2 = 50\ S$; in which L represents the length for measuring the elongation, and S the section of the test piece. The same equation is employed at the celebrated Creusot steel works. This is a most important matter, because it is possible to obtain different results, with the same metal, by changing one of the dimensions of the test piece. At Trubia, the Thomasset testing machine, improved by Colonel Maillard, of the French Naval Artillery, is used; its power is 60 tons. The elongation is measured by an apparatus called the "Dumoulin-Iroment Cathetometer," which indicates to 0·0002 of an inch. The tests are made with the most exquisite care, viz., the elastic limit, the elongation, the breaking strain, the elongation after breaking, and a final test, which it is very important to know—the correspondent to the strain with which the striction of the test piece commences. This elongation is independent of the length of the test piece. Even when the Maillard testing machine behaves very well, I think it is preferable to use the autographic machines constructed by Messrs. Buckton & Co., of Leeds, which indicate, as a final result of the testing, not only the elastic limit, the breaking strain, and its respective elongations, but also the work done upon the metal. It would be very convenient to adopt the work described by Poncelet as "*travail de resistance vive de rupture*," as the measure of the resistance of a metal. It is clear that if this method were adopted in dealing with steels for ordnance purposes, it would be necessary to fix the minimum breaking strain; because the elongation, being preponderant in the value of work, the extra mild steels, which are not suited for the construction of guns, are capable of producing more work per square unit than any other. I think that the quantity of work made by a steel, in each of the states of annealing and tempering, cannot be augmented or diminished by the manner of applying the strain—that is, it can happen that a steel test piece, subjected to a tensional dynamic strain, may break with an elongation greater than that acquired when submitted to successive static strains; but if this happen, undoubtedly the dynamic tensional strain must have been less than the static tensional strain. This is, in my opinion, the only interpretation of the experiment stated by Colonel Maitland in his paper read before the Institution of Civil Engineers on the 15th March, 1886, in which experiment a certain steel, which was submitted to static strains, broke with an elongation of 27 per cent., and when subjected to dynamic strains, broke with 47 per cent. It will be convenient, before describing the tempering process, to demonstrate its necessity. At first sight it would seem that if it were possible to produce, by forging only, a steel with the conditions demanded for gun purposes, the tempering process, which requires a very large and expensive plant, might be avoided. Nay, if the object attained by this process were only that of the increase of the tenacity of the metal, with a corresponding diminution of its ductility, a simple variation of the chemical composition of the steel would give the same result as tempering. The chief object sought to be obtained by tempering at different temperatures, is the uniform distribution in the ingot of the various substances which compose the steel, and more especially of the carbon. The new steel cellular theory by MM. Ormond and Werth, which appeared in *Les Annales des Mines*, Vol. VIII., 1885, and of which, in my opinion, Professor Akerman's admirable paper on "Tempering Iron and Steel" is the base, explains in a satisfactory manner the changes that occur in steel when passing from the forging to the tempering state, changes which are indicated by its mechanical qualities. The foundation of the Akerman theory, in explaining the phenomena of tempering, which has been accepted by the authors of the cellular theory, is the following: The combined carbon is present in the steel in two forms; the carbon more intimately combined, called tempering carbon, and the carbon incompletely combined, described as cementation carbon. If a steel ingot is heated between the points A and B of Tchernoff's scale, and is quickly cooled, the more the part of the total carbon will be converted in tempering carbon, the more may be the temperature of the ingot, or the more quickly the ingot may have been cooled. Now, if the same ingot, whose percentage of combined carbon has been increased, is again heated to a temperature lower than the former, and is also cooled under the same conditions, a certain part of the incompletely combined carbon, converted in tempering carbon by the first operation, recovers its primitive state; and this last change is manifested in its mechanical qualities by a diminution of tenacity and an increase of ductility, so that this second tempering, as compared with the first, has all the appearance of the annealing process. At first sight it would seem that if the temperature of the second tempering is very low, the metal should return to the conditions resulting from being annealed after forging, and then a great amount of time and money would have been wasted. But that is not the case; for, by the second tempering at a low temperature, the carbon incompletely combined is distributed throughout the mass of the ingot in a more uniform manner than by the first. So, at Trubia, after the second or third tempering, we have generally observed that the characteristics of the steel had improved as compared with those possessed by the metal when annealed after forging. I quote the following example, which, I think, is very remarkable:—

Tube A for a 3·5in. gun.	Elastic Limit.	Breaking Strain.	Elongation per cent.
Annealed after the forging...	10·64	20·76	25·85
(1) Tempering at 1620°.....	30·00	51·00	15·15
(2) Tempering at 1260°.....	21·00	40·76	20·2
(3) Tempering at 1080°.....	16·7	36·18	27·3

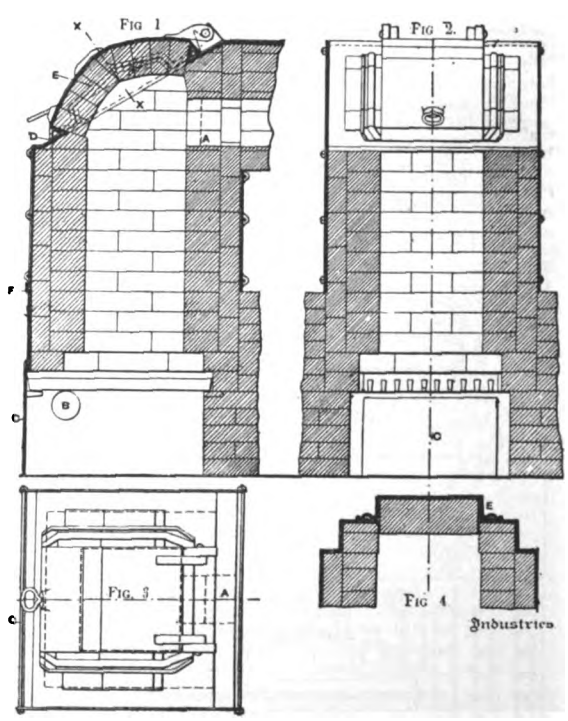
It has been observed in many cases that two low tempers at the same temperature improve the metal considerably. I am now about to explain the manner of practising this process. As I have said, each tube or breech piece is tempered at least twice—the first at a high temperature, about 1800 degrees; the second at a temperature between 1080 degrees and 1260 degrees. If, with these two temperings, the steel has not acquired the characteristics required, the tube or breech piece is tempered again, the temperature being raised or lowered as required by the results of the test pieces, which are cut at both ends of the tubes after each tempering. It is well known that the temper which a steel of a certain chemical composition can take depends on the following factors, viz., the temperature of the metal, conductibility, specific caloric, and quantity and temperature of the cooling medium. At Trubia, as is the case in all steel works, the cooling liquid employed is the oil which, by its small conductibility, produces tempers less energetic than water, both liquids being at the same temperature. The tubes and breech pieces are always tempered in a quantity of oil equal to ten times the weight of the piece tempered. The heating furnace is vertical; its temperature is carefully measured by a Siemens pyrometer, and the tubes are taken out of the furnace and immersed in the oil tank by an overhead travelling crane. Lately, at the "Acieries de St. Etienne," this method of tempering has been changed, by making a stream of oil to pass through the tube. The advantages derived from this method are that the thin cylindrical films of which the tube is composed acquire the best condition for resisting the pressure of the powder gases—that is, the exterior is in tension, and the interior in compression; and the tube, as tempered, can then be assimilated to a series of the thinnest cylinders shrunk on. The method is not a new one; it was invented by the late Major Rodman, U.S.A., for strengthening cast iron guns; and in the opinion of Sir William Siemens, is more applicable to steel than to cast iron. I think that the system of St. Etienne must be adopted, if conducted as Rodman practised it—that is, cooling the interior of the tube, and heating the exterior. Experiments in this direction are about to be commenced at Trubia, and another is to be directed to investigate the possibility of tempering with hot water by the ordinary method, or with water at the ordinary temperature, but in less quantity. In this last case, the experiments must be directed to investigate the caloric conductibility of both liquids; and this point obtained, it will be very easy to calculate the quantity of water, at the ordinary temperature, which may take out of the steel the same quantity of heat in the same time as a weight of oil equal to ten times that of the tube to be tempered. After the tempering process, the only caloric operation practised with the tubes is the shrinkage, which offers little interest, considered from a metallurgical point of view.

In concluding this paper, I must add that the field guns constructed at Trubia have been designed by Major Sotomayor, of the Spanish Artillery, a member of this Institute.

KEEP'S TESTS FOR FOUNDRY IRON.*

All who have had to do with the testing of cast iron are aware of the fact that hitherto there has been no uniform and recognised system of tests applied in order to determine the mechanical characters of the material. Not merely do the tests applied in different countries vary considerably, but the methods used by the scientific experimenter are often widely different in character from those adopted by practical men; and even in the same locality founders and engineers differ considerably in regard to the tests they require for irons to be used for the same purpose. The present paper is written to introduce to the attention of iron founders and engineers in England an attempt to find a common language to be applied in speaking of foundry iron. The apparatus and methods to be described are intended to be as simple in construction and operation as possible, so as to meet the requirements of the practical founder, and at the same time to be of such accuracy as to meet all the ordinary requirements of scientific research. It may be mentioned at the outset that the tests recommended are the result of many years' experience in working with various classes of iron from widely different localities, and that they have been successfully adopted, without any important alteration, for upwards of two years at the works of the Michigan Stove Company at Detroit, Michigan, U.S.A. (of which company Mr. Keep is superintendent), where upwards of 70 tons of pig iron is daily manufactured into thin castings. "Keep's Tests" have also been adopted by a number of important American firms who have to do with the buying and selling of foundry iron.

Re-Melting.—It is desirable to have at least 50lb. of the iron which is to be tested. It is possible to perform the tests with 15lb. or even as little as 10lb. of metal; but it is desirable to retain sufficient for two further meltings, in case a duplicate test is required at any time. The 15lb. of metal is melted in a plumbago crucible of suitable size, and of such a kind as is commonly used by brass founders. The bottom of an old



crucible may be used to cover the pot during melting. The furnace employed by Mr. Keep is shown in Figs. 1 to 4, and will need little more explanation than is embodied in the illustrations. This furnace is of fire brick, coke is used for fuel, while the furnace is driven by a fan producing a pressure of blast of 2½oz. per square inch. The iron will be melted in about thirty-five minutes, and will be changed slightly, if at all, from the original composition. It is important to remember that the object of the tests to be described is primarily to determine the characters of the pig iron, and hence it is necessary that the change produced by melting should be as small as possible. Melting in a cupola, or even in an air furnace, would, of course, produce considerably more change. The furnace may be partly above the floor, or wholly beneath it, as found most convenient. The ash pit must be air tight, and the furnace itself must be tight, so as to exclude air, and prevent flame blowing through the cracks. The most refractory material must be used for lining, and ground crucibles,

* Paper read on the 24th March, before the South Staffordshire Institute of Iron and Steel Works Managers, by Mr. Thomas Turner, Assoc.R.S.M.

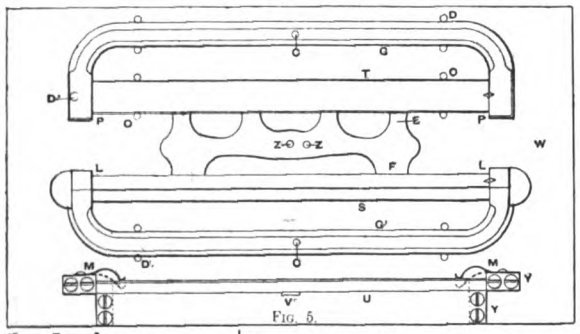
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with just enough fire clay wash to bind it, is best for repairing. Before describing the tests in detail, the annexed table may be referred to as illustrating the results obtained with a particular sample.

No TEST 178	BRAND	POUGHKEEPSIE No1.				TRANSVERSE.			
No SET	SIZE N	SIZE B	SHRINKAGE. COLD.	SHRINKAGE. HOT.	COLD.–HOT.		STRENGTH. LBS.AV.	DEF.	EXC.	
1	496²	496²	134	133²	150	148²	350	26	0	WEIGHT.
2	499	491	135	135	149	146	350	25	0	
3	497	493	133²	133²	146	143	365	24	0	
4	495²	496	134	134	150	148²	322		0	IMPACT.
5	495	494	133²	133²	149	146²	389		0	
6	500	492	137	137	148	145²	329		0	
AVERAGE IMP. WT.	.497²	493²	134²	134²	148²	146²	333	25	0	IMP. WT.
	.497	.494					833		0	
CROOK.		.022								
FLUID 10		.50								
CHILL.		.12								
HARD										

Industries.

Test Bars.—These consist in the first place of two bars, one exactly half an inch in square section, cast with the ends against a chill exactly 12⅛in. apart (see Fig. 5); the other bar is cast with this, and is run from the same gate; it is 1in. wide and $\frac{1}{10}$th of an inch thick, and is run against chills in the same way as the square bar. Six of these pairs of bars constitute a test, and each bar bears the number of the chill against which it was cast. When the bars are trimmed, and both bars and chills have attained the same temperature, the shrinkage of both thin and square bars is measured to $\frac{1}{2000}$th of an inch by inserting a graduated wedge (Figs. 11 to 13) between the end of each and its chill. The mean between the shrink measured on the two ends constitutes the shrinkage. The transverse strength and resistance to impact are measured as afterwards described. It may be mentioned, however, that the transverse strength is obtained by breaking square bars 1, 2, and 3 by means of a gradually applied weight, the deflection being measured at the same time. Bars 4, 5, and 6 are then broken to obtain resistance to impact by a series of blows from a 25lb. weight, the first blow being with a half inch fall, and the fall increases by $\frac{1}{8}$ of an inch each time. An arbitrary scale has been constructed, giving a value in pounds avoirdupois on an assumed value for a foot-pound. This has been done in order to allow of comparison between the effects of a weight gradually and suddenly applied. After these have been determined, the broken bars are used for observing the depth of chill and the character of the grain, both of which are recorded for reference. The depth of chill is determined by splitting off the end of a square bar longitudinally by means of a cold chisel, and measuring the depth of the chilled metal. The grain of the fracture of the bar is observed by means of a pair of lenses, each of 1¼in. diam., and 1in. focal distance. The focal length together is ½in., and with a little practice this gives a clear view. In addition to the bars above mentioned, two other test pieces are made. The first is called a fluid strip, and is intended to indicate the relative fluidity of the molten metal. The pattern for this is 1in. wide, 12in. long, and $\frac{5}{10}$ths of an inch in thickness. This is run from the end and is poured first. This strip rarely runs full, and the length of the strip in inches is taken as a measure

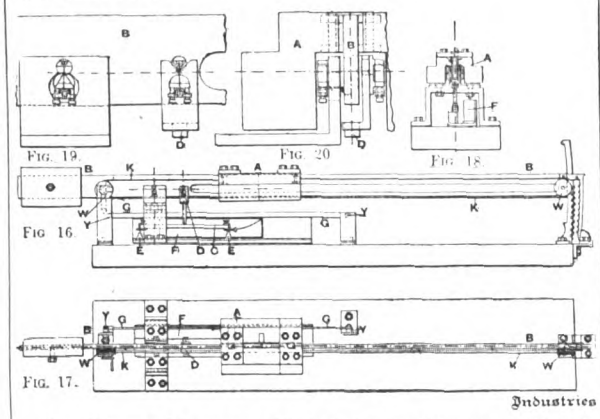


of the fluidity of the metal. It is, of course, necessary for this test that the metal should always be poured at about the same temperature, and, with a careful workman, the test gives fairly uniform results with given brands of iron. The second of these test pieces is called the crook strip; this is 12in. long, 1in. wide, and $\frac{55}{1000}$ths of an inch in thickness. On the centre of one side there is a rib $\frac{412}{1000}$ths of an inch high; this is ⅛th of an inch wide at the base, and $\frac{1}{10}$th of an inch wide at the top. The unequal shrinkage of the thin, flat strip, and of the taper rib, causes a slight curve in the test piece. This, when measured, affords valuable information as to the properties of the iron, and is called the "crook."

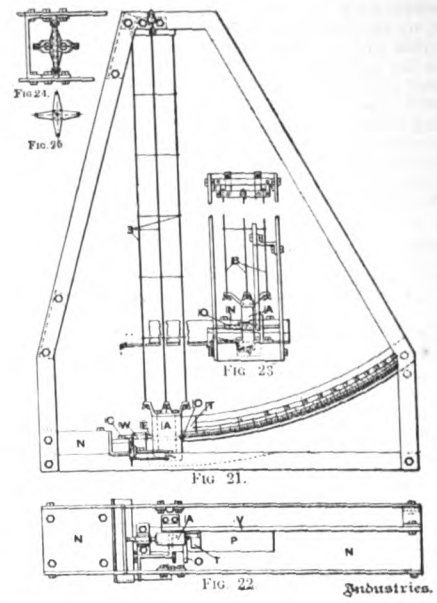
Patterns.—These are fully shown in Figs. 5 to 15, and need no detailed explanation. The follow board is of iron, and everything is made with the idea of durability, and no appreciable wear should take place. No change should be made in the patterns after beginning to use them, as a change might alter some important condition.

Moulding.—This is done with such sand as is used for light castings, and which has been used before, but to which no facing has been added, neither should facing be used in preparing the castings. Enough sand must be tempered overnight to do the work of the day without using any sand over again. The flasks used are of iron, very carefully fitted; the inside measure is 14½in. by 7½in., the nowel is 1in., and the cope 1½in. deep. An iron weight is used on the top instead of clamps. No rapping is done to cause the pattern to leave the sand, and the casting must be like the pattern. The iron is poured from the crucible as soon as it is skimmed; the first flask contains the fluid and crook strips, which are poured before any other. The remaining six flasks are poured in order of their numbers.

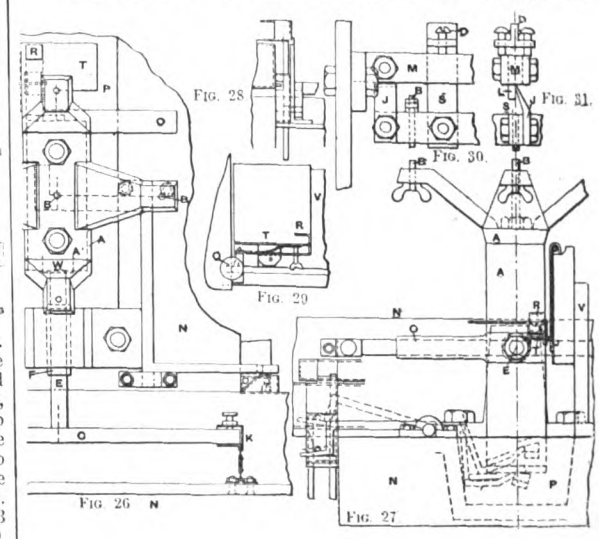
Measuring Table.—The measuring table is mounted on a box or table, so as to be of a convenient height, and is an exact duplicate of the follow board (Figs. 5 and 6). On the front of this iron table (Fig. 5) is the measure for crook strip. The strip is slipped behind the springs M, with the nose of its rib against the straight edge V. The measuring wedge (Figs. 11, 12, and 13) is then slid down the slot V′ in the straight edge. This slot is exactly $\frac{1}{1000}$ths of an inch deep, so that the 100ths wedge (Fig. 12) may be used, and the record, which is the correct crook of the strip, is, of course, $\frac{100}{1000}$ths less than the reading on the wedge. This allows the small wedge (Fig. 13) to be dispensed with, as the shrinkage of iron never runs so low as one hundred, and is rarely higher than 250. It is well to break the ends of the crook strip and record the appearance of the grain. To measure the shrinkage of the square and thin bars, the iron table has steady pins so arranged that the chills and the bars will lie exactly as they did in the mould. In Fig. 5 steady pins are shown on the sides of the thin bar; these are necessary on the measuring table, but are not required on the follow board used in moulding, as the steady pins Z and Z′ on the gate hold the pattern in the same position as the pins hold the loose bars. Openings are made through the iron table, between the ends of the bars and the inside of the chills (see dotted lines I I′, J J′, &c.) so as to allow a measuring wedge to be inserted. The actual measurement is conducted as follows: A chill bearing a certain number is laid in position on the table, and the castings are selected (both square and thin bars) which bear the same number as the chill. The right hand end of the square bar is pressed against its chill, the wedge is then slid between the left chill and the end of the bar, and the reading taken. The operation is repeated at the other end, and the mean of the values obtained is recorded as the "shrink." The bars and chills are marked on their ends to show how they lay in the mould, and the experiment is performed first with the upper corner, which is called the cold edge, and is afterwards repeated with the hot edge of the square bar. The hot and cold edges of the thin bar are then treated in the same way. One of the thin bars should be broken, in order to record the appearance of the grain to the naked eye. There still remains to be described the details of the two machines adopted for testing the strength of the square bars.



The Weight Machine.—The test bar used being exactly 1ft. long, and the bearings being exactly 1ft. apart, the ends of the bars are clamped in small extension pieces made of tempered steel. These may be of any convenient form (see Figs. 16, 26, 27, and 34). If a blow hole or a flaw exists in any bar a clamp is placed over the defect (Figs. 14 and 15). A plate carrying the supports for the bar is placed on the bed plate of the machine, so that the test bar shall come exactly under the beam of the machine, and the centre of the bar under the pressure post D. Figs. 16 to 20 show this machine. It consists of a beam B moving on a knife edge which is shown fully in Fig. 19. Forward from this 1 decimetre is another knife edge which transfers the weight to D. A saddle A, weighing 50lb., travels on the beam B, its centre of gravity corresponding with the knife edge when its weight is pulled to the near extreme. The beam is balanced by a weight, so that when A is clear back it exerts no weight on D. When the weight is over D it exerts a pressure on D of exactly 50lb., and each forward motion of a decimetre adds a pressure of 50lb. The capacity of the machine is 600lb., which is more than is required for cast iron. The perpendicular rise of D is half an inch, and it begins at its upper limit, so that the breaking of the test bar shall be when the beam is near the horizontal. The wheel W is turned by means of a crank, and thus moves the steel cord K, which carries with it the weight A. On the same shaft is another smaller wheel Y, which carries another steel cord G, which moves in the same direction, but only over one-fourth the distance. This cord is employed to impart motion to a portion of an automatic arrangement for recording the deflection. To this cord G is attached a board, which moves with it, and on which is fastened a sheet of paper. Attached to the under side of the beam, at a point 5 decimetres forward from the knife edge, is a pencil whose point is pressed against the paper. By this arrangement the deflection is multiplied five times, and is recorded on the paper. The weight is also recorded at the same time; but as the board moves only one-fourth of the distance traversed by the weight, and as 1 decimetre on the large beam corresponds to an alteration of 50lb., it follows that on the diagram 50mm. represents a weight of 100lb. The use of steel ribbons to hold the knife edges on their bearings does not detract from the sensitiveness of the machine. At the forward end of the machine is a series of steps, and attached to the end of the beam is a dog, which, by means of a spring, allows the beam to descend without friction while the machine is weighing; but the instant the test bar breaks the dog drops into the next step and remains there. For foundry practice this is all that is required, and, if preferred, the weight can be read from the upper graduated edge of the beam. For more accurate work a "recorder" is used (see Figs. 32 to 34). In this machine nearly all the parts are of sheet metal, and by means of a parallel motion the pencil is caused to describe a perpendicular line.



The Impact Machine.—This has a bed plate exactly the size of the weight machine. An iron frame carries sockets at the top which support a swinging weight A of 25lb. The radius arm has a ½in. steel centre strut, and four steel ties, each $\frac{3}{16}$in., forming with the webs B a rigid and very light trussed rod. The bed plate and frame and anvil N form a resistance much in excess of that actually required. The test bar is set on supports just as in the weight machine; but for accurate work the recording device, previously referred to, is used. The weight A is raised by means of the operator's left hand, the handle O being held until the catch T takes hold of it. By pressing a trigger the weight A is released and delivers its blow through the



steel hammer W upon the light hollow slide E, which rests directly on the bar—or in the cage of the recorder if this is used. The blow is thus communicated to the centre of the test bar. While the weight is swinging and delivering its blow the operator moves the catch T up to the next ⅛in. notch, so that each blow is delivered ⅛th of an inch higher than the preceding one. The first blow is always struck from ½in., and each succeeding blow increases by ⅛th of an inch. Only the blows which produce permanent set appear to materially influence the bar, and therefore, by beginning at ½in. (which is lower than the weakest foundry iron), all bars receive as nearly as possible the same treatment. The fall of the breaking blow is shown by the position of the catch on the scale when that blow was struck, and a reference to the table, previously given, shows the value of the blow in lbs.

Hardness Tests.—Hitherto it has not been possible to determine the comparative hardness by any scientific method. This is now done by means of a Turner's "hardness" machine. The test bar to be operated upon has its fractured end polished to a standard surface; it is set under a diamond of a standard cut, and the diamond is weighted until it produces a scratch similar to a standard scratch. The hardness of the bar is expressed by

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KEEP'S TESTS FOR FOUNDRY IRON.

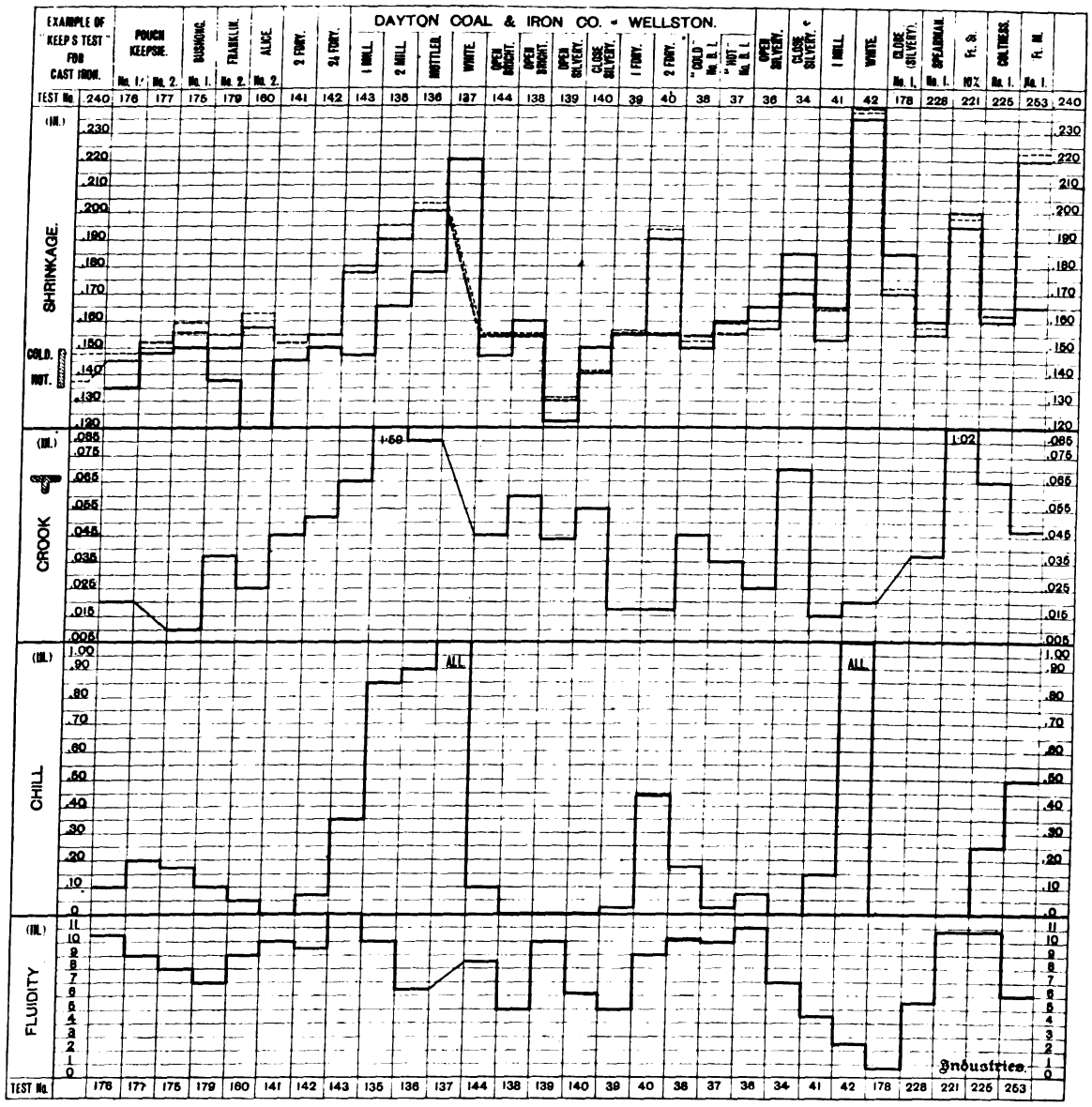
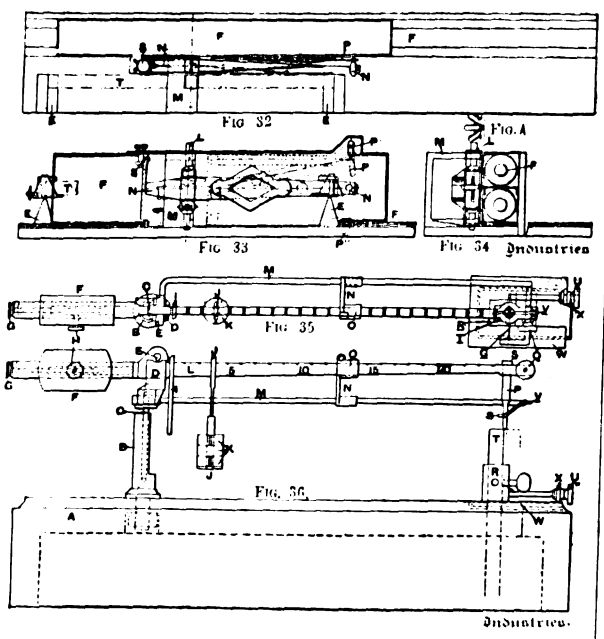


FIG. 37.

the number of grammes necessary to cause the diamond to make this standard scratch. Figs. 35 and 36 show such a machine, which embodies some improvements due to Mr. Keep. When there is no weight on the machine the beam is perfectly balanced. The weight carrier and the weights are each exactly 25grm. In testing cast iron it is usual to commence with the carrier and



three weights; it will be seen, therefore, that as there are twenty-five equal divisions each notch adds 4 grm. Intermediate values are obtained by such different use of the weights as may be necessary. To lessen the chance of the operator varying the scratch in using the instrument in the ordinary way, an arm (not shown in the illustration) is attached directly to the centre pin, and to the end of this arm is attached a silk thread. This allows the diamond to move freely up and down, while it is pulled laterally on its point. The maximum variation in the hardness of cast iron, as given by the above tests, is from about 22 to 72, the latter value being observed in specially hard white iron. The annexed charts (Figs. 37 and 38) give the results of physical tests of a number of American irons referred to in our previous paper. There are also added tests of English 10 per cent. ferro-silicon, No. 1 Coltness, and of specially pure Swedish grey iron (FL M). We cannot enter into a detailed discussion of the results at present; but it will be sufficient to say that an examination of these results show that the application of new methods of testing has opened up quite a field of important questions as to influence of various elements, such as graphitic and combined carbon, silicon, sulphur, phosphorus, and manganese on the shrinkage, chill, crook, and fluidity of the metal. When it is also remembered how much has yet to be done in connection with power to resist a force, either suddenly or gradually applied, and with the deflection of cast iron, we should feel that, in many respects, our knowledge of cast iron, from a scientific point of view, is comparatively in its infancy. If Mr. Keep has by these tests merely indicated some of the points upon which we are at present ignorant, and given us new ideas in connection with methods of investigation, he will have rendered us no mean service. Mr. Keep is at present continuing his tests, and with the assistance of Mr. Fleming, who performs the chemical analyses, hopes at some future time to give an account of the influence of various elements on the properties of cast iron. Mr. Keep has already conducted a series of experiments on the influence of silicon on cast iron, and his results, though bringing out new and interesting matter, substantially support the conclusions arrived at by Mr. Turner. It is probable that some exception may be taken to the size (½in.) of square test bar recommended in this paper. In connection with this Mr. Keep's views are as follow:—

It will be granted by all practical men that no one size of test bar can show the character of metal we may expect in all sizes of castings. A bar must be of such a size that the mould will not alter the character of the metal more than would occur in actual practice where castings are of all sizes. Many castings are only ½in. in thickness, while very much iron is cast thinner than this, and the thinner the castings are the more is the skill necessary to produce a soft, strong iron. In the study of cast iron it matters not what is the size of the bar if each iron is tested in exactly the same way. The ½in. square bar will show the characteristics of every iron more fully to an experienced man than a larger bar, as slow cooling will fail to mark so sharply the effect due to slight variations in any element. But there are other practical reasons in favour of the use of the ½in. bar. In order to give fair averages, and to avoid mistakes, six pairs of bars are needed, and three such sets of of six bars can be cast from one half pig. Any furnace owner will gladly furnish a sample half pig of 50lb. for a test, while such a quantity is readily handled, and the carriage is small. Even after all the required tests have been performed, part of the sample will remain, and can be stored for reference. The six broken bars, with the rest of the test, can be conveniently stored in a pigeon hole 2½in. square, and may be kept under lock; this gives twelve complete samples of the iron, each of which is light enough to send by post if desired. An examination of the specimens forwarded by Mr. Keep will show the value of these tests as applied to scientific research, especially when rare or expensive materials have to be used. Possibly some practical founders of the old school may be a little dismayed at the multiplicity of the apparatus and tests mentioned in this paper. To these we may say that the complete set of apparatus is intended to meet, as far as possible, the requirements not merely of the practical man, but also of the scientific investigator. For ordinary foundry use, to test the cupola product, the only apparatus required is that shown in Figs. 5 to 15 (with only Fig. 12 wedge) and the weight machine. If pig iron is to be tested, the furnace will be necessary; some founders will also need the impact machine. The hardness machine is too delicate for most foundry purposes; it can, however, be readily used by getting a number of standard pieces of different hardness, as registered on the machine, and then comparing the hardness of a particular sample, by means of the ordinary works tests, with the standard specimens.

The complete apparatus can at present be obtained at a price arranged so as to very little more than cover the actual cost of manufacture, from the Dunkirk Manufacturing Company, Dunkirk, N.Y. It is difficult to fix the price definitely at present; but there is every probability that it will not exceed £70 for the complete set, and would be less if a number were required. If these tests should be well received in this country, it is hoped that some firm here may be prevailed upon to take up the matter in the same spirit; but in such a case it is of great importance that perfect uniformity should exist in all sets of apparatus intended for a standard series of tests. The apparatus should of course be a correct copy of that made by Mr. Keep, who, in conjunction with Mr. Turner, would be happy to supply the necessary information. It may be once more mentioned that upwards of two years' use at the Michigan Stove Company's works, where about 70 tons of iron is daily cast into thin stove plate, has shown no cause for modification in the above tests. The quality of their castings has been kept regular, while mistakes have been avoided in the purchase of iron. With such information as this regarding any given iron, the founder should at once know whether or not it will suit his requirements. If any iron acts badly, a test will show what is wrong, and prove beyond dispute whether or not the iron is such as it was represented to be. Thus, the iron broker and the user are at once benefited. But, better than all, such knowledge removes superstition from the mind of the founder, and teaches him exactly what is the remedy for the defective iron, so that he can easily vary his mixture so as to use up brands of iron in connection with which he can now only complain to the furnace manager, or resolve never to touch it again.

The following is a short explanation of the accompanying figures:—

THE FURNACE.—Figs. 1 to 4 show the furnace. A is an arched flue to chimney, B the entrance for blast, C the plate to close ash pit, D a renewable seal for cover, E a removable plate to allow the last arch brick to be driven in to cover, F line of floor, which may be nearer the top if desired. Nothing but brick comes in contact with the fire. The grate bars are removable as usual. The inside lining can be removed and leave the outside shell. The door is lifted by the ring, and to this ring is attached a chain and counter weight.

PATTERNS AND MEASURES.—Figs. 5 to 15 show patterns and measures. W is an iron follow board, on which the patterns S and T and the chills G and G′ are perfectly bedded. Fig. 6 is a cross section. The moulder stamps the same number on each set of bars. D are guide pins to bring chills always to same position, D′ is a guide pin to prevent lateral motion of thin bar chill. The square bar chill is held by the follow board. E are four runners for the thin bar, and F two runners for the square bar. A notch is made in one end of each chill, and a corresponding one in the same ends of each bar T and S; Z is a draw pin for pattern, and Z′ a short steady pin to prevent lateral motion of pattern and fixed gate. K is the gate for the crook strip U, and N the gate for fluid strip H.

MEASURING.—Figs. 5 to 15. The same letters are used as in the last paragraph, everything being duplicated exactly except the same chills are used, and S and T are castings and the gates E F Z are not present. Four more steady pins O are used (but not used on the moulding follow board) to insure bar T being in the same position as the pattern. Between the ends of chills and bars P and L will be a space equal to the shrinkage of each bar. Through the iron follow board between each of these ends is a hole to admit the measuring wedge (Fig. 12), also shown in Fig. 6 at I I and J J, the companion dotted line showing the plain edge. V is a straight edge on the blocks, and Y′ is used for measuring crook strip U. The recess V′=$\frac{100}{1000}$in. is to allow the wedge shown in Fig. 12 to be used. It is run through as shown by I I (Fig. 6). If the "crook bar" is straight it reads $\frac{100}{1000}$ and is read O. If it is crooked the reading, less 100, is the record. M are springs on the blocks Y, which hold the ends of the crook strip against the straight edge V. This measure is of course not on the moulding follow board. The wedge shown in Fig. 11 is used for white irons. The bar S often blows at F. The clamps (Figs. 14 and 15) are put over the flaw.

TRANSVERSE MACHINE.—The knife edges and thin suspending steel ribbons are seen in Figs. 19 and 20. On a simple beam B, lightened by a portion being cut out of its long arm, runs a

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KEEP'S TESTS FOR FOUNDRY IRON.

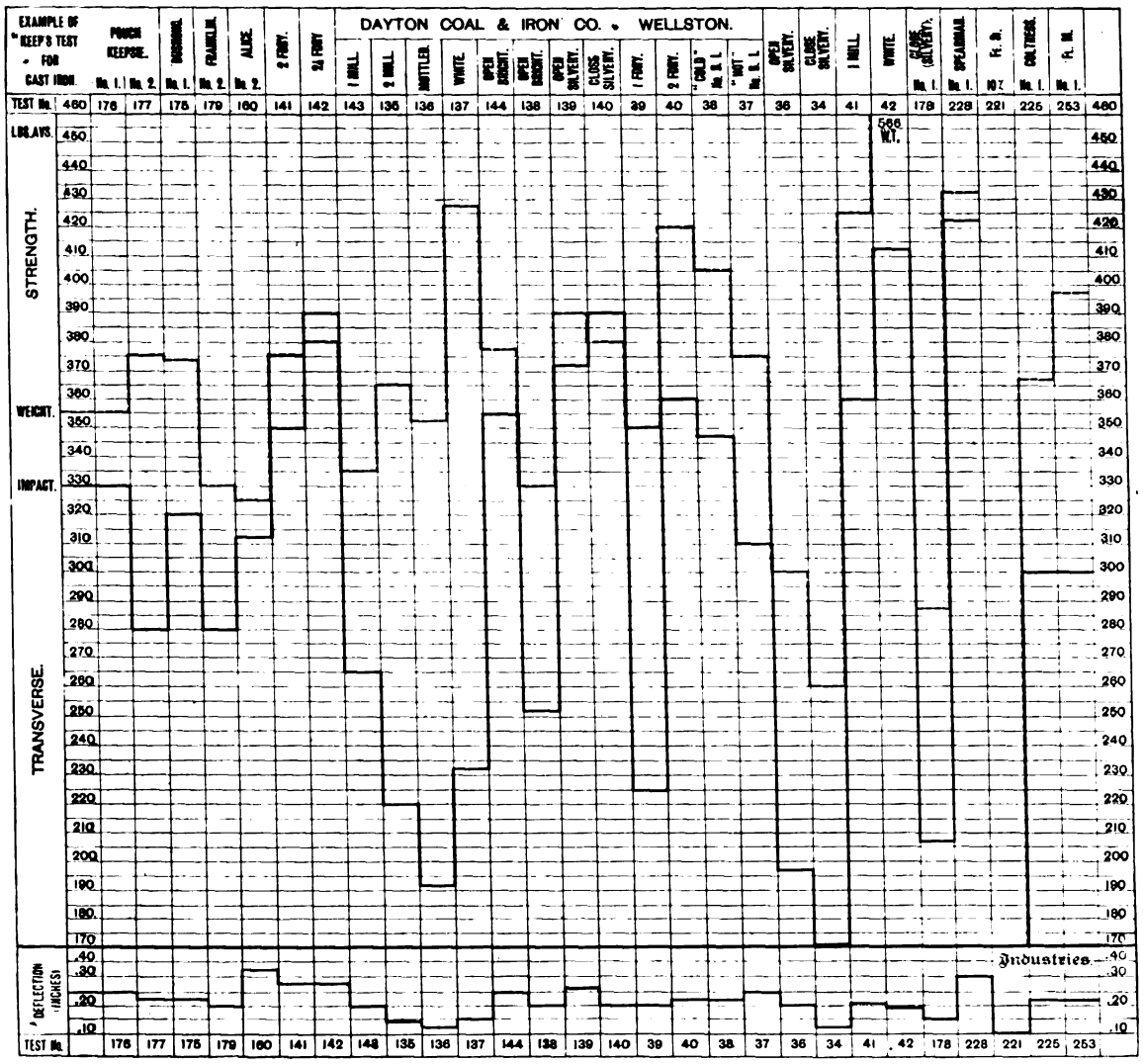


FIG. 38

rolling weight A propelled by the steel cord K K′ running around the wheels W and W′, which wheels are operated by a crank. The device at the forward end of beam is to catch the beam when it begins a sudden fall, but present no resistance to a slow fall. The illustration shows the recording device in position, and the steel cords G and G′ are to move the diagram holder F. The test bar C receives the weight through the strut D. Enlarged details of the recording device are given in Figs. 32 to 34.

IMPACT MACHINE.—Figs. 21 and 22 show the front elevation and plan of the impact machine. The 25lb. weight A swings on knife edges and the supporting steel ribbons S, and is caught by the catch T. By pressing a trigger the weight A is released, and strikes the hollow slide E, through which the blow is delivered to the test bar C. The recorder (Figs. 32 and 34) is shown on this machine, though in the plan (Fig. 22) it is cut off; but the extension is shown in Fig. 23. Fig. 24 and the upper part of Fig. 25 show the upper support to weight, and Figs. 30 and 31 the enlarged details. Fig. 25 is a plan of one of the webs of the truss. The trip to operate the recorder is shown in Figs. 26, 27, and 28. The device for catching the weight on the arc V is shown in Figs. 26, 27, and 29.

THE RECORDER.—This instrument is shown enlarged in Figs. 32 to 34. F is the paper holder with its continuous rolls of paper, which slides in the ways F′. The test bar T is clasped at its centre by a cage made from very thin sheet steel. N is the lever actuated by this cage, and the pencil at its end describes the diagram in the weight machine. The cage slides in the steel yoke M′. The arm P′ draws, by means of a pencil attached to its end, a diagram of the recoil of the bar, and P records the deflection of the bar in the same way. When struck in the impact machine P may be driven to P″. P″, P, and N all move in vertical lines, because of parallel motions. The cage and all levers are contained in a box and are not seen. The lever N has springs for bearings, and the rear bearing S can be varied by a set screw to bring the pencil point to any desired place on the diagram paper. A knife edge bearing for the test bar T is shown at E. An extension for the test bar is shown on each knife edge E. The diagram holder F is moved on the impact machine by a weight attached to the end of a cord running over a pulley, the length of motion being regulated by the trip; but on the weight machine it is moved by the steel cord G′.

TURNER'S HARDNESS TEST.—Figs. 35 and 36 show in plan and elevation the machine used for Turner's hardness tests. B is the pillar containing the bearing C of the head D. This is offset, and B is cut away to allow the weight K to hang on the first notch. L is the beam, and at its outer end, held by the screw Q, is the holder P, containing at its lower end a cutting diamond. The beam L moves freely up and down on the knife edge E, and is counter weighted by the weight F, which is moved by the screw G, and set by the screw H. To the head D is attached an arm, which runs past P and across in front, and then downward in front of P. To this end is attached a silk thread G, which is attached to the holder P. The operator takes hold of the handle V and pulls towards him, thereby actuating the arm which moves the head D. It also, by means of the thread, pulls the holder P without causing any friction on the knife edge E, and at the same time P is perfectly free to move up and down. With no weights on the beam, there is no pressure on the diamond. The carrier J weighs exactly 25grm. There are twenty-five divisions on the beam, and therefore the carrier on the first division brings 1grm. on the diamond. With three other 25grm. weights, each notch brings 4grm. on the diamond.

Notes.

A LARGE TORPEDO SHELL.

ACCORDING to the *Scientific American*, one of the new elements of construction rendered necessary by the invention of the dynamite gun, has been a brass shell for the projectile. Brown & Brothers, a firm in Waterbury, Connecticut, have succeeded in making a shell of seamless drawn brass, with conical head, $\frac{1}{16}$ths of an inch in thickness, and weighing 200lb. Its length is 6ft. 8in., and the inside diameter 14in., the whole being in one piece. It is produced by the cold flow of the metal, drawn into shape with the hydraulic ram. This shell is designed to carry 600lb. of explosive gelatine.

AMMONIA ENGINE.

THE use of ammonia for developing power is again brought into prominence by some tests lately made in New York. The engine used was a 60 h.p. Porter-Allen, and fitted with the Campbell ammonia apparatus. The amount of coal used per h.p. with the Campbell apparatus varied from 2·43 to 2·83; while the same engine had been running at an expense of 5·62lb. of coal, using water. The *Iron Age* gives a description of the apparatus as used in their printing establishment. A 200 h.p. Wright engine is used during the day and a 40 h.p. engine during the night, when there is a smaller demand for power. The plant presents no complications other than those attending an ordinary steam plant, and no special training of attendants is necessary. Any existing steam plant can be fitted with the apparatus with little trouble. The odour of ammonia about the plant is very slight. The liquid used has a specific gravity of 17°B6.

EXPERIMENTS WITH ANEMOMETERS.

AT the last monthly meeting of the Royal Meteorological Society, Messrs. G. M. Whipple, B.Sc., and W. H. Dines, B.A., reported on experiments made by the Wind Force Committee with anemometers at Hersham. A whirling apparatus with arms 29ft. radius was rotated by means of a small steam engine. On the arms of the whirler four different anemometers were placed. Each experiment lasted fifteen minutes, the steam pressure remaining constant during the run. For the Kew standard anemometer, with arms 2ft. long, the experiments gave a mean value for Robinson's factor of 2·15, and for two smaller instruments the factor was 2·51 and 2·96. Mr. Dines' helicoid anemometer gave very satisfactory results, the mean factor being 0·996.

THE LYONS SILK TRADE.

THE British Vice-Consul at Lyons says that the production of novelties was considerable throughout 1887, and that in tissues of pure silk the preference was greater for the coloured sorts than for black. Goods mixed with cotton wool or schappe dyed in the piece were in good demand. The figure given by the Lyons Conditioning House for 1887, is 3,784,284lb., which shows in comparison with 1886 a diminution of 332,599lb.; but this difference is attributed to the circumstance that in the last quarter of 1886, owing to an advancing market, many speculative transactions were made, which would otherwise have appeared in the trade of 1887. The official figure of silk exports of all kinds for the year 1887 is £8,606,040, or a decrease of £1,075,040 compared with 1886, which is partly due to the fall in prices.

PETROLEUM IN EGYPT.

IN our issue of the 21st January, 1887, we referred to the borings for petroleum which were being made at Jemseh. A Foreign Office report states that the Egyptian Government continued operations all last year; but although a depth of more than 2100ft. has been attained, they have met no favourable results, and in the meantime the boring there is suspended. Colonel Stewart, who represented the London Chamber of Commerce at the Petroleum Conference, held at Baku in 1886, is now exploring to the north and west of the Jebel Zeit range of mountains, and until his report is sent in, the Egyptian Government will probably not enter upon any new borings. Opinions differ very much as to whether the proper site has been chosen for the borings, and it is believed, should operations again commence, the borings would be from twenty to thirty miles inland.

THE SKILLED LABOUR MARKET.

THE Labour Correspondent of the Board of Trade reports that the revival in trade which commenced in the opening months of the year still continues to exercise a favourable influence on the condition of the skilled labour market, so far as can be gathered from the monthly reports of the trade unions which publish such returns. Sixteen unions have reported, with a total membership of 172,005, and though this figure forms but a small proportion of the aggregate workmen of the country, there can be no doubt that it reflects with tolerable accuracy the general aspect of the industries they represent. Of this number 8981 are unemployed, as against 10,668 last month. This is a net decrease of 1687, and the proportion per cent. of those out of work has fallen from 6·2 to 5·2. For the corresponding months of last year the proportions were 7·7 and 6·8. The rate of progress is therefore slow, and there seems reason to fear that the revival has well nigh spent its force. The greater portion of the improvement of the month is undoubtedly due to increased employment in the building and other outdoor industries, owing to finer weather, and in those trades the improvement since last month is indicated by a fall in the proportion of unemployed of from 8·5 to 5·2 per cent., the proportion at this time last year being 3·5 per cent. The iron shipbuilding and allied trades still show signs of improvement, although men do not go so briskly off the books as they did two or three months ago; and it is being remarked that new orders are not now booked with sufficient frequency to enable ship and engine builders to replace work now being executed with new commissions. The cotton and woollen trades do not show much activity, and most branches of the iron trade are in a stationary condition, as though an increased demand were needed to put them into more healthy action. Shipwrights (wood workers) have long suffered severely from trade depression, but now report that they are better employed than for some years past. The boot and shoe makers report improved trade.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

11th May, 1888.

7042. Hurst, W. ..... Mules.
7043. Yates, J. ..... Machinery for preparing yarns or threads in the hank.
7045. Mauser, P. ..... Breech loading fire arms.
7050. Lake, H. H. ..... Universal shaft couplings (*Robes and Haskell*). (This Application was originally numbered in error 18037, A.D. 1887.)
7055. Worrall, J. ..... Machinery for producing a nap on velveteens.
7057. Worrall & Kershaw... Machinery for obtaining a cross-over finish and raising on cut pile fabrics.
7058. Holden & Ashworth... Doubling and twisting yarns.
7059. Taylor, G. ..... Apparatus for conveying coal by railway and for loading and discharging coal cargoes.
7061. McDougall, I. S., and others ..... Boilers or vessels lined with lead or other acid-resisting metal.
7063. Elliottt & Elliott ... Printing machines.
7065. Kennedy, E. S. T. ..... Radial tube steam boilers.
7066. Gibbons & Robinson... Gas engines.

12th May, 1888.

7069. Anderson, J. ..... Automatic brick moulding and pressing machine.
7073. Jackson & Martin ..... Auxiliary motor to be used in connection with steam engines and boilers for increasing their motive power without additional working expense.
7074. Houlden, H. W. ..... Transmission of power.
7075. Kelly, P. ..... Drawing off rollers for combing machines.
7076. Kelly, P. ..... Apparatus for actuating dabbing brushes for combing machines.
7077. Mills, J. ..... Steam boiler.
7078. Wilkinson, E. ..... Feeding wool to carding machines, and removing foreign matter from the fibre.
7082. Russell, B. ..... Glass houses.
7085. Hill, H. ..... Lace machines.
7094. Smith & Oldham..... Axle boxes for railway vehicles.
7099. Carter, W. ..... Hydraulic lifts.
7100. Lake, H. H. ..... Type writing machines (*Ganse*).
7103. McGlashan, D. ..... Sewing machines.
7104. Morton & Taylor ..... Fastenings for securing sheet metal to angle, tee, or other form of iron supports.
7108. Harkes, D. ..... Harrow.
7109. Parmiter, P. J. ..... Horse rakes.

14th May, 1888.

7115. Middleton, R. ..... Automatic locking safety appliance for entrances into hoists and lifts.
7117. Morgan, C. ..... Machinery for the manufacture of finings.
7118. Greaves, H. R. ..... Cotton gins (*Greaves*).
7121. Hogg, J. ..... Sight lubricator.
7125. Winby, W. E. ..... Hauling canal boats and sea-going vessels upon the endless cable system.
7128. Shakeshaft, J. ..... Signalling on railways.
7136. Blezard & Nelson..... Looms.
7140. Keavy, T. E. ..... Boot and shoe buffing machines.
7146. Oliva & Bardili..... Preventing the capsizing of ships without ballast or cargo.
7150. Vogel, Sir J. ..... Lubricators.
7151. Bucknill & Day ..... Gear for small steamers employed in laying and raising submarine mines.
7154. Mallett, J. R. M. ..... Apparatus for propelling boats by manual labour.
7160. Clark, A. M. ..... Rotary polishers (*The Zucker and Levett Chemical Company*).
7169. The United Sewing Machine Company and Sharpe..... Lock stitch sewing machine.
7170. Abel, C. D. ..... Furnace grates (*Langen*).

15th May, 1888.

7172. Renshaw, W. R. ..... Surface condensing apparatus.
7188. Baird, E. J. C. ..... Tram cars.
7189. Hindley, J. ..... Steam and gas generator.
7194. Craven, R. E. P. ..... Flues and fire boxes for steam boilers.
7197. Harrison, J. ..... Mitigating the vibration of spindles.
7200. Williams & Williams.. Axle box.
7201. Hart, F. B. ..... Operating railway signals.
7207. Brown, G. W. ..... Lubricators.
7210. Lake, H. H. ..... Diminishing the oscillation of railway vehicles (*Pullman*).
7213. Oliver, P. A. ..... Gunpowder mills.
7215. Burnham, W. ..... Moulding and welding metals.
7216. Reed, A. H. ..... Punch and die for sail grommets (*Wilcox*).
7217. Reed, A. H. ..... Sail grommets and washers used for the same (*Wilcox*).
7218. Benson, W. A. S. ..... Cutting screws in a turning lathe by hand.
7220. Henderson A. C. ..... Manufacture of wire healds (*Bénazet*).
7222. Skinner, A. L. ..... Power looms.
7224. Patrick, J. J. R. ..... Apparatus for regulating teeth.
7226. Steel, W. H. ..... Sewing machines.
7227. Boulton, M. P. W. ..... Steam engines.
7229. Schubert, V. F. ..... Stone breaking machine.
7234. Las, R. le ..... Washing and sorting coal.

16th May, 1888.

7247. Glover, L. ..... Mules.
7248. McGregor, A. ..... Reaping and mowing machines.
7249. McGregor, A. ..... Machinery for pulping turnips.
7255. Fleming & Ferguson... Bucket ladders of dredgers.
7265. Vaughan-Arbuckle, B. Protecting ordnance by the application of armour plates.
7266. Vaughan-Arbuckle, B. Directing the fire of guns.
7269. Thompson, W. P. ..... Type writers (*The Standard Type Writer Manufacturing Co.*).
7273. Schweitzer, T. O. ..... Sizing machines.
7274. Anson, W. ..... Breech loading small arms.
7276. Brigg, T. H. ..... Wheeled vehicles.
7277. Larsen, H. S. ..... Automatic cork cutting machines
7282. Bennett, M. ..... Hand guard for rifle barrels.
7287. Davis & Turner ..... Gas heated boilers.
7290. Morton & Taylor ..... Railways.
7292. Laillet, C. A. H. ..... Automatically re-utilising waste steam.

17th May, 1888.

7294. Wilhelm, J. ..... Joining sheet metal tubes.
7298. Taylor, T., & others ... Gig mills.
7299. King, J. T. ..... Rolling metal rods (*Day*).
7304. Gimson, J., & others ... Heel burnishing machines.
7305. Fawcett & Fawcett ... Double pressing motion for moulding and pressing bricks and other articles.
7312. Burgoine, A. ..... Sailing craft.
7313. Whitehead & Haworth Safety clutch for barring engines.
7316. Greener, W. O. ..... Rocket guns.
7319. Worsley, J. E. ..... Apparatus for breaking up cop waste for re-spinning.
7325. Filbee, G. H. ..... Tubular boiler.
7326. Dixon & Clayton ..... Pickers of looms.
7329. Teague & Wellington Stamping machinery for crushing ores.
7336. Smith & Paget ..... Roller bearings for washing machines.
7339. Bamforth, S. ..... Fire bars for furnaces.
7341. Twelvetrees, W. N. ... Washing machines.
7345. Rongier, H. ..... Manufacture of weldless chains.
7354. Twibill, J. ..... Steam generators and fuel economisers.

ELECTRICITY.

11th May, 1888.

7035. Langdon, W. E. ..... Electrical coupling.

14th May, 1888.

7111. Davies, J. H. ..... Electrical couplings.
7131. Thomson, Sir W. ..... Measuring and regulating electric potentials and currents.

16th May, 1888.

7256. Rowling, F. ..... Holder, switch, and cut-out for electric glow lamps.

17th May, 1888.

7301. Thomson, Sir W. ..... Measuring and regulating electric potentials and currents.
7321. Kent & Beaumont ..... Storage batteries.
7332. Edmunds, H. ..... Conductors of electricity.
7333. McKenzie, R. ..... Electrolytes for batteries (*Weymersch*).

CHEMISTRY.

11th May, 1888.

7046. Borsche & Brünjes..... Conversion of chloride of calcium into chloride of magnesium and carbonate of lime.
7047. Caspers, C. J. ..... Machinery for impregnating liquids with carbonic acid.

12th May, 1888.

7095. Thompson, W. P. ..... Detergent compounds (*Parsons*).

14th May, 1888.

7123. White, W. ..... Sodium and potassium.
7159. Dahl, S. T ..... Amalgamating gold.

15th May, 1888.

7177. Thompson, W. P. ..... Disinfecting compounds (*Belcher*)
7187. Hannay, J. B. ..... Treating ores.

16th May, 1888.

7257. Fenton & Partridge... Preventing loss in the smelting of ores (*Woolford*).
7279. Soldenhoff, R. de..... Washing ores.
7285. Mallet & Pagniez ..... Distilling ammoniacal liquids.

17th May, 1888.

7331. Mills, B. J. B. ..... Manufacture of metallic twist or bullion (*Mallet-Guy*).
7334. Lennard, F. ..... Distillation of tar.

MISCELLANEOUS.

11th May, 1888.

7019. Heaton, R. ..... The regulation of the motion of Nottingham and trolling reels.
7020. Alber, W. ..... Improved oil cement.
7021. Whitehead & Shaw..... Nut locks.
7024. Hargraves, E. H. ..... Finishing cotton goods.
7025. King, R. ..... A tumbler for gaff jaws.
7027. Wolloms, J. W. ..... Safety window fastenings.
7028. Bingham & Bingham.... Horseshoes.
7029. Campbell, M. E. ..... Metallic folding crates.
7031. Wright, G. ..... Register stove grates.
7032. Mackenzie & Wake..... Securing railway keys in railway chairs.
7033. Hannay, J. B. ..... Anti-fouling coatings for ships' bottoms.
7034. Wishart, J. ..... Indicating the length cut from a piece of textile fabric.
7036. Kenyon, J. H. ..... Improvements in weaving by moistening the atmosphere with water, antiseptic, or other liquids.
7040. Walker & Sisterson... Reducing the pressure of gas.
7041. Moyse, E. B. ..... Stoppering glass bottles.
7054. Imray, O. ..... Tongs for handling clothes and fabrics during washing (*Hardy*).
7056. Hollins, M. D. ..... Tiles.
7060. McDougall, I. S., and others ..... Apparatus for making bisulphites used in the treatment of wood pulp.
7062. Poujade, J. B. H. R. ... Connecting pipes.

12th May, 1888.

7071. Bödtker, A. ..... Slag manure.
7072. Nobiling, M. ..... Tricycles.
7080. Schulte, J. ..... Manufacture of non-conducting lagging.
7086. Creed, W. G. ..... Ventilator.
7087. Hughes, J. H., & others Fire proof material.
7089. Richardson, J. ..... Bottle opener.
7091. Thomas, W. B. ..... Lamps.
7096. Thompson, W. P. ..... Locks (*Polleri*).
7097. Meeze, A. G. ..... Manufacturing gas.
7098. Whitehouse, J. ..... Traps for sewers.
7101. L'Ancienne Société J. G. Bideau et Cie., and Michelin ..... Brake blocks.
7105. Cooper, W. C. ..... Compasses.
7106. Freeman & Jenkins ... Coating of metal plates with tin.
7107. Hunt, T. ..... Gauges for steam boilers.
7110. Barton, W. ..... Improved instrument for indicating angles and courses and for measuring distances.

14th May, 1888.

7113. Thorburn, Bain, & Co. Printing by letterpress in gold or colour on glass, china, porcelain.
7120. Sumners, H. ..... Fire proof curtain.
7124. Hall, B. G. ..... Clinometer for measuring vertical angles.
7126. Walsh, B. ..... Carts used for spreading liquid manure.
7132. Lock, G. H. ..... Ventilating drains.
7134. Potter, E. ..... Discharging slag balls from bogies.
7142. Penhorwood, C. F..... Cleaning wall papers.
7149. Smith, G. H. ..... Producing manifold copies.
7152. Borsche & Brünjes ... Manufacture of hollow bodies of cement.
7153. Coop, W. ..... Manufacturing lead shot.
7155. Craig, S. ..... Treating flax.
7156. Bruzon, R. ..... Droppers for wire fencing.
7157. Varley, J. J. ..... Screw stoppers.
7163. Héley, A. ..... Manufacture of boots.
7167. Sargent, T. R. ..... Tilting casks.
7168. Abel, C. D. ..... Roasting, calcining, and drying materials (*Langen*).

15th May, 1888.

7174. Walker, F. ..... Packing for pistons (*Jaeger*).
7178. Burgess, H., & others... Bobbins for looms.
7181. Bolland, T. ..... Distilling apparatus for spirits.
7182. Goodchild, W. ..... Bolts.
7183. Turner, W. H. ..... Towing or scouring ceramic productions in the clay or biscuit state of manufacture.
7184. Marriott, A., & others Cutting a spiral groove in a weft bobbin.
7191. Moseley, J. ..... India-rubber compounds for dental purposes.
7198. Osborne & Richardson Cutting sheet glass.
7203. Johnson, S. A. ..... Automatic extinguishers for lamps.
7204. Berliner, E. ..... Improved process of recording sounds for reproduction.
7206. Straub, C. ..... Wall covering composition.
7211. Hawkins, I. T. ..... Sewers.
7219. Williams, H. ..... Artificial fuel.
7221. Lewis & Hunter..... Tipping coal in collieries.
7223. Smith G. ..... Sockets for earthenware pipes.
7228. Sandison, W. M. ..... Concentrating cane juice.
7230. Edwards, E. ..... Shafts of carriages (*Labarre*).
7231. Kustel, O. ..... Ships' logs.
7232. Earnest, J. T. & others Heating and ventilating railway carriages.

16th May, 1888.

7237. Patterson, W. ..... Safety lamps.
7239. Baller, E. R. ..... Automatic locking bolt.
7240. Main, R. R. ..... Base plates for fencing standards.
7245. Price, T. ..... Manufacture of tin plates.
7246. Appleyard, G. ..... Pulverising and sifting salt.
7252. Pirrie, N. ..... Automatic station indicators.
7259. Death, J. ..... Distilling spirits and distillery plant.
7262. Sheldon, J. ..... Velocipedes.
7264. Layland, A. ..... Manufacture of pens.
7268. Foster, F. ..... Stoppering bottles.
7270. Jackson & Ferguson... Lids for drum heads and for holes in sheet metal structures.

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7271. Crowley, J. ..... Lamps.
7272. Lumley, M. ..... Machine for making wire loops for wiring the corks of bottles.
7283. Willis, E. J. ..... Safety cycles.
7284. Forestier, M. ..... Valves.
7288. Phillips, J. ..... Gullies and drains.

17th May, 1888.

7296. Bentley, J. ..... Screw stocks.
7302. Bodtker, A. ..... Slag manure.
7306. Wilmot, C. F. ..... Steering velocipedes.
7307. Fawcett, A. ..... Clarification of sewage.
7309. Richardson, J. T. H. ... Manufacture of glass.
7314. Whyte & Allan ..... Metallic packing for piston rods.
7317. Jackson, R. ..... Metallic drums and lids.
7322. Marsh, R. C. ..... Watches.
7323. Grayson, J. ..... Preventing the accumulation of fluff in winding frames.
7335. Fullford & Van Laun Gas lamps.
7337. Brock, A. ..... Lamps.
7347. Wilson, R. H. ..... Pruning shears.
7350. Brasier, E. ..... Processes for treating "Bauhinia Vahlii" and other fibrous materials.
7351. Spencer, A. G. ..... Preventing rattling of railway carriage windows.
7353. Gibbons, J. V. ..... Hay rakes and tedders.
7355. Treunfeld, R. von F. . Field telegraph conductors.
7356. Harrison, G. A. ..... Manufacture of linoleum.
7358. Parker, A. J. ..... Manufacture of compounds and their utilisation as printing surfaces.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING

19th May, 1888.

6935. Starley, J. K. ..... Manufacturing articles from rod wire or tube.
7230. Barwick, J. E. ..... Heating steam generators by kilns.
7326. Hadden, H. ..... Traverse warp machines.
7402. Smith & Cowan ..... Steam generators.
7921. Harrison, J. ..... Knife cleaning machines.
7922. Johnson, J. Y. ..... Mules (*La Société A. Grandjeans et Cie*).
8448. Lake, H. H. ..... Sewing machines (*Wheeler*).
8454. O'Donnell, J. P. ..... Hydraulic machines for stamping rivet and bolt heads (*Fréhault*).
8562. Lake, H. H. ..... Warping machines (*Wiedersheim*)
8687. Colam, W. N. ..... Cable tramways.
8954. Johnson, J. Y. ..... Driving spindles in spinning machines (*Masson-Pinel*).
9236. Griffiths & Anthony.. Slide valve.
9343-4. Barrow, J. ..... Lathes.
9380. Cleathero & Stewart. Safety apparatus for lift and mine cages.
9432. McQueen & Moores .... Nipper mechanism of combing machines.
9437. Kenworthy, E. N. ..... Roller bearing for mangling machines.
9501. Thompson, W. P. ..... Furnaces for burning hydrocarbon fuels (*The Aerated Fuel Co.*).
9816. Bertrand-Bocandé, O.. Switch and turntable for railways.
9849. Ehrlich, D. ..... Washing machines.
9860. Preston, E. J. ..... Pumps.
9942. Wailes, E. F. ..... Stern posts and rudders of ships.
9945. Hopkins, M. ..... Washing apparatus.
9992. Thompson, W. P. ..... Grain binders (*McCormick*).
10010. Howard & Gibbs ..... Harvesting machines.
10045. Attenborough & Kent Filling up apparatus as applied to knitting machines known as "Cotton's Patent."
10088. Mason, J. ..... Loose reed looms.
10101. Sauce, E. de la, & others Metal plates and machine for bending the same.
10148. Burgess, G., & others... Regulator applicable to sectional warping & beaming machines.
10365. Perkins & Perkins..... Machinery for rolling roads.
10504. Buck, T. ..... Operating railway waggons upon inclines.
10840. Berry, H. ..... Hydraulic punching machine.
10901. Hardley, S. ..... Steam washing machine.
11444 Abel, C. D. ..... Igniting apparatus for gas engines (*The Gas Motoren Fabrik Deutz*).
11894. Healey, B. D. ..... Furnace rocking bars.
12061. Bayliss, T. R. ..... Machinery for stamping and cutting metals.
12893. Harrison & Sheard.... Testing gas pipes and fittings.
16443. Shepherd, J. ..... Steps for shaft and axle bearings and for bushing loose running pulleys and wheels.
17652. Garratt & Scott ..... Preparing flax for spinning.
17766. Ribault, G. E. ..... Coupling rolling stock.
68. Rowbotham, T. ..... Corve wheels and axles.
1607. Westley, J. ..... Picker for looms.
1998. Leiga, H. H. ..... Screw propellers (*Le Solliec*).
2444. Rariden & Heath ..... Car couplings.
3313. Bollmann, L. ..... Sewing machines.
4978. Lake, H. H. ..... Machines for pulverising ores (*Gates*).
5336. Preble, J. Q. ..... Weighing machines.
5437. Schaeffer & Oehlmann Lubricators.
5471. Colley, A. ..... Magazine for rifles.
5585. Bonvillain & Guyon... Hydraulic apparatus for compressing and baling cotton.
5622. Richards, F. H. ..... Button setting machines.
5636. Dynes, W. ..... Clover seed shelling machine.
5641. Mauser, P. ..... Breech loading fire arms.
5644. Allison, H. J. ..... Casting ordnance (*Gatling*).
5712. Ellis & Sturla ..... Numbering machines.
5741. Lake, H. H. ..... Manufacture of lattice work (*Golding*).

ELECTRICITY.

19th May, 1888.

6809. Eshelby & Eshelby .... Electric bell indicators.
6918. Gedge, W. E. ..... Telegraphy (*Claude*).
7042. Chapman, F. G., & others Electric arc lamps.
9829. Stanley, T. ..... Dynamo-electric machines.
9904. Grabau, L. ..... Insulating coatings in electrolytic apparatus.
10195. Hall, J. P. ..... Dynamo-electric machines.
10575. Emmott & Ryder ..... Instruments for electric measurement.

CHEMISTRY.

19th May, 1888.

9315. Imray, J. ..... Azoic colouring matters (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, Poirrier, & Rosenstiehl*).

MISCELLANEOUS.

19th May, 1888.

6817. Burke & Leather ..... Centrifugal percussion fuse for igniting the bursting charges of shells.
7298. Leonardt, F. C. ..... Manufacture of paper boxes.
7567. Owen, D. ..... Manufacture of tin plates.
8345. Ruscoe, J. ..... Taps, dies, reamers, and cutters.
8491. Smith, T. ..... Needle for sewing machines.
8802. Schmitt, K. ..... Velocipedes.
9108. Dodge, J. M. ..... Chain cable.
9630. Clegg, W. ..... Velocipedes.
9762. Dinsmore, J. H. R. ..... Heating, drying, and circulating air.
9771. Rylands, D. ..... Valves for internally stoppered bottles.
9886. McIlvride, A. B. ..... Collapsible boxes.
9887. Rust, J. ..... Improved material for colouring paints and cements.
9901. Abel, C. D. ..... Illuminating railway carriages (*Rotten*).
9912. Marriott & Cooper ... Driving gear for bicycles.
9931. Singleton, T. ..... Size boiling, beaming and pressing yarn in tape frames.
9949. Sengel & Dobler ..... Gelatinised cloth or artificial parchment.
9973. Gratrix, S. ..... Speaking tubes.
9993. Downie, T. ..... Metallic packings for piston rods.
10025. Burton, W. C. ..... Spindles.
10037. Markham & Shann..... Bicycles.
10061. Warner & Goslin..... Heating apparatus for water and air.
10073. Hannay, J. B. ..... Fire extinguishing apparatus.
10113. Gilliard, A., & others.. Production upon fibres and fabrics of colours varying from black or brown black to blue black and blue.
10227. Cock, W. J. ..... Removing débris from tram rails.
10355. Hill, J. ..... Tilting casks.
10531. Baller, E. ..... Lamp trimmer.
10650. Cohnreich, P. ..... Oiling or fatting wool.
10669. Wolff, C. ..... Machines for stripping the quills of birds.
10989. Barrett & Varley ... Screw stoppers for bottles.
11810. Day, C. A. ..... Locks (*Cole*).
14248. Hudson, F. ..... Rollers for castors.
14422. Newman, G. F. ..... Door springs.
14432. Walker, J. ..... Gas lamps.
15251. Sperry, C. ..... Indicating the speed of and distance run by a vessel.
15254. Clarke, S. ..... Lamps.
15811. Watson, G. ..... Hydraulic gas valve.
15861. Braime, T. F. ..... Oil cans.
16856. Caldwell & Turner ... Fasteners for belts and driving bands.
17694. Dehany, G. E. ..... Extinguisher for lamps.
2206. Aynsley, J., & others.... Ovens for baking or firing pottery ware.
2422. Hargrave, F. ..... Rocket signalling at sea.
2607. Dobbs, C. J. ..... Annealing kilns for slag blocks.
4641. Greene, P. R., & others. Cores for tubes.
5030. Newton, P. A. ..... Cock for conduit pipes (*Christophersen*).
5063. Kilsby, W. ..... Lamps.
5068. Tautz, F. G., & others... Manufacturer of hats, caps, and gloves.
5106. Disturnal, T. J. ..... Apparatus for heating & drying.
5323. Erckel & Englehardt. Sharpening scythes.
5439. Ashberry, P. ..... Sheep shears.
5440. Bennett, J. F., & others. Compasses.
5472. Colley, A. ..... Cleaning the chamber of Martini-Henry rifles.
5635. Bariquand, L. F. J., and others ..... Clipping or shearing instruments
5689. Swallow & Proctor ... Artificial fuel.
5703. Newton, P. A. ..... Watches (*The Ansonia Clock Co.*).
5735. Lake, H. H. ..... Separating grease from steam (*Lowdon*).
5736. Hogg & Hogg ..... Spindles.
6285. Born, P. ..... Apparatus for producing jets of spray (*Schmid*).

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 12th February, 1888, inclusive.)

Year 1884.

2788, 2789, 2790, 2793, 2794, 2795, 2799, 2801, 2802, 2804, 2805, 2806, 2807, 2809, 2810, 2813, 2814, 2815, 2816, 2818, 2820, 2822, 2823, 2824, 2832, 2835, 2838, 2839, 2840, 2841, 2842, 2844, 2845, 2846, 2847, 2849, 2851, 2852, 2854, 2855, 2857, 2860, 2861, 2863, 2864, 2866, 2867, 2869, 2871, 2872, 2875, 2878, 2879, 2881, 2885, 2887, 2891, 2893, 2894, 2896, 2899, 2900, 2903, 2904, 2906, 2907, 2908, 2909, 2913, 2926, 2932, 2933, 2934, 2935, 2936, 2937, 2938, 2945, 2946, 2947, 2950, 2951, 2953, 2955, 2956, 2957, 2959, 2960, 2961, 2968, 2969, 2970, 2973, 2975, 2977, 2978, 2980, 2981, 2983, 2988, 2993, 2999, 3002, 3003, 3005, 3011, 3012, 3014, 3015, 3020, 3023, 3024, 3026, 3027, 3028, 3030, 3032, 3035, 3036, 3039, 3043, 3049, 3052, 3054, 3058, 3061, 3062, 3064, 3065, 3083, 3084, 3086, 3088, 3089, 3092, 3093, 3094, 3096, 3105, 3106, 3113, 3115, 3117, 3119, 3120, 3124, 3129, 3132, 3133, 3134, 3135, 3138, 3141, 3142, 3143, 3145, 3146, 3147, 3149, 3152, 3153, 3156, 3159, 3160, 3164, 3167, 3168, 3169, 3174, 12176.

Year 1883.

637, 638, 651, 657, 658, 686, 689, 690, 697, 700, 706, 711, 752, 756, 758, 763.

Year 1882.

574, 604, 658.

Year 1881.

546, 591, 601, 613.

Year 1880.

521, 554, 601, 606.

Year 1879.

551, 563.

Year 1878.

548.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Turntables for Overhead Rails.—*A. Goodwin & A. Goodwin jun., London.*—Fig. 1 shows a vertical section and elevation, and Fig. 2 a section through two different planes. A is a table or plate arranged to revolve on anti-friction balls B, which are supported on an annular plate C. This plate is fixed to the four adjacent ends of the two pairs of girders G and G¹, which form the two lines of way arranged at right angles to each

Fig. 1.

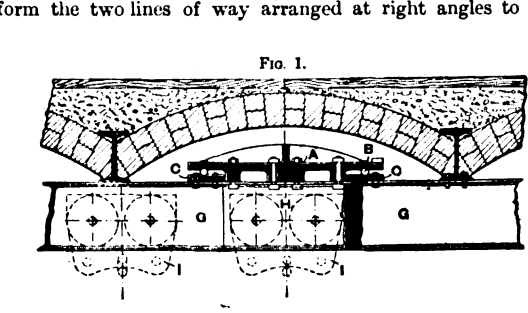
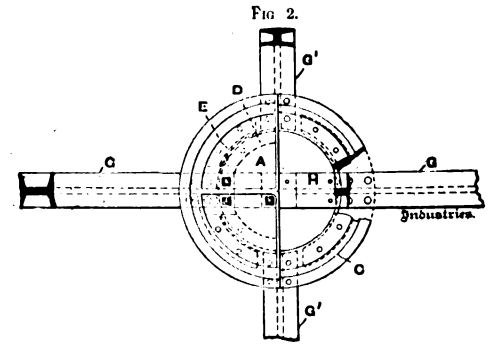


Fig 2.



other. The length of way H is secured to the under side of the table A, in combination with which it constitutes a turntable. It is of such a length as to fill the space between the adjacent ends of each pair of girders. The plates D project downwards, and are arranged so as to block that line of way for which the turntable is not set. The plates E are fixed to the under side of the annular plate C, and project downwards so as to serve as guards to prevent the vehicle leaving the length of way H during the rotation of the turntable. A catch lever is pivoted to one of the girders; one of its arms is weighted, and is adapted to fit into one or other of four slots formed in the table A, and a chain is secured to the other end of the lever to enable it to be raised out of the slots. By this arrangement the turntable may be locked while the vehicle is being run on to it. Four claims are made.—No. 9962. July 16th, 1887. 8*d*.

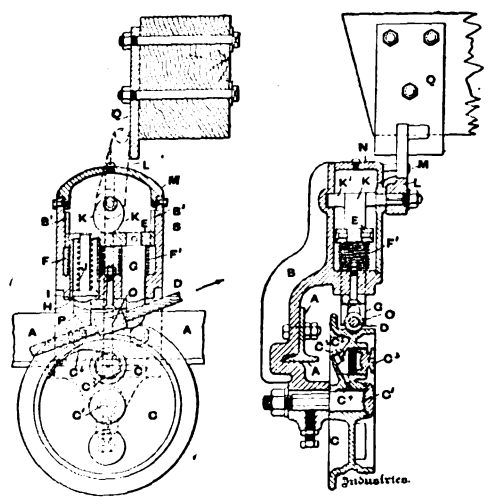
Utilising Scrap Iron.—*J. Gilligan, Abertillery, Monmouthshire.*—This invention relates to the working up of scrap iron and steel in a puddling furnace, by balling it up in the molten metal in the furnace before the stage of full boil has been reached. In carrying out this method, the scrap is introduced in bundles into the furnace, and is moved about the bed until a sufficient amount of puddled iron has adhered to it; the balls are then ready for the hammer. As scrap iron or steel readily unites in any proportion with puddled iron, any quality of

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metal may be used in this process, according to the quality required for the finished material. The scraps are thrown in and balled, without any loss in yield to the metal in the furnace, owing to the metal in the puddling furnace being coated with slag. The inventor claims the method of working up scrap iron and steel by balling it up in molten metal in a puddling furnace before the metal is on the boil.—No. 11868. September 1st, 1887. 4*d*.

CLUTCH.—*W. Sisson, Falmouth.*—The object of this invention is to enable the interlocking clutches to be engaged and disengaged freely without the usual shock and consequent wear and tear of the parts, which is caused by their sudden engagement at a high speed. The clutch handle, in addition to actuating the clutch, is also made to control the motive power of the machine, so that before the clutches can be either engaged or disengaged the motion of the machine is arrested to a greater or less extent. Immediately after engagement the handle is moved back into its original position, and the former conditions of the machine are re-established. The manner in which this reduction of the speed of the engine is accomplished may be varied; but the inventor prefers to use a mechanism by which the steam supply is shut off or reduced when the handle is turned, so that the speed of revolution becomes sufficiently slow for the purpose before the handle can be further turned in order to bring the clutch mechanism into operation. The inventor claims the arrangement of mechanism whereby high speed clutches can be disengaged and engaged while the machine is running slowly, and the arrangement by means of which the same handle serves to perform the series of operations required. —No. 7296. May 19th, 1887. 8*d*.

TELPHERAGE.—*H. H. Lake, London.* (*T. Otto, Schkenditz, Germany.*)—Improvements are here introduced into the method of coupling the trucks to the hauling ropes of wire ways or elevated railways. The claw grip illustrated in the accompanying figure may be advantageously used on steep gradients. A is the cross bar of the suspension frame for the buckets, and B is a casting which is firmly attached to the cross bar; the roller C is supported on a spindle C^1 and acts as a guide for the hauling rope D when the bucket is uncoupled from the rope. For the purposes of lubricating the spindle, a recess C^2 is formed in the wheel; the oil is held in its place by the screwed plug C^3, which is prevented from shaking loose by means of the ratchet teeth C^7 and the spring C^6. The cross head E is supported by the springs F F^1, and may be moved vertically in the guides B^1; to



the lower side of the cross head is attached a forked gripper G and a sleeve H; the sleeve also carries another gripper I, which is constantly pressed against an inwardly projecting flange on the lower end of the sleeve by means of a spring J. An eccentric K is attached to a spindle K^1, and has a projecting extremity upon which is fixed an arm L. In coupling a truck to the rope, the latter is first placed upon the roller C, and then the cross head E is lowered by turning the lever L; the grippers G and I are thus caused to engage with the rope. The travel of the lever is limited by the stop M. When one of the carrier collars O, which are placed at various points along the rope, approaches the gripping apparatus, while the rope is in motion, the collar presses against the inclined surface P of the gripper I, thus lifting the gripper and striking against the other gripper G. As soon as the collar has passed the first gripper I, the latter is forced down by the spring J and the coupling operation is complete. In order to stop the buckets at any point of the line, it is necessary to release the grippers G and I; the lever L strikes against the fixed plate Q, which is placed in the position where it is desired that the buckets shall be released, and is forced back; the eccentric K is turned, whereupon the springs F F^1 raise the cross head E and with it the grippers G and I to a sufficient height to allow the hauling rope and the carrier collar to pass freely between the grippers and the roller C. Seven claims are made for the coupling device, for the construction of the collar, and for an arrangement of the truck frame.—No. 7507. May 23rd, 1887. 11*d*.

EDGE PLANING MACHINES.—*J. Barrow, Johnstone, Renfrew.*—In edge planing machines it is found that the strain on the tool, when cutting the plate, causes the saddle to twist sideways on the bed and the tool to dig into the work. In order to eliminate this disadvantage, the inventor so arranges the sides of the bed that the pressure of the cut upon the saddle tends to release the tool instead of causing it to dig into the work. The bed is provided with slides, which are arranged inside instead of outside, and into which the saddle is fitted, so that when the saddle twists sideways the tool is released. The slides are nearly square to the face of the bed, and any lifting action that the tool may give to the saddle is prevented by a square slide on the outside of the bed; the saddle is clear of this slide at the edge, and is fitted only at the under part of the projection of the same slide. There are two claims.—No. 651. January 16th, 1887. 11*d*.

GRAIN GRINDING MILLS.—*H. H. Lake, London.* (*H. H. Coles, Philadelphia.*)—Fig. 1 represents a central vertical section of a grinding mill embodying this invention, and Figs. 2, 3, 4 show detailed views of parts. A represents the frame, and B the driving shaft. The runner D is secured to the shaft B, and the bed E is secured to the frame A. The casing F contains the runner and bed, and is extended laterally for the purpose of supporting the hopper H. The shaft B has a sliding motion on its bearings; between it and the bearing C is a coiled spring K, whose effect is to force the runner from the bed. In order to force the runner towards the bed, a ring L is employed, whose interior is threaded and engages with a threaded sleeve M encircling the shaft B. The ring is placed between the bearings C and an arm N, whose lower portion is in the form of a boss N^1, and whose upper part is attached to the outer wall of the

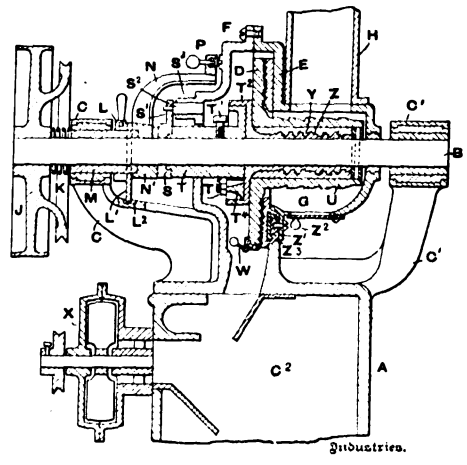


FIG. 1.

casing F by means of a spring pressed pin P. The side of the boss N^1 opposite to the ring L has a cam projection Q, which is in contact with the cam R of a sleeve S. Contiguous to the sleeve S is a sleeve T, which is secured to the shaft B by a bolt T^1. The sleeve S is prevented from rotating by means of the arm S^1 projecting from the sleeve, and is freely connected with a pin S^2, which slides in a bearing S^3 on the wall of the casing F. When L is turned on the sleeve M so as to be moved towards the lever N, it is pressed against the lever, the boss N^1, the sleeve S, and the sleeve T, whereby the shaft B is moved away from the pulley, thus causing the runner to move towards the bed. By these arrangements the mill may be adjusted for fine or coarse grinding. If any obstruction enters between the

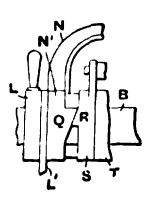


FIG. 2.

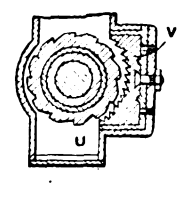


FIG. 3.

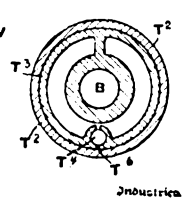
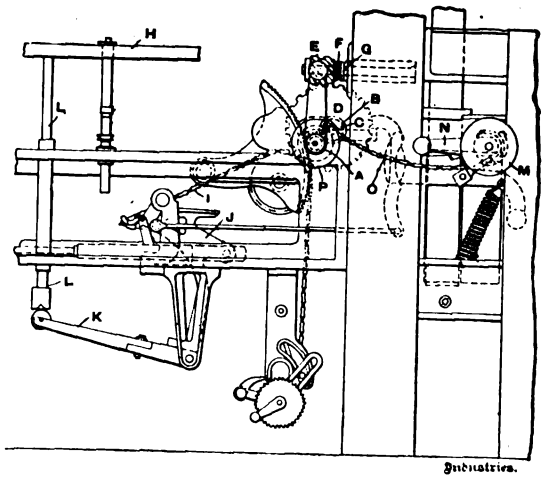


FIG. 4.

runner and the bed, its removal is accomplished by releasing the pin P and rotating the lever N; the wide part of the cam of the boss N^1 thus leaves the similar cam on S, and the spring K exerts its pressure on the shaft B, and quickly removes the runner from the bed to allow the obstruction to escape. The runner has a tubular toothed extension U, which fits with a toothed concave V. In the part G of the apparatus, the grain is primarily broken before it is treated by the runner and bed. The runner is secured to the shaft by means of the rim T^2 connected with the runner, and encloses a split collar T^3, which is formed with the sleeve T. At the ends of the collar T^3 is a conical plug T^4, which has its outer end threaded for engagement with the nut T^5. The degree of expansive action of the plug may thus be regulated. A pin T^6 prevents the rotation of the plug. When the plug T^4 is properly tightened against the ends of the collar T^3, the rim T^2 and the collar are firmly connected, and the power of the shaft is imparted to the rim and runner. A filling of soft metal Z is interposed between the sleeve Y and the runner. The bed is secured to the frame by the dovetailed lugs Z^1. Eighteen claims are made for these various improvements in the adjustments of the various parts.—No. 17798. December 27th, 1887. 8*d*.

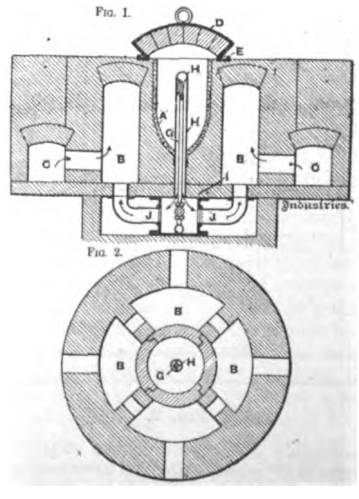
NEWSPAPER PRINTING MACHINERY.—*J. H. Sedgwick, Wolverhampton.*—The object of this invention is to enable late news, such as the result of a race, to be introduced into the stereo forme of a newspaper printing machine at the very last moment before going to press. A box is adapted to fit and to be retained in an aperture provided for its reception in the forme. The frame of the box is bevelled externally to fit the undercut sides of the aperture in the stereo, and is curved to conform with the curvature of the cylinder. The grooved type holders are bevelled at one end and rebated at the other, and they take under the corresponding ends of the box. To enable them to be inserted after the stereo has been fixed on the cylinder, a small gate is provided at one end of the box, and is closed by a spring latch. At the end of the box is a vertical slot, which contains a similar holder for the figures to be inserted opposite to the names of the horses; this type holder is bevelled or rebated at one end to engage with the end of its slot, and is locked in place at the other end by a lever latch, which is itself kept securely locked by the end of one of the adjacent horizontal type holders taking under the tail end of the lever. Three claims are made.—No. 2862. February 25th, 1888. 8*d*.

RING SPINNING AND DOUBLING FRAMES.—*J. Edge, Wigan, and E. Tweedale, Accrington.*—The mechanism here described is designed to insure the automatic lowering of the ring rail just before the "knocking off" takes place. A carrier wheel gears with the teeth on the quadrant lever, and with a pinion on



the end of a cross shaft. On the other end of the cross shaft is a worm wheel engaging with a worm, whose boss forms one half of a clutch box; the worm is loose on the stud, and the other half of the clutch box is formed by the end of the collar of the roller gear. The teeth of the quadrant gear with the pinion A, which gears with the pinion B on the cross shaft C. The worm wheel D is also on the shaft C, and the worm E is loose on the shaft of the ordinary carrier connected with the gear for driving the front roller. The inner boss of the worm E forms one half of the clutch F, whose corresponding half G is fast on the shaft of the carrier. Directly the quadrant is released its teeth turn the wheels A B D, and consequently one or more teeth of the wheel D press against the sides of the threads of the worm E, and slide the worm on its shaft and so engage the two parts of the clutch; as the part G is fast to its axis, the further descent of the quadrant is arrested. The ring rail H and the connections I J K L are regulated and controlled by the motion of the wheel on the axis of the carrier connected with the gear for driving the front roller; and as the latter gear is gradually brought to a state of rest by the knocking off motion and by the transfer of the driving strap from the fast to the loose pulley, it follows that the quadrant and its connections and the ring rail will be automatically and quietly eased down. The pulley M on the axle of the setting lever N is connected by a chain O with a similar pulley P on the axle of the wheel A, and insures the simultaneous movement of the strap fork and the segment lever. The inventors claim the parts A B C D E F G put in operation through the quadrant, and controlled by the wheel on the shaft of the ordinary carrier connected with the gear for driving the front roller.—No. 7233. May 18th, 1887. 8*d*.

CASTING METALS.—*B. H. Thwaite, Liverpool.*—The essential feature of this invention is the cooling of the metal from the centre to the outside. The object of this reversal of the usual order is to allow the enclosed gases to escape from the inside of the metal. Previously to pouring the metal into the mould, a cooling tube is placed exactly in its centre, and in such a position that the absorption of heat from the mass is uniform. The cooling tube is placed inside another of slightly greater diameter, the latter tube serving for the escape of the cooling fluid. The application of this method to the casting of projectiles is illustrated in the accompanying figures. The mould A is surrounded



by a gas combustion flue B, which is supplied with fuel from the flue C, and over the mould is placed a cover D which rests on a recess E. The inner pipe G supplies the cooling medium, which consists of either refrigerated air, oil, steam, or water; and the annular space between the pipes G and H allows the return of the fluid. If air is the refrigerating medium, it is afterwards utilised to support the combustion of the gaseous fuel, and for that purpose it is led through the connecting flues J into the flue B. The cooling pipe H is made of the same quality of steel

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as is used for the projectile, and is fixed in a central orifice I by means of a screw thread. The hollow which is left in the projectile in consequence of the hollow tube H is afterwards filled up with a fine steel plug and cap. If, however, it is desired that the cooling pipe H shall not form part of the projectile, the pipe H may be surrounded with some woody fibre, which will become charred when the metal is poured into the mould; the same object may be also attained by making the pipe of silicious or other refractory material. Four claims are made.—No. 6058. April 26th, 1887. 8*d*.

ELECTRICITY.

Dynamos.—*A. M. Clark, London.* (*L. Maiche, Paris.*)—In the machines designed by the inventor, both the armature coils and the field magnets are fixed and do not revolve, and the development of the induction currents in the coil is due to the motion of an iron armature core, which passes freely through the coil, and is presented alternately to the different poles of the field magnets. The mass of the revolving parts is thus reduced, and

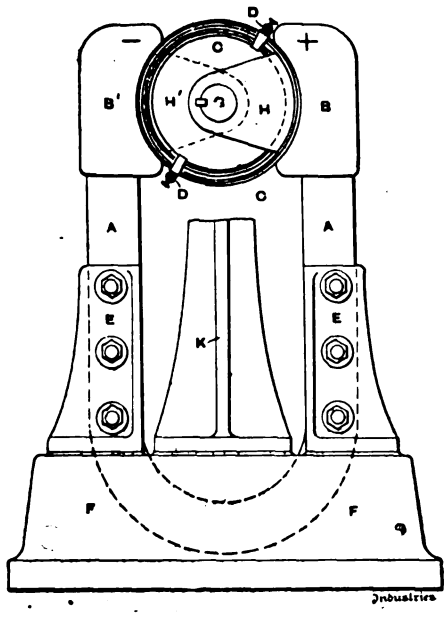


Fig. 1.

there is no need for any special appliances for collecting the currents. The accompanying figures show the application of this principle to a two-pole machine. A is a permanent magnet provided with pole pieces B B¹, whose interior faces are concaved so as to closely embrace the armature coil C. The permanent magnet is mounted on supports E, and the armature coil is traversed by an iron shaft G, upon which are keyed the sector-shaped blocks of iron H H¹. The successive changes of polarity of the shaft G and its appendages, when they are rotated by means of the drum I, will have the effect of inducing currents in the coil C. The permanent magnet may be replaced

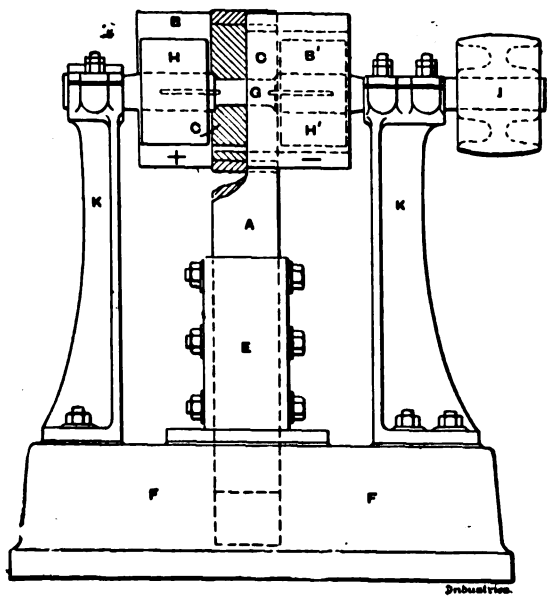


Fig. 2.

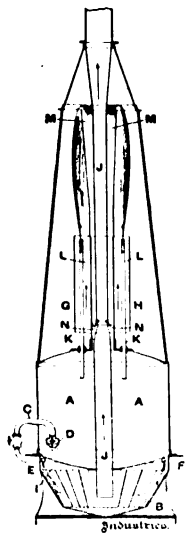
by an electromagnet if desired, and the shaft may be fixed while the blocks H H¹ constituting the armature proper rotate; in the latter case the shaft G is made hollow, and is traversed by another shaft which carries the two blocks. In order to avoid the creation of Foucault currents in the armature, the core and the blocks H H¹ are slit in any plane passing through the axis. When electromagnets are used to excite the field, it is essential that the current should be rectified. For this purpose a circuit is led from the terminals of the machine, and carried to the two extremities of the wires of the field magnets. A voltaic cell is introduced into this circuit, and is composed of a strip of copper and a strip of aluminium immersed in acidulated water; such a cell permits the passage of currents in one direction only. Two claims are made for the machine in which both the field magnets and armature coil are stationary, and the current generated by the motion of an iron core traversing the armature coil and moving in the magnetic field, and for the method of exciting the field electromagnets by rectifying a portion of the current.—No. 5958. April 23rd, 1887. 8*d*.

Secondary Batteries.—*E. Julien, Brussels.*—The electrodes are made of metallic inoxidisable plates which form the supports for the active matter. The component elements of the alloy used in making the plates consist of ninety-four parts of lead, four and a half of antimony, and one and a half of mercury. To the liquid generally used the inventor adds a variable quantity of sulphate of magnesia in order to increase the efficiency of the pile. In each element the electrodes of the same kind are connected by means of a conductor of the same alloy as is used in the construction of the plates, but its composition is slightly altered in order to increase its rigidity; and in a battery the elements are connected by similar conductors. Sixteen claims are made.—No. 8855. June 20th, 1887. 11*d*.

MISCELLANEOUS.

Dust Collectors.—*W. P. Thompson, Liverpool.* (*The Knickerbocker Company, Jackson, Michigan, U.S.A.*)—The air laden with dust or shavings is propelled through a carrying tube by means of an ordinary fan, and conveyed to a wedge-shaped box. The current of air enters at the broad end of the box, and at the narrow end there is an opening into a closed dust box; the upper side of the box is provided with deflecting plates, and with an exit pipe for the purified air. The contraction of the passage due to the wedge shape of the box causes the current to increase in velocity; the suspended dust is therefore shot into the closed receptacle. Six claims are made.—No. 2656. February 22nd, 1888. 8*d*.

Hydrocarbon Lamp.—*B. H. Thwaite, Liverpool.*—The liquid hydrocarbon is forced out in a jet, by means of a current of air or steam which has been heated in a regenerative chamber above the flame. The heated air is also used for the combustion of the oil. One form of apparatus described in the specification for carrying out this method is shown in the accompanying figure. The liquid hydrocarbon in the vessel A is volatilised by the combustion of part of the oil in a cone-shaped combustion chamber B, which has a corrugated side, and is provided with slitted air



openings. The oil, which is syphoned from A by means of the pipe C, flows along a circular distributing pipe I, and streams through perforations in its lower side on to the side of the combustion chamber and down its corrugations. The air to support its combustion enters through the air spaces between the corrugations, and the products of combustion pass through the centre by means of the chimney J. The combustion of the oil generates heat, and soon volatilises the liquid hydrocarbon, and the resulting oil gas passes through the burner tubes K. The tubes are surrounded by an annular space L through which the air ascends. The flame projects to the upper edge of the annular space L, and descends through this space to the position N, where it is drawn into the chimney by aspiration. Two claims are made for the various modifications described.—No 6652. May 6th, 1887. 8*d*.

Measuring and Controlling the Supply of Water.—*O. Brown, London.*—This invention relates to the apparatus described in Patent No. 13228 of 1886. A measuring vessel constructed according to the improved method is formed of sheet metal, and consists of three parts, viz., a central division plate and two body pieces, which form the sides and bottom of the compartments. For regulating the escape of water temporarily confined beneath the loaded compartment, the space between the floor of the tray and the bottom edge of the central plate is varied. By reducing the knife edges the oscillating measuring vessel is lowered in the tray, and the bottom edge of the central plate is brought nearer to its floor; the passage for the water from one end to the other of the tray is thus restricted and the action of the apparatus regulated. By lowering the measuring vessel the angle of oscillation is diminished, and a smaller amount of water serves to overbalance it. For the purpose of cushioning the loaded compartment in its fall, each compartment may be provided with a false bottom open at the sides and closed at centre; when the charged compartment falls, air is temporarily confined between the under side of the compartment and the false bottom. In order to allow the counter to be changed readily, the inventor employs a fork-shaped clip whose loop engages with a rod operating the counter and whose arms embrace the central division plate of the oscillating measuring vessel. To keep the supply orifice free from obstruction, the supply nozzle is placed vertically, and is provided with a valve seat at its upper extremity. To the valve, which rests upon the seat, is attached a pendant wire extending downwards through the supply passage. When the valve is lifted the wire is raised, and tends by its movement to free the passages from any accumulation of dirt. Seven claims are made—for the false bottom, for the variation of the angle of oscillation, for the means of detaching the counter, and for the pendant wire.—No. 8632. June 15th, 1887. 8*d*.

Cleaning Carding Engines.—*C. de Hemptinne & F. de Hemptinne, Ghent, Belgium.*—The object of this invention is to clean the cards by mechanical means instead of by hand. A friction wheel is turned by contact with the loose pulley on the shaft of the main drum, and on the shaft of the friction wheel is fixed an eccentric, which by means of a bent lever transmits a rocking motion to a crank; on the crank is keyed the spindle of a vibrating comb, which acts upon the card cloth in the same way as the hand cleaners. By means of mitre and worm gearing the shaft of the drum is caused to rotate slowly during the cleaning process. A vertical screw threaded rod is passed through the support which carries the whole of the above described gearing, and a hand wheel is fixed to its upper end. The rotation of this hand wheel is transmitted by suitable gearing to two spur wheels, which gear with two toothed segments moving in grooves and carrying a sliding panel of the outer casing of the main drum. On one of these two shafts a spur wheel is fixed, which gears with a pinion on whose shaft is mounted another spur pinion gearing with a vertical rack. On this rack is fixed a laterally projecting pin which, when the rack is lifted, raises the lever and disengages the latter from the lever of the comb. On turning the hand wheel the friction wheel is removed from contact with the loose pulley on the shaft of the drum, while the pin of the vertical rack lifts the bent lever and disengages it from the lever of the comb. Three claims are made.—No. 8422. June 11th, 1887. 8*d*.

GERMAN PATENT ABSTRACTS.

Pipe Coupling.—*M. Schleifer, Berlin.*—This invention relates to a pipe connection which allows the pipes to be slewed through a complete circle. The pipe A is provided with a socket C, into which the ring shaped end E of the pipe B fits. The ring E may either be cast in one piece (Fig. 1) with B, or cast separately

Fig. 1.

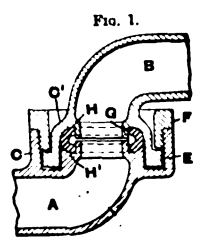
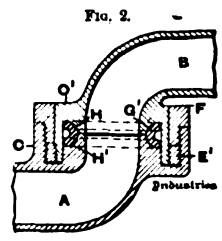


Fig. 2.



and screwed on to B (Fig. 2). After inserting an india-rubber packing G (Fig. 1), if the pressure in the pipes exceeds the outside pressure, or G_1 (Fig. 2) in the reverse case, into recesses H H¹ in A and B respectively, a ring F is screwed into the socket, thereby pressing E downwards and completing the joint.—No. 42518. 6th February, 1887.

Filters.—*H. A. Flebbe, Bergedorf.*—This invention relates to a filter for lubricants. The apparatus consists of a cylinder surrounded by a steam or hot water jacket, and provided with four filters shown in Fig. 1. These filters are secured to the

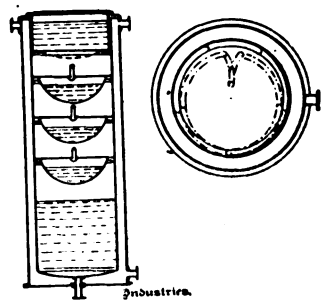


Fig. 1. Fig. 2.

cylinder by expanding rings shown in Fig. 2, and this arrangement allows the filters to be exchanged and cleaned. The lubricant, which is kept liquid by the heat of the steam jacket, penetrates the four filters in succession, and is collected in the bottom of the cylinder.—No. 42306. 24th March, 1887.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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DUCRETET'S OIL FILTER FOR GAS ENGINES.

Gas engines are generally lubricated too abundantly, especially if it be necessary for the attendant to leave the engine for a longer or shorter time without supervision, in which case he prefers to arrange for an excessive supply of oil rather than run the risk of a breakdown owing to insufficient lubrication. In consequence of this state of things, the quantity of oil which passes through the engine is far greater than that required to insure all the bearing surfaces remaining in good condition, and it becomes a matter of importance to be able to use the oil over again. This, however, cannot be done without careful filtration, and for this purpose M. E. Ducretet, of 75, Rue Claude Bernard, Paris, has devised a special apparatus to be attached to gas engines, in which the oil coming from the cylinder is filtered hot. The manner in which the apparatus is attached to the engine will be seen from Fig. 2, where C represents the cylinder of the gas engine, and G G the exhaust pipe round which is placed the filter. The used oil is poured into the funnel at the top until a drop of oil appears at the spout *e*, showing that the filter is full, and the filtered oil is drawn off through an ordinary stop cock into a can beneath. The details of this apparatus will be understood by reference to Fig. 1. By placing the filter round the exhaust pipe, the heat of the escaping gases is utilised to raise the temperature of the oil under treatment, which greatly facilitates the process. The filter itself is contained within an outer vessel coated on the outside with some non-conducting covering. This outer vessel is traversed by a tube T, and forms an oil bath, the tube having for its object partly to render the vessel independent of the exhaust pipe, and partly to prevent the oil in the bath from being injured by the excessive heat of the exhaust tube. The filter consists of a cylindrical vessel, having the spout *e* already mentioned and a loose cover P which can be screwed down by the thumb nuts *b*, so as to compress more or less, by means of a hollow central tube and perforated plate, the filtering medium M, which is generally composed of compressed cotton. The grosser impurities are retained by the perforated plates *r*. The oil from the bath can be drawn off by the plug *d*, and a vent hole *o* is provided at the top to allow for expansion. We learn from the inventor that one of these filters has been in constant use at his own works during the last nine months, and has resulted in a great saving of oil.

PROFILING MACHINES.

In carrying out the various functions of milling or machining metallic surfaces by a rotary cutter, profiling or milling with the aid of a "former" has not played such an important part in modern workshop practice as its merits seem to deserve. This arises from various causes: (1) A disinclination to discard existing practice and obsolete methods; (2) a conservatism on the part of the mechanic in the matter of working with labour saving machines; (3) a fallacious idea that a multiplicity of the same work can only render such machines profitable.

At no period in this country has the necessity arisen for the substitution of machine for hand labour more than at the present time, as competition is extremely keen in every branch of engineering, and our foreign competitors have certain advantages: among others their longer working hours. It is therefore incumbent upon those who undertake the practical management of workshops to use every means they can to minimise the cost of manufacture of the details of the various machines, and be fully alive to the improved methods of working which a perusal of the leading mechanical journals generally affords. It is astonishing to find the pertinacity with which men will cling to the use of machine tools made forty years ago or longer for machining irregular shaped objects. A general opinion held by a great many skilled workmen is that improved methods of working lead to over-production; but it is only by the systematic removal of obsolete machine tools, that long standing firms have been enabled to keep up their past reputation, and compete with younger firms who have an installation of modern tools.

As regards the application of the profiling machine to ordinary machine shop work in which planing, shaping, and slotting machines are now generally used, we may state that much misconception exists as to its advantages, as some think it a machine much overrated by its makers, and, therefore, it becomes difficult to induce many engineers to overcome their prepossessions and substitute profiling or milling machines where their work will well admit of it. A profiling machine is at its best where a multiplicity of the same work is operated upon; but even taken under its worst conditions—for instance, machining straight flat surfaces—the cost of production is much cheapened; but where the work is irregular a still more favourable result is produced. One important condition that a labour saving machine should fulfil is that little or no hand labour should be requisite after the object is machined, and no machine fulfils this better than the machine under notice. A rigidly constructed profile machine, with a cutter of proper form and running at the proper speed, will impart a surface which requires no file finish, with great economy of production. It will, we think, be conceded by those who have had experience in this direction, that far less mechanical skill is required in operating profiling machines than slotting or shaping machines. The cutters used, of course, require skilled labour in their production and maintenance; but then one man can attend to these for a number of machines producing high class work with low priced labour. There are one or two features in the design of the profiling machine, when applied to some branches of engineering, which require some modification. For instance, in a heavy class of milling or profiling it is advantageous to dispense, as far as possible, with gearing for driving the cutter spindle, and substitute large driving pulleys with a good width of belt; for by this means a far cleaner cut is produced, and one that requires little or no labour upon it after leaving the machine. Of course, very heavy machines will require to be geared; but any device which provides an efficient substitute does much to insure its success as an efficient labour saving machine—better, in fact, than all cut gears or other refinements of manufacture. The framing of machines of this type should also be constructed with plenty of metal to increase their rigidity, and prevent vibration as much as possible. The circular, longitudinal, and transverse tables should all be capable of manipulation from one point, so that the operator may have complete control over them. They should run upon square ways to reduce the friction, and have water troughs formed around them, and an effective drain for the lubricant used. An important feature is an efficient means of lubrication for the milling cutter; for upon this the success, when taking a heavy, rough cut, in a great measure depends. Many machine tool makers employ a small centrifugal pump, which draws its supply from a well contained in the frame of the machine, and into which the lubricant from the tables is drained. This pump must necessarily be driven at a high rate of speed to maintain an efficient head, and is often a source of trouble to the operator. A more effective arrangement, we think, is a small force pump, supplying a tank fixed at a convenient height above the machine; for by this means a pressure may be obtained sufficient to keep the cutter perfectly cool, and effectually remove the cuttings or dirt. There seems to be some diversity of opinion regarding the design of a profiling machine for doing heavy work in connection with its spindle bearings. It is thought by some machine tool makers that the perfect alignment of a spindle can only be properly effected by adjustable cone bushes, with lock nuts. On the other hand, others contend that a parallel bearing with ordinary brasses is equally effective. It is not our present object to discuss the merits or demerits of each system; but in deciding the claims of one or the other, the class of work to be machined should be taken into consideration. In heavy milling it has been found desirable to adopt a large diameter bearing at the nose end of the spindle, with a length about double that of the diameter. In such cases this bearing is made parallel as well as that at the tail end, which is backed up by a hardened steel tail pin to receive the end thrust. Bearings of this kind are more adapted for end milling than those in which the spindle is coned and adjusted by means of taper bushes and lock nuts. Very little trouble is given by this class of bearing, whereas with cone bearings it is sometimes otherwise. An effective attachment now usually supplied with heavy machines is an additional outer bearing for the spindle, which is made portable, and can be readily detached when the cutters require removal. Of the various types of smaller profiling machines, the vertical single spindle type is generally useful because of its wide application. In this machine the spindle is carried on a frame, sliding on guides affixed to two vertical standards. This frame is moved in a horizontal plane by a lever moved by the operator. The table for holding the work moves in the same plane, but in a longitudinal direction, and is operated by a hand wheel at the side of the machine. It is important in this type to have the spindle frame easy of movement, and yet quite free from slackness. The table is generally moved by means of a rack and pinion, the pinion being built up of two discs, connected together with an arrangement for adjustment to prevent back lash between the rack and pinion. The bearings in this type are generally made with cone bushes, as end milling is rarely required. The spindle is usually of wrought iron case hardened, coned for each bearing, and arranged to run in hardened steel bushes, which are set up with lock nuts. This is a somewhat expensive machine to make; but a bearing of this kind is very durable and easy of running. In almost every case for which this machine is adopted, a former or copy piece of the object milled is usually employed. If the number of the objects to be machined will allow of it, this former is fixed to the table along with the work to be operated upon; and a tracer pin, arranged at a convenient distance from the cutter and carried in the same frame, is either held against the former by means

DUCRETET'S OIL FILTER FOR GAS ENGINES.

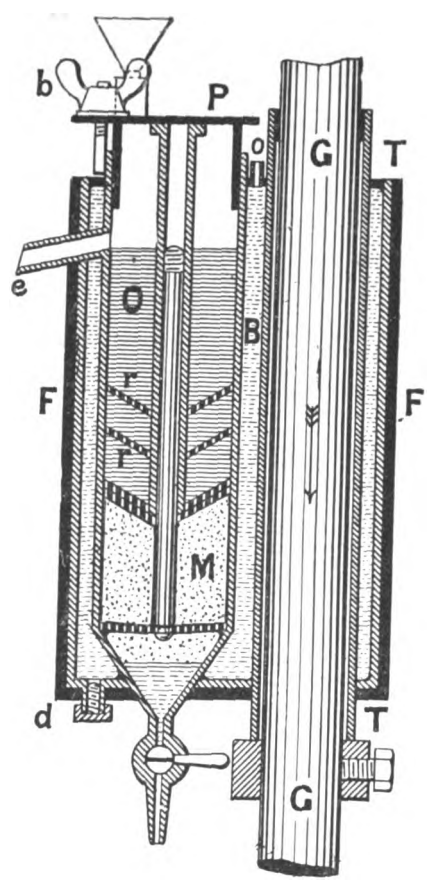


Fig. 1.

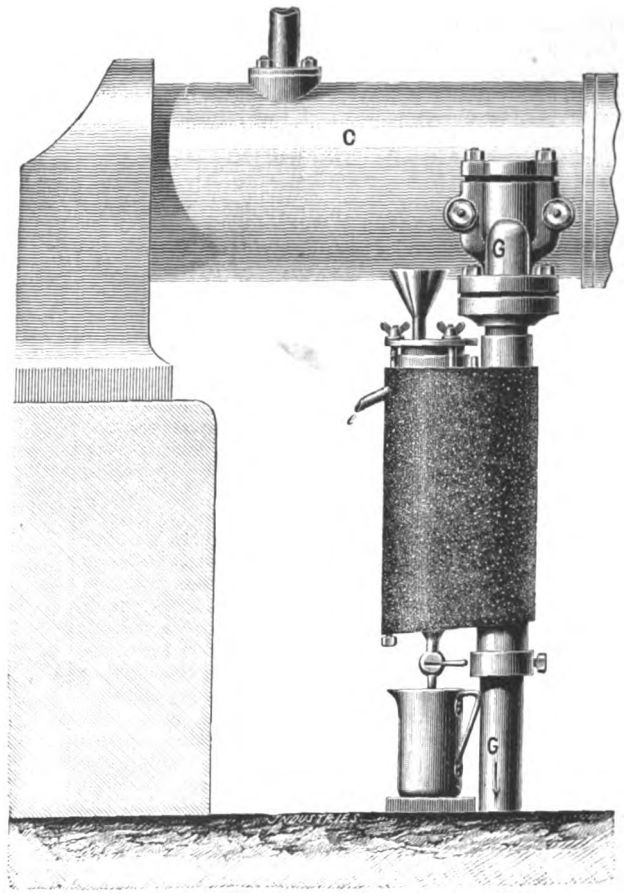


Fig. 2.

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of a suspended weight in the frame or by the operator; so that by the combined movement any object, however irregular in one plane, can by the aid of the former be effectually milled. The tracer pin is usually made taper, so that any reduction in the diameter of the milling cutter, due to wear or sharpening, is allowed for by the vertical adjustment of the tracer pin. There is a limit, however, to the utility of this type of machine for general purposes, as the object milled and the former or copy necessarily limit the table space, and confine the machine to a small class of work. This has been obviated in some measure by placing the former directly over the work milled, and by using the cutter spindle as a tracer pin.

We may now briefly refer to milling cutters, as the care exercised in their production is so essential to the success of profiling machines. There is perhaps no branch of workshop practice in which false economy is better shown, than in placing the manufacture and maintenance of cutters into the hands of unskilful workmen. It is difficult to lay down any hard and fast rule for hardening and tempering cutters, as it is only by long experience that success is attained. Many workmen favour the use of the lead bath for hardening—as they assert that there is less liability of the cutter springing—which is generally used in combination with tepid water having a film of oil on the top of it. On the other hand, some prefer a good clear fire, and a bath of slightly warmed salt water. In the construction of plain cutters it is not advisable to make them of larger diameter than is sufficient for the work. The teeth should be fairly coarse, which renders them less liable to clog, and allows a quicker feed. It has long been considered good practice to have the teeth cut spirally, and in that way diminish the cutting contact along the surface when starting. A step marking a distinct advance in this method of cutting, and which is now adopted for heavy work, is that of cutting a coarse thread upon the periphery of the cutter. This gives greater freedom to the cuttings to get away. Various means are adopted for connecting the cutter to the machine spindle, and perhaps that most usually adopted is to turn the shank end parallel, and secure it by a set screw which is screwed into the nose of the spindle. This method is objectionable, however, as the cutter almost invariably runs out of truth. A superior arrangement, and one which more readily facilitates interchangeability, is to screw the nose of the spindle externally, and bore in it a hole with a large taper, and place therein three split dies. These receive the shank end of the cutter, and are held in position by an hexagonal cap nut, internally flanged at the lower end, and arranged to screw on the nose of the spindle.

THE TAY VIADUCT.

At the ordinary meeting of the Institution of Civil Engineers, held on the 8th ult., the first paper read was on "The Tay Viaduct, Dundee," by Mr. Peter Crawford Barlow, B.A., M.Inst.C.E. The author stated that this viaduct, which carries a double line of railway over the Firth of Tay at Dundee, was built to replace the former bridge, part of which was destroyed during the memorable storm of December 28th, 1879. The viaduct was 10,527ft. in length, and of this a length of 7397ft. was straight and parallel to the straight part of the old bridge, the centre lines of the two works being 60ft. apart. At the southern end the lines of railway branched westward towards St. Fort, and eastward towards Newport, the junction being made upon brick arching of sufficient width for two double lines of railway. The northern or Dundee end of the viaduct formed a curve of 21 chains radius, and joined the existing railway, which was here parallel to the river. The gradient of the line was 1 in 762, falling from the southern shore to the navigable channel, where four spans, each with a clear headway of 77ft. above high water spring tides, were provided, and from this point a down gradient of 1 in 113·75 was maintained to the northern end. Out of a total of eighty-five piers, the foundations of seventy-three were formed of a pair of cylinders placed from 32ft. to 26ft. apart from centre to centre. In the case of the largest spans, the cylinders, which were of wrought iron, were 16½ft. in diameter at their upper ends, and were enlarged by means of conical sides to a diameter of 23ft. at their bases. With these areas the total weight of the structure and rolling load combined produced a pressure of from 3 tons to 3½ tons per square foot upon the foundations. Special pontoons were constructed by Mr. Arrol, the contractor, for the purpose of affording a stationary platform from which to conduct the operations of sinking the cylinders to the required depth into the river bed—an illustrated description of these pontoons was given in *Industries*, Vol. II., page 525. The platforms, which carried all the necessary machinery—steam cranes, dredger, winch, concrete mixer, hydraulic and centrifugal pumps, diving gear, &c.—consisted of rectangular iron tanks, fitted at the four corners with cylindrical legs resting on the bed of the river, each leg having two hydraulic rams by means of which the platforms could be raised or lowered at will. In the centre portion of the platform, the surface of which was maintained at a height of about 2ft. above high water, two rectangular openings were provided to admit the cylinders in their respective positions. The cylinders were prepared on shore in annular divisions, of a size that could be easily handled and conveyed to the pontoons, where they were bolted together. The excavation was then proceeded with by dredging the sand from the interior, and, when necessary, additional weight in the form of cast iron blocks was added to force the cylinder down to the required depth. The whole was finally filled with concrete, composed of six parts of gravel and sand to one part of Portland cement, passed through the water in specially designed hopper boxes. The internal circumference of the cylinder had previously been lined with a ring of brick work 18in. thick, in order to add weight and stiffness during the sinking operations. The foundations were mainly upon sand, but at the shore ends rock and red clay were found. At this stage of the work, the cylinders being about 1ft. above low water, the pontoons, which admirably resisted the force of the gales so prevalent in this part of the Tay, were floated away to the site of the next pier. According to the requirements of the Act of Parliament, the foundations were tested with a weight 33 per cent. in excess of the possible dead and live loads combined, and for this purpose thirty thousand cast iron blocks, each weighing half a ton, were required. The result of these tests, which were personally checked by Major Marindin, R.E., on behalf of the Board of Trade, were very satisfactory, the greatest depression recorded being rather under 1¼in. for a ton per square foot. The whole of the seventy-three piers formed with cylinder foundations were subjected to this test, the aggregate weight representing 92,000 tons. The remaining piers on the north and south shores were of brick work, and adapted to the requirements of the situations in which they were placed. After testing, the piers were continued by brick cylindrical shafts filled with concrete, and to protect the brick work from the action of the tide during construction, the work was enclosed in temporary iron caissons. At 18in. above high water the two brick shafts were joined by a horizontal member of brick work and concrete resting on cast iron girders. This connecting piece was 7ft. deep, and carried at the lower part a string course of granite running round the pier. Upon each brick shaft an octagonal iron frame was secured by eight wrought iron tie bolts, each 2½in. in diameter and 20ft. in length, anchored down into the brick work by cast iron plates. These frames, which served to distribute the weight uniformly over the brick shafts, formed the base to which the superstructure of the pier was riveted. Maintaining the octagonal form, two hollow pillars were constructed of plates, stiffened by horizontal bracing internally, and by vertical T irons and channel irons externally, and were united at the top by a semi-circular arch. The mean stress upon the iron work of the piers was about 2 tons per square inch.

After a careful examination of the girders still remaining on the old bridge, it was decided to use them in the new viaduct, placing them on the outsides under the parapet, and adding to each span two new intermediate girders. To transfer the old girders to the new piers, special pontoons with telescopic columns, actuated by hydraulic rams, were used. The columns were adjusted to the under side of the span to be removed, the rising tide completed the lift, and the whole was floated across to the new piers, which were adjacent and opposite to the old ones; when in position the old girders served as a platform on which to run out the new girders. Rails having been laid on the top members of the old girders, the new ones were brought out on travellers designed for the purpose, and finally were lowered into their places by hydraulic power. The large girders forming the thirteen spans in the central portion of the river were built upon a staging near the south shore, and as each complete span was finished, it was floated on pontoons and landed upon the brick work portion of the piers already prepared to receive it. The entire span, weighing about 514 tons, was afterwards raised by hydraulic machinery to the full height, the superstructure of the piers being completed as the work proceeded. These girders, of which there were two to each span, were 245ft. in length, of "hog back" form, 20ft. high at the piers, and 29ft. high in the centre. They were connected by bracing 16ft. above the rails, and by flooring, which was built up of plates and channel irons, forming a corrugated decking 16in. deep. The flooring of the smaller spans of the viaduct was of a similar type; but instead of channel irons, single steel plates were pressed into a trough form, 8in. deep, with a length equal to the width of the viaduct, 25ft. 6in., and riveted to each other by a cover plate joint. Above the decking throughout the whole length of the viaduct, a parapet of lattice work was riveted to the outside girders, and between it and the rails timber guards were placed, hollowed out to receive on one side a 9in. water pipe, and on the other a gas pipe and telegraph wires. Provision was made for the effects of expansion and contraction at about every 500ft. on the straight part of the viaduct, and in the permanent way there were corresponding fished expansion joints. Between the expansion joints the girders were connected together in groups. To provide against any possible tendency in the girders to travel in the direction of the gradient, at thirty-eight places along the viaduct the girders covering one span in each group were firmly bolted down to two piers. The total expansion provided for was about 5ft. in the length of the viaduct. The rails of the permanent way were laid in chairs upon cross sleepers, the sleepers being embedded in ballast in the corrugations of the decking. The actual work in the river was commenced in June, 1882, and the viaduct was opened for public traffic on the 20th of June, 1887.

The second paper read was on "The Construction of the Tay Viaduct, Dundee," by Mr. Wm. Inglis, Assoc.M.Inst.C.E. Referring to the difficult character of the work, the author stated that the bridge across the Tay was probably the longest in the world over water, and for a considerable distance operations had to be conducted at a point in the river which was navigable for vessels of considerable tonnage. Seventy-three of the eighty-five piers in the structure were cylindrical in groups of two for each pier. The shafts, as sunk into the river bed, were formed primarily of wrought iron cylinders, built in annular sections. The first section was provided with a cutting edge which sank into the river bed as the superincumbent weight was added. The cylinders were filled with concrete, which formed a compact shaft encircled by an iron tube. The sinking of the shafts was accomplished by means of platforms, composed of five water tight tanks, two long lateral tanks being connected by three short ones, the intervening spaces being left open. Through the open spaces or wells the cylinders were sunk and filled with concrete, the distances being exactly measured, so that the centre of the well coincided with the centre of the shaft. Columns or legs were passed through apertures at the corners of the platform, their extremities resting on the river bed, and their shafts being fitted with pin holes, by which the height of the platform could be regulated. The apparatus on each platform was an engine and boiler for actuating the hydraulic and other pumps, workshops for the repair of tools, two 10-ton cranes, one 3-ton crane, a concrete mixer, and a centrifugal pump. The stage was raised or lowered by hydraulic gear, consisting of a cylinder 12in. in diameter, piston, piston rod, open cross head, and the necessary valves. When the platform was to be floated from one pier to another, it was lowered to catch the tide two hours before high water. Ropes were carried from one side of the stage to the piers of the old bridge, and to three heavy anchors on the other. The steam crane was used as a winch, and when the platform had been brought to its new position the legs were lowered down and fixed. The foundation cylinders were riveted together on shore, the various rings being lifted from cargo boats, and placed in position by the 10-ton cranes. The first ring was formed of ⅜in. wrought iron plates, 23ft. in diameter and 13ft. 4in. deep; above this was the taper 7ft. deep, and then the upper portion 18ft. 6in. in diameter. Each added ring was bolted through an internal flange to the preceding one, and these were lined with brick work in the upper portion, and lowered to the bed of the river by hydraulic jacks. The method of placing the cylinders was as follows: Steel links, bolted together in single and double lengths, were passed through the hollow trunk, cotter holes being formed in each link at a pitch of 10in. A bow was fixed on the top of the hydraulic jacks, through which the links were passed, while they were securely bolted to the lower portion of the foundation cylinder. The jack was then brought into action, and by the use of cotters to graduate its descent, the cylinder was sunk to its appointed place, the internal brick work assisting to sink it.

The excavation was accomplished for the most part by a steel digger of the Milroy pattern. This implement, however, was found ineffectual where silty sand had to be lifted, and another process was successfully attempted. Two flexible hose pipes, each 6in. in diameter and 20ft. in length, were placed in the bottom of the cylinder, the ends being brought together and joined into one 12in. pipe leading to the pump on the platform. A diver was then sent down, who manipulated the suction pipes, so that whilst the one threw up sand the other kept the pump free by drawing clean water only. As much as 40 cubic yards had been pumped up in an hour, giving a subsidence of over 2ft. in the cylinder. The cylinders having reached the proper depth, and the interior having been cleaned out to the cutting edge, the concrete was then put in. Tipping measure boxes, filled with gravel and the necessary proportion of cement, were lifted to a staging erected above the concrete mixer. The revolving casing of the mixer was square in section, thus insuring more thorough mixing. The receiving boxes were fitted with hinged hopper bottoms, so that when lowered into the cylinder the concrete was deposited on touching the material already in position. When the concrete was level with the flange carrying the brick work, the diver packed it carefully underneath. The same process was followed in filling the twin pier.

In founding the seventy-three pairs of cylinders from the platforms, the following quantities of material were handled, viz.: 2300 tons of wrought iron cylinders, 680 tons of temporary caissons, 26,000 cubic yards of excavations, 65,000 cubic yards of brick work, 27,000 cubic yards of concrete, and 22,000 tons of cast iron blocks to weight the cylinders. The superstructure of the piers consisted of two hollow octagonal pillars connected by a semi-circular arch. Each pillar was temporarily erected at the works in Glasgow, partially riveted there, and the various parts marked for re-erection. The pillars were placed in position by using one of the movable platforms already described, from which all the apparatus had been removed, and a 5-ton steam derrick substituted. This was only necessary at the south side of the river, where the viaduct was highest, the gradient of the bridge at the north end permitting the use of boats with special derrick cranes instead of the platforms. The shallowness of the water on the sand banks necessitated rapid working at the latter point, and the majority of this work at the north end was erected during portions of three tides, or a total of twelve working hours. The riveting was effected afterwards from a platform of light lattice girders, suspended on each side of the pier, which also served for use in painting the structure.

The lattice girder work of the old bridge formed part of the roadway of the new viaduct. The girders were removed from their old position by floating them upon two large iron pontoons, 80ft. by 27ft. 6in. by 8ft. deep, stiffened internally by lattice girders and water tight bulkheads. These were bound together by girders, upon which lattice columns were erected, fitted with telescopic portions that could be adjusted to any required height. The pontoons were floated at low water underneath the girders to be removed, and as the tide rose the telescopic girders were pushed up, and securely pinned to the main column. At full tide the girders were free from the old bed plates and clearly afloat, and by manipulating mooring ropes, the pontoon was drifted to the site of the new bridge, a distance of 60ft. On reaching its intended position the hydraulic rams, which had raised the girder from the old piers, were opened, and the span was allowed to drop into its place on the new structure. The curve of the bridge at the north side of the river prevented this method from being adopted there, and the girders were transferred from the old to the new piers by means of travelling steam cranes.

The new girders were built in the yards adjacent to the railway sidings on each side of the river, the riveting being done by hydraulic machinery. To bring the girders into position, two travellers were constructed by which each completed girder was transferred to the line of rails, and carried to its position. A locomotive engine attached behind pushed the travellers with their burden forward over the completed work, and the girders were thus carried to their destined positions. The large spans were intended at first to have been erected from staging suspended between the piers; but it was ultimately decided to erect them on shore at the south side of the river, and to float them out to their positions. A timber jetty, 400ft. long by about 100ft. wide, was erected, and provided with two docks capable of admitting

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pontoons, by which the girders might be floated. Temporary rails were laid, so that cranes might travel along the whole length of the girder while in process of erection. The bottom booms were first laid down and riveted, the struts, ties, and parapets were next dealt with, then the top booms were placed and riveted, and afterwards the top cross bracings and wind ties. When the girder was completed, the temporary flooring of the docks at each end of the jetty was lifted, and the pontoons were introduced. During the rising of the tide the pontoons were adjusted, and after the weight of the span, 514 tons, had been transferred to them, the girders were lashed round the pontoon stools. When free and afloat the pontoons were taken in tow by four steam tugs, and towed down the river for some distance, so as to catch the flood tide, which floated them to their positions between the piers. When placed at the spots which they were to occupy, the pontoons were partially sunk, so as to be free of the girder, and were towed back to the dock to repeat the operation. The large spans being now ready at the base of the pillars, had to be raised to the level of the viaduct. As the end posts of the girders passed through the side of the pillars several plates were necessarily left unfixed, whilst the others above them were only temporarily bolted. Eight steel angles, in pairs, were attached to a sole plate bedded on the top of the pier, and placed at right angles and exactly vertical. These were held together by bracing bars, forming a frame work carried to the top of the pier. These formed a channel in which the end of the girder was raised by means of hydraulic jacks, cotter pins being inserted in successive holes in the frame work, as the end of the girder was elevated. Underneath each end post, inverted hydraulic rams were bolted to the flanges of the bottom booms, and cross girders were placed across the frame work, which were secured to the columns so that the rams might thrust from them. The hydraulic power was so regulated that it could be applied to the ends of the girder alternately. In this manner the span was lifted at one end 15in. in two lifts, and the operation was repeated till the top of the pier was reached. The plates which had been removed from the superstructure of the piers to allow of the passage of the girder were fixed and riveted immediately after the span had been raised. The girders rested temporarily on the permanent cross girders of the pier, thus enabling the lifting columns and bracings to be removed to another pier, and again erected for use. The bed plates and rockers were inserted whilst the girders were thus temporarily raised about 6in. above the finished level of the bridge. The flooring, which had been left incomplete until the spans were in position, was then finished and left ready for asphalting and laying for the permanent way. Most of the machinery used in the erection of the bridge was specially designed by Mr. William Arrol, the principal member of the firm of contractors, and the success which attended the work was the best testimony to its efficiency.

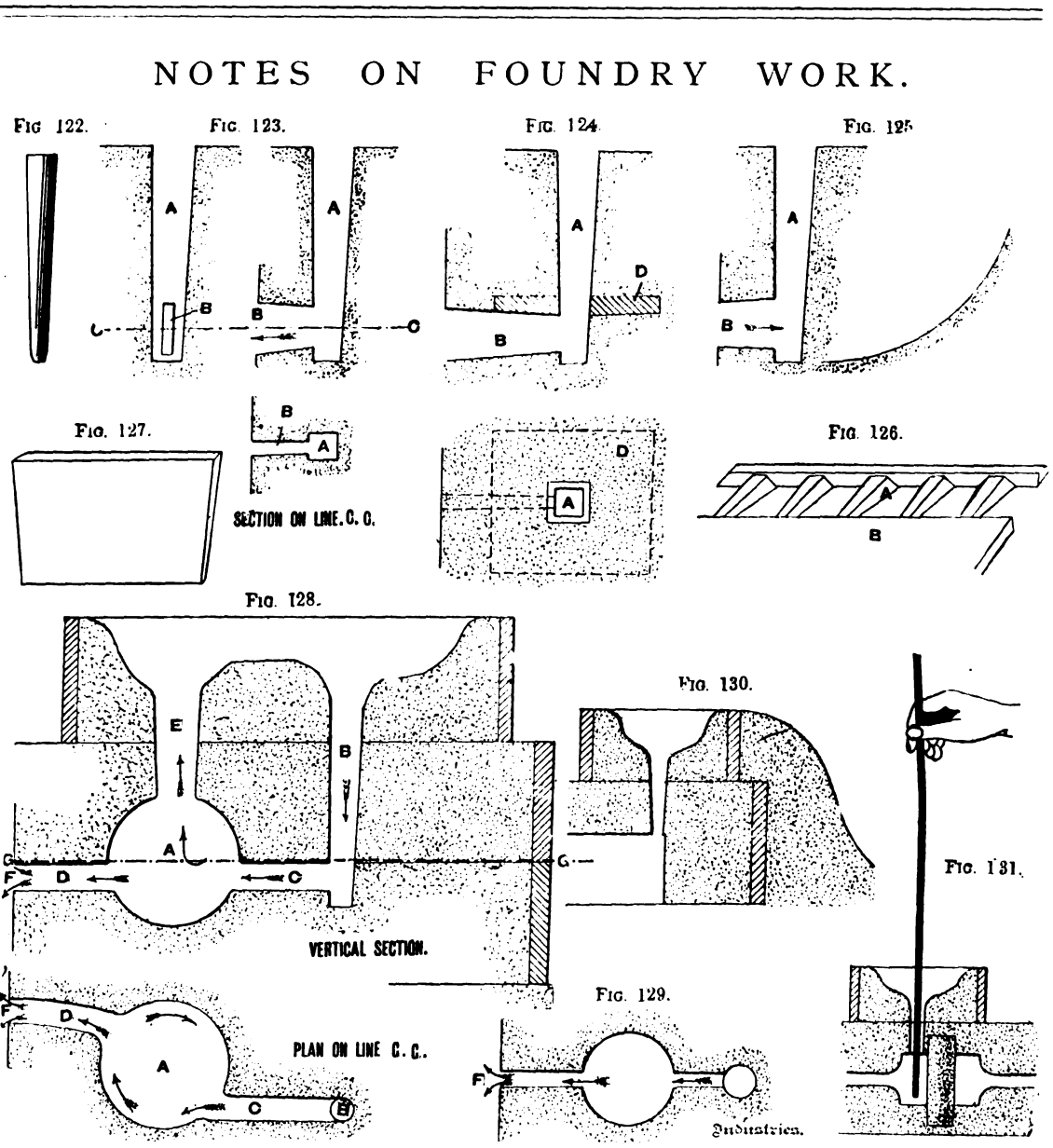
NOTES ON FOUNDRY WORK.

By the Author of "Pattern Making."

(Continued from page 417.)

XV.

Gates, Risers, and Feeding.—The question of the manner in which the metal is to be run is a matter of great importance, and at the same time that the moulder examines his pattern to see how it must be rammed, he decides on the method of pouring. The metal may be run into the mould from the top, bottom, or sides, from a single runner, or from several, with a single ingate, or with a spray, directly, or through a skimming gate, with or without risers, depending on the individual character of each piece of work. The general principles may be enunciated as follows: Moulds are generally run from the top. Those of considerable depth are often run at the sides, and thin ones are run with a spray from the top, or at the edges. Single ingates are used for heavy castings, and sprays for light castings. In common work the metal is poured directly through the ingate; but a skimming chamber is employed when the casting is required to be very free from dirt. When the surface of the mould is of considerable area, "risers" are used to relieve the strain on the cope, and to afford openings for feeding. The risers must always be of larger area than the runners, so as to obtain the full effect of the pressure. When the character of the mould is such that the metal takes a long time to pass through the ingate, a piece of loam cake should be bedded in to receive the concussion of the iron. To prevent the sand from being cut up and washed into the mould, all sharp corners in the runners and basins must be avoided. We will now take up these points in detail. The common forms of runners are shown in the accompanying figures. For all ordinary kinds of work the round runner stick (Fig. 122) is generally used. The figure shows the average amount of taper given to it. The diameter at the small end regulates the admission of metal into the mould, and the taper is only given to it to facilitate its withdrawal from the sand. The diameters of such runners may vary from ½in. to 4in. or 5in. It is impossible to lay down any hard and fast rules for the sizes of runners; in this matter the moulder has to rely on his judgment. When pouring heavy moulds, it is desirable to pour through several runners, and not from a single large one. Large runners tend to produce local shrinkages in the vicinity, because the metal chills at the top and sides of the runners, and "draws" the casting underneath; and the shrinkage taking place at the hottest portions, the metal becomes porous near the junction of the runner and



casting. When a runner is placed directly over a mould, it can also be used as a feeding head, and then there is no objection to the employment of a large runner. A large runner head is, however, more difficult to cut off cleanly than a small one, and much care has to be exercised in order that a depression shall not be produced on the knocking off of the runner. When the metal is made to enter at the side of a casting, there will be one or more ingates which are connected with a single pouring basin. The forms of the ingates are shown in Figs. 123 and 124. The vertical portion A is the "gate," or "ingate" proper, and the horizontal entry B the "runner." The employment of runners of long narrow section like B entails no risk of the drawing of the casting owing to the mass of metal; they are also more easily and safely cut off than those of large area. The metal falls first into the gate A, and afterwards passes through the runner B; its fall is thus broken, and it enters the mould in a quiet stream. The runner should be placed in such a position that the stream shall pass directly into a rib, and not against a wall of sand, or against a core, which would be apt to become dislodged. Also it is not desirable to introduce a runner into the mould at a level with its bottom, as the metal would be apt to cut up the sand; the gate is only carried down a portion of the depth, and the metal is allowed to fall through a short distance into the mould. This method is illustrated in Vol. III., page 162 (Fig. 16), and page 269 (Fig. 35). If the action of the metal happens to be long continued, then the loam cake shown at D, in Fig. 124, should be inserted. It is occasionally the practice to make the ingate and runner in a core, and to put a corresponding print upon the pattern. This plan is generally costly, and will only pay when there are a great number of castings required. Sometimes a number of flat headed chaplet nails are driven into the sand around the runner just where the metal drops; the metal falls upon these, and the cutting up of the sand is prevented. The same plan is also adopted within the mould, when the metal is poured from the top, and falls to a considerable depth. The horizontal runners shown in these figures can be withdrawn in two ways. In Fig. 123, B is drawn inwards into the mould, in the direction of the arrow. In Fig. 125 it is drawn outwards; a narrow mass of sand is dug away from behind A, as shown by the curved, shaded line to the right, and the runner B drawn in the direction of the arrow; A is then replaced, and the sand behind made good. Very often a mould is filled from both the top and bottom simultaneously. Where iron is poured from the bottom, it rises quietly in the mould, and leaves the surface skin clean and unbroken. But the impurities are apt to lodge under projecting portions, such as cores and lugs. Also in a casting of thin metal there is a risk of cold shots, and the corners are not always sharp enough. When poured from the top, the metal which comes in last is as hot as that which was first poured. In casting cylinders of moderate thickness, which require a clean surface, it is usual to cast from the bottom, in order to obtain a clean bore of equal texture throughout. In deep green sand moulds, it is preferable to run from the bottom, because of the cutting action of the metal on the sand. Also, where there are numerous parts projecting into the mould, it would be frequently unsafe to run from the top. And it should always be remembered that when a mould is run from the bottom, the area of the runners should be greater than when it is poured from the top, because of the greater freedom of entry required in order to overcome the inert mass of metal accumulating above. Moreover, when the metal is run at the bottom, there is considerable liquid pressure against the sand which intervenes between the ingate and the mould; the sand should, therefore, be of ample thickness and well rodded. The runners which are used for thin castings take the form shown in Fig. 126, and the arrangement is then termed a "spray," or sometimes a "sprue." The figure shows a pattern spray A laid against the pattern of the plate B, in readiness for ramming up. This method of ramming up is employed in repetition work, instead of cutting out the runners every time of moulding. The abutting ends of the spray should be thinner than the plate, in order to allow of their being easily knocked off. All thin, light work is properly run in this manner. A casting of large area may have three or four ingates, from each of which will proceed three or four thin runners. Their section is not necessarily identical with that shown in the figure, as they may be

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COMPOSITE ELECTRIC BALANCE.

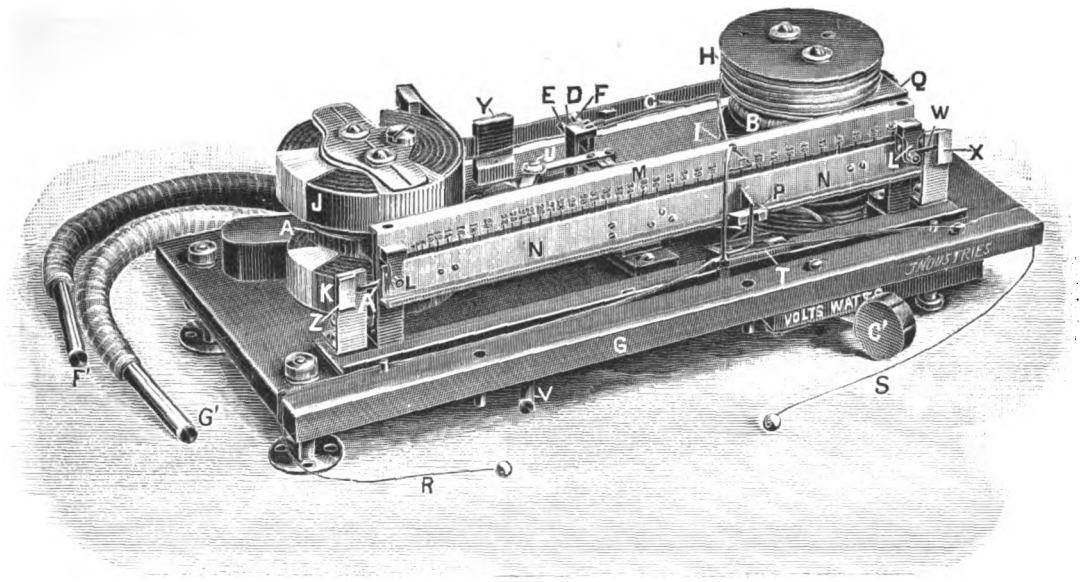


FIG. 1.

semi-circular or semi-elliptical in shape—usually the latter when cut by the moulder himself. For very thin castings, say from $\frac{1}{8}$in. to $\frac{1}{4}$in. thick, the runner stick is of the form shown in Fig. 127, and say $\frac{1}{2}$in., $\frac{3}{16}$in., or $\frac{1}{4}$in. in width, and from 3in. to 6in. in length. The great length is necessary to allow a sufficient influx of metal to prevent chilling. Runners should in all cases be kept as far as possible from those portions of a casting which have to be bored, turned, or faced bright, because the metal in the neighbourhood of a runner is always dirtier, and more open than it is elsewhere. It often happens, however, that a casting has to be machined all over, and in that case there are two courses which may be pursued; one is to allow an extra thickness of metal on the top into which the dirt can collect; and the other is to use a skimming gate. In the first instance the work, if cylindrical, is cast on end, and the ring of head metal so formed is turned off subsequently. In other classes of work, a large number of risers may be placed over the top face, in order to receive the bulk of the impurities. If the surface is quite level, an extra $\frac{1}{4}$in. or $\frac{1}{2}$in. of metal can be allowed over the whole area, and the dirt being spread over this, is afterwards planed or turned away in one or two rough cuts. Each of these methods is commonly practised, but there are numerous cases where a skimming gate is preferable. Fig. 128 shows the arrangement usually employed. A is the skimming chamber, made by ramming up a ball in the mould; B is the ingate, C the runner leading to the chamber A, D the runner passing from the chamber to the mould F. By this arrangement a rotary motion is imparted to the metal immediately it enters the chamber. The metal, impelled by the pressure from behind, passes through D; but the lighter particles remain in the centre of chamber A. If the mould is of small size, the chamber will contain all the dirt; but if of moderate, or of large dimensions, a riser of large capacity must be placed over the centre of the chamber, as shown at E, to carry off the scurf. A ball forms the best chamber, but a flat disc is sometimes employed. The diameters of the ball or disc vary from 4in. to 8in. according to the size of the mould; and if there are two or three different runners, two or three corresponding skimming chambers will be provided. Fig. 129 shows a faulty method in which no rotary action takes place. Risers or "flow-off gates" may, like runners and feeding gates proper, be used for the purpose of feeding castings; but it is always best to consider the function peculiar to them. They are used partly to show when the mould is full, but primarily to relieve the cope of the mould from the strain due to the enclosed air, which is compressed and heated by the rapid entrance of the metal. In filling the mould the metal meets with the resistance of a large body of air, which has no adequate means of exit from the vent, and consequently exerts a considerable pressure on the cope of the mould. But the flow-off gates relieve this pressure, the air passing through the gates as the mould is filled. The metal, though still liquid, exerts no pressure, for the pressure due to the height of the runner is kept in equilibrium by the pressure in the riser, or risers, which are nearly of the same height. When large flat copes are in use the flow of metal will often drive out the air so rapidly as to cut the sand, which, with the rapid heating and drying of the surface, causes damage and scabbing of the sand and drawing down of the cope. In such cases it is therefore the custom to keep the risers closed with plugs of clay, or of dried core sand, until the mould is nearly full, and then to remove them, thereby preventing the scabbing and drawing down. In a large mould there are sometimes as many as four or six risers, each of which is provided with a bank of sand sloping away from the flask, as shown in Fig. 130, and down this bank the metal flows away. In small moulds the riser cups are allowed to simply fill up. Risers are also used as feeding heads. "Feeding" is the supplying of molten metal to a mould to compensate for the loss from shrinkage. Feeding should always be done in the heaviest portions of a casting, such as bosses, lugs, thick flanges, &c. Some founders prefer to cast good heads for obviating the risks of bad feeding, these risks being the knocking down of sand, the shifting of cores, and the blowing of metal near the rods. In feeding several important points have to be observed. One is to make the feeding head large enough in diameter. A head which is so small that the metal will become solidified therein, while that in the mould is still liquid, or in a semi-fluid condition, is useless. It is preferable to have the heads larger than strictly required. The process of feeding is as follows: Just before the metal is poured into the mould, the feeding rods are dipped into the metal in the ladle, and held there for about half a minute, in order to make them white hot and clean, *i.e.*, free from rust, which would cause blowing. Immediately the metal is poured, each rod is lowered gently and carefully into a runner or riser, until its bottom end is felt to touch the mould. It is then raised just clear of this, care being taken not to touch the mould again, and the feeding or "pumping" begins, which consists of a vertical up and down movement, as in Fig. 131, the amount of which is regulated by the depth of the mould. As the metal becomes partially solidified the vertical movement of the rod is lessened, metal accumulates around it, and at every few strokes it becomes necessary to raise the rod nearly out of the feeder head and to detach the metal clinging to its sides.

The subject of pouring basins may fitly conclude this article. Illustrations of these will be found in Vol. III., page 56, Fig. 4; page 162, Fig. 16; page 269, Fig. 35; page 368, Figs. 43 and 48. It will be seen from these illustrations that there is a depression at the spot where the iron is poured out of the ladle, and that the bed rises upwards from this depression, and gently slopes down to the ingates. The depression is made in order to retain the droppings of metal which fall from the ladle during the time its position and angle are being adjusted, and which, if allowed to run at once into the mould, would produce cold shots. When pouring a deep mould from the top, cold shots are often floated up, and accumulate in the upper part of the casting, and are turned off with the head metal. The iron being continually poured into the depression of the basin, falls into a pool of metal instead of upon sand, which would be cut up and portions of it carried down into the mould. The slope of the bed of the basin is towards the ingates, in order to keep the runners well supplied with metal. The space around the ingates is widened, in order to give an area over which the dirt in the metal may be distributed. If this space is too small, the floating dirt is in such close proximity to the openings that it is liable to be sucked or carried down into the mould. For the same reason, the basin is filled during pouring as quickly as possible, and kept full; and the dirt floating on the surface is thus kept as far as possible away from the ingates. The function of the pouring basin is therefore to keep the metal clean, and run a continuous stream into the mould. Any dirt which passes the skimmer will float upon the top, giving the heavier metal time to pass on into the mould. To make a pouring basin after the top flask is in place, the runner pins are put back into position to prevent sand from falling into the mould, and loose sand strewn round them. The iron frame or flask which is to enclose the basin is put on, the frame filled with sand around the runners, and lightly rammed with the pegging rammer. The sand is then loosened in the centre with a trowel, scooped out with the hands, the runners are drawn, and the basin is finished. Should vents from the mould come up underneath the basin, a thin layer of loose hay must be strewn between the top of the cope and the under side of the basin, through which the vents will be brought out.

(To be continued.)

SIR WILLIAM THOMSON'S COMPOSITE ELECTRIC BALANCE.

BY THOMAS GRAY, B.Sc.

A NEW form of electric balance has recently been introduced by Sir William Thomson, which can be adapted either for the measurement of volts, of ampères, or of watts. In the forms hitherto made the range for current is from $\frac{1}{50}$th of an ampère to 500 ampères for continuous currents, and from $\frac{1}{30}$th of an ampère to 250 ampères for alternating currents. The range for volts is, as in all such instruments, only limited upwards by the resistance available; but, as the resistance of the potential coils is about 40 ohms, the lowest potential which can be accurately measured is about 1 volt. These coils are of copper wire, and, in consequence of the high temperature variation of that metal, very high accuracy is not attainable for such low potentials as necessitates the use of the balance without any resistance in its circuit external to its coils. Potentials of from 10 volts upwards may, however, be measured with almost perfect accuracy with this instrument by introducing sufficient non-inductive resistance of platinoid or German silver wire into the circuit. For the measurement of potentials on alternate current systems there should be at least 500 ohms of non-inductive resistance in the circuit.

The general form and construction of the balance will be better understood by reference to Fig. 1. Two coils of silk covered copper wire A B, made in the shape of anchor rings, are fixed to the two ends of a light aluminium frame C, which forms the beam of the balance. This beam is suspended in such a way that the planes of the coils are approximately horizontal, by two flat ligaments, one of which is shown at D, consisting of twenty copper wires, each about $\frac{1}{10}$mm. diam. The suspension ligaments are about 1·5cm. long, and are attached at their lower ends to two insulated brass tubes, carried on a trunnion E, which passes across the middle of the aluminium frame. Their upper ends are attached to round pins F, fixed horizontally, and with their length parallel to the trunnion, in two brass uprights, which are screwed to the sole plate G of the instrument. The suspension ligaments serve the double purpose of forming a flexible elastic joint about which the beam can freely turn, and of conveying the current into and out from the coils fixed to the beam. These movable coils are about 8cm. mean diameter, and the cross section of the ring is about 1 sq. cm. Symmetrically placed with reference to each other and the suspended coil, one above and the other below the coil on the right hand end of the beam, are fixed two coils H I of silk covered wire similar to that used for the movable coils. These coils have about the same mean diameter; but the cross section is rectangular, nearly square, and about 4 sq. cm. in area. Similarly placed with reference to the coil on the left hand end of the beam, are fixed another two coils J K, which are capable of carrying strong currents. When the instrument is specially designed for continuous currents, these coils are made of copper ribbon of sufficient thickness to carry 500 ampères safely. When the instrument is intended for alternating currents, the conductor consists of a rope of thin copper wires, each of which is silk covered to insulate it throughout its length from the others. The ends of all the wires are soldered together; and in order to avoid, as far as possible, error due to irregular distribution of the current across the section, the rope is given one turn of twist for each turn which it makes round the coil. Two turns of this rope is sufficient for each coil, and the maximum current is 250 ampères. The bobbins on which the fixed coils are wound, and the sole plate of the instrument, are made of good insulating slate, and the beam of the balance is cut at each end, so as to avoid Foucault currents in the frame work and sole plate.

To prevent excessive shake during the use of the instrument, and for convenience of portability, capstan headed stop screws L are attached to the supports at the ends of the fixed scale M, and to an upright at the middle of the

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suspension trunnion. In the ordinary use of the balance these stop screws are turned until they are just clear enough of the movable scale N (which forms the front bar of the beam) and of the trunnion, to allow the beam to swing freely. For packing, the trunnion screws are turned back, the beam lifted up against two stops above the trunnion, and two packing pieces containing V's for the trunnion slipped between them and fixed by the screws, while the screws at the end of the scale M are screwed so as to grip the movable scale. The instrument may then be carried about, or sent anywhere, with perfect safety under ordinary usage.

The method of using this balance is similar to that of the other balance, already fully described in these columns. The instrument having been levelled, and the stop screws adjusted so as to limit the shake, as above indicated, the proper weight is put on the carriage P, and the corresponding counterpoise weight in the trough Q, and the zero adjusted. Before making this adjustment the carriage and weight are moved to the zero of the movable scale by pulling the cords R S, which move the slider T. Having set the index of the carriage exactly to the zero line, using the lens which is supplied with the instrument, if necessary, the flag U should be turned by moving the handle V until the index W on the end of the scale points to the middle one of the five black lines on the vertical scale, when the beam is allowed to swing freely and come to rest. Should by any accident the flag not have sufficient power the mass y on the back bar of the beam may be slipped a little to one side, until the flag is able to make the adjustment. A second vertical scale Z is fixed at the left hand end of the beam, and the index A should point to the middle line of it when the index W points to the middle line of X. The two scales are placed in the instrument to allow the observer to see whether by any accident the ligament has been elongated since it left the maker's hands. Such an elongation of the ligament may take place with rough usage, and a slight change of constant would be the result; but it very rarely occurs. The mode of using the balance for the different classes of measurements will be more readily understood from the diagram Fig. 2. In this diagram B_1 represents a set of non-inductive resistances of suitable magnitude for the potential of the circuit to which the suspended coils are to be connected. Suppose, in the first place, that the balance is to be used as a voltmeter. The handle C_1 of the switch is turned to volt, and the electrodes D_1 E_1 connected to the points whose difference of potential is to be measured. The current then flows through the electrode E_1 and the suspended coils A B to the switch, then from the "volt" terminal through the fixed coils H I to the "watt" terminal, and from that terminal through the resistance B_1 to D_1. As the result of this current, the right hand end of the beam is deflected upwards, and the weight has to be pulled towards the right in order to restore the balance. The distance through which the weight has to be moved gives the couple produced by the ampèrian forces between the coils, and from the constant supplied with the instrument the potential between D_1 and E_1 is deduced. It will be seen that by this method of using the balance, small currents may be measured. It is, in fact, a modified "centiampère" balance. The maximum current these coils are expected to carry is 1 ampère, and currents from $\frac{1}{10}$ to 1 ampère may be measured in this way.

Next suppose the instrument is to be used as a wattmeter. The switch handle is turned to "watt," the electrodes D_1 E_1 connected to the supply mains, and the electrodes F_1 G_1 of the current coils J K connected to the two sides of a break in one of these mains. The whole current passing that break flows through the coils J K, and a current proportional to the difference of potential between the mains flows through the movable coils, but not through the fixed fine wire coils. The left hand coil of the movable system is thus acted upon by a force proportional to the product of the difference of potential between the mains and the current passing through them—that is, proportional to the rate of working in the circuit.

For the measurement of current the strength of which exceeds 1 ampère, the instrument is used heterostatically—that is to say, a constant measured current is passed through the suspended coils, and the current to be measured is passed through the fixed current coils. The connections for this use of the instrument are the same as for the measurement of watts. When a constant e.m.f. is available, the current passed through the suspended coils may be measured by the instrument itself, by first turning the switch to "volt," and adjusting an external resistance so as to obtain the required current, and then turning the switch to "watt," and at the same time increasing the external resistance by an amount equal to the resistance of the fixed coils H I. Generally, however, a separate indicator or galvanoscope requires to be used in circuit with the suspended coils of the balance when it is used for the measurement of ampères. This indicator can, of course, be standardised by the balance itself, arranged for the measurement of small currents, and it need not be capable of measuring change of current, but it should be sensitive to such change.

COMPOSITE ELECTRIC BALANCE.

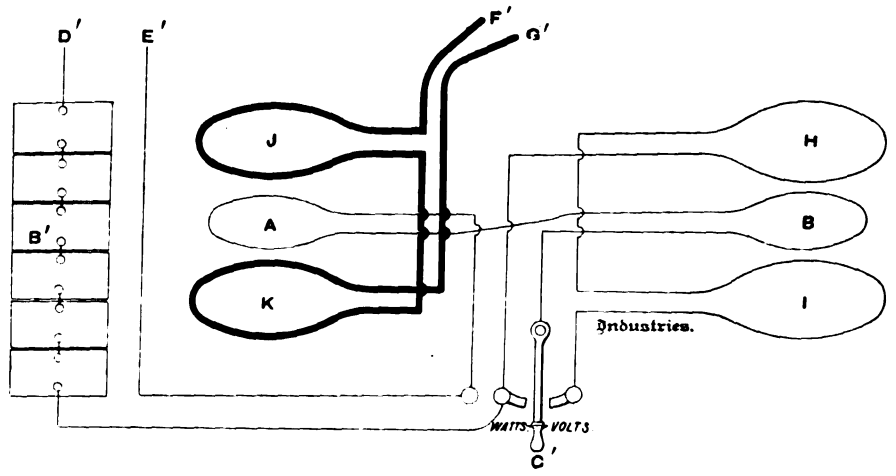


Fig. 2.

In standardising this balance two sets of weights are determined, one of which, generally marked $v\,w_1$, $v\,w_2$, $v\,w_3$, is used when the instrument is connected as a voltmeter or a centiampère metre. The current corresponding to any displacement of the weight is, in this case, half a centiampère, one centiampère, and two centiampères per division of the fixed scale for the three weights respectively. The other set is adjusted to measure the current flowing through the fixed coils J K when a quarter of an ampère is flowing through the suspended coils. There are two weights in this set, marked $w\,w_1$ and $w\,w_2$. The smallest weight has to be displaced one division of the movable, or equal division, scale for each tenth of an ampère flowing through the fixed coils J K, and the larger weight has to be displaced one division of the movable scale for each half of an ampère flowing through these coils.

This second set of weights also serve for the watt measurements, as all that requires to be known in order to allow the constant to be deduced is the resistance in the circuit of the suspended coils. Suppose this resistance to be equal to R, and the number of volts between the terminals to be V. Then the current through the suspended coil circuit $=V/R$, and the constant of the instrument requires to be divided by this quantity and multiplied by the number of ampères used when the constants were determined—that is, $\frac{1}{4}$ in this case. Hence the constant supplied with the instrument divided by $4\,V/R$ will serve in any particular case for the measurement of the current through the fixed coils or the circuit of the installation. Let for any particular measurement the reading on the scale of the beam be N divisions, and the constant supplied for the weight used be C, and we get for the current in the circuit:—

$$A = \frac{CRN}{4V}.$$

Now the number of watts being used in this circuit is equal to $A \times V$, that is to $CRN/4$, or the constant to be used for the calculation of watts is equal to the constant supplied for the measurement of ampères multiplied by $R/4$ where R is the total resistance in the circuit of the suspended coil.

In connection with the use of instruments of this class for the measurement of potentials, or of energy in alternating current circuits, the question of the effect of the self induction and the mutual induction of the coils of the instrument on its indications has always to be considered. Consider first the measurement of volts by the instrument just described. The suspended coils are about 4cm. mean radius; the diameter of the cross section is about 1·1cm., and they each contain on the average a little under 400 turns. The co-efficient of self induction of such a coil is approximately 18×10^6cm. The fixed coils have about the same mean diameter, and the section is square, 2cm. to the side, and they contain each about 670 turns. The co-efficient of self induction of this coil is about 36×10^6cm. The mutual induction between the movable and fixed coils is zero, as the fixed coils are at equal distances on opposite sides of the movable coil, and the one attracts while the other repels. There remains the mutual induction between the fixed coils, the mean distance between which is 5cm. This is of opposite sign to that of the self induction; but as it is small compared with it, and is favourable to the instrument, we may neglect it. Taking, then, the sum of the self inductions of the two movable and two fixed coils, we get for the induction co-efficient of the instrument 108×10^6. Let R be the total resistance of the circuit supposed, with the exception of the instrument, to be non-inductive; E the electromotive force at time t, and C the current flowing at that time; and L the co-efficient of induction. Then

$$RC = E - L\frac{dC}{dt}.$$

Assuming that $E = E_0 \sin \frac{\pi}{\tau} t$ where E_0 is the amplitude of the alternating e.m.f., and 2τ its period, we get

$$L\frac{dC}{dt} + RC - E_0 \sin \frac{\pi}{\tau} t = o \quad \ldots\ldots\ldots\ldots (1)$$

From this we deduce that

$$C^2 = \frac{1}{2} \frac{E_0^2}{R^2 + \pi^2 \frac{L^2}{\tau^2}}.$$

Now, since the force between the movable and the fixed coils is proportional to the square of the current, the readings for volts deduced from it will be proportional to $E_0/\sqrt{R^2 + \pi^2 L^2/\tau^2}$, and thus the indications of the instrument will be diminished, by induction, in the ratio of R to $\sqrt{R^2 + \pi^2 L^2/\tau^2}$. The resistance of the coils of the instrument is a little over 40 ohms, and the additional resistance is usually made equal to six times the number of ohms that there are volts to be measured. On a 100 volt circuit, alternating at the rate of two hundred reversals of the potential per second, we should have the ratio of the indicated potential to the true potential equal to $640 \times 10^9 / \sqrt{640^2 \times 10^{18} + 3{\cdot}1416^2 \times 108^2 \times 10^{12} \times 200^2}$ equal to 0·9945; that is to say, the indicated potential would be fully a half per cent. too low. The rate of alternation is here taken rather higher than the usual practice, and the induction co-efficient somewhat overestimated, so that we may conclude that for ordinary purposes such an instrument forms a reliable voltmeter. For measuring the number of volts in the supply mains of transformer circuits, the resistance R becomes so great that the indications for alternating and continuous e.m.f.'s are absolutely the same, so far as they can be measured.

For the measurement of watts, the induction co-efficient is the sum of the self induction of the two suspended coils, or, approximately, 36×10^6. The effect of mutual induction between the fixed or current coils and the suspended coils is zero, since they are symmetrically placed one above and the other below the suspended coil, and the current made to flow in opposite directions in the two. From equation (1) above we have by integration

$$C = Ae^{-\frac{R}{L}t} + \frac{E_0 \tau}{\sqrt{R^2\tau^2 + \pi^2 L^2}} \sin\left(\frac{\pi}{\tau} t - \varepsilon\right)$$

where $\sin \varepsilon = \frac{\pi L}{\sqrt{R^2\tau^2 + \pi^2 L^2}}$, and $\cos \varepsilon = \frac{R\tau}{\sqrt{R^2\tau^2 + \pi L^2}}$

This quantity ε gives the difference of phase between the current flowing through the coils and the e.m.f. on their terminals. Taking the same values for R and τ as before, we find

$$\sin \varepsilon = \frac{3{\cdot}1416 \times 36 \times 10^6}{\sqrt{620^2 \times 10^{18} \times {\cdot}005^2 + 3{\cdot}1416^2 \times 36^2 \times 10^{12}}} = {\cdot}000011$$

which gives ε equal to a little over two seconds of angle. It is therefore clear that if the e.m.f. is as much as 100 volts, the instruments will give to a very high degree of approximation the true watts, so long as the difference of phase between the current in the fixed coils and the e.m.f. on the supply mains does not approach 90° nearer than a few minutes of angle—that is, so long as there is any sensible amount of work being done in the circuit.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 29TH MAY, 1888.

THE IRON MARKET.—Prices have again given way, and business is now being transacted at the rates which prevailed before the last circulars were issued by the merchants announcing a rise. This lamentable state of affairs is not due to a lack of orders, as business is brisk and increasing; but competition among the merchants has exceeded all reasonable limits. As if matters were not bad enough already, the merchants are selling to petty dealers, who in their turn sell to the consumer at a price below that asked by the manufacturers. We shall now see whether or not the latter are prepared to carry into effect their threat to establish a common sales office and to ignore the merchants altogether. From the reports received from the provinces it would appear that trade is somewhat less active this week, in consequence, probably, of the Whitsuntide holidays. Prices are firm, and manufacturers have plenty of work in hand. All the details of the combination between the manufacturers of the Nord and those of the Centre are now agreed to; the syndicate of axle makers, too, is definitively formed, and is to last two years. The foreign trade is not active. The temporary admissions of pig iron have greatly increased in anticipation of the restrictions which will shortly come into force, and amount to 41,383 tons in the first four months of the year, against 27,918 tons in 1887; but the duty-paid imports are only 8450 tons, against 13,027 tons. The total imports of finished iron amount to 8082 tons, against 11,863 tons, those of steel being 3245 tons, against 5502 tons. The exports of finished iron show a considerable increase, except in the case of rails, which have decreased considerably, leaving the total exports 11,582 tons, against 11,399 tons in the corresponding period of last year. The exports of steel amount to 5654 tons, against 15,792 tons in 1887. The shrinkage here is chiefly in rails. Steel plates have increased from 35 tons to 421 tons.

THE METAL MARKET.—The copper market preserves the same features which have distinguished it for several weeks past. The demand is light, stocks steadily increase, and prices, supported by the syndicate, remain firm. The drop in tin has brought consumers into the market. Business is brisk, and the downward course of prices is checked. Lead continues to decline. Prices have now fallen to the level at which they stood before the recent rise, and they will probably go lower yet. The demand is reviving for spelter.

SOPHISTICATED WINE.—The death of eleven persons in the South of France, traceable to arsenic in the wine sold by a local merchant, has directed attention to a new process of sophisticating wine. *Mouillage* has long been a custom in the trade. It consists in multiplying the quantity of a good wine in the following manner: A quantity of good wine is purchased, and to it is added an equal quantity of a much cheaper sort. Sometimes water is also added. This is the *mouillage*. The process does not, however, end here, for the eye and the palate of a fairly good judge, to say nothing of the analyst, would easily detect the fraud. The doctored wine is flat to the taste, and spoiled in colour. The palate of the taster and the skill of the analyst have now to be cheated. This is effected by adding alcohol. Sometimes the alcohol is added pure; sometimes it is introduced in the form of glucose from which alcohol is derived by fermentation. There remains the colour. Those who have travelled much in France may have noticed acres of tall flowers called hollyhocks, and wondered for what purpose they were grown. The petals of these flowers afford a decoction which is capable of restoring the colour to the wine without revealing its presence to the chemical analyst. This was the old and harmless method; but it appears that we have grown less scrupulous and less careful, for in the case of the wine which occasioned the deaths alluded to, it was found that coal tar colours had been substituted for the hollyhock petals. The matter is yet under investigation; but it is said that some arsenic was contained in the colouring agent.

BERLIN, 28TH MAY, 1888.

THE COAL MARKET.—The condition of the coal market in Upper Silesia at the present moment is not very satisfactory. At the commencement of the month the demand for domestic and gas coal considerably decreased, but this was partly compensated for by the increased requirements of brick and lime kilns. The cold weather, which returned, accompanied by frost, about a fortnight ago, had only a local and temporary effect, but did not influence the market. The collieries in the Eastern districts only have during the month done a fair export trade, whilst those in other districts have had to restrict their output in order to avoid the accumulation of stocks. The sales of coke have been satisfactory.

THE IRON MARKET.—The event of the week has been the proposal for an agreement between the German rolled iron syndicate and the Austro-Hungarian bar iron syndicate. The initiative has been taken by the latter, who offer to abstain from exporting any iron to Germany, provided the German syndicate undertakes not to send any more iron to Austria-Hungary, with the exception of building iron for further working up. Two large iron works, which have hitherto kept aloof from syndicates, have now agreed to adopt the prices of the rolled iron syndicate for Mid Germany, but without allowing their output to be regulated by the syndicate. The general condition of the market remains satisfactory. There is a fair demand for crude iron in the Upper Silesian districts at the same prices as in the previous week. Bars are now quoted at 140s. to 142s., angles and profile iron at 155s., and sheets at from 160s. to 165s. The difficulty between the Bromberg railway administration and the rolled iron syndicate, which I mentioned in my previous letter, has been overcome by the syndicate agreeing to a reduction in price of 3s. per ton, and the order for rails has consequently been placed with German steel works. The Hanoverian State railway invited tenders a short time ago for the supply of 1450 tons of steel rails, and the Georg-Marienhütte, in Osnabrück, obtained the contract at 116s. per ton at their works, their offer being the lowest which was made. Tenders received from English works were somewhat higher. The Königin-Marienhütte, in Cainsdorf, obtained a contract for 1216 tons of ingot iron sleepers, at 124s. per ton delivered at their works; whilst the Witten works were successful in obtaining an order for the supply of 250 tons of fish plates and 160 tons of switch tongues, at 118s. delivered at their works. At a recent meeting of the Union of West German Sheet Manufacturers it was stated that the works belonging to the union were well employed with orders at remunerative prices, and that a further advance in the price of boiler plates was justified on account of the high rates at present quoted for coal, coke, and pig iron. The condition of the small iron and hardware industry in the district of Hagen is very satisfactory, and the works have plenty of orders on hand for builders' fittings, agricultural implements, and tools.

LINEN.—The orders which have recently been received in Bielefeld for linen goods have not been very considerable; but notwithstanding this the manufactories have been well employed with old orders for bed and table linen. Business in linen underclothing is well developed, and factories are working full time. The demand for yarn by the Rhenish Westphalian spinning mills has not been particularly active; but the export trade has been satisfactory, in consequence of previous orders on hand, and the production has been disposed of.

SUGAR.—At the beginning of last week the sugar market was quiet, but towards the end of the week considerable orders were received from home refiners. In the Magdeburg market the sales during the week amounted to 3750 tons, whilst in that at Halle 11,000 bags of refined sugar changed hands. Offers are only being made in moderation, since refiners are well employed in the working up of raw sugar contracted for some time ago, and which has already been delivered. The process most in favour in Germany for the separation of molasses from sugar by the use of lime is that of Herr C. Steffen. The strontian process, on the other hand, is, in consequence of the high price of carbonate of strontium, now only used by those firms which have the necessary plant installed, and is not being adopted by other works.

VIENNA, 28TH MAY, 1888.

THE IRON MARKET.—With the exception of a reduction in the base price for black sheets, which Bohemian makers have found necessary, no change of importance has taken place in the iron trade, and even the reduction just mentioned has only local importance, and it is satisfactory to note that, to make up for it, the Alpine Mining Company have found it possible to increase their price for heavy sheets 16s. per ton, a step which is justified in their case by the great number of orders they have now in hand, and which will engage their capacity of production for several months. Consequently, the works are not able to accept orders even at the increased price for immediate delivery. In bar iron, the market is fairly satisfactory, and has, moreover, received a considerable impetus by the agreement of the Austrian bar iron syndicate with their German rivals, under which Austrian makers will regain the profitable Galician market which during the last year or so they have seen slipping through their hands owing to the competition of Upper Silesian manufacturers. Under the new agreement, Roumania, which at present has no commercial treaty with Austria, would be left entirely to the German manufacturers, whilst Servia and Galicia are to be supplied jointly by German and Austrian makers. The agreement has yet to be ratified by the local syndicates, but Austrian iron masters are somewhat sceptical regarding the question whether their German rivals will carry out these stipulations when they find that by doing so they will lose a large portion of their Galician trade. In Hungary, business in all branches of the iron trade is fairly satisfactory, although prices are not advancing, except in the case of heavy sheets, for which there is momentarily a strong demand for shipbuilding purposes. Castings, and especially cast iron stoves and ranges, are in good request, dealers already beginning to place their orders for the autumn trade. The demand for rails is brisk, and prices are firm.

TEXTILES.—Owing to the favourable season, business in most branches of the textile industry is very brisk. There is a strong demand for satins, cretonnes, and Warnsdorfer cottons, and unbleached cotton piece goods are also in good request. In cloth and woollen goods the market is somewhat languid, and only those makers do a fair trade who succeed in imitating English patterns. Business in silk goods, velvets, and ribbons is satisfactory.

SUGAR.—The season is now practically ended. The total quantity of beetroot declared by the sugar factories to the Excise amounted to 3,310,000 tons, as compared with 4,290,000 tons in the previous year, and 2,650,000 tons in the season 1885-86. The total exports during the past season amounted to 20,000 tons raw sugar and 99,000 tons refined sugar, together equivalent to 130,000 tons of raw sugar, as compared with 200,000 tons during the previous season. The total payments for Excise duty exceeded 26 millions of florins, whilst nearly 14 millions have been returned to the makers in the shape of export bounties.

A NEW CIGARETTE MACHINE.—Messrs. Jadowsky and Schmitt of this town have, after a long series of trials, perfected a machine for the manufacture of cigarettes, which is remarkable for its ingenuity and workmanship. The frame of the machine consists of a cast iron table supported on angle iron legs, and the various organs of the mechanism are geared to a main spindle, which receives motion either from a hand crank or by power from a belt. At each revolution of the spindle a complete cigarette with cardboard mouthpiece is turned out. The tobacco, slightly moistened, is placed in an open trough, the bottom of which is in part formed by an endless cotton band travelling forward under a knife, which automatically cuts off the quantity of tobacco required for one cigarette. This quantity is then pressed into a cylindrical form between a pair of semi-circular metal sleeves, and retained in this mould until a little piston pushes it into the paper envelope, which has meantime been prepared by another part of the machine. The tissue paper and the tape of cardboard for the mouthpiece are on separate rollers under the table, and the former is drawn between guide rollers under a printing roller, which prints the brand on to the paper. The paper band is then seized by a gripper, whilst a knife cuts off the length required to go round the cigarette, leaving sufficient length for the lap, which is gummed by being pressed against a roller. The piece of paper is next coiled over a mandrel, and then released from the gripper, which moves back to seize again the end of the paper tape, whilst the paper cylinder is pushed into a metal tube. Meanwhile, the cardboard tape has undergone a similar operation, and a little cylinder of cardboard is pushed into the tube from the other end, where, through its own elastic expansion, it jambs itself tight in the tube of tissue paper. This receives now its charge of tobacco from the mould already mentioned, and the finished cigarette is thrown on to a travelling band, which deposits it in a box at the side of the table. An almost similar machine, by the same inventor, was shown at the Manchester Exhibition last year, and illustrated in *Industries*, Vol. III., page 463.

BRUSSELS, 29TH MAY, 1888.

THE COAL MARKET.—The coal market continues firm, and there is especially a good demand for nuts. The rates for coke and coke dust are also maintained. The Longwy works have bought 90,000 tons of coke in Westphalia, their offer of 11s. 3d. per ton not having been accepted by Belgian producers. The balance sheet of the united collieries of Bonne Espérance, at Montigny-sur-Sambre, and at Du Bois Communal, shows a net profit of £3,006, on a capital of £72,000. A contract has been made for 2000 tons of coal for the State railways, and further contracts will be made to-morrow on the Brussels exchange for the supply of coal and briquettes required during the second half of the year for the Ostende mail steamers. These contracts will be for two lots each of from 9000 to 10,000 tons. A number of coal contracts will terminate in a few weeks, and it is expected that the new contracts will be made at current rates without any further rise.

THE METAL MARKET.—The constant production of the four blast furnaces which have lately been blown in, as mentioned in previous letters, is beginning to tell on the market, and stocks are now commencing to accumulate. The rates for pig iron, which had risen to 56s., have dropped to 52s., on account of the large imports from Holland, and the small exports to America. There is consequently greater ease, and those rolling mills which have no blast furnaces of their own find themselves in a better position. Efforts are at present being made to obtain an American order for 20,000 tons of girders. The merchant iron syndicate is maintaining the rise of 4s. per ton, and the following are the present rates, with a discount of about 8s. per ton for home consumption, and of 6s. for export:—

Merchant Iron.

No.	Delivered at a Belgian Railway Station.	For Export.
1	96s.	92s.
2	104s.	98s.
3	112s.	104s.
4	128s.	116s.
5	144s.	132s.

Angle Iron.

2	104s.	100s.
3	112s.	106s.
4	128s.	118s.

No. 2 sheets are quoted at 120s.; steel sheets, at 140s.; large plates, at 112s.; and girders, at 100s. For the contracts for the Goliath rails, to which I referred last week, the Government will accept the offer of the Acieries de France to supply 2000 tons at 87s. 7d. per ton, the rest of the order being divided between the Cockerill Company, the Ougrée Company, and the Angleur works.

THE EXHIBITION.—The English section of the Exhibition is proving very attractive to visitors. Among the exhibits

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are cutlery, pottery, textiles, weaving machinery, life saving apparatus, and a type setting and distributing machine. In connection with the English section there is a Japanese village. Next to the English portion of the Exhibition the German section is making most progress under the direction of M. Cornéli, the German commissioner-general. The Austrian and Italian sections are next best advanced, whilst the Belgian and French portions are in the most backward condition. In the machinery department, however, rapid progress is now being made. Two of the large engines for driving the machinery are nearly ready, and a third is now being erected. The shafting for the electrical machinery is now in its place. The foundations for the dynamos are also finished, and the circuits are now being laid, and lamps are being fixed. The electric light installation for the Paris hippodrome, which began performances last week, consists of thirty-five Brush lamps.

Electric Lighting.—The Thomson-Houston Company are actively pushing the electric light in Belgium. They now propose to light the Galerie du Roy in the Passage St. Hubert. They have also been commissioned to light one of the largest spinning mills in Ghent. Messrs. Mourlon & Co. are paying special attention to private house lighting, for which purpose they are introducing a new American petroleum engine, which is of simple design and very steady in its running. Experiments made with it at the works of the firm proved very satisfactory, and it is now used in several installations of fifteen to fifty lamps. The Comte de Flandre, the brother of the King, is having the electric light installed in his palace in the Place Royale, Julien accumulators being used; and Messrs. Mourlon are supplying plans for a large installation at Laeken for the King's palace.

DÜSSELDORF, 28th May, 1888.

The Iron Market.—The iron market has wholly recovered from the slight relapse which took place in April. The renewed life visible in the trade in crude iron is doubtless due, in part at least, to the constantly advancing prices for coke. Coke makers seem disposed to push their advantage to the utmost limit, but the wisdom of this policy is questionable. Consumers seem to have satisfied their most pressing needs for basic steel pig, for the demand has slackened a little. For other classes of pig the market remains unchanged since my last report. Production steadily increases, and larger quantities are being imported from England. The production of pig iron in the German Empire reached in the month of April 349,880 tons, against 314,621 tons in the corresponding month of last year. This quantity consisted of 180,615 tons of forge and spiegel pig, 98,293 tons of basic steel pig, 28,094 tons of Bessemer pig, and 42,878 tons of foundry pig. The total output of pig iron in the first four months of the current year amounts to 1,395,455 tons, against 1,200,439 tons in the corresponding period of 1887—an increase of 16·25 per cent. The finished iron market is not satisfactory in all its features. Business is very animated in common plates, and there is considerable activity in joists; but bars are dull, and there is no improvement in wire. It must be admitted that the prospect in these directions is not encouraging. Business is restricted by high prices, and the tendency of the raw materials is to advance still further. Sheets are a little more sought after. The international rail market is in a bad state. For the Copenhagen contract for 2000 tons gained by an English firm, one German firm tendered a price which would not exceed £3. 14s. at works, a quotation which is much below the cost of manufacture.

Higher Prices for Paper.—A meeting of paper makers has been held at Hamm, at which it was agreed to raise the prices of straw paper and coloured and grey packing paper throughout Westphalia, Rhineland, Saxony, and the South German States. Another meeting is to be held on the 4th of June, to fix the prices for the second half of the current year. The exports of these classes of paper in the first two months of the year amounted to 49,210cwt., against 40,728cwt. in the corresponding period of 1887.

LILLE, 29th May, 1888.

Textile Manufactures.—Though the general situation has not materially changed since my last report, symptoms of improvement have appeared in some branches of the trade in textile goods. In linen fabrics, the tendency of the market is towards languor, as is usual at this season of the year, and the volume of business compares unfavourably with that of the corresponding period of last year; but more encouraging accounts have come to hand from the Roubaix-Tourcoing district. The business in woollen goods has become a little more active. Important orders have been booked within the last ten days, and manufacturers seem disposed to regard the revival as indicative of approaching activity. Such hopes, however, have been disappointed so often, that it would be rash to predict anything concerning this matter. South American wool constitutes a fairly active market, and prices have an upward tendency. Australian is for the moment neglected, but there is a prospect of greater animation and higher prices in this market. There is nothing new to record of the cotton or silk trade. The declared values of the textile fabrics imported and exported in the first four months of the current year are as follow, the figures within parentheses being the values for the corresponding period of 1887. Imports: Linen goods, £74,640 (£75,280); jute goods, £20,720 (£22,920); cotton goods, £697,600 (£830,640); woollen goods, £711,120 (£740,440); and silk goods, £806,720 (£696,560). Exports: Linen goods, £122,440 (£108,160); jute goods, £31,080 (£31,600); cotton goods, £1,486,160 (£1,632,800); woollen goods, £5,069,120 (£4,582,040); and silk goods, £3,172,120 (£3,248,920).

Flax and Yarn Market.—The market for home grown flax is wholly lifeless, the quantity remaining in the hands of sellers being now very small. The few transactions which have taken place show prices to be in favour of sellers, a circumstance largely due to the cold weather, which threatens to injure the growing crop seriously. The market is a little more active for yarns, both linen and jute yarns being more sought after.

The Iron Market.—The amount of business in iron is undiminished. Fresh orders come to hand freely, and as manufacturers are already provided with sufficient work for at least several weeks to come, the tone of affairs is cheerful. Manufacturers have confidence in the situation, and contemplate the near future in a hopeful frame of mind. It is scarcely necessary to add that prices remain very firm. The steel works at Isbergues have won a success in Belgium. The State Railways Administration asked for tenders for 8000 tons of steel "Goliath" rails, that is the 52 kilogram (114·4 lb.) per mètre rails. The Isbergues Company tendered for 2000 tons, £4. 7s. 7d. delivered at Schaerbeck, the lowest price offered.

The Sugar Industry.—It is now officially stated that the quantity of beet operated upon in the season now practically ended was 3,614,632 tons, against 4,876,850 tons last year. Expressed in raw sugar, the production amounts, in round numbers, to 389,000 tons, against 480,000 tons in the previous season, a difference of 91,000 tons.

AMSTERDAM, 29th May, 1888.

Shipbuilding.—The new mail steamer "Bromo," built for the Rotterdam Lloyd Company, and intended for their fortnightly service between Holland and Java, has left the stocks at the yard of the Royal Shipbuilding Company Schelde, at Flushing. She is the largest vessel of this class yet constructed in Holland. The trial trip to the mouth of the Maas showed great steadiness and a speed of eighteen knots an hour.

Holland and the Transvaal.—Some more engineers for the Dutch Transvaal Railway have left for the Cape. After their arrival in the Transvaal, the total number of Dutch engineers engaged upon the railway there will exceed twenty. As the capital for building the line is guaranteed by the Pretoria Government, it is satisfactory to learn that the resources of the republic continue to expand in a remarkable manner, the receipts showing an increase of nearly £80,000 for the first quarter of 1888.

Coffee.—Recent advices from Batavia show that the production of coffee in Menado, a well known coffee district, is again increasing rapidly. It rose to 22,000 piculs in 1885, and to 28,000 piculs in 1886, but suddenly fell to 4000 piculs last year, owing to the failure of crops. This year's production is estimated at 15,000 piculs. This coffee is of the very highest quality, and commands a corresponding price.

MADRID, 28th May, 1888.

Basic Steel.—At the iron works of Messrs. Duro & Co., of Telguera, Martin-Siemens steel is made by the acid process; but it is found expensive to import Bilbao ore into Asturias, when phosphoric ore can be obtained more cheaply in the district. The firm is consequently preparing to work the basic process, but it will be some time before they can induce the naval authorities to sanction this kind of steel for shipbuilding purposes, as it has hitherto been totally excluded fron the national arsenals and yards.

The Alkali Industry.—The recently disclosed invention of Mr. Chance, of Birmingham, relating to the recovery of sulphur from alkali waste in the manufacture of soda, is likely to give rise to the manufacture of soda in Spain by utilising the sodium sulphate mines in the province of Madrid. So far, these have only been worked on a small scale, and merely for sulphate of soda for glass works, but none has been converted into carbonate of soda. There is no likelihood, however, of any soda being manufactured for export, and the most that can be expected is a supply sufficient for a part of the home demand.

Cotton Mills.—The cotton mills belonging to the old established company, La España Industrial, which are probably the largest in Spain, are to be fitted throughout with new machinery. At the meeting of shareholders at which this decision was come to there was some opposition to this proposal of the directors, but the resolution was ultimately carried by 529 votes against 177.

NEW YORK, 19th May, 1888.

The Coal Market.—The improvement in the anthracite coal trade which I reported in my last letter continues, and though it is not possible to prevent cutting of prices by individual operators anxious to move their stocks and keep up production, prices are generally well maintained. The opening of navigation on the lakes is bringing a fair demand from the West, stocks at lake ports being thereby reduced.

The Iron Market.—Prices here have been gradually dropping, but without leading to much business; and although there is nothing on which to base predictions of early improvement, the chances are that the decrease in consumption has almost reached its limit. The shrinkage has been at the rate of 1,250,000 tons per annum, as compared with 1887, and while business is still large, as against that in the periods before 1884, the loss of so much business, compared with the large production of the last two years, is a serious matter. The shrinkage in prices is the most serious point, as it represents a decided cutting down of both wages and profit; buyers in the meantime are acting with great caution, and buy only small quantities at a time. The pig iron market has been an irregular one, but on the whole decidedly easier. Prices are not entirely settled; makers of some brands have fixed their ideas on certain figures as a minimum, while others are undecided as to what to do. It is safe to say that prices will go very low, perhaps as low as they have ever been, before any reaction takes place. Reductions are being fought step by step, but there are the same reasons why prices should become as low as at previous periods of depression, and the additional one of Southern competition. Business in manufactured iron has not improved. In some departments there has been a little more inquiry, but offers were at such low figures that only moderate amounts were bought. Mills which are running close to the end of their orders are taking a few hundred tons at about cost price, but only very small lots can be sold with a fair margin of profit. In plates and shaped iron there is no improvement whatever, and while manufacturers think they see business in the near future, very little has been placed during the last month. Prices are weak and irregular, but the general quotations are: 1·8c. to 1·85c. per lb. for bars; 1·9c. to 2c. for plates; and 2·10c. to 2·15c. for angles.

The Metal Market.—The copper market has shown greater activity than for some time past, and prices have slightly risen in consequence. Lake navigation has opened, and the first cargo of copper has been shipped. The belief among consumers has been freely expressed that the break in tin was the first sign of weakening in the copper syndicate, but transactions on the metal exchange give no hope for better prices at present. The tin market is still very much unsettled. A week ago a 10-ton lot sold on the exchange at 20·30c. per lb., but all sales since that time have been at 18c. Plates are a little more active. Lead is very quiet, with but little business doing even at 4¼c. per lb. Spelter is quiet, with the market at 4·62½c. to 4·65c. per lb. for domestic.

Heating Railway Carriages.—The New York Railroad Club recently sent out circulars to obtain expressions of opinion from railroad officials on various points relating to steam heating, such as the use of flexible or metallic connections, the use of traps, the desirability of further delay before adopting a uniform coupler, and the coupler preferred. The lessons taught in the adoption of car couplers have impressed railroad men with the necessity of the early adoption of some uniform system of coupling the tubes. The answers received were not numerous, and were about evenly divided upon most of the points dealt with. The majority of the companies answering recommended one coupler.

PHILADELPHIA, 19th May, 1888.

The Iron and Steel Market.—Prices for Pennsylvania iron range from $19 to $20 per ton for No. 1 foundry, $18 to $18·50 for No. 2, and $16 to $16·50 for grey forge. Southern irons now seem to be out of the race, as there is no inducement to take them at present prices, which are but 50c. per ton less than local irons of the same grade. The steel rail market is very dull, and although $31·50 to $32 at mill is quoted in Eastern Pennsylvania, it is impossible to secure any but small orders. One of the Southern roads is said to have bought 12,000 tons from an Eastern mill, and an order for 20,000 tons was taken by the Chicago mills for Kentucky delivery. Apart from these sales only small sales are reported at the figures quoted.

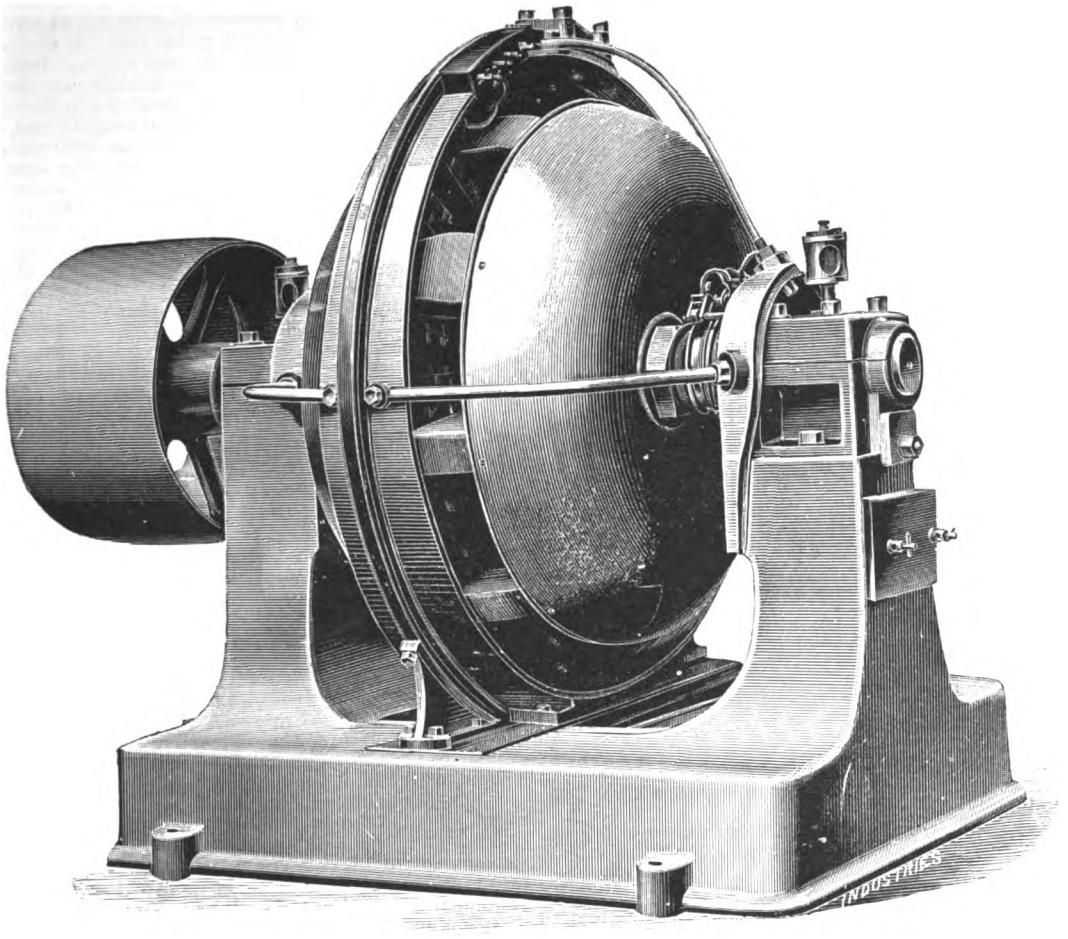
The Oil Trade.—The investigation of the House Committee on Manufactures has brought out some interesting facts in connection with the monopoly of the Standard Oil Company. From the testimony of the late President of the Pennsylvania Railroad, that company in 1878 allowed the Standard Oil Company a rebate of 50 cents per barrel on all crude oil shipped by them, and in addition paid them 22½ cents on all oil shipped by other parties. The laying of pipe lines rendered them independent of the railroads, and since that time they have dictated their own terms. The total amount of rebates is estimated at over £20,000,000.

Tube Works.—The last of the eight large welding furnaces of the lap welding department of the National Tube Works, at McKeesport, Pennsylvania, has been put into operation. There is another furnace at the works, which is being fitted for electric welding. The capacity of the works has more than doubled in the last year, having increased from 40 tons per twenty-four hours to 85 tons. The Pittsburgh Tube Company's works, which were closed because of the refusal of the workmen to accept a 10 per cent. reduction in wages, has been again started, as the men have agreed to submit to a 5 per cent. decrease.

The Brotherhood Engine.—The Chester Foundry and Machine Company, of Chester, Pennsylvania, have secured the exclusive right to manufacture the well known three-cylinder Brotherhood engine, and have just finished fitting up a department with special tools for the work. The department will be under the charge of a superintendent from the English works, and the engines will be fully up to the English standard.

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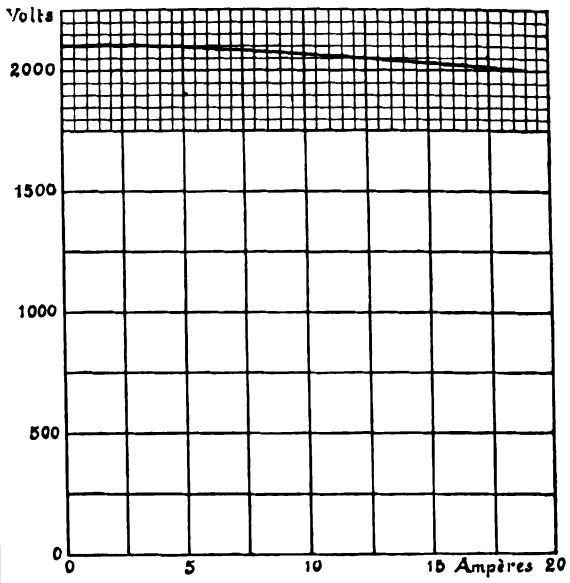
THE MORDEY ALTERNATOR.



THE MORDEY ALTERNATOR.

Some few years ago the manufacturers of continuous current dynamos vied with each other to produce new types, the motive being not so much a desire for improvement as for some distinctive design which would have the same commercial value as a trade mark. The number of different types which were thus brought on the market was considerable; but eventually the trade settled down to a few leading designs, which are now used with little variation by the best makers. The same process of evolution, which resulted in the survival of the fittest dynamo types for the production of continuous currents, seems now to be going on in regard to alternate current dynamos, and new designs are continually being brought forward. The latest example of this process of development is an alternator, designed by Mr. W. M. Mordey, and built by the Anglo-American Brush Corporation, in which a principle has been adopted which is decidedly novel in the construction of alternating current machinery, viz., the principle of an iron clad field. In continuous current dynamos the principle of an iron clad field, that is of such a configuration of the magnetic circuit as to produce no stray lines outside the machine, dates back to 1882, when it was first adopted by Wenström for a two-pole machine. In 1885 the same inventor employed it for a six-pole machine. In this case the system of field magnets surrounded the armature, and was arranged in the shape of a double shell, the inner web forming one pole and the two outer flanges the other pole, to which were alternately attached the north and south pole shoes. The magnetism was produced by two exciting coils laid into the shell between the central web and the external flanges. This type of iron clad field differs, however, from that adopted by Mr. Mordey in two essential points. In the first place, Wenström's exciting coils had a larger diameter than the armature, being arranged outside of it; and in the second place, the magnetisation of neighbouring pole shoes was of opposite character. In the machine shown above and on page 546, the exciting coils have a smaller diameter than the armature, and are wholly within it; and all the poles on one side of the armature are north, whilst all the poles on the other side are south. Thus the lines of magnetic induction flow through the armature in a direction parallel to the spindle on which the field magnets are mounted, and there is never a reversal of flow, as in other types of alternators. With a given strength of field and given speed, the e.m.f. created in the armature is, therefore, only half of what it would be were north and south poles of the same strength to succeed each other alternately. On the other hand, Mr. Mordey's arrangement has the great advantage of almost entirely avoiding magnetic leakage and economising exciting wire.

The construction of the machine will be readily seen from the illustrations given above and on page 546. The field system is built up of a central cylinder of wrought iron, forming the core, through the axis of which passes the spindle. This cylinder is surrounded by a single coil of exciting wire, the ends of which are brought out to two gun metal collectors which are insulated from the spindle. The exciting current is supplied by means of two brushes rubbing against these collecting rings. It is, however, not necessary to employ brush contacts at all. The exciting coil can be held stationary whilst the core revolves within, and the polar extensions revolve outside of it. In this case the exciting wire is brought down to the coil through a clearance left between two adjacent armature coils, and the armature would serve to support the exciting coil by means of the angle ring which is shown in our illustration, although in the machines as actually constructed, this ring is omitted, and the exciting coil revolves with the field magnets. As already mentioned, the core of this system of magnets is formed by a stout wrought iron cylinder. To the ends of this cylinder are pressed cast iron flanges, with radial extensions curving over the exciting coil. There are nine such arms to each flange, and they are so set as to bring the end faces of one set of arms exactly opposite those of the other set, with a clearance of $\frac{11}{16}$in. between them. The lines of force created by the exciting coil flow through the arms and leap across this narrow air gap, whilst the space between succeeding pairs of arms remains absolutely free from lines. The armature consists of eighteen coils of insulated copper strip, $\frac{7}{16}$in. wide. Each coil is supported on a porcelain core, $\frac{7}{16}$in. thick, and attached to a gun metal ring which, for convenience of manufacture and repair, is made in halves, the two portions being held together at the bottom by the attachment to the bed plate, and at the top by a special casting, clearly shown in our illustration. The two ends of each armature coil are brought out through porcelain insulators, and adjacent coils are joined in series by connecting wires, which are easily accessible. A separate armature coil is shown in our illustration by the side of the armature as it appears when built up. The edges of the porcelain cores are provided with notches through which the taping of the coils passes. This armature is placed within the narrow slot left between the polar extensions of the magnets, and as the latter revolve, the bundle of lines of magnetic induction flowing across each pair of pole faces is swept past the radial parts of the copper strip forming the armature coils, and thereby is created within these strips an e.m.f. which is proportional to the intensity of the field, the length of conductor acted upon, the linear speed, and the number of convolutions in each coil. It will be evident that there must be twice as many armature coils as there are pairs of magnet poles in order to avoid a differential action, and the circumferential dimension of the poles is equal to the corresponding dimension of the porcelain cores. As this machine is intended to produce a high e.m.f., all the coils in the armature have, as has already



been stated, been coupled in series; but it is obvious that any other combination can be adopted if a lower e.m.f. and more current be required. The machine is designed for an output of $17\frac{1}{2}$ ampères at 2000 volts pressure when running at 650 revolutions per minute. The accompanying diagram shows the characteristic when the speed and exciting power are kept constant whilst the current through the armature is varied. It will be seen that the difference in the terminal pressure between open circuit and full current is only 100 volts, and to produce constant terminal pressure a slight variation in the strength of the exciting current is all that is required. The total weight of the machine is 41cwt., of which 22cwt. is made up of the armature and field magnets. The external diameter of the field magnet castings is 2ft. 11in. To prevent loss of power from air resistance and to avoid noise, the field magnets are partly covered in by copper dishes. Two of these alternators are now being erected at the Oxford-street Electric Lighting Station (Messrs. Pritchett & Co.), to be used in conjunction with Mordey transformers also supplied by the Brush Corporation.

THE NEW AMERICAN FIELD GUN.

Captain C. W. Whipple, in the first number of a new publication—*The Journal of the United States Cavalry Association*—gives an interesting description of the new field piece which will shortly be issued to the United States artillery. In comparing it with the field guns of other nations, he draws some pardonable but rather incorrect conclusions, and claims for it that, with a less weight of metal, it has a higher muzzle velocity than any other gun of the kind, and that the Russian 15-pounder alone throws a heavier shell. Without going into the errors of such comparisons, we may say that the English gun he selects to compare it with is the 9-pounder R.M.L.

	English 12-pounder R.L. Gun.	American 3·2in. Rifle.
Calibre ...	3in.	3·2in.
Weight of gun ...	784lb.	791lb.
Length ...	92·35in.	83·2in.
Chamber ...	Cylindrical, 11·2in. long by 3·625in. in diameter	Ellipsoidal, 10in. long.
Rifling ...	Increasing twist from 1 turn in 120 calibres at breech to 1 in 28 at 35·8 inches from breech; thence uniform 1 in 28 to muzzle	Uniform 1 turn in 30 calibres.
Weight of projectile	12·5lb.	13lb.
Weight of charge ...	4lb. selected pebble	3½ to 3¾lb.
Muzzle velocity.	1686–1740f.s.	1710–1730f.s.

When this gun was introduced, about eighteen years ago, it was as good a gun as Europe could show; but very

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soon after, all the Great Powers re-armed their field artillery, and for some time we were in the unenviable position of having a heavier equipment and a weaker gun than any of our neighbours; but it will be seen from the accompanying table that our present gun, the 12-pounder B.L., can well bear comparison with this its latest rival. The American gun consists of a steel tube containing the bore and the seat for the gas check; over the rear of the tube a jacket is shrunk, which projects 5ft. 6in. to the rear; there is a trunnion ring, sleeve, key ring, and base ring, which screws into the rear part of the jacket, and forms the seat for the breech block. The breech block is fastened to the body of the gun by an interrupted screw, which can be locked and unlocked into corresponding threads in the base ring by a lever handle, and the general arrangements for opening and closing the breech are similar to those in use in England.

In America, as elsewhere, great difficulty was found in obtaining a suitable carriage. A design has at last been obtained with cheeks of double steel plate, riveted together with curved flanges, above and below. The axle is of steel, braced by rods to the cheeks, and reinforced by two steel plates, $\frac{7}{8}$in. thick, projecting front and rear, and riveted together, thus giving the structure of a beam, with its depth in the direction of the greatest strain. The English axle tree, it will be remembered, is a steel forging, connected to the brackets by strong tensile stays, fitted at the centre with a spiral spring in a box, to give additional elasticity. The American brake, which is attached at each side, consists of two rods, one connected by an eye to the axle tree shoulder at one end, and at the other screwed into a hausing, which encloses a stout spiral spring. Through the latter passes one extremity of the second rod, which terminates in a nut that bears against the spring, its other end being fitted with a shoe that can be placed against the tyre of the wheel. This brake is found to act well; it can be attached or not at pleasure, and on the march acts as a mud scraper. In England we employ self acting friction brakes, applied to the naves, and also a hand brake that can be thrown in or out of gear. The weight of the American carriage is 1300lb., that of the English 1260lb.

SHIPBUILDING NOTES.

On the 19th ult., the steam tug "Hereward" went on her trial trip at Hull. The vessel was built by Messrs. Cook, Welten, & Gemmell, for Mr. C. D. Holmes, who was entrusted with the contract from the owners, Messrs. T. Gray & Co. She is the most powerful tug on the Humber, having triple expansion engines of 50 n.h.p., which are capable of making twelve miles an hour at 120 revolutions a minute. Steam is supplied from a steel boiler at a pressure of 150lb.

On Thursday, the 24th ult., Messrs. Robert Thompson and Sons, Sunderland, successfully launched from their yard a large steel screw steamer, named the "Drumburlie," built to the order of Messrs. Gillison & Chadwick, of Liverpool. Her dimensions are: Length, 305ft.; breadth, 39ft. 6in.; depth of hold, 25ft.; and has a deadweight capacity of 1830 tons. The vessel is classed 100 A1 at Lloyd's. The engines, which will be supplied by the North-Eastern Marine Engineering Company, Limited, of Sunderland, are of large size, having cylinders 23½in., 38in., and 62in. diam., with a stroke of 42in. There are two boilers of the cylindrical multitubular type, 11ft. 9in. diam. by 15ft. 6in. long. The vessel and her machinery have been built from the plans and specifications of Messrs. Flannery and Blakiston, consulting engineers, of Liverpool, who have also superintended their construction.

On the 26th ult., the Blyth Shipbuilding Company, Limited, launched a screw steamer, named the "Sultana," from their yard on the Tyne. The vessel has been built to the order of Messrs. Bailey & Leetham, of the Humber Iron Works, Hull, under the superintendence of Mr. Thomas Thompson, the owners' managing engineer. The principal dimensions are: Length, 265ft.; beam, 36ft.; and depth, 23ft. She is built on the three-deck principle, and the main and upper decks are of iron. There are six compartments formed by iron bulkheads extending from the keel to the upper deck. Four steam winches will be fitted for working the cargo; Amos & Smith's steam steering gear is on the bridge, and Emmerson & Walker's patent windlass on the forecastle deck. Triple expansion engines, with cylinders 23in., 36in., and 60in. in diameter, are being made by the owners.

A saloon paddle steamer, the "Princess of Wales," has been launched by Messrs. Barclay, Curle, & Co., from their yard at Whiteinch. The "Princess of Wales" has been built to the order of the Southampton, Isle of Wight, and South of England Steam Packet Company, and is intended for passenger service on the Southampton, Portsmouth, and Isle of Wight route. The dimensions of the vessel are: Length, 215ft.; breadth, 21ft.; and depth, 8½ft. The engines will also be built by Messrs. Barclay, Curle, and Co.

On the 26th ult., Messrs. Thomas Turnbull & Son launched from their shipbuilding premises, Whitehall, Whitby, a well modelled screw steamer. The new vessel is constructed of steel, and as she left the ways she was christened the "Northgate." Her dimensions are as follow: Length over all, 298ft. 9in.; length between perpendiculars, 288ft.; breadth, 38ft. 2in.; depth to top of floor plate, 20ft. 11in. She is classed A1 at Lloyd's, and her deadweight carrying capacity is estimated at 3440 tons. Her engines are of 175 n.h.p., and are constructed by Messrs. Blair & Co., Stockton-on-Tees. The new steamer has been built to the order of Messrs. Turnbull, Scott, & Co., London.

Messrs. Osbourne, Graham, & Co. launched from their yard at Hylton, on the 26th ult., a steel screw steamer called "Kathleen," which they have sold to Messrs. Pyman, Bell, & Co., of Newcastle. The vessel will take the highest class at Lloyd's, and has been built to carry a large cargo on a light draught of water. Her dimensions are 258ft. between perpendiculars, by 37ft. beam, and 16·95ft. to top of water ballast tanks, which are constructed on the cellular system fore and aft. She is built with short, full poop aft, raised quarter deck to bridge and long bridge, and topgallant forecastle, and is provided with four steam winches, a donkey boiler by Messrs. Welford Brothers, steam steering gear by Amos & Smith, of Hull, Harfield's patent windlass, and usual appliances for rapid loading and discharging. The engines will be fitted by Mr. George Clark, of Southwick, the cylinders being 20in., 33in., and 54in., by 36in. stroke, being of 160 n.h.p. The steamer will carry nearly 2500 tons on 17ft. 6in. draught, and steam nine to ten knots loaded.

Notices of Meetings.

NEXT WEEK.

SOCIETY OF ENGINEERS.—Monday, 4th June, 7·30 p.m. Paper to be read on "The Acton Main Drainage Works," by Mr. C. Nicholson Lailey.

ROYAL INSTITUTION OF GREAT BRITAIN.—Monday, 4th June, 5 p.m. General monthly meeting.—Tuesday, 5th June. Lecture on "Conventions and Conventionality in Art," by Mr. Sidney Colvin.—Thursday, 7th June. Lecture on "The Growth and Sculpture of the Alps," by Professor T. G. Bonney.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, 4th June, 8 p.m. Papers to be read on "The Mode of Using Char in Sugar Refining," by Messrs. B. E. R. and J. A. R. Newlands, and on "The Adulteration of Olive Oil and Methods of Detection," by Mr. T. Bruce-Warren.

ROYAL SOCIETY.—Wednesday, 6th June. Annual (Ladies') Conversazione.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 8th June, 8 p.m. Paper to be read on "Military Cycling," by Lieutenant-Colonel A. R. Savile.

PHYSICAL SOCIETY.—Saturday, 9th June, 3 p.m. Paper to be read on "The Analogy between Gases and Substances in Dilute Solutions," by Professor J. H. van't Hoff, communicated by Professor W. Ramsay. Exhibition of a Lantern by Mr. W. Lant Carpenter.

PRICES CURRENT, 31ST MAY.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		30/10	Cash
Scotch Warrants, m/n		37/2	"
Hematite Warrants, m/n		40/9	"
Stocks in Stores. Scotch	986,814—Inc. for week,	3163	Tons
Middlesbro'	293,084—Dec. "	3252	"
Hematite	208,894—Inc. "	3220	"

Exclusive of stocks in makers' yards.

Market still weak and lifeless.

	No. 1.		No. 3.		
Coltness	47/3	.....	42/9	f.o.b.	Glasgow.
Gartsherrie	44/–	.....	41/3	"	"
Dalmellington	39/3	.....	37/6	"	Ardrossan
Eglinton	38/–	.....	36/9	"	"
Glengarnock	43/–	.....	39/–	"	"
*Derbyshire	—	.....	34/6	f.o.t.	Works.
*Lincolnshire	—	.....	31/6	"	"
*Lancashire	—	.....	37/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	4 15 0	.....	5 5 0	f.o.t. wks
" Angles	4 12 6	.....	5 2 6	"
" Plates	4 17 6	.....	5 7 6	"
Staffordshire Bars	5 0 0	.....	6 0 0	Manch'r.
" Angles	5 10 0	.....	6 10 0	"
Crown Sheets	6 10 0	.....	6 15 0	"
" Hoops	5 7 6	.....	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		.....	8 0 0	"
" Ship and Girder		.....	7 15 0	"

METALS.

Spelter: Ordinary	£16	12	6	to	16	17	6
Copper: British Cakes and Ingots	81	0	0	"			
" Chili Bars	80	10	0	"	80	15	0
" Manufactured (strong)	88	0	0	"	90	0	0
Lead: Common Pig	13	15	0	"	13	17	6
" English Sheet	14	12	6	"	14	15	0
Tin: Straits	85	15	0	"	86	0	0
" Australian	87	0	0	"			
" English Ingots	94	0	0	"	96	0	0

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/–	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/–
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/–
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/–

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—Quotations for Chili spot parcels are irregular, and down to £80. 15s. per ton; three months, £77. 5s. to £76. 5s. Manufactured is unaltered, with little or no demand. There is still much uncertainty as to the future of copper. Chili bars are freely offered for delivery in three months below the price maintained by the French syndicate for spot copper. It is felt that this price is too high, and manufacturers are greatly hampered by it. Stocks continue to increase, and the copper trade is altogether in a most unsatisfactory position.

TIN.—Quotations for Straits are also lower; spot parcels, £85. 15s.; forward, £86. 10s. to £87. per ton, according to date.

LEAD slightly firmer. Spanish, £12. 5s. to £12. 7s. 6d. per ton.

SPELTER quiet, and without alteration.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	26	0	0
" Ceylon	"	23	0	0
Cottonseed	"	20	15	0
Cod	"	18	10	0
Lard	"	43	10	0
Linseed	"	18	10	0
Palm, Lagos	"	20	0	0
Rapeseed: English	"	24	10	0
Seal: Pale	"	22	10	0
" Brown	"	16	0	0
Sperm	"	42	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	11	6
Coal	per gal.	0	0	5½
Petroleum (Refined)	"	0	0	5⅝
" Spirit	"	0	0	7¼

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2½	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	9
" Citric	lb.	0	1	7¾	—	0	1	8
" Oxalic	"	0	0	3	—	0	0	3¼
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	6	—	0	1	6¼
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	15	0	—	11	17	6
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	7	6	—	7	12	6
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	30	10	0	—	32	0	0
Benzole (90%)	gal.	0	3	0	—	0	3	6
" (50/90%)	"	0	2	3	—	0	2	6
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	12	6	—	.....		
Lead: Nitrate	"	23	0	0	—	.....		
" White Sugar	"	26	10	0	—	27	0	0
" Brown "	"	21	0	0	—	22	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	21	0	0	—	21	10	0
" Carbonate	"	17	15	0	—	.....		
" Chlorate	lb.	0	0	5¾	—	0	0	5⅞
" Prussiate (Yellow)	"	0	0	6¾	—	0	0	7
" Sulphate (Basis 90%)	ton	8	17	6	—	9	5	0
Precipitate: Red	lb.	0	3	1	—	0	3	2
" White	"	0	3	2	—	0	3	3
Salts: Epsom Bags	ton	2	10	0	—	2	12	6
Salts: Epsom Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	8	10	0	—	9	0	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	12	6	—	6	17	6
" " (" 60%)	"	5	12	6	—	5	17	6
" " (Cream, 60%)	"	5	12	6	—	5	17	6
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	2	6	—	6	5	0
Zinc Sulphate	ton	7	10	0	—	8	0	0

WE understand that Professor Forbes having adjudicated upon the tenders received by the House to House Electric Light Supply Company, Limited, London, for three sets of alternating current dynamo electric machinery, the directors of the above company have decided to entrust the order to Messrs. Elwell-Parker, Limited, Wolverhampton.

JUNIOR ENGINEERING SOCIETY.—At the concluding meeting of the present session of this Society, held recently, a paper was read by Mr. F. W. Quick, C.E., on "The Elements of Stresses in Structures." Reference to diagrams and models assisted the author in his investigation of the character of stress to which constructional material, under various conditions and circumstances, was subject. An animated discussion ensued. Arrangements are now in progress for visiting several places of engineering interest in the vicinity of London during the summer months.

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HOME INDUSTRIES.

MANCHESTER, 31st May, 1888.

The Iron Trade.—The iron trade continues to be very lifeless; no great quantity of material is being bought, and offers are only made at very low rates. The continued decline in the price of warrants both in Glasgow and Middlesbrough has its natural effect in this country, and there is a difficulty in maintaining even the present rates for local pig iron. As we pointed out a fortnight ago, the continued increase in stocks prevents a rise in prices, and unless the opening of the shipping season checks the further accumulation, it is probable that some curtailment of production will become necessary. The bar iron trade does not improve, and prices continue to be very low. Common bars may be obtained at £4. 17s. 6d. per ton, and marked bars are nominally quoted at £5. 5s., although less is being taken. The loom and spinning machine makers, however, are using a considerable amount of wrought iron. Steel is in good request, and both bars and boiler plates are being well sold, although at rather lower rates than were prevalent a few weeks ago. Steel hoops are quoted at £6 per ton for ordinary thicknesses such as are used for baling purposes. Steel castings are now more generally used than formerly, but the increasing competition in this business is reducing the prices; a general quotation for machine moulded wheels with plain teeth is now at 23s. to 24s. per cwt. The Steel Nut and Tube Company, who make a specialty of hollow steel bars of various sections, nuts, rigging screws, and similar goods, are very busily employed, and their business is rapidly developing. The goods are manufactured by patented machinery.

The Engineering Trades.—Almost every engineer in the district has been very busy during the past week with repairs, having taken advantage of the long Whitsuntide holidays. Otherwise not much business has been done, and very little new or prospective work has come to hand. Boiler makers and general millwrights continue to be well employed. Brass founders and copper smiths are suffering very severely, owing to the artificially enhanced price of copper, which checks the sales in all classes of goods. Locomotive builders are only moderately employed, and the amount of new work coming forward is very small. The condition of tool makers is gradually improving, and there is, generally speaking, a brighter prospect for this department. Machine makers are still as busy as ever, and a great many additional orders are coming to hand; prices, however, are difficult to raise.—Mr. R. Matthews is retiring from the well known firm of Messrs Goodfellow & Matthews, general engineers, Hyde, with which he has been connected for several years. The business, which is a large one, especially in connection will mill engines, hydraulic plant, and refrigerating machinery, will be carried on as usual by the remaining partner, Mr. Goodfellow, under the style of Benjamin Goodfellow.

Wages Disputes.—Consequent upon the success of the Oldham operative spinners, the Bolton workpeople are agitating for a similar advance of 5 per cent. Notices to leave are to be handed in on the 12th June, unless in the meantime the advance is conceded. While it is probably true that the coarser counts are now being spun at a profit it by no means follows that the finer counts which are spun in Bolton can be equally profitably produced, and there is ample reason to believe that the margin in these counts is not anything like so good as the operatives imagine.—The dispute at Blackburn has ended in a partial strike, though hopes were entertained that it would be settled by the adoption of a uniform list.—In the engineering trades the dispute between the moulders and their employers has been practically settled by plenty of substitutes being found for those who went out on strike.

The Ribble Scheme.—Following upon the opposition which was partially successful in the House of Lords, a petition has been prepared for presentation to the House of Commons, praying that until the report of Mr. Abernethy has been presented no sanction shall be given to the proposals to raise new capital. If the opposition is successful it will place the Corporation of Preston in a very awkward position, as they have already incurred a large liability in excess of that for which they have powers. At the present time the dredging of the river channel is only being ineffectively performed, and until the additional dredger ordered is put to work, cannot be thoroughly carried out. In the meantime the effect of the dredging has been to deepen the river channel behind the actual point of operations in addition to the deepening at that point, and if the works are stopped, Preston will be in the position of having an almost completed dock, access to which will be impossible for ships of large burthen.

LONDON, 31st May, 1888.

The Money Market.—Money is still plentiful, and it is expected to remain so for some considerable time to come. This week there was a good demand for accommodation in connection with the Stock Exchange settlement, although as a rule the rates of continuation were by no means heavy. This demand was met by an abundant supply of money, so that the rates for accommodation were not materially hardened. The new account on the Stock Exchange opened rather badly, at least in the more speculative departments. Government stocks and home railways were inclined to improve. American railways should recover again very soon, but there is little encouragement in that direction from Wall-street. The feature of this week was the sudden break in copper shares, which was probably due to the fact that the quotation for Chili bars for three months delivery is considerably below that for spot cash. The collapse in diamond shares was no doubt simply the inevitable reaction from the high pressure of the past few months.

Companies.—The following new companies have been registered since our last report: The South Durham Alkali Company, Ld., with a capital of £85,000, to manufacture alkali, caustic soda, soda crystals, muriate of ammonia, and other chemical products; T. & J. Leigh, Ld., with a capital of £250,000, to carry on business as cotton spinners; The Mather European Patent Bleaching Company, Ld., with a capital of £40,000; The New Belgrano (Buenos Ayres) Gas Company, Ld., with a capital of £200,000; Aërial Passenger Car Company, Ld., with a capital of £25,000, to acquire an invention for improvements in relation to wire rope suspension ways and carriages for the same; George Angus & Co., Ld., with a capital of £330,000, to carry on business as tanners and dealers in gutta-percha, &c.; The Alliance Aluminium Company, Ld., with a capital of £500,000, to manufacture sodium, potassium, aluminium, &c.; Wilson Mining Company, Ld. (United States), with a capital of £350,000; The British Columbia Smelting Company, Ld., with a capital of £65,000; The South African Gold Quartz Crushing Mills and Mining Exploration Company, Ld., with a capital of £60,000; and The London and Orange Free State Exploration and Mining Company, Ld., with a capital of £250,000.

Metals. — The symptoms which showed themselves previous to the recent fall in tin are now manifesting themselves in copper, the rates for Chili bars at three months being considerably lower than for cash. On the other hand, Straits tin is recovering, the rate for three months being higher than for cash.

Textiles.—The wool market shows greater activity, and the prices obtained for Australian and South African wool compare favourably with the rates at the last series of Colonial wool sales. The accounts from the manufacturing districts also promise well. The arrivals for next month's series are slow. There is but little business being done in Baltic hemp. A fair amount of Manilla hemp for arrival has been sold at somewhat harder prices.

Aluminium.—We had last week an opportunity of inspecting the exhibit of the Aluminium Company intended for the Melbourne Exhibition. The collection comprises a bust of Lieutenant-General Sir Andrew Clarke, R.E., and other works of art, besides a large number of articles for domestic and industrial purposes. The alloy used for all these articles contains aluminium, copper, bismuth, and nickel, the proportions being varied to suit the special requirements of each case. The alloy is known under the name of Webster's Crown Metal, and in preparing it the makers use commercially pure aluminium, produced under Webster's process, which requires the use of sodium. The latter is made by Castner's process, to which we have already several times referred. Among the industrial exhibits we noticed some highly finished fittings for railway carriage doors, and also some samples of wire rope, which is now being introduced for trawling, the metal having the great advantage of not being affected by sea water. We were informed by the manager of the company that the tensile strength of the drawn wire, as made for this purpose, is as high as 70 tons.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 20th May amounted to £1,311,337 on 15,852¾ miles, as compared with £1,175,530 in the corresponding period of 1887, when the mileage was 15,737½ miles. An increase is thus shown in the mileage of 115¼ miles, or 0·7 per cent., and in the receipts of £135,807, or 11·5 per cent. The cause of the great increase in receipts is that the figures for the week include the Whitsuntide holidays, which always cause an advance over an ordinary week.

The Sugar Bounties.—The draft convention drawn up by the International Sugar Bounties Conference has been under the consideration of the different Governments concerned, and it is stated that the communications received have without exception been favourable to the adoption of the convention, which, with certain reservations, provides for the abolition of the bounty system.

Exhibitions.—Among the English exhibits at the Anglo-Danish Exhibition there is a model of an unsinkable man-of-war, invented by Sir Henry de Burgh Lawson, Bart., which is designed with a triple keel, with propellers working between these. It is claimed that such vessels can turn in their own length. On the ornamental water where the fountains formerly were, there is a boat worked by means of a "rudder motor," the invention of Captain T. B. Heathorn, of the Royal Artillery, which is an ingenious arrangement, and is intended mainly to be applied to yachts, for enabling them to beat against the wind. —A National Co-operative Exhibition will be held at the Crystal Palace in August, and the Council of the Society of Arts offer a bronze medal in each of the classes, which include engineering, cutlery, weaving, and metal work.

Finsbury Technical College.—The students' conversazione was held at this college on Friday last, when popular lectures were delivered by Professor J. Perry on "Magnifying Springs," and by Professor S. P. Thompson on "Polarisation of Light." A number of electrical firms sent specimens of their manufactures, and one room was lighted by the batteries of the Electrical Power Storage Company, and the staircase by a Gülcher dynamo. Mr. John Orchard exhibited appliances used in connection with military ballooning, including steel tubes made from one plate without welding for the carriage of compressed hydrogen.

GLASGOW, 31st May, 1888.

Metals.—The pig iron market has again taken a turn downwards. The quantity in store is advancing steadily, and foreign orders appear to be falling off. While the prices of German pig iron are, in that country, almost prohibitively high, in consequence of the action of the German syndicates, prices here seem to be altogether in favour of the "bears." In the early part of the week there was a good deal of unloading of copper shares. A decline was the natural result, Mason & Barry shares falling 12s. 6d.; Rio Tinto, 11s. 3d.; and Tharsis, 4s. 9d. The collapse or cessation of operations of the tin syndicate seems to have suggested the possibility of the copper combination following suit.

The Exhibition.—The attendance at the Exhibition bids fair to beat the record of provincial exhibitions. The average daily attendance during the first eighteen days has amounted to 37,111; as compared with the Colonial, 25,816; Manchester, 21,512; and Edinburgh, 19,418. It is understood that some English firms have succeeded in booking considerable orders, which they attribute to the fact of their having exhibited. On the afternoon of Friday last, the Bishop's Palace, which contains an archæological museum, and which constitutes one of the attractions of the Exhibition, was opened by the Duke of Montrose. The building, which is constructed after the manner of Old Manchester and Salford, Old London, and Old Edinburgh, is a reproduction of a Scotch baronial building, which was the castle or palace of the Bishop of Glasgow, and which occupied the site upon which the present Royal Infirmary was erected in the end of last century.

The Boundary Commission.—The Town Council of Glasgow has resolved to memorialise the Government, urging them to take the necessary steps to give effect by legislation to the recommendations of the commission as expressed in the recent report. The Council has also resolved to make a representation to the joint committee of both Houses of Parliament now sitting upon private bill legislation, in favour of a great diminution in the expenses of such legislation to the promoters and opponents of private bills. One of the magistrates has been appointed to give evidence before the committee.

Shipbuilding.—It is announced that Messrs. G. & J. Burns intend to supplement their fleet of Channel steamers by the construction of a couple of steamers to make a daylight passage between Ardrossan and Belfast.

(From our own Correspondents.)

LIVERPOOL, 30th May, 1888.

Engineering and Shipbuilding.—Advantage has been taken of the holidays to make any necessary renewals or repairs to the plant and buildings. There is an undoubted improvement in the different branches of the trade, although competition has reduced the prices to an unprofitable basis, and most of the shops and yards present a far livelier aspect than they did this time last year. Orders have been received for several large steamers, and a large number of engines of the old compound type are being converted into triple expansion engines, the iron boilers being replaced by steel ones, to reduce the extra weight in the plates required to work under the necessary increased steam pressures. Forced draught has proved so satisfactory that it is now being applied to the majority of the steamers when practicable.

Hydraulic Passenger Lifts.—The public has so appreciated the comfort and convenience of the high pressure passenger lifts at present fitted in offices and public buildings, that many of the old low pressure lifts are now being replaced by the high pressure balance lifts, and most of the new buildings in course of erection are being fitted with such lifts, the pressure being obtained either from a gas engine pump and accumulator or from the Power Company's mains; and as the latter are now rapidly extending their system it is always adopted when possible, on account of the greatly increased economy and other advantages. Two balance lifts are now being erected on the premises of the Liverpool, London, and Globe Insurance Company, and a second one for the Queen's Insurance Company, by Messrs. R. Waygood & Co., who are also erecting a number of lifts for the new Tithebarn-street Station, the Household Stores Association, &c.

SHEFFIELD, 30th May, 1888.

The Heavy Branches.—Last week there was comparatively little work being done, except in repairs and putting down new plant. Work has re-commenced again after the holidays, and in nearly all the shops there is considerable activity. The demand for Bessemer steel continues extensive, and within the past few days very large orders have been booked. The crucible steel makers are also doing a steady trade, and noted marks maintain their prices. At the blast furnaces there is little diminution of the output; but orders are not quite so plentiful, and the tendency of pig is to decline. In the armour plate mills employment is not so plentiful. Heavy machinery is, on the whole, in good request, and a great portion of it is for export. Stationary engines, pumping machinery, and

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boilers are all on better order; and shipbuilding material and chains for bridge construction are yielding a great deal of employment. Perhaps the busiest branches of Sheffield trade, however, are the railway branches. Rails are being sent out in large quantities to distant markets, and tyres and axles are in greater demand for both home and foreign customers. One or two of the large English companies have just placed large orders for tyres, axles, and railway springs. There is great activity in the carriage and waggon building shops. The Midland Railway Company, a few days ago, sent extensive orders to Sheffield houses for railway material, and probably some of this is intended for plant on the Dore and Chinley Railway. A start has been made with this new line through the Peak, and a shaft has already been driven near Totley, for the tunnel that will go under the moors.

New Limited Company.—A company has recently been formed for the purpose of acquiring the business of Messrs. Oldham & Booth, engineers and millwrights, Hull, which was established more than a hundred years ago. A leading feature of the business is the manufacture of bone crushing mills and manure plant, and a trade in paint, cement, and flour mills has lately been developed.

LEEDS, 30th May, 1888.

Iron and Steel.—The manufactured iron trade is rather quiet; but there is an increasing call for Bessemer billets, and the steel trade, so far as Leeds and district is concerned, may be described as satisfactory. Orders are numerous for most kinds of heavy material. Machinery, girders, and agricultural implements are more freely inquired for, and the railway branches have not been so brisk for some time past. Messrs. Kitson have several very good orders on hand for locomotives, one being from the Great Indian Peninsular Railway; and they are also doing moderately well with tram engines. One or two firms are engaged on war and other heavy material, and at the foundries and rolling mills there is more work. Operations are to be resumed at the Aireside Hematite Iron Works, or rather steel works. A commencement was made some time ago, after plant valued at £200,000 had been put down, and very excellent steel was turned out; but the vast works were suddenly put in the market. They have been bought by a wealthy syndicate, and steel making on a very large scale will soon be carried on there. Engineers' tools and cut nails are both finding a ready market. For colliery plant there has been a more active demand, as the owners have taken the opportunity of making renewals during the idle days.

NORTH STAFFORDSHIRE, 30th May, 1888.

The Iron Trade.—Works have now generally resumed operations after the Whitsuntide holidays; but orders and specifications are scarce, and prices remain at a low and unremunerative level. For pig iron there is a somewhat improved demand, and stocks in some instances are being reduced; but prices do not alter from a basis of 34s. to 36s. per ton for forge iron at the works. Foundry pigs are being stocked in consequence of a falling off in the consumption of local foundries.

Canal Communication.—Much interest is just now being taken by local traders in the subject of canal carriage. Owing to its land-locked position, North Staffordshire is heavily handicapped in competition with other industrial centres. One example may suffice. The rate for pig iron to London is 12s. 6d. per ton, whereas the Scotch brands, with which this district competes, are conveyed by water for about half that sum. The experiments made last week by the London and North-Western Railway Company on a length of their Shropshire Union Canal, with a view to utilise locomotives as a propelling power, were on the whole very successful. Rails had been laid on the towing path, and a small locomotive from the Crewe workshops hauled six to eight boats at a speed of about six miles an hour. It remains to be seen whether the bridges and locks will prove insuperable difficulties to a further development of this scheme, but the officials express themselves as confident of success. The saving in cost if steam power were substituted for horses would be considerable.

SOUTH WALES, 30th May, 1888.

Colliery Fire.—Shortly after eight o'clock on Thursday evening last a large fire broke out at the Maritime Colliery, near Pontypridd, which endangered the lives of sixty-five men in the workings at that time. The fire originated in a large shed at the top of the downcast shaft, and soon spread to the pit framing, the heat and smoke being carried into the pit by the downward air current. The danger of firing the workings was removed by stopping the fan. The hot steam pipes in the downcast soon created an upward draught, and the fireman below arranged the doors to suit the ventilation in its reversed state. The men, who had previously felt discomfort from the smoke and heat, were now, through these judicious exertions, able to await with confidence the preparations for bringing them up by the upcast, an operation which was completed without accident.

Salvage Operation.—The Dundee Salvage Company have just succeeded in righting, by a novel method, the "Salatiga," of Rotterdam, which capsized during a squall in the East Bute Dock in April last. Huge logs of oak were fastened to the broadside of the ship, extending some distance beyond her bottom, and the protruding ends of the beams were loaded with about 40 tons of chain to act as a counterweight. The yards, masts, and similar structures aloft were removed, and the hatches and all other openings were closed by divers, who made them perfectly air tight. The powerful centrifugal pumps of one of the Dock Company's steamers then removed the water from the capsized hull, which righted herself when the contained quantity was insufficient to hold up the counterbalancing weight. The operation has cost £500.

BARROW-IN-FURNESS, 30th May, 1888.

Iron and Steel.—A further decline is noticeable in the hematite pig iron trade. The demand is less extensive from all sources, and makers are not nearly so well off for orders as they have been. The position of Barrow is an exception to the general rule, as both the iron and steel works remain very busy. There is likely to be a reduction in the output of the district, however, within the ensuing few days, as a protest and a check against the downward tendency of prices. To-day mixed numbers of Bessemer pig iron are quoted at 41s. 6d. per ton net f.o.b., and No. 3 forge at 41s. per ton, being a reduction of 1s. per ton on the week. The weaker tone of the market is clearly shown in the fact that the quotations asked by makers are practically those at which hematite warrants have been changing hands in the open market. Stocks of pig iron are still very large, and in this fact lies the reason of the lowering tendency of prices. In the steel trade a fair business is doing, but makers are not in receipt of so many inquiries as of late, and generally speaking the demand is not so pressing. There is a large output of steel rails, which are somewhat lower in price. Heavy sections are quoted at £3. 16s. 6d. per ton, and light sections of 30lb. to 35lb. at from £4 to £4. 7s. 6d. per ton net f.o.b. A fair business is being done at the hoop and wire works, and improved facilities have been provided for the development of what promises to be a large trade in steel forgings. There is not so brisk a demand as of late for ships' plates and angles, but makers are well sold forward. Current quotations show plates to be at £6. 12s. 6d., and angles at £5. 17s. 6d. per ton net f.o.b.

The Jute Trade.—The large jute works at Barrow are briskly employed. Indeed, there has been no scarcity of orders for a few years past, and under the present management it seems probable there will be a continuance of activity in jute spinning and weaving. Wages are not high for workmen and workwomen; but a considerable amount of employment is afforded to girls and young women who would otherwise find no employment at all in Barrow.

MIDDLESBROUGH, 30th May, 1888.

Pig Iron.—At the market held on 'Change yesterday there was a very good attendance, but the market was even flatter than it has been, the nominal price of No. 3 G.M.B. having fallen to 31s. 1½d. Warrants are 30s. 11d. cash, which is a more reliable figure, representing what actual business may be done. Makers, however, will not part with their iron under 31s. 6d.

Shipments of Pig Iron.—The shipments of pig iron continue to increase. Up to the 28th inst. they amount to 99,265 tons, as against 87,511 tons to similar date last month, which was considered uncommonly good, and 71,302 tons to the 28th of May, 1887. Germany and Holland are still the heaviest foreign importers, and Scotland beats them only by a few hundred tons.

Manufactured Iron and Steel.—There is no change in these industries. The rolling mills are going steadily, but there are few new inquiries, and still fewer new orders. Plates are quoted at £4. 15s., angles at £4. 7s. 6d., and bars at £4. 12s. 6d. per ton less 2½ per cent. discount. The steel works are steady on full time, but the demand is very quiet. Rails £3. 12s. 6d. per ton for heavy sections. The men are still locked out from the Darlington Steel Works, and are using the Mayor of Darlington as a means of reconciliation.

Shipbuilding.—The entire North of England shipbuilding trade is threatened with a strike on the part of the men for a rise of 12½ per cent. on wages and piece work alike. This the masters cannot see their way to grant. The men in this quarter have given in their notices, which expire on the 31st. The chairman of the masters being ill, has prevented a conference taking place to see if a compromise could not be arrived at. It is generally considered that the state of the trade does not warrant this movement on the part of the men.

SUNDERLAND, 30th May, 1888.

The "Lancashire Witch."—This screw steamer, which was specially constructed for the Liverpool and Isle of Man traffic, has come into her builders' hands again, and is now lying in the river, awaiting a purchaser. It is probable that she may be acquired for local passenger trading in the Australasian Colonies.

Shipping.—The recently published returns of the River Wear Commissioners show that during the month of April there was a falling off in the coal shipments as compared with April, 1887, probably due to the Tyne ports recovering the trade lost last year by the Northumberland strike. 324,314 tons of coal were shipped last month, as compared with 333,904 tons in the corresponding period of last year, showing a decrease of 6904 tons. The total revenue of the Commission shows a similar falling off, being £9,551. 14s. 7d. as compared with £10,163. 17s. 6d. During last week the quantity of coal shipped, 61,914 tons, was not so large as that exported during the previous week, when 72,968 tons were shipped. Of the total quantity, 29,890 tons were sent to foreign ports, and 32,024 tons coastwise. There were also exported during the week 820 tons of patent fuel, 265 tons of cement, 630 tons of lime, 66 tons of coke, besides glass, wood, &c. The imports included 2330 tons of iron ore, 447 tons of moss litter, 320 tons of silver sand, and large quantities of pit timber, deals, battens, spars, &c. The freight market is generally steady, and the homeward trade from the Black Sea continues to be animated.

NEWCASTLE, 30th May, 1888.

Shipbuilding.—Owing to the unsettled state of the relations between employers and employed in the shipbuilding industry, few new contracts have been entered into lately, and for the moment little disposition appears to exist among the leading shipbuilders to undertake additional responsibilities. Messrs. Palmer & Co. have at present nine vessels on the stocks, all of them being of large tonnage, and all but two in early stages of construction. The firm have succeeded in partially filling the places of the platers' helpers who went out on strike for an advance of wages some weeks ago, and fair progress is now being made with the work of the vessels in hand. Messrs. Readhead are keeping their five building berths almost constantly occupied, for no sooner is a vessel launched than the vacated place is being put in readiness for the reception of another keel. Two of the five vessels that are now on the stocks are in advanced stages. A large vessel, which has been built to the order of Greek owners, and which also has been engined by the firm, is now being fitted out beside the yard. Four vessels, that are to form an addition to the fleet of the "Gulf" Company, of Greenock, are now on the stocks, and one of them will shortly be ready for launching. At the Low Walker yard of Messrs. Armstrong, Mitchell, and Co. the pressure of work is still exceptionally great, the whole of the berths being occupied with vessels of large dimensions. Messrs. W. Richardson and Co. are among the extremely busy firms, and will no doubt be able to fully utilise their building accommodation for some months to come. There are some half dozen shipbuilding establishments on the river, however, that have still very little to do, from which circumstance it may be deduced that the development of activity in the industry has not yet reached its highest point.

Engineering.—The state of uniform briskness recently noted continues to exist in the marine engineering establishments, and the boiler shops connected therewith are also kept very actively going. In the locomotive shops only a limited business is being done; but at several establishments, where ships' pumps and other engineering specialties are manufactured, orders are very plentiful. Messrs. Noble & Lund, machine tool makers, are now exceedingly busy, having orders in hand for several planing and angle bending machines. The firm have also an order for a band sawing machine to cut iron or steel plates, &c., up to a width of 2ft. 6in. This machine, it may be stated, is intended for use in one of the largest engineering works in the country.

The Coal Trade.—The shipments of coal and coke at Tyne Dock for the week ending May 26th, amounted to 89,215 tons, being an increase of nearly 7000 tons over the shipments for the corresponding week of last year.

The Wages Dispute.—The platers' helpers did not return to work to-day at any of the yards; the lock-out has therefore become a strike. The ship joiners have also come out on strike for an advance of 3s. per week. There are in all about two thousand men on strike from the Tyne ship yards, and fully as many more are laid idle as a consequence.

BELFAST, 30th May, 1888.

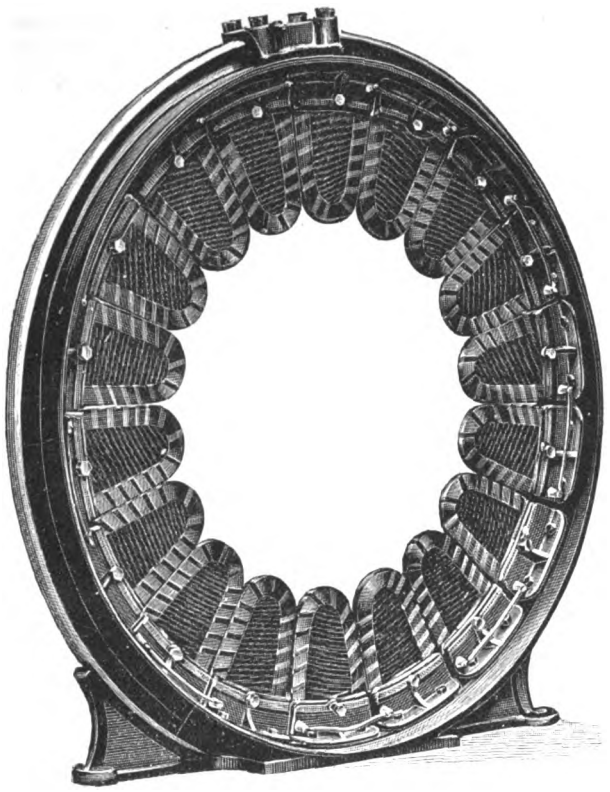
Shipbuilding.—The yards still continue to be well supplied with work, and some new orders have been booked. The riveters in Messrs. Workman, Clark, and Co.'s yard have been out on strike for the past fortnight, in consequence of the employers not acceding to their request for higher rates of piece work wages. Owing to the state of the vessels on the stocks, the strike is causing considerable inconvenience to the other outside trades, and the men are gradually dropping out of employment. The strike is rather ill timed, as, of course, the work in hand was contracted for before there was any improvement in prices, thus leaving the margin for profit very small. This firm have now completed the four large dock caissons which they had in hand, and await the completion of the docks at Haulbowline and Belfast for their delivery. The splendid steamer "Arcadia," built by Messrs. Harland and Wolff for the Peninsular and Oriental Company, is now on her station, and gave most satisfactory results during the trial trips.

Engineers and Boiler Makers.—These branches are very fully employed at present, and some firms hold large orders. Marine engineers are exceedingly busy both on new work and on repairs. Messrs. James Reynolds & Co., of Belfast, are about to exhibit, at the Irish Exhibition in London, a new flax scutching machine constructed by them, and invented and patented by Mr. John Orr Wallace. It is very similar in action to an ordinary threshing machine, and its principal features are speed and effectiveness at a small cost, and the thorough removal of the woody portion without any waste or damage to the fibre.

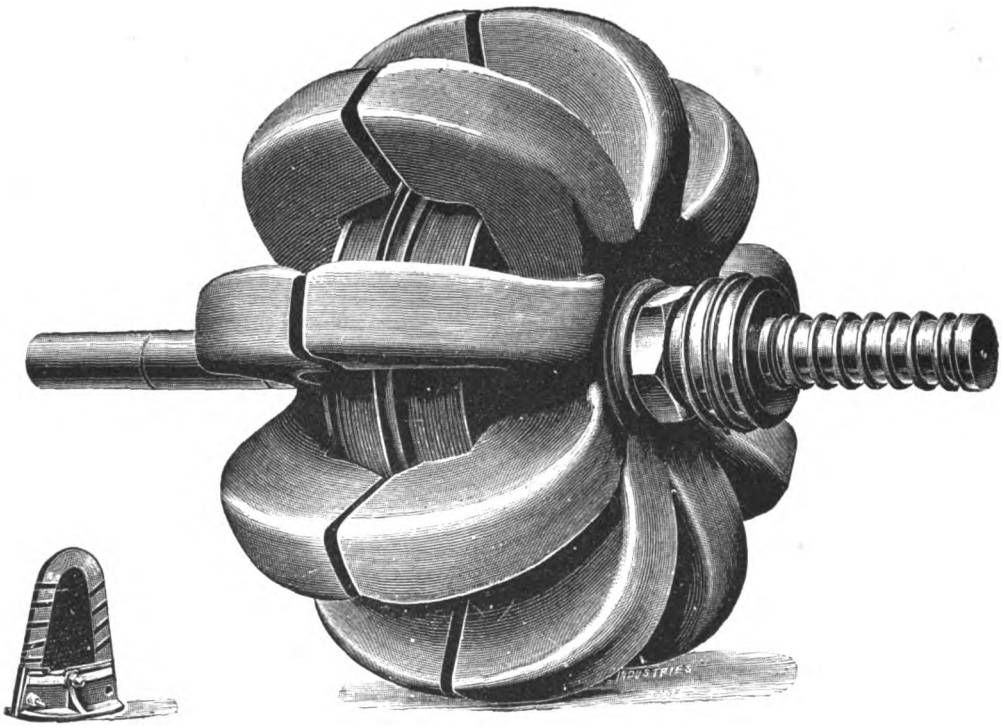
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THE MORDEY ALTERNATOR.

(For description see page 542.)



ARMATURE.



FIELD MAGNETS.

THE BOARD OF TRADE AND SHIPOWNERS.

ONE of the most remarkable parts of the report of the Royal Commission on Loss of Life at Sea was a paper by Mr. John Warrack, in which he criticised with great vigour the proposed legislation of the Board of Trade. In the last paragraph of that paper, he said "The whole policy of the Board of Trade's scheme tends to the suppression of British shipowning enterprise. By its interference with the ordinary rights of shipowners in their contracts as to insurance and the carriage of goods, it would prevent them from managing their ships by the common rules of commercial prudence. By its proposed 'arrangement' of the law, it would let loose upon them every possible claimant, and tie up their hands for their own defence. All this means the inflicting on British shipowners an enormous dopreciation of their property, by rendering their ships of little use for commercial purposes. It would give foreign flags not under such disabilities (and some of them aided by bounties and subsidies from their Governments) an incalculable advantage as against British ships." If these were the opinions of a single individual, we might put them aside as being exaggerated and one sided; but when we find them indorsed by the great body of shipowners of such an important port as the Clyde, we are compelled to believe that there must be good reasons for them being held and expressed.

About three years ago, when the Clyde shipowners were called upon to nominate a gentleman to represent them on the Royal Commission on Loss of Life at Sea, they unanimously agreed to appoint Mr. John Warrack, of Leith, and a few days ago that gentleman was presented by the Clyde shipowners with a handsome testimonial in recognition of his services to that Commission, and especially of what was called his admirable exposition of the questions under consideration, as contained in the above mentioned paper, which was said to express a truly excellent defence of the shipowners' position. Mr. Edward Martin, the President of the Clyde Steamship Owners' Association, in supporting Mr. Alexander Allan in presenting Mr. Warrack with the testimonial, gave an account of what had been done by that gentleman, and he spoke as the representative of an association having the highest membership, embracing the largest number of vessels, and, with one exception, having the largest tonnage in the world, and he wished to tell Mr. Warrack, not only how they appreciated and were satisfied with his services, but that they considered the honour he had done to himself had reflected, not only on the shipowners of the Clyde, but upon the shipowners of Scotland. Mr. Warrack worked under difficulties from the very first. The shipowners only got what they considered their proper representation on the Commission, after a threat by Mr. Joseph Cowen that he would move an amendment to the Queen's Speech, unless the reasonable demand of the shipowners was conceded. This was only screwed out of Mr. Chamberlain after it was clear that a refusal would involve the defeat of the Government. Mr. Martin was of opinion that never had a Royal Commissioner such an uphill battle to maintain the honour and honesty of his calling as Mr. Warrack; for in the first place he had to face, in a packed Commission, an able and powerful Cabinet Minister, who had created a strong public feeling by sensational speeches, misleading figures, and unreal facts. This Minister was, again, backed up by all the information and influence which a great Government Department could bring to bear, and which was responsible for proving the truth of the misleading and inaccurate statements which had called the Commission into existence. The charges which that Government Department tried to establish before the Royal Commission were: (1) That the loss of life at sea was excessive and increasing, and was to a great extent preventable; (2) that the present state of the law of insurance rendered it possible for owners to make a profit by losing a vessel, and that this is an incentive to carelessness; (3) that over-insurance and under-manning are common practices, and that the power of over-insurance and freedom from responsibility may contribute to the loss of life at sea. The Board of Trade proposed to remedy these alleged abuses by suggesting to alter, in what shipowners considered an impracticable manner, the law of insurance, which they said was the outcome of generations of experience, which had worked well, and upon which the British mercantile marine had been built up. Further, to increase, in the event of a loss, the responsibility of an owner, and to attach an invariably criminal responsibility, and assume him to be guilty until he proved his innocence. Shipowners joined issue with the Board of Trade on all the points raised; and they produced evidence before the Commission to show that the statistics of that Department were misleading, untrustworthy, and useless as a basis for legislation; that loss of life at sea was not only not increasing, but decreasing; that over-insurance and under-manning were not common; that owners had a direct and substantial pecuniary interest in bringing their adventures to a safe termination; and that the power of over-insurance did not contribute to the loss of life at sea; while, on the other hand, they believed that the proposed remedies of the Board of Trade for decreasing loss of life were not only unsuitable, but in many cases absurd, and that certain regulations enforced by the Board of Trade directly contributed to, and were immediately followed by, an increase of loss of life at sea. Mr. Martin concluded by saying that what shipowners now demanded was the suppression, or rather the elevation, of a certain high official to some more ornamental, if less powerful, sphere, and an entire re-organisation of the Marine Department of that antique and quaint anomaly called the Board of Trade.

These are very strong opinions, and in replying Mr. Warrack said that he was glad to find that his sentiments were thoroughly in accord with the sentiments of those who had called him to that position. He pointed out that the origin of the whole dispute was the publication by the Board of Trade, in 1883, of a manifesto, in which they set forth in the very strongest terms that they were incompetent to cope any longer with the increasing number of shipwrecks, and they went on to say that the only remedy for that was either to extend their powers indefinitely, which would never have done, or else to go on with legislation the effects of which would have been to expose shipowners to liabilities in every possible quarter without it being possible for them to vindicate themselves. A very significant fact, however, was this, that although the Board of Trade had no greater powers than it had before, and although the legislation it had proposed had not been carried out, the loss of life and property at sea had for years gone on steadily diminishing. The increase of some years ago, which frightened the Board of Trade officials, seems to have been caused by the transition from wood to iron, and from sails to steam, and the consequent difficulty of finding men who were able to take charge of the ships under the new conditions. When we remember that the gross annual receipts from our carrying trade amount to an immense sum, in fact more than our total net receipts from railway working, considerably more than the gross annual value of our coal products, and about as much as the present agricultural rent of the country as a whole, we see that it is one of the most important industries of the country, and therefore care must be taken that no legislation is allowed which unduly hampers its development. We have in this article given the views of a large body of shipowners, and on another occasion we may consider how far these are consistent with the interests of the general public, which are supposed to be entrusted to the care of the Board of Trade.

AN ELECTRIC ORGAN.

A NEW electric organ has been erected at the back of the stage of the Burg Theatre, in Vienna, and is connected by a cable with the orchestra, where the key board is situated. The cable is long enough to admit of altering the position of the key board within a radius of 30ft. The organ has been built by Messrs. Rieger Brothers, of Jägendorf, and the signals are transmitted from the key board to the relay lever by five Callaud cells.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 1ST JUNE, 1888.

GERMAN GUNPOWDER IN ENGLAND.

AN article in the *Standard* newspaper, the inspiration of which it is not difficult to trace, directs public attention to a serious scarcity of gunpowder in the Government stores. The question is of industrial as well as political interest, and in the former relation no less than in the latter, it calls for instant remedy. The deficiency in special qualities of gunpowder is due to the rapid progress in the science of gunnery made within the last few years, though its present existence cannot be justified, or even defended, upon that ground. The gunpowder of to-day is not that of even ten years ago. The requirements of modern artillery have created a necessity for an explosive different in its behaviour under combustion and more under control than the powder of former times. The end to be attained is to impart to the shot the highest possible velocity without dangerously straining the gun. The qualities requisite to fulfil this condition are combined in a satisfactory manner in "cocoa" powder, so named from its resemblance in colour to cocoa. This, which is nothing more than a slightly modified form of the old black gunpowder, is a German invention, though, if we may believe the writer of the article in the *Standard*, the suggestion came originally from Captain Noble, of Elswick. Great care has been taken to surround the manufacture of cocoa powder with mystery, while its merits, on the contrary, have been loudly proclaimed from the housetops. Whether or not these merits have, as some eminent authorities contend, been exaggerated, is a question into which we will not now enter. Cocoa powder, such as it is, has been adopted by the British Government for heavy guns, and to this fact, combined with certain contracts which we are about to comment upon, is due the scarcity of which complaint is rightly made. This state of things is a danger and a disgrace; a danger, because in case of war it would seriously weaken our means of defence; a disgrace, because it is an admission of inability on our part to keep pace with our rivals in a matter that is of a purely industrial character. How it came about that only the Government mills at Waltham Abbey, and the German Manufacturing Company, established since 1884 at Chilworth, in Surrey, are now producing this powder, is the question we now purpose to answer.

It is a fact within our own knowledge, and therefore presumably within the knowledge of the Government officials, whose duty it is to keep themselves informed on such matters, that British manufacturers, or at least some of them, are capable of making a powder possessing all the qualities of "cocoa" powder or even "cocoa" powder itself, without going to the Germans for instruction. Their ability to do this has been demonstrated in one instance by the actual manufacture of such powder as verified by the Government tests. Why then have our military authorities made themselves and the nation dependent upon one newly formed manufacturing company which, with the most liberal intentions, we cannot describe as English. We have derived some amusement, and perhaps a little instruction; from the clumsy efforts of the *Standard* writer to show that the Chilworth Company is not essentially German, a mere affiliated offshoot of the Westphalian Gunpowder Company. Better evidence is needed in support of this view than the fact of two Englishmen being on the Board of Direction. Moreover, the statement that "certainly no money grant has been made" by the British Government to the Germans for the possession of their secret, is not likely to gain belief in any sense beyond the strictly literal one. The Germans are an astute people, and are not yet to be credited with that sublime disinterestedness which cheerfully foregoes the *quid pro quo*. When the invention began to be noised abroad the British Government sent over to Germany a sort of committee of inquiry. This committee was permitted, on a certain day after due preparation had been made, to walk over the factory in which the "cocoa" powder was being manufactured, on condition that a large order should be given. But having failed to make themselves master of the trade secret they were sent to discover by such means as this, they were fain to approach Herr Heidermann and his associates in a more business-like way. These second negotiations resulted in a bargain which the Germans probably have not had cause to regret. It scarcely falls within the scope of this article to set out these terms in detail. We will merely remark thereon that the same terms failed to tempt the more astute Americans. Besides, it is not against the payment, whether directly or indirectly, of large sums of money that we protest. Our objection lies principally against the terms of the contract, which practically keep the whole of this manufacture in German hands, to the express exclusion and immense injury of our home industry. Waltham may, indeed, manufacture as much as it can; but all purchases of powder are to be made of the German Company at Chilworth. Under no circumstances may our Government officials, to whom the trade secret has been confided, reveal it to a British manufacturer. Hence the scarcity of powder, with its danger to the nation; and hence, also, the disgrace and injury to British industry.

But without infringing the terms of the contract, so hastily entered into, there was a remedy. All that was necessary was to encourage British manufacturers to produce a powder possessing the same qualities as that for which the nation has paid so high a price. Some of our leading gunpowder makers at once set to work; but every advance on their part was met by the Government officials with a rebuff. In spite of such discouragement, one great firm at least persisted in its efforts and achieved success. Others have given up the struggle. Experiments of the character in question involve heavy expense. Is it to be expected that manufacturers will incur so great an outlay, if the early and perhaps only partially successful endeavours meet with cold neglect, or worse, with a hostile reception at the hands of the Government, who alone can be their customers for goods of this nature? Why do the authorities, who submitted so readily to the oppressive condition of the Germans, manifest such stubborn unwillingness to afford the smallest aid or encouragement to our own manufacturers? Native industry is not so treated abroad. Imagine the German Government making itself dependent upon an English firm for what can easily be produced at home! The Americans, instead of rushing into a contract with Messrs. Heidermann & Co., first appealed to their own powder makers, who were not long in producing what was asked for. The

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Standard writer admits that "there are excellent makers of gunpowder in this country who only require encouragement in order to develop their resources. That no doubt other factories besides that at Chilworth will be stimulated to improve the make of powder, &c." This is true enough. But where is the stimulant to come from? This is a question which just now presses for an answer both in the interests of the British powder makers, and in those of the nation at large. We are informed that further improvements are being made at the Chilworth works. This is not surprising, since the German company knows that its produce is sure to find a ready customer in the British Government. British manufacturers, on the other hand, know with equal certainty that no such market is open to them. This is the state of things to which we have been brought, and we protest earnestly that it is humiliating to us as a great industrial people, and intolerable to one of our important national industries.

OUR RAILWAYS AND THE STATE.

The motion which was recently brought forward in the House of Commons, by Mr. Hugh Watt, "That in the opinion of this House the time has arrived when the Government should appoint a committee or royal commission to take into consideration the question of acquiring the railways of the United Kingdom in accordance with the provisions contained in the General Railway Act of 1844," received so little support that it was negatived without a division. The question of State purchase is, therefore, not likely to be revived in the House for some time, and the attention of our legislators will probably be confined to the consideration of the regulation of railways by such measures as the Railway and Canal Traffic Bill now before Parliament. Mr. Watt, in his speech introducing the motion, enumerated some facts which ought to be known and remembered. After giving a brief history of the question, he directed attention to the present position of railway enterprise in this country. According to the latest published returns the total capital employed in the railways amounted to 828½ millions, the total receipts from all sources exceeded 66½ millions, and the net receipts 30 millions. Of the total stock, the ordinary stock exceeded 305 millions, preferential and guaranteed stock 314½ millions, and debenture stock and loans 208½ millions. The amount which had been paid by way of dividend upon the ordinary capital exceeded 12 millions, upon preferential and guaranteed stock 13 millions, upon debenture stock and loans, nearly 9 millions. The average rate per cent. upon ordinary stock had amounted to 3·94; upon preferential stock to 4·14; and upon debenture stock and loans, 4·18. The average rate of interest had, therefore, slightly exceeded 4 per cent. The current rates in the chief railway countries were as follow: In Sweden, 30s. 4d. per ton per mile; France, 12s. 10d.; Great Britain, 11s. 3d.; Holland, 9s. 10d.; Austria, 9s. 3d.; Italy, 9s.; Germany, 7s.; Belgium, 6s. 10d.; United States, 5s. 3d. The English rates were, therefore, nearly 20 per cent. above the average Continental rates, and more than double those current in America; but if we take the two Continental countries which had control of the railways, we found that our rates were 85 per cent. above those of Belgium, and 60 per cent. above those of Germany, showing the enormous extent to which our traders and manufacturers were handicapped by the present system, as compared with our two chief rivals. The terminal charges were also much higher in England than in other countries. He then went on to argue the advisability of the State purchasing the railways in this country, and in addition to pointing out the difference in favour of foreign manufacturers in their own countries, he complained that it was notorious that railway companies in this country had offered inducements in rates to Continental competitors for the importation of their products, to the great disadvantage of home manufacturers.

Mr. Bolton, the chairman of the Caledonian Railway Company, admitted that undoubtedly cases could be found in which the rates charged on the Continent compared favourably with those in this country; but they had to consider not only the rates charged, but also what work was performed for those rates. Speaking as a railway shareholder, and as one with many years' experience in the management of railways, he would say for himself, and many of those associated with him would agree with him, that they would welcome very heartily a scheme for the purchase of railways by the Government if they considered only their own pecuniary interests; but he was of opinion, if he could for a moment transpose himself from the position of a railway shareholder into that of a member of the general public, that the public by the purchase would not enjoy the advantages in the matter of railway travelling which they now had. He argued that if the railways had been acquired by the State twenty-two or twenty-three years ago, as Mr. Watt urged they should have been, that the country would not now have been covered with such a network of railways as now existed. After Sir M. Hicks-Beach and others had spoken against the proposal, Mr. Gladstone said that Mr. Watt had not misstated the general intentions of the Act of 1844, which was to preserve the freedom of the State in regard to railway companies; but he pointed out that the railway system had extended much more rapidly and widely than the promoters of that Act ever anticipated. He had always thought that if the purchase of railways could have been dealt with as a merely financial operation, that is to say, if it had been practicable that the Government could have been owners of the freehold and permanent way, and that active and vigorous commercial companies could have taken the working of the railways under Government, there would have been a great deal to say in favour of that operation. But then came the question whether leasing was a practical system, and he was afraid that the commercial mind of this country had arrived at the conclusion that it was not, and that if the Government owned the railways the Government must also be managers of them. He, however, entirely agreed with those who had objected to the proposal that the difficulties incidental to that system were conclusive against it. The Government of this country was the heaviest laden government in the world. No other government had such an extent, diversity, and complexity of functions, and for them, unless in the case of the strongest necessity, to load themselves with an operation involving the taking of what might be called roughly a tenth part of the property of the country invested in railways, and then become responsible for their management, was a proposal which could not seriously be entertained by Parliament. He hoped, however, that Parliament would exercise its best abilities in the reasonable control of the railway system, and that some attention would be given to canals.

Mr. Gladstone's arguments tend in the direction of the proposals of those who simply wish all our legislation to have a no-government-interference tendency, except so far as the interests of the whole community are involved, and who would enlarge the field of private initiative. The railway system of Europe—which includes a confederation of a score or so of separate societies—involves the direct transport of passengers and merchandise, over a great many lines. That these were built independently and federated together without the interference of any Government, or even a Central Board of European Railways, is a striking example of what can be done by mere agreement. Fifty years ago such an arrangement would have been pronounced impossible. Who shall say that fifty years hence sufficient progress will not have been made to enable the whole people—that is, the State—to manage the railway system for the benefit of the community?

In the meantime every effort should be made to remove inequalities, especially those which tell in favour of our foreign competitors. The recent Conference between the London Chamber of Commerce and the representatives of several of the railway companies in regard to the Railway and Canal Bill, showed most distinctly that the latter have recently shown themselves more amenable to reason than they formerly were; and this in itself is a sign of the time, and an admission of the growing power of the commercial element. The points under discussion referred to preference rates, terminal charges, and canals. The first of these admittedly gives an advantage to foreign manufacturers, the second item is in many cases too high. With regard to canals, as we pointed out in a recent article, we have too much neglected a cheap method of transport for heavy and bulky goods; and we have made a further mistake in allowing so many of our canals to fall under the control of the railways. The pressure of competition, however, is forcing these and other subjects to our notice, and in the future they will doubtless receive more attention than they have for some time past.

THE NAVAL DEFENCES OF THE UNITED KINGDOM.

An interesting and most opportune lecture was delivered on the 18th ult., at the United Service Institution, by Rear-Admiral P. H. Colomb, on the Naval Defences of the United Kingdom. The gist of the lecture was that in all our present deliberations the assumption was made that the navy would fail in its old historic *rôle* of safeguarding the kingdom, and that instead of increasing its efficiency we, as it were, gave it up as a bad job and spent our money in other directions. In support of this, the report of the Royal Commission of 1860 and the later official utterances of Mr. Stanhope's Committee were both quoted, with a view to show that in each case the temporary absence or disablement of the fleet was regarded as a possible contingency, while the possibility of an organised system of naval defence was completely ignored. The lecturer pointed out that in even more critical times than the present, such a system not only existed, but very effectually fulfilled its purpose. The lecturer showed that while both Lord Howe and Lord St. Vincent effectually protected the coast, the latter also protected the commerce, and he demanded that those who so loudly called for the expenditure of public money on fortification, should at least show some *primâ facie* cases for the always assumed possibility of naval failure. Lord St. Vincent's system started with the broad principle that these islands were merely the capital of a vast water territory, whose frontiers were the enemy's coasts; that the exits from his ports were to be held by us as the gates of the empire, and consequently our first line of defence was our blockading squadrons; behind them was a reserve fleet, which would attempt to sweep the sea of any vessels that might evade the first line, and behind this second line was a reserve of coast defenders. As long as this triple line held command of the sea, we need not fear territorial attacks, as all naval history shows territorial attacks to be impossible without the undisputed mastery of the waterways, and our commerce and ships bringing food supplies would be comparatively safe from attack. This system of Lord St. Vincent's depends merely on the efficiency of the navy; that being granted, all else will follow, just as much in 1888 as in 1803, for the fleet that is stronger under sail will also be stronger under steam, and all the later applications of electricity are on the side of the coast defenders. Nor is there now any fear of a blockading fleet being blown off the coast by stress of weather. The American Civil War gave an undisputable proof of the perfect efficiency of a blockade under steam. The Federal navy, for nearly four years, observed a coast line of 3500 miles, including 189 ports, with complete success, and the number of steamers captured or destroyed by them amounted to three-fifths of the whole number of steamers of 100 tons and upwards now possessed by France.

As practically carried out in 1803, Lord St. Vincent's measures were a triumphant success in all the main points; but at the same time the second line of defence somewhat failed in its purpose, as it was not sufficiently complete, and once a raider escaped the blockading squadron, she was able to do a good deal of damage before her capture or destruction. On this head the Admiral remarked: "If the 'despicable' privateer eighty years ago could make such havoc when shipping was thin and winds uncertain, what grounds have we for supposing that the equally 'despicable' raider will not in a future war do far more mischief in the much larger and richer field now open to him. Plainly none. That sort of attack on our commerce is as certain as any operation of war that can reasonably be predicted. The defence must be naval; but to be at all effective the defending ships must be so numerous that I do not see how the regular navy can possibly undertake it. Our noble chairman (Lord Cowper) has looked to a system of local volunteer effort as alone competent to deal with such a difficulty, and I have fully agreed with him. We believe that given local effort turned in that direction, a complete guard of our territorial waters can be established by the volunteer system, using chiefly the selfsame class of vessel that might be brought against us. My conviction is that the mere existence of such a system will prohibit the attempt to test its powers, and that even with an incomplete blockade, the commerce near our shores would be tolerably secure." In conclusion he pointed out that though Lord St. Vincent's plan was a possible and effective one, we were not, at the present time, sufficiently strong to carry it out, even in a war with France alone, but would have to fall back on that of Lord Howe, and concentrate the naval force at home in a defensive, expectant attitude, which would practically mean the abandonment of our commerce, though our shores would be perfectly secure.

A lengthy discussion followed the paper. Colonel Sir Charles Nugent pointed out the necessity of land defences, and reiterated the argument that we must provide for a possible naval disaster. He frankly admitted that money was badly wanted both for military and naval defences, and both departments should get as much as they could; but he was prepared to uphold the conclusions of the Defence Commission of 1860. General Brackenbury followed in the same strain. Several distinguished naval officers supported the statements of the lecturer, who in his reply advocated that money should only be spent on fortification after the rule of the sea had been secured.

We have just received an illustrated catalogue which has been issued by Messrs. Lucas & Davies, 21, Charles-street, Hatton Garden, London. This catalogue will be found useful by amateurs and inventors, as it contains a description and price list of various engine models, and also of the special castings and forgings used in the construction of the models.

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THE PHYSICAL SOCIETY.

At the last meeting of this Society, Professor Ayrton read a note by himself and Professor Perry

On the Governing of Electromotors.

In 1882, the authors worked out and published a method for obtaining a constancy in the speed of an electromotor with a varying load, based on a combination of a motor with a brake dynamo which re-converted the surplus mechanical into electrical energy. After passing through various stages of developments, the arrangement finally adopted consisted of an electromotor having the field magnet wound with a shunt, and a series coil traversed by the current in opposite directions, so that the magnetisation of the field magnet was that due to the difference in the number of ampère turns in the two coils. This method had been re-invented in France by M. Deprez, and in America by Mr. Sprague, and had been submitted to exhaustive tests by Dr. Frölich; but the authors had not attempted to develop it further, owing to the waste of power which was necessarily involved in the use of a demagnetising coil. The original method was applicable either to the supply of constant current or of current at constant potential difference; but the authors noticed recently that in the former case the original equations were capable of giving a solution in which the demagnetising coil was dispensed with, and yet a constant speed obtained, together with the high efficiency of a well made dynamo. As it was only required to determine whether or not a certain combination would give a certain required result, the equations are simplified by neglecting saturation, and therefore the results obtained cannot be applied without correction to actual practice. Let E be the back e.m.f. in the armature of a motor running at a speed of n revolutions, p a term depending on the permanent magnetism of the iron of the field magnet, S the current through the series coil, q the number of turns in it, Z the current through the shunt coil, and t the number of turns in it.

Then $$E=n(p\pm qS\pm tZ) \quad \ldots\ldots\ldots\ldots (1)$$

the upper or lower sign being used according as the current in the corresponding coil assists or opposes the permanent magnetism.

Let s and z be the resistances of the series and shunt coils respectively, a the resistance of the armature, and A the current in it, then for a short shunt machine

$$E=Zz-Aa \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

and for a long shunt machine

$$E=Zz-A(a+s) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

and in both cases, if C is the constant current supplied to the motor,

$$C=A+Z \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

In the former case C=S, so that equations (1), (2), and (4) give $$n\{p\pm qC\pm t(C-A)\}=(C-A)z-Aa \quad \ldots\ldots (5)$$

In the latter case S=A, so that equations (1), (3), and (4) give

$$n\{p\pm qA\pm t(C-A)\}=(C-A)z-A(a+s) \quad \ldots (6)$$

When n and C are given, equations (5) and (6) have to be satisfied for all values of A. Thus, for a short shunt,

$$\pm n(-tA)=-A(z+a) \quad \ldots\ldots\ldots\ldots (7)$$

and for a long shunt

$$\pm n(q-t)A=-A(z+a+s) \quad \ldots\ldots\ldots\ldots (8)$$

Now n, t, q, z, a, and s are all necessarily positive, and t is always larger than q, so that the positive value of tZ in equation (1) is the one which must be taken, *i.e.*, whatever the arrangement of the series coils, the shunt coil must be a magnetising and not a demagnetising one. In the paper on "Electromotors and their Government," by the same authors, in Vol. XII. of the Journal of the Society of Telegraph Engineers, they had already pointed out that the solution for constant current was a shunt motor with a series demagnetising coil; but in a standard English treatise the only solution for constant current with which the authors have been credited, was the impossible one of a series motor with a shunt demagnetising coil, which would require the speed to be negative, or the armature rotation to be reversed, which would simply turn the combination into a shunt motor and series demagnetising coil.

In another important English work the method is given correctly, but it is stated that it would not work, because if a greater load were put on, the motor would slow down, the back e.m.f. would decrease, and less current would flow through the shunt coil, thus weakening the field magnet, and, therefore, further diminishing the speed of the motor, which would thus be brought to rest or possibly reversed. The explanation of the apparent anomaly that to maintain the speed of a motor constant the field must be weakened when the load is increased, is, of course, that the power depends on the current through the armature as well as on the strength of the field, and when the latter is diminished, the former is much increased.

For a simple shunt motor supplied at constant potential difference V, $V=Z/z$, $E=Zz-Aa$, and also

$$E=n(p+tZ) \quad \ldots\ldots\ldots\ldots\ldots (9)$$

So that $$n\left(p+t\frac{V}{z}\right)=V-Aa \quad \ldots\ldots\ldots (10)$$

The left side of this equation is constant when n and V are given; while the right side is variable, as A depends on the power given out by the motor. The solution which makes the equation true independently of the value of A, is clearly the well known one of making a very small; but the authors have elsewhere given reasons against making the resistance of the armature of a motor as small as that of a dynamo armature. If then this solution be rejected, a negative term proportional to A must be added on the left hand side, and this is most simply done by adding a series demagnetising coil, when equations (9) and (10) in their more general form become respectively

$$E=n(p-qA+tz)$$

and $$N\left(p-qA+t\frac{V}{z}\right)=V-A(a+s).$$

The latter will always be satisfied for any value of A if

$$n=\frac{a+s}{q}.$$

When the supply is a constant current, the equations for a simple shunt motor are

$$E=n(p+tz)$$
$$E=Zz-Aa$$
$$C=A+Z$$

which give

$$n\{p+t(C-A)\}=(C-A)z-Aa \quad \ldots\ldots\ldots (11)$$

and which will always be satisfied if

$$n=\frac{z+a}{t} \quad \ldots\ldots\ldots\ldots\ldots (12)$$

So that a series demagnetising coil is unnecessary.

Substituting this value of n in equation (11), gives us the current for which the motor governs

$$C=\frac{np}{z-nt}=-\frac{np}{a}.$$

The terminals of the motor must therefore be reversed. This will reverse the current round the field magnet; but it must not reverse the residual magnetism, or p would also become negative. The core of the electromagnet must therefore be of steel so strongly magnetised that the shunt current does not reverse the polarity, and the permanent magnet and rotating armature will form a brake dynamo, while the shunt coil and the armature will form the motor. This is simply one of the solutions (theoretical, of course, not practical) given in the paper referred to. To obtain a practical solution alter this equation so that when the speed equation (12) is satisfied, equation (11) gives a positive value of the current, which may be done by adding to the right side of the equation (11) a positive constant term e numerically greater than np, for then

$$n=\frac{z+a}{t}$$

and $$C=\frac{e-np}{a}$$

for all values of A. This may be effected by introducing accumulators of an electromotive force e into the armature circuit, and joining them up in such a manner as to assist the main current C. The resistance of the armature circuit will then be increased by a value a^1 (being that of the accumulators), so that the final equations to determine the speed and the constant current at which the motor governs, will be

$$n=\frac{z+a+a^1}{t} \quad \ldots\ldots\ldots\ldots\ldots (13)$$

$$C=\frac{e-np}{a+a^1} \quad \ldots\ldots\ldots\ldots\ldots (14)$$

This solution is a practicable one, and, moreover, it does not require many accumulators, for np, the back e.m.f. of the motor due to the residual magnetism alone, will be small if the core of the field magnet is of soft iron, and a and a^1 need not be large, so that C can be made as large as required without giving a very large value to e.

The essence of this method consists in combining a shunt motor with a store of electric energy in the armature circuit; this energy being, as shown by the equations, automatically dealt out to assist the motor, exactly in proportion to the power required to keep the speed constant as the load is varied. The store is easily maintained by reversing the connections of the accumulators when they are disconnected from the motor, and the motor is at rest, and leaving the accumulators to be charged without supervision by the constant current which is continuously supplied.

At the same meeting, the Secretary read a note by Professor S. P. Thompson,

On the Formulæ of Bernoulli and of Haecker for the Lifting Power of Magnets.

Bernoulli's empirical rule is given by the formula

$$P=a\sqrt[3]{W^2}$$

where P is the lifting power or pull exerted by the magnet in contact with its keeper, and W the weight of the magnet. Haecker wrote the formula

$$P=a\sqrt[3]{W^2}$$

and taking the German pound as the unit of mass, found that a varied according to the quality of the steel, and the intensity of magnetisation from 8 to 10 for bar, and double these values for horseshoe magnets; so that a steel horseshoe magnet weighing 1lb. would lift from 16lb. to 20lb.

Van der Willigen repeated the investigations with Haecker's own and other magnets, and arrived at the formula

$$P=bK\sqrt{A}\sqrt{\frac{L}{A}}\frac{L}{l}$$

where b is a constant depending on the quality of the steel and the intensity of magnetisation, K the perimeter of the polar surface, A its area, L the distance between the poles, and l the mean of the interior and exterior lengths of the bar. For similar magnets $K\sqrt{A}$ is proportional to the surface A, so that according to this formula the lifting power of similar magnets is proportional to the polar surface multiplied by a correcting factor depending on the proximity of the poles. Van der Willigen found that b, which is virtually identical with Haecker's a, varied from 19·5 to 22·5.

Now, in similar magnets the linear dimensions are proportional to the cube root of the weight, and the polar surface is proportional to the square of the linear dimensions. Therefore for similar magnets both formulæ mean simply that the lifting power is proportional to the polar surface, which we know from Joule's and subsequent researches to be approximately true for equal intensities of magnetisation.

In the light of more recent researches on the magnetic induction in closed circuits the same conclusion is arrived at, for if the magnetic induction B has been carried to an equal degree in the metal, the tension in degrees per square centimetre at any point of the circuit is

$$T=\frac{B^2}{8\pi}$$

and the element of pull over the area dA is

$$dP=TdA=\frac{1}{8\pi}B^2dA$$

so that

$$P=\frac{1}{8\pi}\int B^2dA$$

which can be determined if the law of distribution of magnetic induction through the cross section is known. Assuming this to be uniform, we have

$$P=\frac{1}{8\pi}B^2A.$$

This formula gives a convenient method of determining B from measurements made of the pull on a given polar surface, the formulæ becoming

$$B=5000\sqrt{\frac{P\text{ kilos.}}{A\text{ sq. cm.}}}$$

$$B=1317\sqrt{\frac{P\text{ lbs.}}{A\text{ sq. in.}}}$$

The a of Haecker's formula may therefore be considered to be simply proportional to the square of the magnetic induction through the surface of contact, or

$$a=\frac{1}{8\pi}B^2d^3c$$

where d is the density of the steel, and c the ratio of the polar surface to that of the face of a cube of volume equal to that of the magnet. According to Haecker, a is twice as great for a horseshoe magnet as for a bar magnet; according to Van der Willigen, three or four times as great, showing that in the former case, owing to the great resistance offered by the long return path through air of the tubes of magnetic induction, the steel magnet was only able to produce a much smaller induction (in the ratio 1 to $\sqrt{2}$, according to Haecker's results) than when the circuit was closed. The lifting power being proportional to surface, with a given intensity of magnetic induction, explains the greater lifting power of small magnets in proportion to their weight, without assuming, as is often done, that small pieces of steel can be more highly magnetised than large ones.

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In electromagnets a simplification is introduced by the principle of the magnetic circuit. Assuming the material of the core and armature to be similar in permeability and cross section, B is independent of the value of the latter, and is given by the formula

$$B=\frac{4\pi S i \mu}{10 l}$$

where μ is the permeability, l the total length of the magnetic circuit, i the current in ampères, and S the number of convolutions in the coil. For values of B between 6000 and 16,000 μ is approximately given by the formula

$$\mu=\frac{16{,}000-B}{3{\cdot}2}$$

which gives for the approximate lifting power of such an electromagnet

$$P \text{ kilos.}=A \text{ sq. cm.}\times\left(\frac{3{\cdot}2Si}{Si+2{\cdot}56l \text{ cm.}}\right)^2$$

or

$$P \text{ lbs.}=A \text{ sq. in.}\times\left(\frac{12{\cdot}2Si}{Si+6{\cdot}5l \text{ in.}}\right)^2$$

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

At the meeting of this Society, held on the 24th ult., Sir William Thomson exhibited and described his standard balance and some other electrical measuring instruments, of which an illustrated account has already been given in the present volume of *Industries*, page 93. We shall, therefore, limit ourselves to the description of improvements in the details of construction which have since then been introduced. The marine voltmeter, consisting of a small oblate of soft iron in the centre of a solenoid of fine copper wire and supported on a platinoid wire stretched by a spring of the same material, and of a form resembling a coach spring, but without the friction joints of the latter, was originally constructed with a latent zero. The reason for this was that in the case of all the materials which had been tried for the supporting wire previously to the use of platinoid, the elastic retentiveness of the wire had caused "creeping" to take place for some time after the current had been sent through the instrument. Sir William, however, found that with platinoid wire there is no appreciable elastic retentiveness, and the needle can be allowed to return to zero, because, after a year's experience with the instrument, he found that the variation does not exceed one-fifth per cent. The instrument is now being constructed with a visible zero. He pointed out, moreover, that if any "creeping" should be found to take place, the instrument might easily be converted into one with a latent zero by the use of a movable stop which could be removed when it was desired to verify the zero. The original form of instrument was not available for use over a large range, as there was found to be a difference in the readings when the current was reversed, due partly to earth induction and partly to a small amount of retained magnetism. With the instrument as now constructed the difference in reading on reversal is found to be less than one-tenth per cent. with a range of 90 to 120 volts. The instrument is now supplied with a commutator by which its accuracy on reversal can be tested, and if there is any trace of retained magnetism it can be easily eliminated by rapidly turning the handle of the commutator for a short time, and so producing a series of rapid reversals in the current. It was stated that the instrument had been practically tested by being used on four or five voyages across the Atlantic, and had been found perfectly satisfactory. In the standard balance instruments intended for use with alternate currents, the base and the core of the coils were made of slate instead of copper, and a number of these instruments had been supplied for use at the Grosvenor Gallery installation. With reference to their adaptability for rough usage, it was stated that an instrument which had been damaged at a Belgian Custom House, and in which the lever had actually been bent, had been returned to the maker to have the lever straightened. After repair, this instrument was tested in Sir William's laboratory, and its variation was found to be only about one-twentieth per cent., a result due to the fact that according to the design of the instruments the working range is always in the neighbourhood of the minimum value of the force, and a small variation in the length of the ligament or centre of suspension has no appreciable effect on the calibration. Owing to the difficulty experienced in getting thick copper rings forged with accuracy, the fixed rings of the large current instruments, termed the hecto- and kilo-ampère balances, were made of a number of turns of tinned copper ribbon, wound in the proper shape, and then soldered together by heating the ring.

The indications of the original form of the direct reading vertical scale voltmeter, usually known as the "engine room voltmeter," in which one fixed and one movable coil were used, were found to vary slightly with the hygroscopic condition of the air owing to absorption of moisture in the movable coil, and it was necessary to test the instrument each time it was used, especially if it had been out of use for a few days, by stopping the current and removing the weight, and then observing whether the movable coil came to rest in the zero position. This was very inconvenient, and has been remedied by the use of two fixed pairs of coils. The variation of weight due to moisture in the two movable coils has no effect, as the coils are on opposite ends of the balance beam. The temperature correction is now made with great accuracy by simply setting a small flag on the balance to the number indicated by a thermometer attached to the instrument.

After the close of the description of these instruments, samples of which were exhibited, Mr. Preece alluded in complimentary terms to the great value of the different electrical measuring instruments designed by Sir William Thomson, and pointed out that electricians were entirely indebted to him and to Dr. Werner von Siemens, who was present at the meeting, for the introduction of instruments of precision for the purposes of electrical measurement. He stated that a considerable experience with the instruments described, and also of Sir William Thomson's older forms of instruments, had convinced him that they were, without exception, absolutely reliable.

Professor Ayrton, after alluding to the great importance of electrical measuring instruments which would give accurate results, and expressing admiration for the great skill shown by Sir William Thomson in devising instruments for exact measurement in all branches of physics, stated that he and Professor Perry had experienced difficulty in the use of platinoid springs, owing to their becoming oxidised and so undergoing changes in elasticity.

Professor Forbes, referring to an instrument among those exhibited, but which had not been alluded to in the present communication, mentioned that he had pointed out that a water tube used to prevent short circuiting when connecting the instrument with high potential mains would not work with alternate currents, and inquired whether Sir William Thomson had succeeded in getting over the difficulty.

Professor Fleming stated that he had used a standard balance almost daily for the last two years, and had found it absolutely reliable. A small standard balance instrument for currents ranging from a small fraction of an ampère to 3 ampères, he had found most useful for calibrating graded galvanometers in the lamp factory. The galvanometers were connected up in a single series every morning at 10 o'clock, and a current of 1 ampère, measured by Sir William's instrument, was sent through them, when each workman adjusted his instrument for the day. He stated that though the instruments looked somewhat complex, observations could be made with them in even less time than with a tangent galvanometer.

Mr. Swinburne pointed out that the Deprès d'Arsonval galvanometer, now so extensively used in France, and which was extremely dead beat, was simply one of Sir William's syphon recorders inverted.

Mr. Granville inquired whether the instruments, working with feebly saturated iron, would not be liable to error from vibration, as with feeble currents the magnetisation of iron was greatly facilitated by vibration.

Sir William Thomson, in replying to these questions, stated that in his experience platinoid was not liable to oxidation, and he had used a platinoid spring on a deep sea sounding apparatus, and though sea water was allowed to dry on it daily, no oxidation or change of elasticity was observed. Different specimens, however, varied greatly, and even specimens of the same wire showed great variation both in resistance and in the value of the temperature co-efficient. As platinoid was a substance which had only been recently manufactured, he thought this was due to defects in the process of manufacture, and suggested that the subject was well worthy the attention of physicists and chemists, owing to the great value of platinoid for electrical purposes. He was much indebted to Professor Forbes for his observation with regard to the water tube, and thought the explanation he had suggested the right one—viz., that the water was not electrified with sufficient rapidity to change the plates in time, and therefore the value of the potential obtained was not the true mean value. He had on this account abandoned the use of the water tube for alternate currents, and substituted a wire. With regard to the effect of vibration on the magnetisation of iron, he pointed out that more than thirty years ago Flinders had suggested for the correction of the compass the use of a soft iron bar, the magnetism of which would be reversed when that of the ship was reversed, as would be the case on crossing into the southern hemisphere. It was, however, found unsatisfactory, on account of its liability to sudden changes of magnetism from accidental jars. In experimenting on the subject, he had found that while this was the case with long thin bars, it was not so when the length of the bar did not exceed eight or ten times its diameter, and such a bar might be mounted near the compass needle, and then receive a blow from a mallet without any effect being produced on the needle. He had applied the same principle to the instruments in which feebly magnetised soft iron was used, employing an oblate with the equatorial diameter about double of the polar diameter, and he had then found no difficulty from vibration.

Books Received.

Journal of the American Chemical Society. Vol. IX., Nos. 6 to 10.

A Treatise on Mathematical Instruments. By J. F. Heather, M.A. Revised, with additions by Arthur T. Walmisley, M.Inst.C.E. 14th Edition. London: Crosby Lockwood & Son.

The Watch Makers' Hand Book. Translated from the French of Claudius Saumei, and considerably enlarged, by Julien Tripplin, F.R.A.S., and Edward Rigg, M.A. London: Crosby Lockwood & Son.

Cassell's Technical Educator. New and Revised Edition. Part I. London: Cassell & Co., Limited.

Wealth and Progress. By George Gunton. London: Macmillan & Co.

The Testing of Materials of Construction. By William Cawthorne Unwin, F.R.S., M.Inst.C.E. London: Longmans, Green, & Co.

Allan Glen's School and Technical Education. An address by George G. Ramsay, M.A., LL.D. Delivered at the distribution of Science and Art Department prizes and certificates to the pupils of Allan Glen's School, 22nd December, 1887.

A Pocket Book of Electrical Rules and Tables for Electricians and Engineers. By John Munro, C.E., and Andrew Jamieson, M.Inst.C.E. Fifth Edition, Revised. London: Chas. Griffin & Co.

Reports from the Consuls of the United States: Bimetallism in Europe. No. 87. December, 1887. Washington: Government Printing Office.

Counsel's Retainers. By E. B. G. London: William Clowes & Sons, Limited.

The Cornell University Register, 1887-88. Ithaca, N.Y.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Meeting, 21st February, 1888.

Hand Book of Brewing Calculations. By O. W. Villiers. London: Sheppard & St. John.

The Vosburg Tunnel: Description of its Construction. By Leo von Rosenberg, 35, Broadway, New York.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Meetings, 11th January, 1888, and 8th February, 1888.

A National Canal between the Four Rivers a National Necessity. By Samuel Lloyd. London: James Hogg and Sons.

Factory Accounts: Their Principles and Practice. Second Edition. By Emile Garcke and J. M. Fells. London: Crosby Lockwood & Son.

The Increase in the Produce of the Soil through the Rational Use of Nitrogenous Manure. By Professor Paul Wagner, Ph.D. Translated by George G. Henderson, M.A., B.Sc. London: Whittaker & Co.

The Proceedings of the Bimetallic Conference held at Manchester, 4th and 5th April, 1888. Published by the Bimetallic League, 5, Cross-street, Manchester.

The Rothamsted Experiments on the Growth of Wheat, Barley, and the Mixed Herbage of Grass Land. By William Fream, B.Sc. Lond., F.L.S., F.G.S., F.S.S. London: Horace Cox, *The Field* Office.

Reviews.

On a Surf Bound Coast, or Cable Laying in the African Tropics. By A. P. Crouch. London: Sampson Low, Marston, Searle, & Rivington.

"This book," as the preface states, "forms a portion of a diary kept during a cable laying expedition down the West Coast of Africa, commencing at the English settlement of Bathurst, on the River Gambia, 13° north of the equator, and terminating at the Portuguese town of St. Paul de Loanda, 8° south of it." The whole expedition occupied six months; but in this volume the author only treats of the first half of his travels, reserving, as he informs us, the publication of the remainder until he can estimate public encouragement of this class of literature. The reception of books of travel in this country is fortunately not uncertain, and we doubt not that Mr. Crouch's volume will find not a few appreciative readers. Many of his sketches of shipboard scenes and of places visited during the cruises are well drawn and true to life; but his sea experience has evidently been rather limited, and the range of his observation narrow, or so many very trivial entries in his diary would not have found their

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way into print. Again, his style is somewhat juvenile, for almost the only trace of that "go" which is usually associated with travel, is to be found in the title of the book. The author on the title page is Mr. Crouch; in his diary, however, he assumes the name of Bertram, and also bestows fictitious names on his ships and shipmates. We cannot see the necessity of so doing, as the author is not, or is not supposed to be, romancing. Perhaps there is no class of travellers who possess more ample facilities for observation than telegraph cable engineers; splendidly equipped, as they are, with scientific apparatus, and enjoying ample leisure, we are justified in expecting from them new light on some of the many branches of science which may be so enriched by extended observational research. Travel is common now, and probably the readers are growing fewer who are inclined to absorb pages of mess room gossip; but there is an ever increasing class to whom the traveller by sea or land may confidently appeal with fresh and vigorous descriptions and thoughts of distant men and countries, or new glimpses into the wonders of the ocean.

Labour Statistics: Returns of Wages published between 1830 and 1886. Parliamentary Blue Book C.—5172. 4s. 8d.

Statistics of wages are of so vast importance to the industrial community, that few will grudge the modest sum which is now voted for the office of Labour Correspondent and for the preparation and publication of blue books of labour statistics; but the public interest demands that such sums should be usefully spent, and those who wish to have the new Labour Bureau efficiently conducted ought to be most anxious in their insistence that none of the moderate sums devoted for its service should be fruitlessly expended. The bulky Blue Book which has recently been published is a compilation of figures about wages made from the periodical publications of the Board of Trade during the past fifty years. Even had these figures originally possessed any statistical value, their re-publication might have been objected to on the ground of its involving unnecessary expense; but since from first to last these figures are utterly void of significance as labour statistics, their re-publication is an unmitigated absurdity. The note by Mr. Giffen, which prefaces the tables, states that they have been based mainly upon returns obtained by circular from chambers of commerce throughout the country. They are, therefore, not official but distinctly amateur returns, made up without uniformity of method and with inevitably varying degrees of inaccuracy. The figures as they stand afford absolutely no basis for inductions as to wages movements during the past fifty years. The possibility of irregularity of employment affecting the result is scarcely hinted at, and in many cases the approximations are so wide (35s. to 50s. *e.g.*) that there is no possibility of drawing any conclusions from them. The volume before us consists of two parts; the first containing returns of wages in some dozen industries between 1832 and 1853, though in a few cases they date back to 1810, and the second containing returns of wages from 1855 till 1886. A third part is promised, the work upon which is described as "most laborious," and as involving considerable time to complete. This part will contain reprints of miscellaneous statements, which have appeared in Parliamentary papers and in the reports of Royal Commissions. It will also contain an attempted comparison of the figures as given in the two earlier parts. Part III. will, therefore, probably be of more importance than Parts I. and II., although its value may be largely discounted, so far as any of the conclusions it may contain are based on the figures published. Statistical science has on the Continent and in America, at all events, reached a much higher level than the mere huddling together, without rational arrangement, of sets of figures destitute of authority and destitute of value, even if they were authoritative. The Labour Bureau might do good work both of a practical and of a scientific order; but the three volumes which so far have been published during nearly two years of its existence, are simply a frittering away of public money. It is worth while for those who interested themselves in Parliament in the establishment of the Labour Bureau, to consider the advisability of its re-organisation with a staff of competent statisticians, or its abolition. As it is at present it is utterly useless for any purpose, whether practical or scientific.

The American Journal of Mathematics. Vol. IX. Nos. 3 and 4, 1887. Baltimore: Publication Agency of the Johns Hopkins University.

The eight volumes of the "American Journal of Mathematics" that have already been published are well known to mathematicians as containing original work in the field of pure mathematics of the very highest order, and the two numbers of the ninth volume that lie before us maintain the standard of previous issues. The form of the Journal, apart from its contents, is worthy of notice; its wide pages are admirably adapted for the lengthened formulæ of modern analysis, and compare favourably with the narrow pages of most English journals, in which it is frequently necessary to print the formulæ of a memoir so as to read from top to bottom instead of from side to side. Number 3 opens with a paper by Professor Cayley "On the Transformation of Elliptic Functions." In the earlier articles he makes a comparison of what may be called the $Mk\lambda$- and the $\rho\alpha\beta$-forms, discusses the connection of the $Mk\lambda$- and the $\rho\alpha\beta$-theories, and deals with the modular and multiplier equations. He then takes up the development of y in the form $y=\rho x\,(1+\pi_1 x^2+\pi_2 x^4+\ldots)$ where π_1, π_2, &c., are functions of ρ, α, β, and in connection with this theory considers the solutions of the problem of transformation given by Jacobi's partial differential equation, and by the Jacobi-Brioschi differential equations, and also develops the theory contained in his own memoir (in the Phil. Trans.) on the "Transformation of Elliptic Functions." The present memoir is an interesting one; but like most of Professor Cayley's papers requires a good deal of work to follow it thoroughly. "Forms, Necessary and Sufficient, of the Roots of Pure Uni-Serial Abelian Equations" is the subject of a very able memoir by Mr. G. Panton Young. He applies the term "uni-serial" to an abelian equation when the roots form a single circulating series. An idea as to the contents of the paper will best be given in Mr. Young's own words: "First, a criterion of pure uni-serial abelianism is established. A deduction is then given of the necessary and sufficient forms of the roots of pure uni-serial abelian equations of all prime degrees. Then the necessary and sufficient forms of the roots of the pure uni-serial abelian quartic are obtained by two different methods. Then the necessary and sufficient forms of the roots of the pure uni-serial abelian of a degree which is the continued product of any number of distinct prime numbers are found. Then the problem is solved for the pure uni-serial abelian of a degree which is four times the continued product of any number of distinct odd primes. Finally, from the relation between the solvable irreducible equation of prime degree n and the pure uni-serial abelian equation of degree $n-1$, the necessary and sufficient forms of the roots of the irreducible solvable equation of prime degree n are shown to be determinable for all cases in which $n-1$ is either the continued product of a number of distinct primes, or four times the continued product of a number of distinct odd primes." The memoir forms a substantial contribution to the theory of abelian equations. A table of the "Symmetric Functions of the 14ic," by Mr. W. P. Durfee, concludes the number.

In the second of the two numbers before us, the most important article consists of Lectures XXV.—XXXII. of Professor Sylvester's "Lectures on the Theory of Reciprocants." Mr. Hammond, who reports these lectures for the Journal, is, as might be expected from such a skilled algebraist, not merely a reporter; to him exclusively is due, as stated by Professor Sylvester, an important proof in Lecture XXIX. These lectures, the conclusion of which is promised for a subsequent number, will not be the least valuable of the numerous contributions their eminent author has made to the development of the more difficult branches of analysis. "Sur une Classe de Nombres remarquables" is the title of an article by M. Maurice d'Ocagne. The article is a study of certain numbers which have been met with by previous writers, but not systematically discussed. In addition to systematising known results, M. d'Ocagne gives some that are both new and interesting. His formula, numbered (42), is noteworthy. In a letter addressed to the associate editor of the Journal, M. Hermite, the distinguished French *savant*, communicates *inter alia* a treatment of the "Fourier Formula," which is, we believe, new to English readers; though M. Hermite intimates that the results had been previously obtained in a different way by the German mathematician Lipschitz. This is but one of many instances in which different investigators have independently reached the same results; yet the feelings supposed to be cherished towards those "*qui ante nos nostra dixerunt*" may often be pleasurably modified by the consideration that in mathematics methods are equally important with results. The latter part of the extracts from M. Hermite's letter is remarkable for the reconciliation of two apparently conflicting developments of the cosine in a product of primary factors analogous to that given by Weierstrass for the sine. The concluding paper of the number contains two proofs of Cauchy's theorem, "that $\int_1^2 wdz$ has the same value for any two paths joining the points 1 and 2, if w be a uniform and continuous function of the complex variable z throughout the area included between those paths" by Mr. F. Franklin. Both proofs are simple; the second, in particular, is extremely neat; the wonder is that it has not previously been given.

To mathematicians, the two numbers we have thus briefly noticed are full of interesting reading, and they will take a fitting place alongside their predecessors.

WATER GAS AS USED FOR METALLURGICAL PURPOSES.*

Some years ago a paper was submitted to this Institute on apparatus for making water gas by Messrs. Lowe & Strong. Since then, however, great improvements have been effected, principally by German engineers, so that the plant is now extremely simple and durable. Before entering upon the construction of the improved apparatus which is now used in Europe in the generation of water gas, a pause may be made to consider the reactions which are involved in passing steam through a mass of incandescent carbon. Steam, in passing through red hot carbon, produces a mixture of carbonic acid, carbonic oxide, and hydrogen, in which mixture the proportion of carbonic acid varies according to the temperature of the mass of heated carbon when the steam is passing through it. If this temperature is high enough, there is no carbonic acid produced at all, only carbonic oxide and hydrogen, so that the water gas which is obtained is composed theoretically as under:—

By volume.	By weight.
CO, 50 per cent.	94 per cent.
H, 50 per cent.	6 per cent.

As the temperature decreases, the proportion of carbonic acid increases, whilst the proportion of carbonic oxide in like manner decreases, so that finally the result would be the production of a gas composed as under:—

By volume.	By weight.
CO_2, 33 per cent.	92 per cent.
H, 66 per cent.	8 per cent.

Carbonic acid passed through carbon begins to be decomposed into carbonic oxide at a temperature of 550°C.; and at a temperature of 950°C. the production of oxide rises to 94 per cent., while at 1000°C. the transformation is completely obtained. Similar results are realised on passing steam through incandescent coke; at a temperature of 500°C. its decomposition to hydrogen and carbonic acid is complete. From 1000°C. to 1200°C. the carbonic acid is converted into carbonic oxide. The whole reaction is, therefore, as follows: The decomposition of steam produces hydrogen and carbonic acid, and by continued contact with the incandescent coke, the carbonic acid is transformed into carbonic oxide. It may be stated that a cubic metre of water gas develops in round numbers 3000 cals. Theoretically, the temperature produced is 2839°C. Combustion of the carbonic oxide to carbonic acid causes 3021 cals., that of the hydrogen 2649 cals. The first figure, therefore, constitutes a mean between the others. In regard to this, it may be mentioned that the figures given for the first and the third of these temperatures are evidently exaggerated. This slight inaccuracy must be attributed to the supposition that, whilst at these high temperatures, the specific heat remains constant in the case of steam, as in the case of carbonic oxide; but this cannot be the case, at least as far as steam is concerned, seeing that the experiments of MM. Langen and Mayer have proved that with this vapour dissociation commences at 1200°C., whilst with carbonic oxide no change is perceptible even at a temperature of 1690°C. A word should be said about a reaction which occurs also in the manufacture of water gas, viz., that of carbonic oxide on steam. In heating a mixture of carbonic oxide and steam, a reaction is set up (according to the experiments of Professors Nauman and Pistor) on carbonic oxide, which begins at a temperature of about 600°C., and produces carbonic acid and hydrogen. With an augmented temperature this reaction increases, so that at 900°C. there is produced 10 per cent. of carbonic acid. According to experiments made at Essen in the water gas generator, where ordinary steam was replaced by a mixture of water gas and steam, and the mixture then passed through the generator at a high temperature, the whole of the carbonic oxide contained in the water gas was finally reduced to carbonic acid. As one kilo. of oxygen, in reducing carbonic oxide to carbonic acid, gives more heat than when it is employed with hydrogen to form water, the operation which we have described is accompanied by an evolution of heat. It will now be seen how these facts, derived from experiments, can be practically utilised. In all water gas apparatus the principal part consists of a generator, in which the fuel, by the aid of an air blast, is raised to a high temperature, to be afterwards cooled by a jet of steam for the production of water gas. During the heating up by means of the blower, Siemens or generator gas is produced, whilst the cooling effected by the steam produces water gas. The characteristic, therefore, of the water gas generator consists in producing alternately Siemens gas and water gas. According to the use which it is desired to make of the Siemens gas, the fuel which is used, and the manner of passing the steam or passing the air, or *vice versâ*, there has arisen a combination of apparatus of different construction. A description will be given of one amongst these. At the beginning of the operation the gas is entirely free from carbonic acid and steam. In proportion as the mass of combustible is cooled, the gas acquires a larger quantity of one or the other. The passage of 1100 litres of gas into a condenser yields 24cm. of water, which is equivalent to 4 per cent. by weight. The fuel employed by preference in Germany is the small coke easily obtained from the residue of the fires of puddling or heating furnaces, or coke obtained directly from coke ovens or gas works. In any case, the percentage of sh varies from 10 per cent to 30 per cent.: frequently it is from per cent. to 20 per cent. It is desirable, then, to construct the s erating apparatus in a form from which large quantities of c ers may be easily withdrawn, and to make it durable. Thi problem has been resolved by the adoption, in the lower part of the generator, of a water ring, which obviates the use of a grate, and protects that part most exposed to heat and to destruction by the slag. This water ring is arranged so that beneath it there is an open annular space, round which the air enters during the blowing operation. It is also by this that the water gas escapes which is produced by the next process. The slag is thus deposited on the conical surface of the fuel, in a covering which extends up to the opening of the water ring, and the cinders may be easily withdrawn by means of four cleaning doors. The cleaning out

* A paper read by Mr. A. Wilson, before the Iron and Steel Institute, on May 9th, 1888.

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is done every six hours, and occupies from fifteen to thirty minutes, according to the quantity of cinder produced. In blowing in the air, the cold blast arrives against the surface of the lower part of the ring and cools it, and so carries away the radiant heat thrown off at the bottom. This radiant heat, further, only exists, or has no importance, except just after cleaning, when the slags which have been deposited have been removed. The almost immediate formation of a new layer of cinder or slag then prevents much loss by radiation. The matter is different during the operation of gas making; the water gas escaping at a temperature of from 1200°C. to 1500°C., imparts its heat to the lower part of the water ring, and this is carried off by the cooling water; but this quantity of heat would in any case be lost, seeing that it must be disposed of before the entrance of the gas into the gas holder. It matters little, therefore, whether this abstraction is commenced by the water ring or whether it is effected entirely in the scrubber. The first water gas plant successfully put to work for practical use in Europe was erected by Messrs. Schulz, Knaudt, & Co., at Essen, and consisted of two generators, each capable of producing 10,000ft. of water gas per hour. These generators are about 6ft. 6in. external diameter by 18ft. high. The gas, on leaving the scrubber, passes by a cast iron pipe to a gas holder of about 40ft. diam., and situated about fifty yards from the generator house. From this holder the gas is led away by mains to the various welding furnaces; and another portion is taken from the holder expressly for lighting purposes, and this portion only is passed through the purifier to remove carbonic acid and sulphur compounds. The generation of the gas is so rapid, that when the steam is passed into the fuel, the holder rises some feet at one operation, and may easily be observed to be rapidly ascending. As to the other details of the apparatus which is at work at Essen, in the works of Messrs. Schulz, Knaudt, & Co., it should be stated that

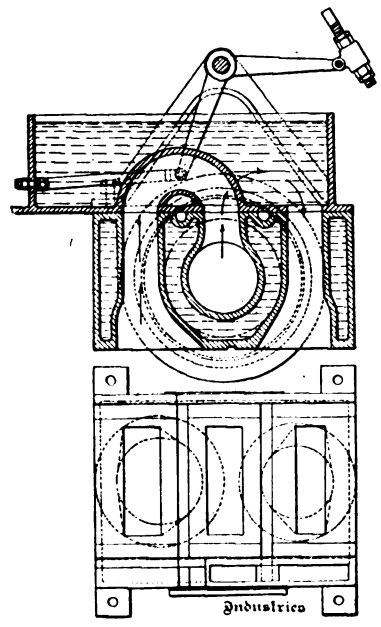


Fig. 1.

it was constructed on the system of Strong's patent, at least so far as concerns the employment of a double regenerator, heated by the hot gas which escapes when the air is blown in, intended to superheat the steam serving for the production of water gas; and this steam did not pass through the incandescent mass of coke except in a superheated state. In working the apparatus it was soon found that the complete combustion of the Siemens gas had a tendency to cause a rapid destruction of the bricks in the regenerator, and this not only on account of the very high temperature, but also on account of the cindery dust—the combustible containing as much as 25 per cent. of ash. When this was ascertained, the top supply of air to the regenerator was stopped, and the regenerator chambers were only heated by the sensible heat in the Siemens gas; that is to say, to a temperature of about 500°C. In consequence of this, the steam was not highly superheated, but the consumption of fuel did not increase in the proportion which had been feared; further, the yield of the apparatus increased to a notable degree, because the quantity of air furnished by the blower, instead of being divided into two parts, for the top supply and the bottom supply, was entirely utilised for the latter, and the heating up did not require more than half the time previously employed. This had the effect of doubling the production of water gas, *i.e.*, a production which at first not being more than 120cm. per hour, rose to from 250cm. to 300cm. per hour, without any sensible increase in the consumption of fuel. After being transformed to gas by the action of the fuel, of which the lowest part is heated to whiteness, whilst the upper part is of a dull red, the steam passes by way of the first named portion through a hydraulic lute communicating with a coke scrubber. Cooled in this manner, the gas enters the gas holder. In order to prevent any danger of the blast passing by leakage along with the gas, an ingenious and highly successful slide valve was introduced by Mr. Blass, of Essen. The construction of this is indicated on diagram Fig. 1, by which it will be observed to consist of a D valve, sliding on three ports, and provided with an open water trough to keep it cool; whilst in the face of the valve between the ports grooves are cut, so that any leakage of air or gas respectively must pass to the atmosphere instead of forming mixtures in the pipes, which might prove dangerous. When once the charge is heated up, the steam is admitted for the production of water gas for about five minutes, when the valves are reversed simultaneously, and the charge is blown up to restore heat during about ten minutes, the various movements of the apparatus being all controlled in a convenient manner by one lever or hand wheel. Owing to this construction the generator is converted into a machine, and for three years its mechanism has worked with perfect regularity, whilst the repairs needed by the brick lining have been of a most trifling description. Employing ten minutes for blowing up, and five minutes for the manufacture of water gas, each generator

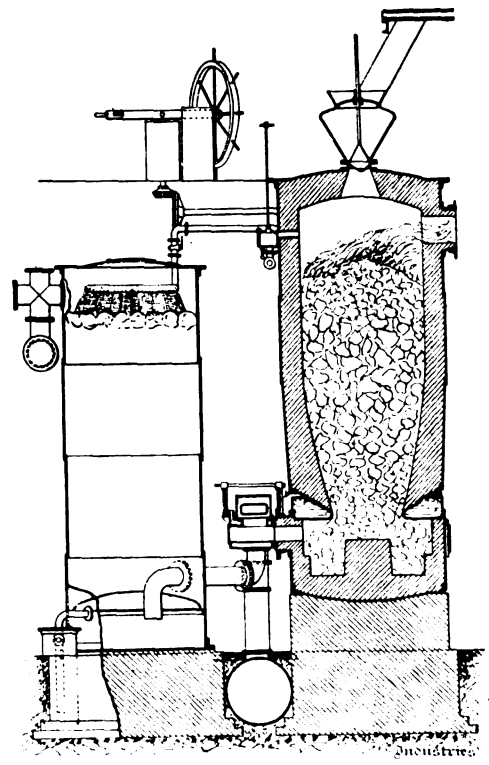


Fig. 2.

produces from 250 to 300 cub. m. per hour. The carbonic acid never exceeds 4 per cent., so that the final result is a gas composed of 5 per cent. nitrogen, 4 per cent. carbonic acid, 41 per cent. carbonic oxide, and 50 per cent. hydrogen. The next plant put to work was erected at the Witkowitz iron and steel works, in Austria, and consisted at first of two generators, each capable of making 20,000ft. of water gas per hour (the construction of these is indicated by Figs. 2 and 3), also the necessary scrubber and gas holder. In this case the water gas is used for driving

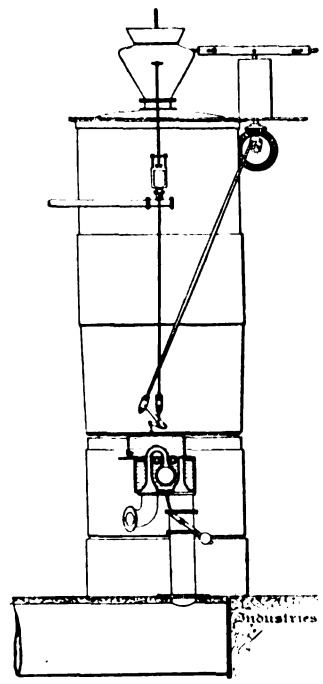


Fig. 3.

open hearth steel melting furnaces, and for lighting the works on the incandescent system, which will be shortly described, whilst the generator gas is used for firing the boilers. As regards the construction of the steel melting furnaces, it may be observed that only two regenerator chambers, instead of four, are employed, and this arrangement tends to simplify the construction of the furnace, and reduce the wear and tear and first cost. With only one pair of regenerators, which are used for heating the air, the temperature is so high that very great rapidity is attained in working, no less than five charges being got out in twenty-four hours, with a proportion of scrap of less than one-third. Five hundred cubic metres (=17,655 cub. ft.) of water gas is used per ton of ingots; and the manager, Mr. J. Langer, expresses himself as convinced that there is a great advantage in using water gas for steel melting, always provided that the generator gas which is produced at the same time is employed for boiler firing or similar purposes. There is no doubt that, if the furnaces were of a larger size, such as are generally used in this country, say, working from ten to twenty ton charges, the consumption would be very much smaller. Water gas is also employed at Witkowitz for heating the billet furnaces, the consumption being 270 cub. m. (= 10,000 cub. ft.) per ton of steel billets rolled. At Witkowitz the fuel used is small coke, and the water gas produced amounts to about 33,000 cub. ft. per ton of fuel, along with about 130,000 cub. ft. of generator gas, which, as before mentioned, is used for firing boilers. At Hoerde, a very extensive water gas plant has been erected by Mr. Massenez, who intends to use the water gas generally for melting and heating, also for lighting the works, and the generator gas for boiler firing. A similar plant has been erected by Mr. Sampson Fox, at the Leeds Forge Company's works, for welding flues and illuminating. A smaller generator, for the production of about 2000ft. of water gas per hour, is shown in Fig. 4. As this is designed particularly for lighting purposes, the greatest simplicity was aimed at in its design. The draught is obtained by a small steam jet exhauster sucking out at the top, and this combination possesses the following advantages: During the blowing up it is impossible for the air to pass the hydraulic seal and escape to the gas holder, this seal being sufficiently heavy to resist the suction without materially augmenting the back pressure during the manufacture of gas; the suction also allows of the extraction of ashes during the heating up without work being stopped. The small opening through which the charging is done serves alternately for the chimney. A plate, provided with three openings radiating from a pivot, is turned by means of a hand wheel into three given positions. In the first there is a chimney provided with the aspirator, in the second there is a charging hopper, and in the third there is a cover plate. To work the apparatus, therefore, the attendant has nothing to do but to turn his wheel to right or to left during intervals which are exactly determined by experience, or, more particularly, by analysis. This apparatus consumes 3lb. of coke, containing 14 per cent. of ash and 5 per cent. of water, in making 35 cub. ft. of gas. There is included in this figure such coke as is uselessly

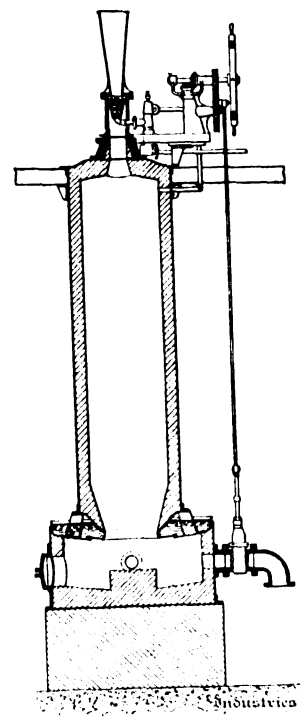


Fig. 4.

consumed during the night. The blowing up is continued ten minutes, after which the manufacture of gas occupies five minutes; the quantity of water used by the water cooling ring is about 750 gallons per day of twenty-four hours. It should also be mentioned that the water runs during the night as well as when the gas is being made. The first generator of this size was erected by Mr. Pintch, whose name is well known in connection with railway carriage lighting, and it is used for illuminating his works at Furstenwald, near Berlin, as well as the railway station adjoining, with all the signal lamps, &c. Another of the same size has been erected by the author at Stafford, and may be seen at work at any time. It should also be mentioned that water gas plants are successfully at work at the Terni Steel Works in Italy, and in the engineering shops of Messrs. Sulzer Brothers, Winterthur, Switzerland. Water gas is made in America almost exclusively for lighting by carburation. In Europe this has not been practised, partly on account of the price of petroleum refuse. In the first apparatus constructed in Germany there was no object in view but the production of heating gas for metallurgical work, or that which limited its employment to heating and melting purposes. It was then found that the water gas burnt without an excess of air, and produced so high a temperature that a platinum wire was melted by being placed in the open flame; this corresponds to a temperature of 1700°C.—the highest temperature recorded by Rosetti with a Bunsen burner using coal gas being only 1350° ("Annual Report of Chemical Technology, 1887"), a heat which does not approach that of water gas. According to the experiments of Aime Witz ("Annals of Chemistry and Physics"), lighting gas only develops 4000 cals. to 5000 cals. instead of 6000 cals., as before supposed. It accrues from this, that this gas, owing to the rapidity of its combustion, has a reduced flame area, and consequently is less cooled on the surface by radiation. A flame of ordinary gas, with the same speed of consumption, possesses a surface six times as large as the water

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gas flame; and although a cubic metre of lighting gas produces theoretically double the heat by its combustion, the temperature of the flame is at the same time much less. Thus, in a small trial furnace, Bessemer steel was easily melted by water gas and cold air, and poured out in a perfectly fluid state. But the best proof which it is possible to have of the high temperature of water gas is found in the incandescent magnesia light on Fahnejelm's system. This constitutes the very best system of gas lighting by incandescence, and it may be described as follows: The flame heats a comb, composed of little magnesia rods, to whiteness, producing a light superior to the incandescent electric light, but without having the bluish tinge of the arc lamp, and consequently resembling more nearly the splendour of sunshine than any other existing system of lighting. This light possesses, besides, the advantage of absolute steadiness. This follows from the circumstance of having a certain mass of matter in an incandescent state, requiring an appreciable time to cool it and to effect a variation in the power of the light, and consequently preventing any irregularity in the luminosity of the flame. In order to obtain the same quantity of light by this system, it is necessary to consume the same quantity of gas as of coal gas. With a consumption of 150 litres per hour (=5·3 cub. ft.), a magnesia comb gives at first a photometric power of from 20 to 22 candles; after fifty hours it gives but 15 candles; and after one hundred hours only 10. The combs cost 1½d. each, so that their consumption amounts to about one farthing per hour, and per cubic metre of gas consumed the price amounts to one pfenning (1·25 centimes), equal to 2¾d. per 1000 cub. ft. The magnesia comb is supported by a wire, slipped into a socket on the carrier of an ordinary gas bracket. The burners used are exactly the same as those used for town gas, and so are the globes and all the fittings concerned. In substituting lighting by incandescence with water gas, therefore, no changes whatever are necessary in the existing pipes and gas fittings. The magnesia combs, being quite loose, may be removed and replaced in a moment. As before mentioned, this system of lighting has been adopted with great success at several large works on the Continent, and it is also largely used in America; and seeing that it offers a convenient and beautiful means of illuminating, possessing the convenience of town gas with the brilliancy of the electric light at less than half the cost of either, it must commend itself for adoption in this country also. On these grounds, it was thought by the author that some mention of this system of lighting in connection with this paper would be of interest to the members of the Institute, although perhaps the subject possesses the greatest importance to those present from a metallurgical standpoint. It may be well, before concluding, to revert shortly to the economic aspect of the question of the use of water gas in large quantities for steel melting and such purposes, as compared with the cost of the gaseous fuel at present generally used for the same purposes. The most approved and economical types of generator for making producer gas are worked by a mixture of air and steam, and make in reality a mixture of producer and water gas simultaneously. The water gas generators are alternately worked by air by itself to make producer gas, and then by steam by itself producing water gas; thus the same gases are ultimately produced by each system, but in the water gas plant they are separated. As the cost of the fuel and attendance is about the same in each case, as is also the loss of heat by external radiation, there can be no material difference in the value of the heating gases produced by either system, at a given cost for fuel and otherwise; thus in the manufacture of water gas, when this is averaged together with the producer gas necessarily generated in the operation, the cost of the water gas is, as demonstrated below, practically the same at that of the mixture known as generator or producer gas; and it cannot, therefore, be more expensive to use water gas for any operation than producer gas, when the value of the latter, also produced by the water gas plant, is credited, as it can be in any works where there are boilers, &c., to be fired. At the same time the separation of these gases, so as to have the water gas by itself, has very important collateral advantages and economies which are of great value. In the manufacture of water gas, if the water gas and the producer gas, also made separately, are subsequently mixed, the analysis of the mixture is substantially almost identical with producer gas made in the best and most economical manner, thus proving that the heating value of the gas made from the fuel is the same by each system, and the value received practically equal. Producer gas: One ton of slack coal, at 5s. 6d. per ton, yields of this gas about 150,000 cub. ft., equals per 1000 cub. ft., 0·44d., or slightly under one halfpenny per 1000. Water gas: One ton of inferior coke, at 6s. 3d. per ton, yields of this 35,000 cub. ft. of pure water gas, and about 140,000 cub. ft. of generator gas equals 175,000 cub. ft., equals per 1000 cub. ft. of the whole of the gas produced, 0·43d., or slightly under one halfpenny per 1000. The cost of steam raising and labour is the same in each system for the same analysis of mixed gases.

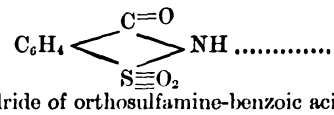
SACCHARINE, A NEW COAL TAR DERIVATIVE.

By Dr. Otto N. Witt.

Some two years ago, a new departure was made in the technology of coal tar derivatives by the production of an artificial sweetening stuff, called saccharine. This invention, made in the United States by a German chemist, Dr. Constantin Fahlberg, created an immense sensation when it was first published in 1886. As usual in such matters, the value of the invention was considerably exaggerated, and it is only now that we begin to have a somewhat clearer conception of its intrinsic merit.

Like all coal tar derivatives, saccharine belongs to the so-called aromatic series of organic substances. This series contains a very large number of useful substances, especially colouring matters and perfumes. Saccharine is the first among their number which claims a place amongst alimentary preparations. The fact that a compound of this series has a sweetening property is by no means so novel as has been supposed both by the public and by many scientific chemists. Those who are in the habit of working with aromatic compounds, know how exceedingly sweet many of them are. I remember very well a visit which I paid in the early spring of 1876 upon Dr. Peter Griess, the eminent chemist, of Burton-on-Trent. It was on that occasion that Dr. Griess demonstrated to me the excessive sweetness of baric orthonitrobenzoate, a comparatively common aromatic preparation; and I was in a position to reciprocate by explaining how, in the reduction of binitrobenzene, vapours of an extremely sweet taste were produced, and that the appearance of these sweet vapours was a reliable indication of a certain stage of the process having been reached. These two instances may suffice to show that saccharine is neither the first nor the only sweet compound among aromatic substances. It is, however, distinguished from its congeners by its apparent harmlessness. As far as has been ascertained hitherto, saccharine has no action whatever on the human organism. It is this peculiarity, comparatively rare amongst aromatic compounds, which qualifies saccharine as an admixture to human food. This virtue of saccharine is, however, also its fault. It does not injure our organism, but it has no nourishing properties whatever. For this reason saccharine is unable to do what at first was thought it would do in replacing sugar. The latter is not only sweet, but it has also strongly marked nourishing properties. Saccharine is only fit to tickle our palate; it is a mere luxury, a concession to our taste. Its proper use is, therefore, restricted to the comparatively few occasions where the sweetness of sugar is required without its nourishing properties—cases to be mentioned presently.

Before, however, entering into the details of the use of saccharine, I shall say a few words about its constitution, and the mode of its production. It has already been mentioned that orthonitrobenzoates are endowed with a remarkably sweet taste. Saccharine is also an ortho compound, and it is remarkable that its isomerides of the meta- and para- series are not sweet. For its manufacture this is a serious drawback. For, as we shall presently see, large quantities of the para- compound are formed together with the ortho derivative in an early stage of the process. The formation and consequent separation of this para-isomeride not only complicates the process of manufacture, but it also encumbers it with large quantities of a useless by-product. The constitution of saccharine is given by the following formula:—



(1)

it is the anhydride of orthosulfamine-benzoic acid. Only ortho compounds are capable of forming such anhydrides; parasulfamine-benzoic acid, for instance, exists in a free state, and cannot be induced to form such an anhydride. It is necessary to know this in order to understand one of the patented processes for the manufacture of saccharine. There is, chemically, only one way practically possible to obtain this interesting product. We start from toluene, a hydrocarbon which is largely prepared from crude benzole, and is now an article of commerce, in a state of perfect purity. Toluene is methyl benzene, and its transformation into saccharine is readily accomplished by a series of successive operations.

The first of these has for its object the introduction of the necessary sulpho group. It consists in treating toluene with sulphuric acid at a temperature below 100°C. This operation presents no practical difficulties whatever. It is strictly analogous to similar processes practised many years since in the manufacture of artificial dye stuffs. The acid is mixed with the toluene in a cast iron vessel, which is jacketed so that it may be heated by steam. A closely fitting lid prevents the hydrocarbon from evaporating, and a mechanical stirrer produces an intimate contact between the two ingredients. Gradually the toluene dissolves in the acid, and thus disappears entirely. When the operation is finished the contents of the vessel form a thick dark liquid which is readily soluble in water. In order to separate the toluene-sulphonic acids formed from the excess of sulphuric acid, quicklime is added. The calcic sulphate formed is insoluble, and may be separated from the solution of the calcium salts of the new sulpho acids by means of a filter press. The calcium salts are then transformed into the corresponding sodium salts by the addition of the necessary quantity of sodic carbonate. By renewed filtrations a solution is obtained, which, on being evaporated, yields sodic toluene-sulphonate in a state of purity. It is in this stage of the manufacture that the unwelcome formation of an isomeride takes place, which is not required, and the subsequent removal of which is both troublesome and costly. If the sodium salt, which is the outcome of this operation, be examined, it is found to consist of two isomerides belonging to the para- and ortho- series of benzene derivatives respectively. The ortho compound only is required, but its proportion never exceeds 50 per cent. of the mixture, whilst the useless para derivative is present in at least an equal quantity. It is not possible to separate these two isomerides by fractional crystallisation. The whole mixture has, therefore, to be subjected to a treatment forming the second stage of the manufacture. This second stage has for its object the production of the chlorides of the new sulpho acids. It is here that the manufacturer of saccharine encounters the greatest difficulties. One method only is known for the production of the chlorides of organic acids. It consists in treating these acids or their salts with phosphorus pentachloride. Now this latter substance is among the most unpleasant and dangerous ones to deal with. It is very volatile, and its vapours are most irritating. In order to avoid the use of this dangerous and disagreeable compound, the inventors work with phosphorus trichloride, which, although still dangerous and disagreeable in the extreme, is liquid, and therefore allows of more easy manipulation. According to the patent specification, the dry sodium toluene sulphonate is mixed in a finely powdered state with phosphorus trichloride, and a current of dry chlorine gas is introduced into the mixture. Earthenware or enamelled cast iron vessels are used in all probability for this operation. Phosphorus oxychloride is formed in the process. This is distilled off when a mixture of the two isomeric toluene sulpho chlorides with sodic chloride remains in the still. Of these two sulpho chlorides the para compound solidifies on cooling, whilst the ortho compound remains liquid. They can, therefore, be easily separated by filtration and pressure. The solid para compound forms the by-product of the manufacture, whilst the liquid ortho compound alone enters the third stage of the process.

It is in this stage that the amido group is introduced into the molecule. This is easily accomplished by either leading a current of dry ammonia gas into the liquid chloride, or by mixing it intimately with dry ammonium carbonate, and heating the mixture. The orthotoluene sulphamide formed is a solid; it is washed with water in order to free it from the ammonium chloride formed in its production, and thus rendered fit to undergo its last transformation into saccharine.

Orthotoluene sulphamide is, as its name implies, still a derivative of toluene. If it be exposed to gentle oxidation, the methyl group which it contains, and which, so far, has remained unchanged, is attacked, and transformed into the carboxyl group. By this transformation the compound ceases to be a derivative of toluene, and becomes a derivative of benzoic acid, viz., sulphamine-benzoic acid, which, however, as has already been explained, being an ortho compound, immediately on being liberated from its salts forms its anhydride saccharine. The practical method of bringing all this about consists in an oxidation with permanganate of potassium. In order to obtain satisfactory results, it is necessary that the liquid be always strictly neutral. Free alkali is liberated, as a rule, in permanganate oxidations. In order to counteract the injurious action of this alkali, a sufficient quantity of sulphuric acid has to be added, along with the permanganate, to insure the strict neutrality of the liquid. Manganic peroxide is formed in the process; but this is separated from the liquid by filtration. The clear, colourless filtrate is a solution of potassic sulphamine benzoate, which, on addition of an acid, immediately deposits saccharine in white crystals.

This process, which has been patented by Dr. Fahlberg and the heirs of Adolph List in Leipsic, has been slightly modified in a subsequent patent. The first stage of the process remains the same; it is followed by the oxidation process, and thus a mixture of the two isomeric sulphobenzoic acids is produced. These are transformed into their chlorides by being treated with chlorine gas in the presence of phosphorus trichloride. Thus the two isomeric sulphobenzoic dichlorides are formed. These are treated with ammonium carbonate. By this treatment the para derivative is transformed into sulphobenzoic diamide, which is quite insoluble in water. The ortho compound, on the other hand, yields ammonium sulphamine benzoate, which is soluble in water, and may thus be separated from the para-diamide. The aqueous solution thus obtained is acidulated, when saccharine settles out in white crystals.

For carrying out these processes the patentees have erected works in Salbke-Westethusen, near Magdeburg. Considerable practical difficulties seem to have been encountered at first in the manufacture, for it is rather less than a year that the works have been able to supply the numerous orders received. It is, therefore, a comparatively short trial to which the new product has been subjected. In conjecturing, as I shall now try to do, the probable use and importance of the new product, I have but few practical results as a basis, and must speak with due reserve. Saccharine has, of course, to be compared with cane sugar. Now, it is quite clear that the complicated process of its manufacture does not allow of its being produced at anything like the cost price of sugar. If, therefore, its sweetening power were only equal to that of

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sugar, its future would be hopeless. The sweetness of saccharine is, however, quite extraordinary. Of course it is difficult to establish the ratio of sweetness of two substances. It is, however, asserted by competent and impartial judges that saccharine is *two hundred and thirty* times sweeter than the best cane or beetroot sugar. A very small quantity of saccharine will, therefore, go a long way, and may, even at a high price, prove cheaper than sugar. Opinions differ as to the exact "shade," if I may so call it, of the sweetness of saccharine. Some say that its taste is exactly identical with that of the best sugar, others find a marked difference in favour of sugar.

The question is: Have we any reason or inducement to replace sugar by another sweetening agent, and if so, in what cases?

When saccharine was first brought before the public, it was believed by many persons that it would readily supplant sugar in all its uses. At present this opinion is no longer held even by very sanguine judges. To begin with, there is the impossibility of producing sufficient quantities of toluene to provide for the world's want of sugar. Then, saccharine is a mere sweetening agent, whilst sugar is strongly nourishing. Even if we could procure saccharine at the price of sugar (in the ratio of its sweetening power) we would have to eat so much more bread, in order to make up the loss of food by discarding the sugar. Again, although saccharine has on short trials proved quite harmless even in large doses, it is not known what effects it may produce on being taken continually.

There are, however, certain applications in which saccharine does not compete with sugar; and for these it has rapidly gained general favour, and is sure to take and hold a permanent place. One of these applications is based upon the fact that saccharine, with its excessive and overwhelming sweetness, is capable of covering very strong disagreeable tastes. Thus medicines of very unpleasant taste, such as quinine, strychnine, and others, have been made palatable by being combined with saccharine. Saccharine also renders most valuable help in the treatment of certain diseases, in which, like diabetes, a craving for sweet food exists, whilst sugar is prohibited in the patient's diet. In such cases saccharine is a boon and a blessing, for it supplies the necessary sweetness, without participating in the economy of the patient's body. Saccharine is now already very largely used in the treatment of diabetes, and all kinds of preserves, formerly forbidden to the patients on account of the sugar they contain, are now manufactured with the addition of saccharine. Saccharine champagne, saccharine fruit jellies, and coffee and tea sweetened with saccharine, are now common articles of diet with patients suffering from this widespread disease.

Another application has been proposed for saccharine, which, if it be carried out practically, may assume rather large proportions. It has of late been demonstrated that grape sugar may be produced in a practical manner from potato starch in the shape of hard, white, glittering crystals, very much resembling cane sugar. Grape sugar is, however, less sweet than cane sugar, and cannot therefore compete with the latter, although it is quite as nutritious and wholesome. It has therefore been proposed to impregnate pure crystallised grape sugar with such a quantity of saccharine (very little would be sufficient) as to make it exactly as sweet as cane sugar. It would then be able to hold its own against the latter. There is no reason why this suggestion should not be carried out, provided always that saccharine be proved to be harmless, even on prolonged regular use.

Besides its sweetening power, antiseptic properties are also claimed for saccharine. No conclusive experiments seem, however, to have been made as yet in that direction, and it remains for the future to show whether saccharine may justly claim a place in the large array of antiseptic substances for which there seems always to be a want.

Notes.

ELECTRICITY IN THE NAVY.

A REPORT has been prepared by the Engine Room Telegraph Committee, which has been sitting at Portsmouth for the last year, and following out their recommendations the whole of the ships of the "Admiral" class will be fitted with the electric telegraph in addition to the customary mechanical telegraph for communicating between the bridge and the engine room. It is also announced that as the ventilation of the dynamo flats in these ships is so bad that it is nearly impossible for the men to live in them for any length of time, it has been resolved to provide them with peace fittings in the shape of additional dynamos to be placed on the main deck. These will be 100-ampère machines. In time of war the service dynamos, which are below the water line and are protected from shot, will be used for the search lights and glow lamps. Another innovation is to be introduced whereby four projectors will be fixed in each of the Nordenfelt projections at the corners of the superstructure deck, so that in case of an expected torpedo attack the ships will be able to surround themselves with radial beams of light.

BRAZILIAN IMPORT TRADE.

IN reporting on the trade of the province of Saõ Paulo, Brazil, the British Consul at Santos says that in the import trade Great Britain takes the first rank, and may be considered as progressing. Indications exist that the British manufacturer is becoming alive to the necessity of overcoming foreign competition, and that in certain trades, such as glass and earthenware, which were mentioned in the last report from this Consulate as passing into German hands, we are regaining the lost ground to some extent. The Consul, however, points out that much care and attention is required to enable our manufacturers to keep pace with their rivals, as the Germans are constantly improving in design and make, and are always prompt to study the particular requirements of the market.

THE ROYAL AGRICULTURAL SOCIETY.

THE annual report of this Society states that during the past year 393 new members were elected, and that the Society now consists of sixty-six life governors, fifty-six annual governors, 3521 life members, 5225 annual members, and sixteen honorary members. An excellent site for the country meeting of 1889 has been selected in Windsor Great Park, and the Council have every reason to anticipate a satisfactory and successful jubilee meeting. Her Majesty the Queen has consented to accept the position of President of the Society in the coming year. It has been decided by the Council that the country meeting of 1890 shall be held in the district comprising Berkshire, Cornwall, Devonshire, Dorsetshire, Hampshire, Kent, Somersetshire, Surrey, Sussex, and Wiltshire.

LOCOMOTIVES FOR TOWING ON CANALS.

FROM the remarks made by many of the speakers at the recent Conference on Canals at the Society of Arts, it might be supposed that railways and canals are irreconcilable antagonists. Last week, however, an experiment was made on the Shropshire Union Canal at Worleston by officials of the London and North-Western Railway which is suggestive of the lion lying down with the lamb. A set of rails of 18in. gauge was laid down on the canal bank for a distance of about a mile, and a small locomotive from the Crewe railway works was placed on the line. When steam was up two boats were attached by ropes to the locomotive, which drew them along easily at the rate of seven miles an hour. Four boats were then attached, and the same speed was attained. The locomotive worked very smoothly, and the experiment is looked upon as a success.

LARGE SUGAR REFINERY AT PHILADELPHIA.

IN our issue of 27th April our Philadelphia correspondent referred to the new sugar refinery which was to be erected in that city by Mr. C. Spreckles. Some further details are now given by the British Consul at Philadelphia, who states that some of the buildings will be nine storeys high, others eleven storeys: the cost of construction, &c., will be between three and four million dollars, which will include the construction of the buildings and the necessary machinery. The number of men required to keep such an extensive establishment running to its full capacity will be 1500. The consumption of coal will be 250 tons daily, and 15,000,000,000 gallons of water will be required per annum. The raw sugar, beetroot, and cane, to a large extent will be imported by Mr. Spreckles direct from the West Indies and Germany. An ordinary steamer's cargo will be consumed every two days, averaging a daily output of 600 hogsheads. Centrifugal beetroot sugar will be used, about one-third being mixed with two-thirds of cane, and the product will be cube, cut loaf, granulated, and various yellow sugars.

A NEW OIL REGION.

CANADA seems likely to become, at no very distant date, a competitor for a share of the world's petroleum trade. The existence of oil fields in the North-West Territory has long been known, but until recently they were regarded as unimportant. About a year ago Professor Bell discovered that the extent and probable productiveness of the Athabasca River petroleum field had been much under-estimated. He found surface indications of oil over a wide tract of country stretching for about 150 miles along the course of the river, and approaching to within a short distance of the Grand Rapids. He furthermore stated that boring would probably reveal the presence of oil over a very widely extended area. These views have received general corroboration from the newly published report of the Government Committee appointed to examine into the resources of the Great Mackenzie Basin. The report states that "the evidence submitted to the committee points to the existence in the Athabasca and Mackenzie Valleys of the most extensive petroleum field on the American continent, if not in the world." The transport difficulties to be overcome are considerable, but by no means such as to debar the product from European markets.

LIFTS ON CANALS.

IN the course of a paper on canal engineering, read by Mr. L. F. Vernon Harcourt, at the recent Conference on Canals and Inland Navigation, held at the Society of Arts, the author stated that the adoption of hydraulic lifts for connecting two reaches of a canal, where the difference of level is considerable, appears to be growing in favour at the present time. The system is comparatively modern, for though a simple lift, with two counterbalancing troughs, lifted and lowered 8-ton barges a vertical distance of 46ft. on the Grand Western Canal many years ago, it was subsequently abandoned. The first hydraulic lift was erected at Anderton, in 1875, for connecting the River Weaver with the Trent and Mersey Canal. The difference of level is 50½ft.; and the barges are raised or lowered in two wrought iron troughs, 75ft. by 15½ft. with 5ft. depth of water, each resting on a central hydraulic ram, 3ft. in diameter, working in two hydraulic presses underground, which can be connected at pleasure, making the troughs counterbalance one another. One trough accordingly ascends as the other descends, the motion being imparted by removing 6in. of water from the lower trough; and only the final lift of about 4½ft., required when the descending trough reaches the water in the lift pit, has to be effected by hydraulic power. The whole lift is accomplished in 2½ minutes, and one 100-ton barge can be transferred from the river to the canal, and another from the canal to the river, in eight minutes, with an expenditure of only 6in. depth of water over the area of one trough, and the power required for the final short lift. A similar lift, on a somewhat larger scale, has recently been opened at Les Fontinettes, near St. Omer, on the Neufossé Canal, in place of a flight of five locks, which were inadequate for the traffic. The height of lift is 43ft.; and each trough is 132¾ft. by 18⅓ft., containing a depth of 6½ft. of water, and weighing 700 tons, and accommodates barges of 300 tons. On the Canal du Centre, in Belgium, there is a rise of 220ft. in a distance of only five miles, and this is to be surmounted by four hydraulic lifts similar to, but still larger than, the two just described.

EXPLOSIVES.

IN the current number of the "Proceedings of the R.A. Institution," a further instalment is given of Major J. P. Cundill's "Dictionary of Explosives," consisting of Class V., "Gun Cotton and Other Nitro Compounds;" and Class VI., "Picric Powders." The gradual development of the manufacture of gun cotton is traced up to Abel's perfection of the process, and due credit is given to the late Mr. E. O. Brown, of the Royal Arsenal, for the valuable discovery that wet gun cotton can be detonated and its whole power evolved by the use of a dry primer. As the practicability of using gun cotton or some kindred explosive for the bursting charges of shells is at present a matter of Government inquiry, we are not surprised that no opinion is expressed as to the possibility of using any of the various patent powders described. Major Cundill, however, expresses a very decided opinion on so-called "harmless explosives," and referring to the claim of inventors and others that certain explosives give off no noxious fumes, he states that no such explosives exist to his knowledge. If perfect explosion or detonation be achieved, then we have at least a considerable amount of carbonic acid, which is not a harmless gas. In actual work such perfection is, however, exceptional, and we have carbonic oxide and nitrous fumes evolved as well. Men have been killed by poisonous fumes from an explosive which was stated to be absolutely harmless in this way. In the introduction to Class VI. the author says that in 1885 M. Turpin took out an English patent claiming the employment of picric acid, unmixed with any other ingredient, as an explosive agent for military and other purposes. He proposed to compress the acid, to agglomerate and mould it with an aqueous solution of gum arabic, or oils, fats, &c., or to use collodion jelly. When the last named substance is diluted in the proportion of from three to five per cent. in a mixture of alcohol and ether, he states that the blocks of picric acid moulded with it will explode in a closed chamber with a priming of from one to three grammes of fulminate. He also proposed to cast picric acid into projectiles, the cast acid having a density of about 1·6. In shells he dispensed with the use of fulminate, substituting for it a priming charge of violent gunpowder (25 grammes), or a powder composed of chlorate of potash, tar, and charcoal. This invention probably closely resembles melinite, but the exact composition of this explosive is kept secret.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

5407A. Tarrillion, J. ..... Boats. (This Application having been originally included in No. 5407, dated 11th April, 1888, takes, under Patents Rule 23, that date.)

18th May, 1888.

7366. Sowden, A. ..... Looms.
7370. Oldham, A. ..... Metallic packing for pistons, piston valves, and pump buckets.
7371. Litchfield, L. ..... Drilling machines.
7374. Heaton & Holden ..... Motor engines actuated by anhydrous ammonia.
7377. Wise, W. L. ..... Looms (*Martini & Co.*).
7380. Vering, J. H. ..... Apparatus for driving tunnels in water-bearing soil.
7392. Downing, G. ..... Steam engine lubricators (*Mease*).
7402. Boulton, M. P. W. ..... Steam engines.
7404. Petry & Buch-Muller Repeating breech-loading fire arms.
7409. Durafort & Durafort Manufacture of articles cast in moulds with a covering of a hard metal.

19th May, 1888.

7410. Maxfield, W. B. ..... Taking up apparatus for circular knitting machines (*Heidelmann*).
7419. Stone & Turner ..... Cisterns, tanks, reservoirs, hoppers, drums, and like vessels.
7424. Dronsfield, S. ..... Prevention of snarls and lashed ends in ring spinning and doubling frames.
7430. Wilkinson and Wilkinson ..... Jacquard machines.
7434. Sauvée, A. ..... Quick-firing guns (*Canet*).
7435. Sauvée, A. ..... Ordnance (*Canet*).
7439. Bosshardt, F. ..... Water motors (*Delon*).
7443. Terrers, R. T. ..... Steam engines.
7446. Dombrowski, R. R. von Sporting guns.
7451. Hooker, J. J. ..... Power storing apparatus for stopping and starting tram cars.
7454. Atterton, J. ..... Grinding the blades of lawn mowers and similar machines.
7455. Boult, A. J. ..... Double acting presses (*Roux*).
7459. Wickstead, J. H. ..... Testing machines.
7462. Chambers, J. ..... Tools for expanding and cutting boiler tubes.
7464. Richardson & Greaves Adjusting the covers of carding engines.
7467. Yarrow, A. F. ..... Engines worked by vapour or volatile liquids.
7473. Edwards, G. ..... Interlocking levers for operating railway points and signals.
7474. Jordan & Howard ..... Printing machines.
7477. Blezard, N. ..... Apparatus for causing vessels to travel along waterways.

22nd May, 1888.

7490. Engelson, I. ..... Twist drill grinding machines.
7493. Knowles, J. ..... Machines for printing fabrics.
7495. Gallon & Chapman ... Hydraulic engines for driving capstans.
7496. Allison, H. J. ..... Button hole attachments for sewing machines (*The Harris Button Hole Attachment Co.*).
7499. Ashworth, J. ..... Machinery for stretching and guiding fabrics.
7500. Birley & White ..... Vacuum brakes.
7509. Fletcher, C. W. ..... Weft catching motion for looms.
7513. Liston, J. ..... Machinery for cutting corks.
7514. Calderwood, R. ..... Relieving ropes or chains when subjected to sudden shocks or strains (*Calderwood*).
7518. Groth, L. A. ..... Machines for breaking textile plants (*Céran*).
7521. Wordsworth, C. T. ..... Gas motors.
7526. Payne & Burstow ..... Screw propeller.
7534. Buffington, L. S. ..... Iron buildings.
7539. Schulz, R. ..... Rope winding drums.
7540. Boult, A. J. ..... Freight cars (*Brown*).
7542. Boult, A. J. ..... Carriage trucks (*Youmans*).
7547. Browett & Lindley ... Gas engines.
7550. Brice, T. ..... Apparatus for use as a fire escape and for lowering weights from buildings.
7552. Willcox, B. ..... Machines for sewing straw braid (*The Willcox & Gibbs Sewing Machine Co.*).
7554. Arthur & Garfield ... Steam engines.
7557. Haddan, R. ..... File cutting machines (*Neswadba*).

23rd May, 1888.

7560. Grote, C. F. ..... Music note printing machine.
7565. Munro, A. ..... Type writing machines.
7566. Tennent, J. ..... Supplying feed water.
7567. Ray, R. A. ..... Oscillating fire bars for furnaces.
7575. Barker, W. ..... Carding engines.
7578. Igel, H. ..... Hosiery machines.
7584. Rammoser, A. ..... Washing machine.
7593. Goodbody, W. R. ..... Sewing machines (*Barber*).
7597. Wrigley, J. ..... Forming hot high pressure gaseous material, applicable for producing motive power in engines.
7598. Nordenfelt, T. ..... Machine guns and mountings.
7600. Carroll, C. ..... Apparatus to facilitate locomotion in fluids.
7606. Craven & Sellers ..... Fluid pressure engines.
7610. Armit, R. H. ..... Ordnance.

24th May, 1888.

7614. Krause & Collin ..... Water motors.
7615. Biddiscombe and Hilton ..... Couplings for railway rails.
7620. Tweedale, E. ..... Machine tools for determining the position of the teeth on card flats, and for securing the clothing to the iron flats of carding engines.
7621. Templeman, J. ..... Pressing machines.
7627. McInnes, T. S. ..... Engine indicators.
7629. Barlow & Cree ..... Apparatus for trimming the edges of "hat leathers."
7631. Gruyter, F. A. L. de ... Raising and lowering ships' boats.
7633. Taylor, G. H. ..... Self contained gas fired steam generators.
7639. Pickford, J. ..... Mules and twiners.
7644. Wade & Cherry ..... Rotary engine.
7653. Volker & Nyland ..... Apparatus for insuring the stoppage of locomotives at stations.

ELECTRICITY.

4673A. Justice, P. M. ..... Incandescent electric lamps (*Heisler*). (This Application having been originally included in No. 4673, dated 27th March, 1888, takes, under Patents Rule 23, that date.)

19th May, 1888.

7463. Kotyra, M. ..... Alternating commutator.
7479. Rawson & White ..... Insulation in electrical machinery.
7480. Rawson & White ..... Insulation in electrical wire.

22nd May, 1888.

7487. Binswanger & Coates.. Electric switches.
7522. Houghton, E. J. ..... Dynamo.
7523. Houghton, E. J. ..... Electric lighting.
7530. Chittenden & Vaughton ..... Portable electric safety lamp.
7536. Willcox, B. ..... Galvanic batteries (*Whittier*).
7541. Thompson, W. P. ..... Electric machines (*Spang*).
7548. Dieuleveult, U. ..... Floating telegraphic or telephonic station or apparatus for enabling ships at sea to communicate with one another or with the shore.
7551. Kendall & Cooper ..... Coupling devices for electrical purposes.

23rd May, 1888.

7585. Whalley, A. ..... Telephones.

24th May, 1888.

7619. Weir, G. J. ..... Electric battery.
7636. Appleton, J., & others.. Holders for electric incandescent lamps.

CHEMISTRY.

18th May, 1888.

7398. Avenarius, R. ..... Treatment of tar oils for use as wood-preserving paints or coatings.

22nd May, 1888.

7497. Allison, H. J. ..... Explosive compounds (*Fitch*).
7507. Parnell & Simpson ... Sulphuretted hydrogen.
7511. Dawson & Hirsch ..... Amido-dimethyl aniline chloride.

MISCELLANEOUS.

5008A. Phillips, J. H. ..... Improved vehicle. (This Application having been originally included in No. 5008, dated 4th April, 1888, takes, under Patents Rule 23, that date.)

18th May, 1888.

7361. Lofthouse, R. ..... Ventilating.
7363. Heys, W. E. ..... Selvedge protectors for use in nap raising machines (*Martinot*).
7369. Cordingley and Fletcher ..... Picking sticks for looms.
7376. Hornung, F. ..... Self lighting fuses.
7379. Hamilton, J. C. ..... Retorts for distilling shale.
7383. Cheswright, C. ..... Protecting metallic tubes from external pressure.
7384. Lawson, E., & others ... Ships' berths.
7385. Sauvée, A. ..... Regulating the temperature of places heated by the circulation of water (*Crespin*).
7386. Körber & Steuth ..... Regenerating gas lamps.
7387. Freeman, A. ..... Balancing and regulating cabs.
7388. Pyke, G. W. ..... Rifle and gun target signalling.
7393. Duffy, T. W. ..... Wedge.
7394. Lund, E. ..... Pumps.
7396. Buswell & Buswell ... Tents.
7399. Leigh, H. H. ..... Optical telegraphy (*La Cour*).
7400. Linn, S. H. ..... Process and apparatus for making illuminating and heating gas from water in combination with carbonaceous substances (*Flannery*).
7405. Martin, J. G. ..... Binding bundles of cut crops.

19th May, 1888.

7411. Horn, A. ..... Saccharometers.
7414. Barbour, J. ..... Compressing brass covered rollers for wet spinning frames.
7415. Marsh, E. ..... Glass as a surface for cutting leather.
7417. Burton & Walker ..... Piano keys used in the shedding motion of looms.
7421. Panter, W. ..... Railway carriage doors.
7423. Shaw & Shaw ..... Stop valves.
7425. Ashworth, E. ..... Securing of the clothing to carding engine flats.
7431. McBride, H. ..... Corkscrews.
7432. McKellen, S. D. ..... Photographic cameras.
7433. Wilson & Hull ..... Safety lever for the purpose of moving the bodies of carts and vehicles.
7436. Beevers, J. ..... Cycles.
7437. Johnson, G. ..... Cleaning bottles.
7438. Bosshardt, F. ..... Purifying middlings (*Mistiaen*).
7440. Landless, J. W. ..... Securing the picking strap to the picker in looms.
7441. Bailey, J. ..... Regulating the supply of gas.
7442. Pattison, S. ..... Saddles for velocipedes.
7444. Linley & Biggs ..... Saddles of velocipedes.
7447. Minors, J., & others ... Padlocks.
7448. Onions, W. J. ..... Utilising waste lengths of metal tube.
7449. Wenham, W. P., & others Locks.
7453. Jungbluth, W. ..... Bars for weaving purposes.
7456. Rigby, J. S. ..... Utilisation of the lime mud refuse of sugar for cement.
7469. Spielmann, I. ..... Gas heaters.
7478. Pitt, S. ..... Course and bearing deviation eliminator (*Hart*).
7484. Bland, R. ..... Propelling bicycles and tricycles.

22nd May, 1888.

7505. McRobb, J. ..... Operating the shutters for signalling in mantlets for rifle target practice.
7506. McRobb, J. ..... Operating of targets for rifle practice.
7510. Garrard, C. R. ..... Velocipedes.
7512. Harding, T. W. ..... Machine wool combs.
7524. Kelly, W. P. ..... Lubricant.
7525. Lones, E., & others ..... Coating metal plates with tin.
7528. Williams, E. ..... Sweeping soot from flues.
7531. Hillman, W. ..... Bicycle stands.
7533. Newton, H. E. ..... Purification of water and sewage (*Leeds*).
7538. Boult, A. J. ..... Reflectors for lamps (*Péral*).
7543. Simon, H. ..... Sieving apparatus.
7544. Kendall & Cooper ..... Locking apparatus for railway carriage doors.
7546. Hearington, A. H. ..... Oil lamps.
7549. Slade, C. G. ..... Disappearing targets.
7555. Passburg, E. ..... Vacuum drying apparatus.

23rd May, 1888.

7559. Knoop, A. ..... Receptacles for liquid carbonic acid.
7561. Robbins & Creed ..... Disc tap.
7563. Martin, G. ..... Cycles.
7569. Hastie, W. ..... Copying presses.
7570. Miller, W. ..... Buckets and cans.
7571. Parker, G. W. ..... Street fire alarms.
7573. Letheren, T. W. ..... Preventing water pipes from being frozen.
7576. Shreeve, W. S. ..... High pressure self making joint.
7577. Parker, J. ..... Cycles.
7579. Baker & Le-Masurier Pumping water by means of weights.
7587. Birkovits & Köszegi ... Removing or preventing boiler scale.
7592. Thompson, W. P. ..... Treatment of cotton seed.
7594. Eland, G. H. ..... Seasoning timber.
7595. Gelder, P. van ..... Separating cockle seeds.
7596. Fletcher, J. ..... Protractors.
7604. Bois, W. A. ..... Bolts.
7605. Ketcher, J. L. ..... Springs for carriages.
7607. Kness, V. J. ..... Manufacturing vitrifiable colours.
7608. Orville, G. de. ..... Indicating the presence of noxious gases.

24th May, 1888.

7612. Chambers, G. J. ..... Internally stoppered bottles.
7613. McDonald, J. ..... Self trimming lamp (*Græme*).
7616. Fenby, J. B. ..... Oil burners.
7617. Bardsley, J. ..... Couplings for lead pipes.
7618. Ross, W. ..... Brick.
7624. Cubley & Preston ..... Stopper for bottles.
7630. Douglas & Logan ..... Flanges of copper tubes.
7632. Langlands, A. ..... Velocipedes.
7640. Thompson, W. P. ..... Filtering liquids (*Diebl and Mensik*).
7641. Croker, G. H., & others Cleaning cotton seed.
7646. Heys & Heys ..... Manufacture of plaster or cement.

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COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

26th May, 1888.

5591. Edoux, F. L..... Hydraulic lifts.
7335. Snelgrove, W. ..... Weighing machines.
7599. Morris, S..... Slubbing frames.
7739. Brewer, G. ..... Sewing machines (*Jansen*).
7835. Fairfax, J. S. ..... Boilers, flues, and furnaces.
8930. Bellinger, F. C..... Uniting metal plates.
9455. Cook, J. C. ..... Block printing machines for textile fabrics.
9803. Boult, A. J. ..... Button hole attachments for sewing machines (*Blodgett*).
9831. Orr & Brown ..... Fastening sheet metal roofs.
9896. Wadsworth, J. ..... Boilers.
10042. Boult, A. J. ..... Roofs (*La Progresiva Joint Stock Company*).
10047. Perks & Salmon..... Manufacturing hoes, spades, and other tools.
10081. Tatham, R. ..... Ring spinning and doubling machines.
10125. Browne, N. ..... Harvesting machines (*Parkerson*)
10126. Scott, G. A..... Signalling on railways.
10141. Wallace, P..... Spinning, doubling, and roving fibrous substances.
10184. Clarke, W., & others... Steam pumps.
10198. Bull, H. C., & others... Hydraulic engines.
10202. Bull, H. C., & others... Gas motors.
10271. Moffatt, A. C. ..... Hydraulic lifts.
10277. Eadie, P., & others..... Spinning and doubling fibrous materials.
10291. Bennett & Browne ... Manufacture of surgical lint and other fabrics.
10303. Owen, C. G..... Railway and tramway rolling stock.
10340. Baldwin, J. ..... Steam boilers.
10360. Dougill, J. ..... Gas motor engines.
10406. Allison, H. J. ..... Forming metallic ingots in a sectional bar (*Atha & Hinsdale*).
10526. Pass, E. de ..... Paper cutting machines (*Debié*).
12532. Coubrough, H. ..... Bolting machines for flour (*Summerton*).
12687. Nagel, A. C., & others.. Presses with reciprocating pistons.
12810. Carter, J. ..... War ship.
13820. Arundel, H. B..... Machines for doubling and twisting fibrous materials.
16801. Boult, A. J..... Mowing machines (*Mowat*).
17193. Pursall & Lister ..... Fuel economising apparatus for furnaces.
7. Hanson, J..... Chairs for railway rails.
3059. Koerner, A. C..... Breech mechanism of rapid-firing guns.
3248. Jones, C. W..... Spinning and doubling machinery.
3508. Thompson, W. P..... Cable coasters, carriers, and rope way bridges (*Van Zandt*).
4296. Evenstad & Senstad... Machines for making wood wool.
4297. Pistoja, A. G. von B. di Torpedoes.
4432. Cito & Funck ..... Lifting jacks.
4850. Jucker, J..... Looms.
4902. Lake, H. H. ..... Railway ties (*Sea*).
4981. Jarvis, S. E..... Steam engines.
5339. Bradbury, C. ..... Apparatus for lifting doors (*Messrs. Grimme Natalis & Co.*)
5566. Russell & Cooper..... Anchors.
5739. Gould, C. E..... Manufacture of rolled metal articles.
5890. Hawkins, F. P..... Steam engines.
5915. Pitt, W. A. ..... Steam engines.
5980. Gibbs, W. A..... Furnaces.
5989. Buxton, J. H., & others. Newspaper printing machinery.
5997. Turner, C..... Loose reed looms.
6032. Hallatt, B. ..... Twist lace machines.
6097. Lake, H. H. ..... Repair of ships' propellers under water (*Kirkham*).
6159. Vismes, Count A. V. de Drilling holes in metal and stone.
6951. Bookwalter, J. W..... Converting crude iron into malleable iron or steel.

ELECTRICITY.

26th May, 1888.

5648. Holmes, J. H. ..... Making and breaking electric circuits.
9017. Cross, W. ..... Electric furnaces.
10240. Hanson, L..... Field magnets.
10454. Gent & Ellery ..... Electrical signalling apparatus.
5362. Holmes, J. H. ..... Arc lamps.
5713. Hallock & Blickensderfer ..... Electric elevators.
5913. Heaviside, A. W..... Electric insulators.

CHEMISTRY.

26th May, 1888.

5896. Kern, A. ..... Sulpho nitrosulpho, nitrosulpho, and amidosulpho acids.
8929. Güttler, H..... Manufacture of charcoal for explosives.
10153. Fleming, J. ..... Calcining of sulphurous ores.
10168. Knowles, W. H. ..... Generating carbonic acid gas (*Pohl*).
10554. Walton, J. A. ..... A liquid blue.
5949. Kuhnt & Deissler..... Explosive compounds.
5971. Haddan, H. J. ..... Percolators for the extraction of oil by the naphtha process (*Evans*).
6102. Jensen, P..... Extracting metals from ores (*Russell*).

MISCELLANEOUS.

26th May, 1888.

7502. Boyce, G. R..... Combination locks.
7727. Dyer, J. W. ..... Cartridges for signalling.
8194. Baillard, C. L. ..... Preparation of mineral oils.
8398. Edwards, G. ..... Expanding apparatus useful for fire escapes, scaffolding, ladders, observatories, piers, pontoon and other bridges.
8442. Young, W. ..... Valves.
8498. Adamson & Hall ..... Miners' safety lamps.
9063. Nockold, F. ..... Cutting diamonds.
9571. Redfearn, J. A. ..... Miners' picks.
9694. Stokes, F. W. S. ..... Cement.
10085. Toft, C..... Decorating of pottery.
10132. Doulton & Marshall. Manufacture of spiral tubes, rods, and pedestals of terra cotta.
10207. Brooke & Brooke..... Stoppering bottles.
10221. Walker, W..... Ventilating buildings.
10268. Payne & Davison ..... Gas kiln for burning pottery.
10311. Haines, E. ..... Cocks and spreader appliances.
10331. Cooper, J. ..... Shuttles for weaving.
10345. Townsend, G. ..... Velocipedes.
10350. Gehre, M. ..... Superheating of steam.
10361. Phillips, J. ..... Ventilation of sewers.
10385. Larsen, E ..... Slag cement.
10420. Green, W. ..... Treating waterpoof fabrics.
10443. Tabary, C. P. ..... Metallic cement.
10558. Guibout, O. E..... Lighting and heating by means of gas.
10693. Hillman, W. ..... Ball bearings for velocipedes.
10829. Clay, J..... Saddles of velocipedes.
11406. Rae, R. J. ..... Capstans.
12038. Doran, J. S. ..... Heating apparatus (*Reilly*).
13248. Barlow, E. G. B..... Apparatus for inhaling nitrous oxide gas.
13474. Heath, A..... Ornamentation of metallic mounts.
13528. Thrush, J. M. ..... Traps for drains.
14296. King, F. J. ..... Manufacture of metal chests.
14714. Wescott, J. ..... Stop valves.
14798. Johns & Johns ..... Stoppers for bottles.
16355. Johnson, J. Y...:..... Decorating glass (*Aubriot*).
1851. Johnson, J. Y..... Graphophones (*The Volta Graphophone Co.*).
2177. Sickels, F..... Locks.
2744. Smith, D. ..... Indicators for railway carriages.
2870. Tuthill, E. ..... Preparation of an oil or tar from birch tree bark.
3671. Halstead, C. ..... Covering for rollers or pulleys.
4686. Bulpitt, W. H..... Lamps.
4866. Sanders, A. ..... Lamp fittings.
4971. Kertsch, C..... Preventing waste of water in pipes.
5180. Walker, A. H..... Sea oiling projectile.
5327. Peters, G. M. ..... Cartridges.
5331. Haddan, H. J. ..... Gas burners (*Jackson*).
5350. Godfrey & Meeker ... Fire extinguishing apparatus.
5384. Birchall, C. F. B., & ors. Reproduction of designs upon glass.
5698. Fontenilles, J. M. E... Air pumps.
5859. Gutensohn, A..... Coating iron plates with tin.
5860. Skarek, J..... Keyless watches.
5950. Rawlings & Rawlings. Blow pipe apparatus.
5970. Burrow, W. B., & ors... Apparatus for bottling liquids.
5976. Utter, H..... Barbed fencing.
6126. Kilner, T..... Tools for forming glass bottle necks.
6150. Heenan, R. H..... Apparatus for mixing substances.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(*To the 19th February, 1888, inclusive*).

Year 1884.

3175, 3177, 3182, 3184, 3186, 3189, 3193, 3194, 3195, 3196, 3197, 3200, 3206, 3210, 3214, 3215, 3216, 3221, 3222, 3226, 3232, 3233, 3234, 3237, 3238, 3239, 3240, 3242, 3243, 3244, 3246, 3248, 3249, 3250, 3253, 3259, 3261, 3262, 3265, 3268, 3270, 3273, 3274, 3277, 3279, 3280, 3281, 3282, 3284, 3288, 3291, 3293, 3298, 3299, 3301, 3302, 3303, 3306, 3312, 3313, 3314, 3318, 3320, 3322, 3323, 3324, 3325, 3326, 3329, 3331, 3337, 3340, 3341, 3345, 3348, 3352, 3353, 3357, 3370, 3372, 3374, 3377, 3378, 3379, 3380, 3381, 3384, 3385, 3386, 3390, 3392, 3394, 3396, 3397, 3398, 3399, 3405, 3406, 3407, 3413, 3414, 3419, 3423, 3427, 3432, 3434, 3436, 3439, 3442, 3443, 3445, 3446, 3447, 3450, 3451, 3453, 3454, 3456, 3457, 3461, 3462, 3464, 3465, 3473, 3479, 3483, 3485, 3495, 3496, 3498, 3499, 3500, 3501, 3506, 3507, 3510, 3517, 3518, 3520, 3521, 3522, 3533, 3535, 3537, 3545, 3549, 3552, 3554, 3555, 3559, 3560, 3562, 3566, 3567, 3568, 3569, 3570, 3571, 3582, 3588, 3590, 3595, 3596, 3597, 3599, 3600, 3601, 3603, 3605, 3606, 3607, 3611, 7386.

Year 1883.

798, 812, 817, 889, 897.

Year 1882.

716, 735, 746, 768, 782, 789.

Year 1881.

615, 667, 676, 721.

Year 1880.

731.

Year 1879.

596.

Year 1878.

596, 624, 673.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Converters.—*W. P. Thompson, Liverpool.* (*G. L. Robert, Stenay, France.*)—The construction of converters according to the present invention will be understood by reference to the accompanying figures, which represent a vertical and horizontal section respectively of one form described in the specification. The cross section is made rectangular with rounded corners. The tuyeres D are arranged in a straight line on one side only

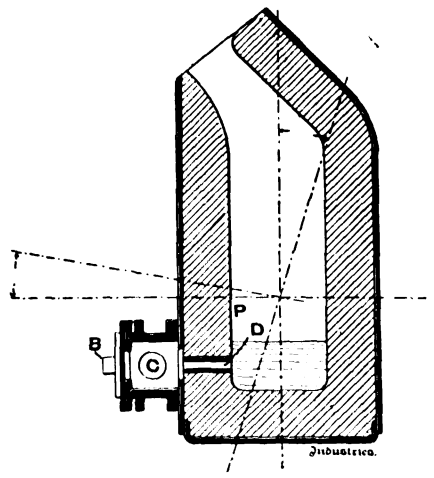


Fig. 1.

of the converter, and they open into a box C into which the blast enters from the supply pipe G. This box is provided with sliding glazed sight holes B, which are carried by a removable back plate. The plane in which the tuyeres are formed is parallel to the axis of rotation A A¹ of the converter, so that whatever the inclination of the latter and the height of the fused metal may be, the head of pressure on the orifices of each of the tuyeres is always the same. The cross section of the tuyere orifices is a rectangle having its corners rounded off so that the blast is injected in rectangular currents. This form of air current is found to give a greater force of penetration than that with the circular section, and it also gives a greater surface of contact between the air and the metal for the

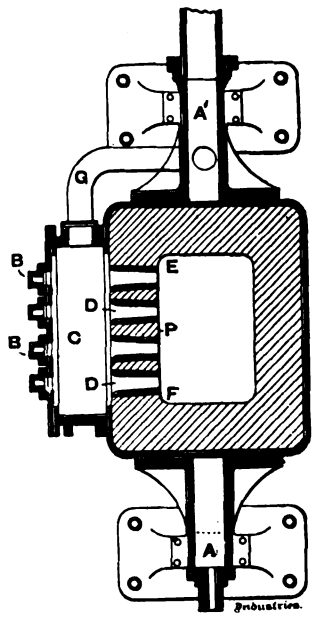


Fig. 2.

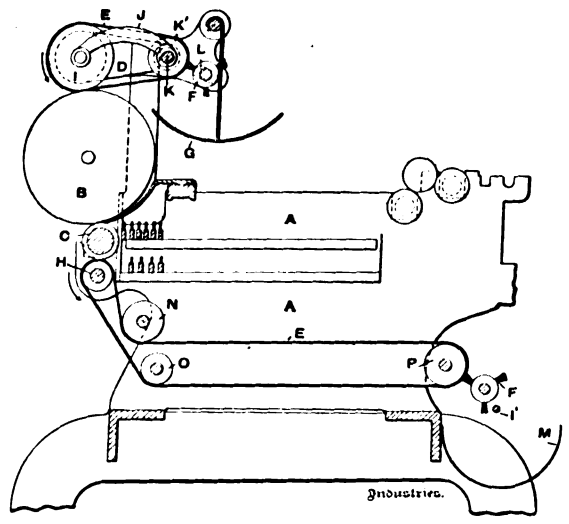
same sectional area. In another arrangement of the converter the cross section is elliptical, but with a straight face parallel to the axis of rotation, on which the tuyeres are disposed in the same way as before. The tuyeres placed thus horizontally form different angles with the straight face; the object of this arrangement is to facilitate the imparting of a gyratory motion to the fused metal. Six claims are made for the single row of tuyeres arranged in a plane parallel to the swinging axis, and for the combination of the sight holes, and for the common air chamber C.—No. 10659. August 2nd, 1887. 8*d*.

Disintegrators.—*J. A. Yeadon & R. Middleton, Leeds.*—The type of disintegrator in which two revolving cages are mounted on a fixed horizontal shaft, has the disadvantage that its bearings cannot be properly oiled. This invention is intended to remedy this defect by affording an improved means of oiling the machine. A central chamber for holding the oil is made as usual by arranging recesses in the boss of each cage; a hole is also formed through the axis of the fixed shaft, and transverse holes are arranged in a line through the boss on one side so as to tap the oil in the recessed space through the fixed shaft in

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order to tap the central oil hole, and also through the other side of the boss. By this means any clogged oil may be easily dislodged by thrusting a rod through the hole in the central shaft and through the three holes when they are in line. The two holes in the boss are fitted with caps. An oil cistern is placed in an elevated position above the shaft so that the feed shall be under a small pressure. The arrangement of this invention allows the fixed shaft to be moved round into different positions in order to make up for wear and tear. The fixed shaft is firmly held on one base plate, which is cast solid with the vertical standards, and in the standards are formed oil pockets into which the waste oil can be run. Two claims are made, for the manner of lubricating, and for mounting the shaft on two standards cast in a solid piece with the base plate with pockets as described.—No. 8671. June 16th, 1887. 8*d*.

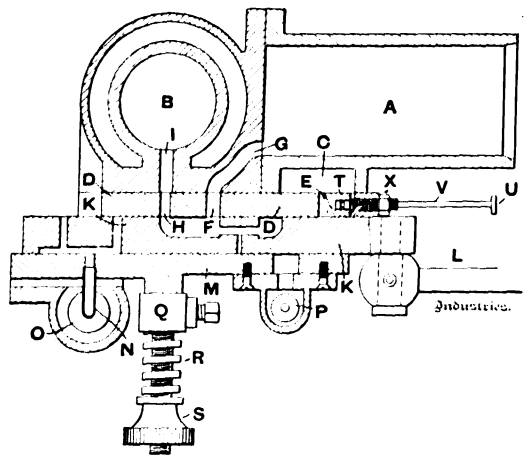
Spinning Machinery.—*J. Wallace, Belfast.*—This invention introduces an improvement in the rubbers or cleaners used for keeping the rollers in a clean condition, and for preventing the adherence of fibres to them. The ordinary rubbers hitherto in use are made of flannel, fastened to revolving bosses which press against the rollers; this arrangement is liable to allow some of the dirt to pass from them to the material which is being operated on. The present inventor employs cleaners which are made of travelling bands of flannel or other material, and means are also provided for automatically cleaning these rubbers. The accompanying figure illustrates the application of this method. A is part of the frame of the machine, B is one of the pressing rollers, and C one of the boss rollers. A roller I of metal is carried by the arms J pivoted upon a driving shaft K, so that



the rubber roller I will rest upon the pressing roller B with a freedom of movement towards and away from its axis. A boss K¹ is fixed on the driving shaft K, and round the roller I and the boss K¹ is passed a leather driving belt D and a band of flannel E. Near to the driving shaft K is placed a brush F, which cleans the belt E, and keeps it rough, and the axle of the brush is mounted in slots L; the trough G catches the droppings from the brush. In applying this method of cleaning to the boss roller C, the inventor passes another belt of flannel E round a revolving roller H, under the guide pulleys N O, and round a roller P; and a similar brush F and trough M are employed. This belt also carries the droppings from the fallers, and delivers them into the same receptacle. A rod may be fixed in close proximity with the revolving brush F, in order to free it from any dust which becomes attached to it. Four claims are made for this rubber, which consists of a travelling belt of flannel arranged as described.—No. 5985. April 25th, 1887. 8*d*.

Gas Engines.—*H. T. Dawson, Salcombe, Devonshire.*—Besides varying the quantity of gas admitted to the cylinder, the inventor causes the governor to regulate the degree in which the gas and air are intermixed, so that as the speed of the engine diminishes a less intimate mixture is obtained, and *vice versâ*. For this purpose a cylindrical mixing chamber is employed, whose length may be varied by the governor, or baffle plates are arranged in the mixing chamber, which are turned by the governor in order to lengthen or shorten the distance traversed by the gas and air. A certain minimum amount of mixture is partly secured by fixing interference rings, and partly by a gauze at the entrance to the cylinder. The motor cylinders are kept at an approximately constant temperature by water spaces in the sides and covers of the cylinder, and these spaces communicate with cisterns, so that the surplus heat is dispersed by radiation and evaporation. An interrupted jacket of different proportions, according to circumstances, is also employed, with the object of sustaining a higher temperature than usual in the cylinders, and the water in the jackets may be allowed to boil by throttling the inflow circulating pipe by a valve. The ignition apparatus is modified by a jet of air which plays between the flat flame and the ignition port; at the other side of the flame a platinum coil is arranged for the purpose of lighting. An automatic gas cut-off valve consists of a ball valve on a seat in a chamber in the gas supply passage. The valve normally keeps the passage closed; but a striking pin, which is actuated by a lever engaging with a pin on the crank shaft, raises the ball at each revolution. The pistons and cylinders are lubricated with black lead or other dry lubricant formed into pellets, which are contained in short tubes in the cylinder or piston, and which are pressed against the surfaces by springs. A compound movement of translation and rotation of the pistons spreads the lubricant over the surfaces, and depressions may be made in the surfaces in order to assist in spreading the lubricant. In some cases the lubrication is effected by a powder, which is injected automatically into the cylinder at each explosion of the charge. Baffles are placed in the cylinder in order to control the disposition of the combustible and non-combustible elements of the charge. In particular, a baffle is arranged opposite the ignition port inside the cylinder, in order to cause a slight delay in the ignition; and a deflector is placed in the air aperture in the cylinder, to soften the ignition. The head of the piston is covered with asbestos. For rotating the piston, a bracket is fixed to the piston at some distance from its centre, and the end of the bracket remote from the piston is connected by a universal joint to a bent arm fixed to the connecting rod. As the connecting rod swings to and fro, it carries with it the end of the bracket, and thereby turns the piston. Seventeen claims are made for these various arrangements.—No. 6501. May 3rd, 1887. 11*d*.

Gas Engines.—*R. Wallwork, Manchester, and T. Sturgeon, Ilkley, Yorkshire.*—In most gas engines the air is drawn through a port, and in its course towards the cylinder it travels past a number of holes, through which the gas flows in. The present invention consists in making the port through which the air is admitted adjustable, so that the amount of air can be controlled to suit the quality of the gas. The accompanying figure shows the application of this principle to the gas described in the specification of Patent No. 4923 of 1887 granted to T. Sturgeon. A is



the charging cylinder, B the working cylinder, and C is part of the air passage. D is a loose plate, in which are formed the air port E, the mixture port F, and the firing port H; the port F communicates with the charging cylinder by the passage G, and the port F with the working cylinder by the passage I. The slide valve K is shown in the position it assumes when the charge is being driven from the charging cylinder to the working cylinder. The cover M carries the igniting tube N, the chimney O, and the gas valve P, and is kept up in its place against the valve by the usual clamps Q, springs R, and nuts S. An adjustable slide in the air port in the loose plate is shown at T, and can be moved in and out by turning the milled head U on the long spindle V. By screwing up this rod the size of the air port can be varied to suit the requirements of the case. One claim is made for making the port through which the air is admitted adjustable.—No. 7925. June 1st, 1887. 8*d*.

Machine for Dressing Hides.—*M. Martin & V. Martin, Paris, and E. Schloesser, W. Schloesser, & F. Schloesser, London.*—This machine is intended for scraping and smoothing hides and skins, and for other operations necessary in their preparation for tanning. In the accompanying figures are shown a front and side view of one form of the machine. J and A are revolving cylinders, the lower one of which can be raised or lowered by means of the pedal C and lever D to bring it more or less near the cylinder J, according to the thickness of the skins under operation. The pressure regulator F fixes it in position when adjusted. This regulator comprises two bevel wheels G H, a fly wheel I, and a screw working up and down in the centre of the

Fig. 1.

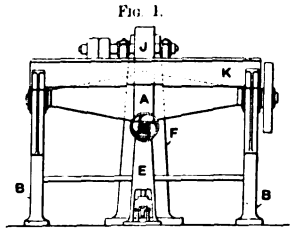
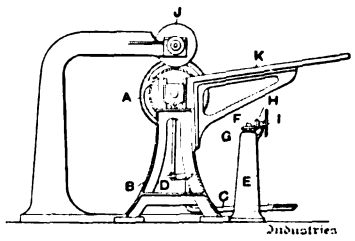


Fig. 2.



wheel G; on turning the fly wheel, this screw rises or descends, and its lower end presses on the pedal C and keeps it in position. The cylinder J may be furnished either with sharp spiral blades running from right to left, or with helical blades on one side only; the same effect may also be produced by a coating of emery cloth. The skin is placed on the table K so that the operator can feed it by hand. When used for smoothing the skins, the cylinders are plain and are heated internally by gas or steam. Another form of apparatus is also described in the specification. The supports B are removed together with the cylinder A, and instead a sliding table is substituted which is worked by hand. Two other rolling tables are mounted on this one, and the skins are placed upon the uppermost of them. In both forms of apparatus there are blades of india-rubber fixed upon the cylinders in front of the cutting blades, their purpose being to spread the skins out before the shaving takes place. Six claims are made.—No. 2154. February 13th, 1888. 8*d*.

ELECTRICITY.

Electrical Transformers.—*W. J. Muller, London.*—In the induction coils as at present manufactured the outer layers of the wire of the secondary coil are less influenced by the electromagnet than the inner layers. The improvement introduced by the present inventor consists in winding another primary coil outside the usual secondary wire, in order to make the induced current more uniform. Outside this second primary wire is laid a series of iron wires forming a second core. Two primary coils are thus obtained, and two iron cores influencing the secondary coil. The primary coils may consist of two or more layers, the outside wire being preferably stouter than the inner one. When large quantities of wire are to be induced, the wire of the secondary coil is wound by the disc method; and sometimes another layer of wires may be wound round the outside core in order to intensify its magnetisation. The two primary coils are wound and connected together in such a manner that when a current is passed through them a uniform magnetic field is produced. Two claims are made for the induction coil in which second primary coils and cores are employed as described.—No. 6204. April 28th, 1887. 8*d*.

Regulating Dynamos.—*J. Feaveryear, London.*—The magnetic field of a continuous current dynamo is here arranged in such a way as to allow of a constant e.m.f. being maintained at its terminals; the generator may also have its field magnets arranged in series with the external circuit, in which case any variation of the external resistance would cause a corresponding variation of the e.m.f. at the terminals. Several methods are described for carrying out this invention; in one example, a pair of vertical field magnet coils are mounted upon a swivel stage. Two pole pieces are rigidly fixed with respect to the bore of the field surface by means of two connecting pieces of brass. An extension on each pole piece is arranged to carry two vertical field magnets of the bobbin type, which are mounted on a transverse yoke pivoted to the extension of the lower pole piece. The bolt which passes through the bobbin nearest to the field surface fastening it to the pole pieces, acts as its magnetic core. This bobbin is wound with thin wire, while the other is wound with thick wire, so that the latter may be included in the external circuit when in action. The fine wire is preferably of three hundred times greater resistance than that of the external circuit. The generator can be readily converted into a shunt or series machine, according to the work requiring to be done, by simply unscrewing and removing the bolt which passes through the bobbin wound with fine wire. Six claims are made for the various ways of converting the machine into a series or shunt machine, for the purpose described.—No. 2515. February 20th, 1888. 8*d*.

CHEMISTRY.

Mordants.—*W. Crowther & J. Crowther, Dewsbury.*—The mordants employed by the inventors are the acetates of alumina, copper, iron, and chromium. A cold or tepid solution of these metallic acetates, either separately or conjointly, is used as a bath; and after the wool, yarn, or cloth has remained therein for three-quarters of an hour it is wrung out and suspended in a wet state for some hours. The fibres are then dried and heated in order to remove the acetic acid, thus leaving the insoluble oxides firmly fixed upon the goods. It is claimed for the use of these acetates that blacks and blues do not turn green on exposure to light, and that the goods are not impoverished so much by the subsequent dyeing process. Three claims are made.—No. 9027. June 25th, 1887. 6*d*.

Sulphate of Cobalt.—*W. N. Hartley, Dublin, and W. E. B. Blenkinsop, London.*—This invention relates to improvements in the manufacture of sulphate of cobalt and its separation from other metallic sulphates. For every ten parts of the metallic oxide in the cobalt ore five and a half of sulphur is taken, or twenty-eight parts of pyrites containing 45 per cent. of sulphur. This mixture is placed in a covered crucible or upon the hearth of a reverberatory furnace, and heated with as little access of air as possible to a temperature near that of melting zinc. Air is admitted freely when a barely perceptible red heat has been reached, and the mass is caused to burn. When the combustion becomes so slack that the mass no longer burns when stirred, the temperature of the furnace is raised and maintained as long as it is possible that the materials will absorb oxygen. On treating the mass with water, after it has been removed from the furnace, the cobalt sulphate gradually dissolves. Special methods are also described for separating the sulphates of other metals present in the ores. Two claims are made.—No. 8922. June 22nd, 1887. 6*d*.

Obtaining Sulphur from Sulphides.—*C. F. Claus, London.*—The ores containing sulphur, more particularly pyrites and blende, are broken up into suitable pieces, and charged into a deep kiln, which is built of brick and covered with an iron plate. Highly superheated steam, either alone or mixed with hot air, is passed through this deep layer of sulphides from the top downwards. The effect of the steam is to expel part of the sulphur, and to reduce the sulphides to monosulphides, or to reduce the monosulphides to oxides, at the same time giving off sulphuretted hydrogen. Apertures are made at various heights in the kiln, through which regulated quantities of air are admitted to burn with the hydrogen of the sulphuretted hydrogen. The fresh ores are fed in at the top of the kiln through a charging door, or by means of a bell cover, such as is used in a blast furnace; and there is also a door at the bottom of the kiln to allow of the discharge of the residual oxides. An aperture is provided near the bottom of the kiln for the escape of the volatile products given off. In smelting works, where there is an abundance of waste heat, the heating of the steam

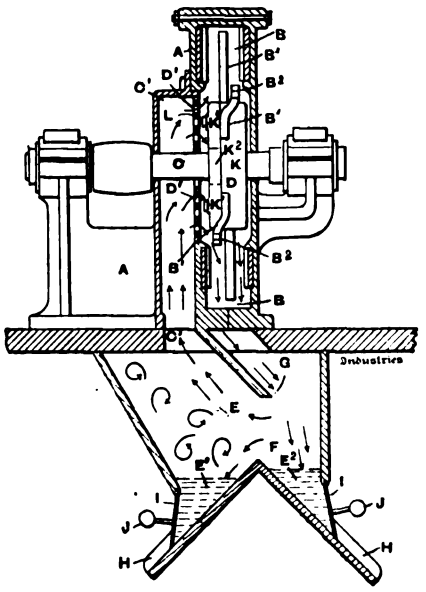
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or air may be effected at a very small extra cost. The kiln may be either vertical or horizontal: in the latter case it is subdivided into compartments similar in principle to annular brick kilns. Each compartment is connected to the adjoining one by means of flues, which can be closed by dampers, and may also be separated from the others for charging. An opening in each compartment communicates with the sulphur chamber. The heated air and superheated steam enters the last one charged with fresh ore, and passes on from one chamber to another until it arrives at the last. Three claims are made for obtaining free sulphur from the sulphuretted hydrogen by passing superheated steam and air through metallic sulphides, and by admitting free air to burn the hydrogen of the sulphuretted hydrogen, and for the two methods of carrying out the process.—No. 6909. May 11th, 1887. 6*d*.

Permanganate of Soda.—*G. H. Bolton, J. R. Wylde, & H. Auer, Widnes.*—The alkaline manganate obtained by igniting a mixture of oxide of manganese and caustic alkali always contains a quantity of these ingredients still uncombined. The inventors therefore treat the aqueous solution of the ignited mass with chlorine; by this means the alkaline manganate is converted into permanganate, and the caustic alkali into the corresponding hypochlorite, chlorate, or chloride. The insoluble oxide of manganese left after lixiviation, if sufficiently pure, may be furnaced with a fresh charge of caustic alkali. The mixed solution of alkaline permanganate and hypochlorite possesses strong bleaching and deodorising properties. If the material is required in a solid state, the water is driven off by heat, and during the evaporation the hypochlorite is converted into chlorate and chloride; and the latter, when soda is the alkali employed, is fished out from time to time. Almost pure permanganate and chlorate of soda is thus obtained. Four claims are made.—No. 8217. June 8th, 1887. 6*d*.

MISCELLANEOUS.

Pulverisers.—*G. Little, London.*—The main object of this invention is to diminish the back draught which is caused by the revolving beaters, by combining with the disintegrating chamber a return air chamber, through which the air shall pass in a continuously circulating current. In some cases the current of air is utilised for the purpose of sorting and separating the pulverised material. The accompanying figure shows a vertical central section, with a separating chamber attached. B is the disintegrating chamber, and C is the spindle on which the beaters are attached; a perforated screen is fixed round the cylindrical part of the chamber, and is fastened to the two end pieces. The



pulverised material passes through these perforations into the chamber E, together with the current of air; the air returns by the passage C¹, through the holes D¹, and into the chamber B. The separating chamber has an inverted V shaped bottom, and is provided with deflecting plates G. The two compartments E¹ E² are provided with doors I I¹ which open when a sufficient weight of material has accumulated. The beater arms B¹ are secured to the hub in such a way that only a small number of bolts are required; the hub is made in two parts, and a number of dovetail slots are formed in them to receive the beaters, which are secured in their places by bolts passing through the two parts of the hub. Six claims are made, for the continuous circulation of the air, for the separator, and for the improved construction and arrangement of the beaters.—No. 8054. June 3rd, 1887. 8*d*.

Purifying Petroleum.—*W. H. Pitt & G. H. Van Vleck, Buffalo, New York.*—The object of this invention is to distil petroleum, in order to remove the disagreeable odour which is detrimental to the sale of such oil. The hot vapours of the oil are passed through and around a heated metallic substance suitably comminuted, which exercises an affinity for the sulphurous and other objectionable vapours. One claim is made for this process.—No. 3830. March 13th, 1887. 8*d*.

Wood Pulp.—*H. J. Simpson & G. de M. Mackirdy, Liverpool, and A. Taylor, Edinburgh.*—Up to the present time the bark and wood of the Californian redwood tree has been practically useless in commerce. The bark consists of three parts—a rough outer bark, a fine bast fibre immediately below the outer bark, and the remaining main bark. Of these the inventors have found that the outer bark is applicable for making a coarse pulp suitable for conversion into coarse and brown paper and felting; that the bast fibre may be used as a textile material; and that the main bark and the wood is particularly adapted for making cellulose. The bark or wood is cut up into blocks of a size which will preserve the continuity of the vegetable fibre. The rough outer bark and the bast fibre may be removed by mechanical or chemical means, and the remaining portions are then steeped in heated vats containing a solution of caustic alkali. The liquor resulting from this treatment is removed after four hours, and the partially pulped material is subjected to the action of dilute sulphuric or hydrochloric acid in hot water. The gallates and kinos will now be deposited, and may be removed. When the pulp is to be used for felting, the last process may be dispensed with, and the material treated instead with alkali with the addition of sulphate of alumina or copper. Three claims are made.—No. 8817. June 18th, 1887. 6*d*.

GERMAN PATENT ABSTRACTS.

Railway Coupling.—*A. Bolzano, Augsburg.*—This invention shows a new form of automatic coupling for railway carriages. The draw bar B carries at its end a plate A, to which a hook C is connected, pivoting round the horizontal pin D. The other side of A is provided with an inclined plane E. In shunting the

Fig. 1.

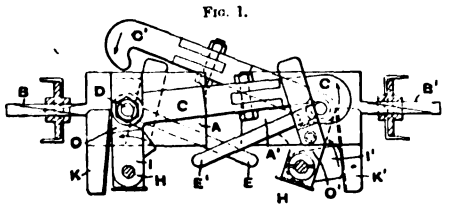
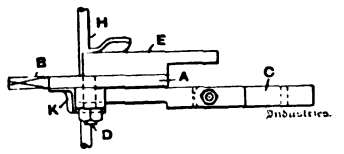
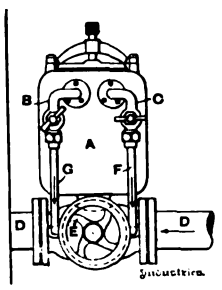


Fig. 2.



carriages together, the hooks slide along the inclined planes, and engage with the upper ends of the latter. The hooks C are provided with projections O to which the shafts H are connected. These shafts are fitted with cams I. In order to disengage the hooks, or to prevent their engaging, the cams I are put into the position shown on the right hand side of Fig. 1, when they engage with projections K, and lift or keep the hook in the position indicated.—No. 42978. August 27th, 1887.

Feed Water Purifier.—*E. Mertz, Basle.*—This apparatus is intended for introducing chemicals for purifying purposes into the feed water of boilers. A vessel A, supported on the valve E, is charged with the chemicals in use for purifying the feed water.



E is introduced into the feed water pipe D, and connected with A by means of the tubes F and G, which are provided with the valves B and C. Part of the feed water ascends through F into A, is saturated with the chemicals contained in A, and descends through G, when it is mixed with the rest of the feed water.—No. 42697. September 20th, 1887.

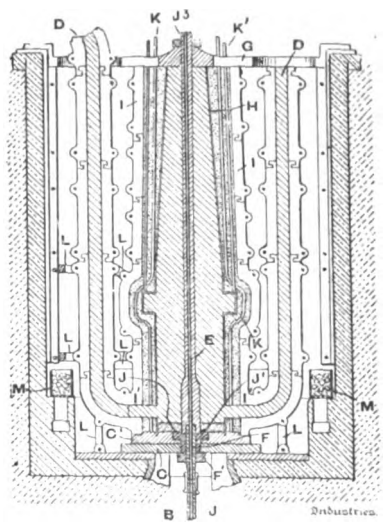
UNITED STATES PATENT ABSTRACTS.

Carding Engines.—*A. Falls, Lowell, Massachusetts.*—In order that the stripping mechanism may have a quicker motion while stripping the top flats than while passing from one flat to the next, a portion of the periphery of the stripping cam gear is provided with double teeth; the actuating pinion has a member provided with a single tooth, which, at the proper time, engages the double teeth, and imparts a slower motion to the cam gear. One claim is made.—No. 382598, dated 8th May, 1888.

Fertiliser.—*S. L. Goodale, Saco, Minnesota.*—The present invention relates to a new process for utilising hydrated aluminium and iron phosphate as a plant fertiliser. The crude mineral which contains the phosphate is first pulverised, and is afterwards heated with carbonaceous matter and sulphuric acid. The resulting product is then suitable for use as a manure. One claim is made.—No. 382604, dated 8th May, 1888.

Looms.—*W. Driver, Mannville, Rhode Island.*—This invention introduces a new arrangement for checking the picking mechanism of looms. The check rod is supported in hangers on the shuttle box; a spring rests against one of the hangers and encircles the rod, and also bears against an adjustable stop on the rod, thereby permitting the regulation of the tension of the spring. The stop on the rod is made of various interchangeable forms, in order to adapt it to the different species of picking mechanism. Three claims are made.—No. 382640, dated 8th May, 1888.

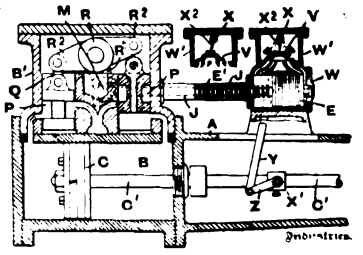
Casting Ordnance.—*R. J. Gatling, Hartford, Connecticut.*—The accompanying figure represents a vertical section of an improved pit and flask for casting large guns. The pit is built of brick work, and is lined with a metallic lining, and an annular fire box M surrounds the lower end of the flask and run ways. The metallic flask I is made in sectional parts, which are provided with annular grooves and projections for interlocking



with one another. The run ways D are built in the same way A thin metallic shell H forms the outline of the mould, and between H and I is placed a packing. The central tube E, forming the bore of the gun, is supported by the brace J³ and by the lock nut J. The base pieces C C¹ are fitted with central openings to receive a hollow uniting bolt, which is also internally threaded, to receive the lower end of the tube E. The lateral brace pieces L are formed with a bend, so as to provide for the expansion of the flask. Seven claims are made.—No. 380756, dated 10th April, 1888.

Whip Roll for Looms.—*D. Durkin, Northbridge, Massachusetts.*—This improvement comprises a yielding whip roll, which is designed to obviate accidents when the shuttle is caught in the shed, and to prevent the occurrence of thin and thick places in the fibre after the stoppage and re-starting of the loom. Springs co-operate with the journal boxes, in order to permit the bearing roll to be moved bodily in an approximately horizontal plane towards and from the breast beam and the fell of the cloth, and an arm and rod are provided for vibrating the bearing rail. Two claims are made for this whip roll.—No. 381617, dated 24th April, 1888.

Slide Valve.—*J. H. Fogarty, New York, and F. M. Wheeler, Montclair, New Jersey.*—This slide valve is actuated by steam and not simply by a mechanical connection with the moving parts of the engine. The two valves P are connected by means of the links Q with the double lever R² which oscillates on the pivot R³. The reciprocating movements of the valves P are imparted to them through the lever R² by the arm R¹ and rod J. The rod J receives its motion from the auxiliary cylinder W, in which the piston E is made to work by means of an ordinary slide valve V. The rod X has a tongue X², which shifts the slide valve V, and is attached to the rod Y, which transmits motion from the main piston rod C¹. The valves P are balanced by the steam pressure on both sides. The exhaust steam passes between the two cylindrical bosses of the valve; in the figure the piston is travelling to the left, and the steam



is leaving the space at the left hand side of the piston and is passing to exhaust; the steam is entering on the right hand side. Three claims are made for this steam actuated slide valve.—No. 380882, dated 10th April, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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TURNER'S IMPROVED STEAM ENGINE AND BOILER.

(For description see next page.)

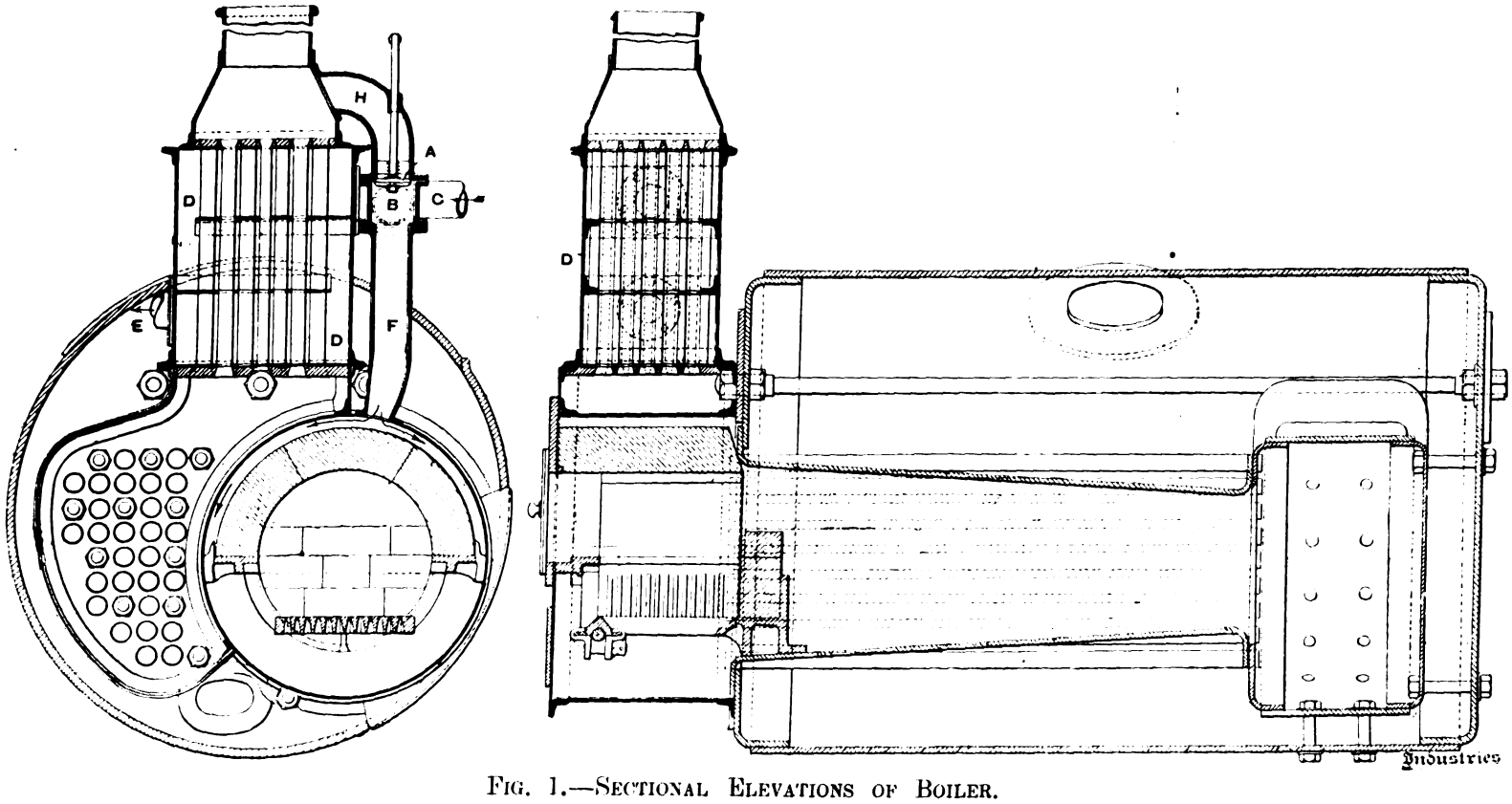


FIG. 1.—SECTIONAL ELEVATIONS OF BOILER.

NOTES ON SCREWING APPLIANCES.

IV.

(Concluded from page 235.)

CHASERS.—These tools are used for cutting threads by means of a lathe. There are two kinds of chasers, viz., those clamped to the slide rest, which is moved along by the "guide screw" at a rate corresponding to the number of threads per inch cut by the chaser; and those which are fitted into a wooden handle and are used by hand. Both classes of these tools are subject to slight modifications in form, for cutting internal and external threads. Figs. 1 and 2 show chasers for use in a lathe. Those for hand use are lighter, and tapered at the back end for fixing them into the handle.

In small engineering works which make their own chasers, and also in some works where the manufacture of screwing tackle is a specialty, a piece of steel is clamped to the slide rest, and a plug-sized master tap revolved between the centres of a screw cutting lathe, the guide screw being geared in the same manner as if a screw of the same pitch as the thread of the tap, which is called

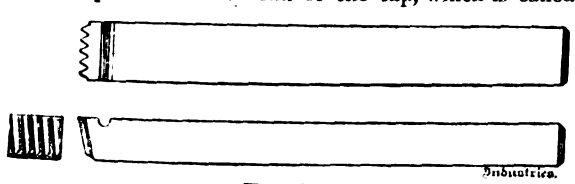


FIG. 1.

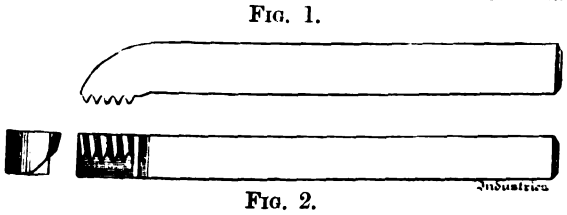


FIG. 2.

the "hob," had to be cut. The piece of steel is forced by means of the slide rest against the tap until a full thread is cut on the end of the piece under operation. The chaser is then removed from the slide rest and attached to a long wooden handle, and pressed by hand against the hob until the thread is straight, and has obtained sufficient rake as shown in Fig. 3. This is rather a slow and laborious operation; but with this kind of hob it is the only means of removing the curvature at the end of the chaser, and of making a proper cutting tool of it. With this method of production the expenditure of time is large, and an expensive lathe is used which might be more advantageously employed. Hobs of larger diameter, made specially for cutting chasers, have been used in place of the plug master tap. The diameter of such hobs, being from three to four times that of the tap, the number of grooves and cutting edges is increased. But, as the diameter increases, the inclination of the thread accordingly decreases, and trouble is experienced when using the chasers, owing to the want of sufficient clearance between the thread on the chaser and that traced on the rod. This difficulty might have

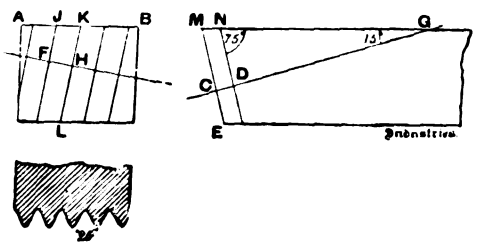


FIG. 3.

been overcome by backing off the bottom edge of the chaser, but even then the angle of the thread would not be correct; and, considering the amount of trouble and expense involved in making a good hob of large diameter, besides the disadvantages mentioned, their use has been almost discontinued.

MACHINE FOR CUTTING CHASERS.—This machine is specially designed to avoid the process of straightening the ends of chasers in a lathe by hand, while securing the advantages of the large thread surface, the numerous cutting edges of a large sized hob, and of cutting the thread on the end of the chaser at the proper angle. The machine is similar to a small milling machine, the hobs being keyed on to the spindle, while the chasers are held in a slide rest at such an angle as to give the thread the right inclination, and to back off the bottom edge at one operation. The hob, instead of having a screw thread cut on its surface, is provided with a number of annular grooves, the angle between them and the pitch being arranged in such a manner that the chaser cut by the hob will produce a thread of the required pitch and angle. Fig. 3 shows a chaser in three different views. The cutting edge of the chaser is along the line M N and A B, and this line must be exactly level with the lathe centre when using the chaser. The outline of the cutting edge should, in plan, have the required pitch, and the thread should have the exact angle. Suppose the thread be ·25in. pitch and the angle of thread be 55°, then the depth of thread is ·64 × ·25 = ·16in. = MN. Then draw C D at right angles to the thread M E, and passing through the centre of the annular hob used for cutting this chaser: CD is then equal to the depth of the annular grooves on the hob. CD = MN cos ∠ CGM, and ∠ CGM is, in this case, 15°, consequently we find that CD = MN cos 15°. Now, cos 15° = ·9659, consequently the depth of the annular grooves on the hob must not be ·16in., but ·16 × ·9659 = ·1544in. if the chaser is intended to cut a thread ·16in. deep. The pitch of the thread on the cutting edge of the chaser J K = ·25in. Let F H, which is at right angles to the thread K L, represent the centre line of the hob, then F H is the pitch of the grooves on the hob; the difference between F H and J K being almost inappreciable for large chasers; but for the smaller sizes, however, it should be considered. For instance, in a ¼in. screw with twenty threads per inch, the pitch is ·05in. and the circumference of the bolt ·7854in., then

$$\frac{1}{FH} = \frac{\sqrt{\cdot 7854^2 + \cdot 05^2}}{\cdot 05 \times \cdot 7854} = \frac{1}{\cdot 0499}$$

consequently the pitch of the grooves on the hob must be $\frac{1}{1\,0\,0\,0}$in. less than the thread to be cut; and if this is not allowed for in making the hob, the error in one inch length of the screw cut would amount to $\frac{1}{3\,0\,0}$in., which is about the thickness of an ordinary sheet of tin foil. This difference may be of little practical consequence; but, when making such costly standards as these hobs are, no effort should be spared to make them as accurate as possible. Similarly, the angle of the thread on the hob is slightly different to that cut by the chaser, owing to the inclination of the thread on the end of the chaser.

Proceeding now to consider the making of the hobs, the first step in this direction is the choice of the steel and its treatment. As regards the quality of steel which is most suitable for this, or, in fact, for any other kind of tools, the tool maker cannot do better than make his wants known to the firm from which he buys his steel, as there are many details and intricacies in the manufacture of tool steel, which only those engaged in the trade know. Moreover, he is more likely to make good tools which will not split or warp in hardening, if the steel maker knows, when melting the steel, what shape the finished tool will have, and what work it has to do. When the hob is forged, the outer portion of the metal is unavoidably hardened by hammering, and is in a state of irregular tension. If the hob be cut when the steel is in this condition, it will be almost certain to warp or crack in hardening, and thus cause annoyance and expense which might have been avoided by taking the precaution to carefully anneal the steel after forging, and thus relieve the initial tension of the outer portions, and remove all internal strains. The annealing is a very simple operation, consisting in raising the steel to a cherry red heat, and cooling it slowly. The hob should then be carefully bored and fitted to its own spindle; then it is turned, and annular rings of the form and pitch required cut on its surface. This is an operation requiring great care, as

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TURNER'S IMPROVED STEAM ENGINE.

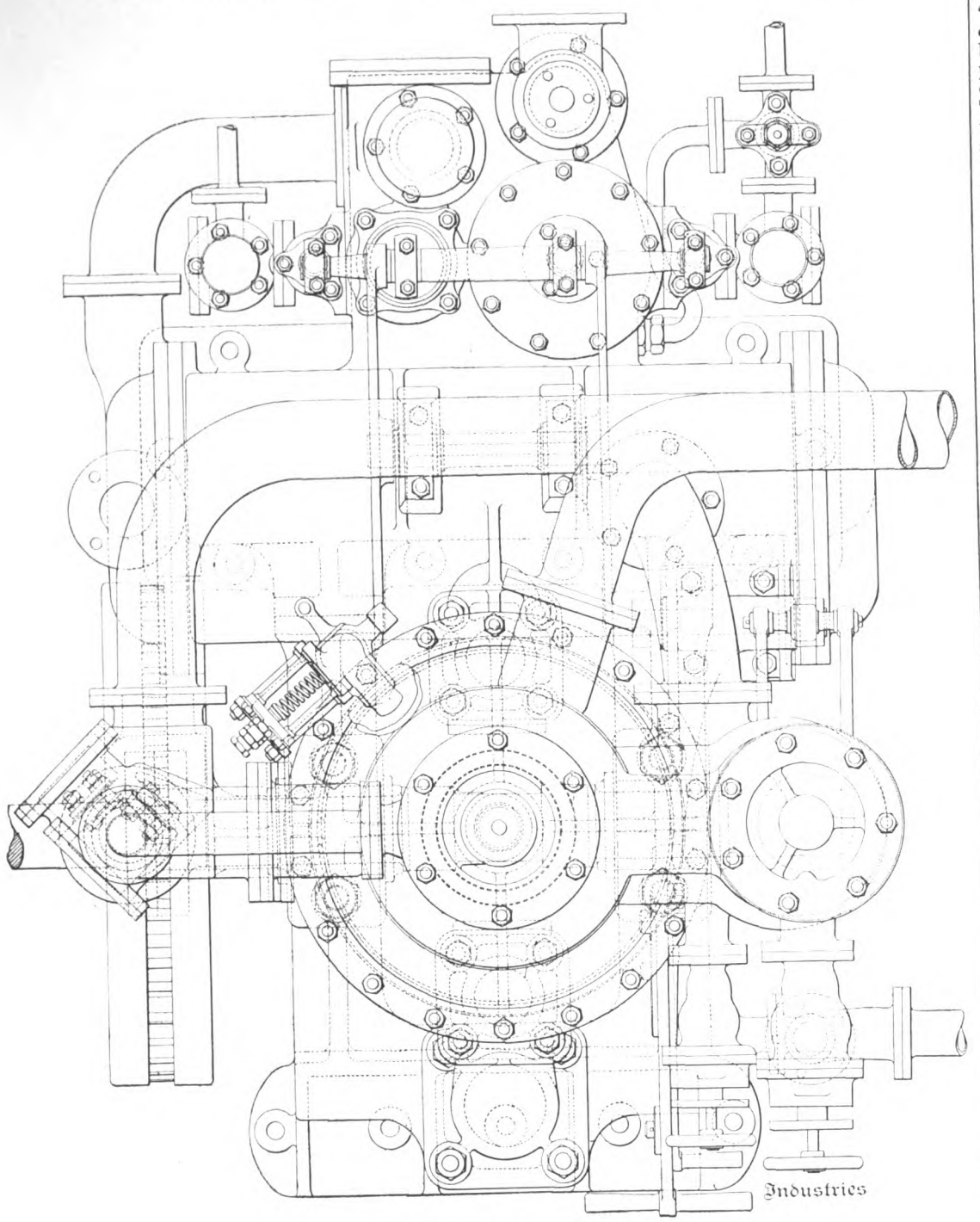


FIG. 2.—GENERAL PLAN.

all the threads must be of precisely the same form and pitch. When this is done, shallow grooves are cut parallel to the axis of the hob, about $\frac{5}{32}$in. to $\frac{1}{4}$in. pitch to form the cutting edges, and the hob is then ready for hardening—the most difficult operation of all. For that purpose the hob is placed in an iron box, and crushed charcoal carefully placed all round it to protect the threads from air contact and prevent scaling; the lid is then put on and carefully luted round with clay, and the box is then heated to the lowest temperature at which the steel will harden—as found by experiment. If heated too much, the danger of water cracking is increased, even though the heat may not be sufficient to spoil the steel. The next point for consideration is the cooling of the hob. Water warmed to from 80° to 100°F. is the best for tools of simple form, but for more complicated shapes a mixture of soft soap and water heated to about 100°F. is preferable, the soap having been boiled with the water until it is almost as thick as cream. Into this the hob is lowered in a perfectly horizontal position. It is not advisable to lay it on a plate for this purpose, or even to thread it on a rod with a plate riveted on the bottom, as the under side would be prevented from cooling as quickly as the upper one, and the circulation of water through the hole would be stopped. A better plan is to pass the hob over, or suspend it from a wire rod having three horizontal arms at its lower end to receive it. The hob must not be removed until it has assumed the same temperature as the bath, and whilst immersed it must not be moved sideways to hasten cooling. The soap solution has been used for many years, and is generally well known; but it is the safest bath for hardening tools such as hobs, milling cutters, riveter's snaps, &c., as by its adoption water cracking is largely prevented. A riveter's snap, for instance, will almost always crack at A A (Fig. 4) when hardened in warm water; but very

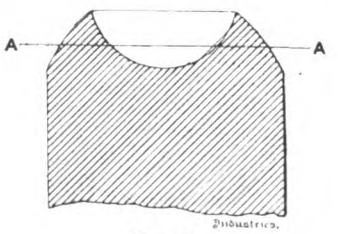


FIG. 4.

rarely when using the soap bath. After solid steel hobs and milling cutters have been hardened and tempered, it has been observed that they frequently slightly change in form for several days afterwards, and sometimes even break into several pieces without any apparent cause. This is, in some cases, the fault of the steel; but generally it is due to internal stress, originated in the metal whilst being hardened. The utmost care should therefore be taken in performing that operation; and when tempered, the hobs should be allowed to stand for a few days before being finished. The hole is then "lapped" out with a copper lap, and the threads examined to see if they are true. Frequently they will be slightly eccentric, and besides this, they will have probably warped sideways; and sometimes to such an extent that a good chaser could not be cut with them. To remedy this defect, a copper lap is made to fit the threads, and each one is ground true separately. Considering these difficulties, it is not surprising that other ways of making hobs have been tried. The idea was conceived of making a hob not wholly of steel, but of a face attached or welded to a centre of soft iron or very mild steel; and ultimately the difficulty of warping and cracking was avoided by forging a wrought iron centre, about 1in. less in diameter than the finished size of the hob, and welding a ring of steel about $\frac{5}{8}$in. thick on to it. The hob was then turned, the annular grooves cut, and the cutting edges formed; but the hole in the centre was not bored until after the hob had been hardened and tempered. It was then centered as truly as possible in the lathe, and bored out to fit the spindle. In this way the difficulty of water cracking was entirely avoided, and the threads needed no grinding afterwards.

TURNER'S IMPROVED STEAM ENGINE AND BOILER.

WE illustrate on this and adjacent pages, an engine and boiler, designed and patented by Mr. Henry Turner, 8, Chapel-street North, Liverpool, which together possess several important and novel features. One important feature in the engine is in the arrangement of the valves, by means of which the cylinders are used alternately for steam pressure, and for forcing air into the closed furnace of the boiler; and as the air is drawn round the tubes of a heater in the uptake, two objects are gained: (1) The heated air raises the temperature of the cylinder equal to or greater than that of the incoming steam; and (2) an automatic forced draught is created. In the engine illustrated, only one pair of cylinders is shown; but it is proposed to use two, three, or more pairs for large steamers, each pair working on a separate crank. The high pressure cylinder is placed on the top of the low pressure cylinder, the two pistons being coupled and working one crank. The steam after having acted in the upstroke of the high pressure cylinder passes direct through the valve box O to act on the downstroke of the low pressure cylinder, thus acting only on one side of each piston, the vacuum acting only on the top side of the low pressure piston. In the opposite strokes, heated air is drawn from D (Fig. 1) to the top side of the high pressure and to the bottom side of the low pressure pistons, and forced into the furnace of the boiler. The high pressure cylinder is 6in. diam. and $10\frac{1}{2}$in. stroke, the low pressure cylinder being $17\frac{1}{2}$in. diam., with the same stroke. The difference of the two diameters will, no doubt, appear very great; but while the vacuum is acting on the low pressure piston (as shown on the diagram, Fig. 4) it will be seen that the high pressure steam is forcing up the high pressure piston—the downward stroke being due to expansion. If the vacuum, therefore, be deducted from the low pressure diagram, and added to the high pressure diagram, it will be found that the pressures in each stroke only vary an amount necessary to overcome the weight of pistons, &c., to be raised in the upstroke. The valve chest H may be constructed in one with the chamber E, which connects the two cylinders, or separately, according to the size of the engines. H_1 is the steam port to the high pressure cylinder, H_2 to the low pressure, D being the exhaust leading to the condenser. The valve is of the piston valve type, and consists of two metallic packed valves M M^1 combined in one with the spindle T, and actuated by the link motion. The valve chest H has an annular steam passage U communicating with the stop valve C. The circular liner R has a number of triangular shaped ports R^1 R^2 R^3 R^4 opening into the belt U and to the exhaust D. The valve has three circumferential grooves N P Q, the groove N communicating the port R^1 to the steam belt U and the port R^2 to the steam passage H^1; the groove P communicates the port R_2 and the central passage V in the valve, by which the steam is led to the bottom of the valve M^1, and enters the port R^4 as it uncovers and passes through H_2 to the low pressure cylinder; the groove Q opens the port R^3, allowing the exhaust to pass from the low pressure cylinder to the condenser through D. The piston rings, or valve surfaces, are shown at S S^1 S^2 S^3. The piston S acts as a balance valve only; piston S^1 is for the admission and exhaust of steam in the high pressure cylinder, having a large amount of lap to insure an early cut-off; piston S^2 forms a division between the high and low pressure exhaust; piston S^3 is for the admission and exhaust of steam in the low pressure cylinder, being provided with a

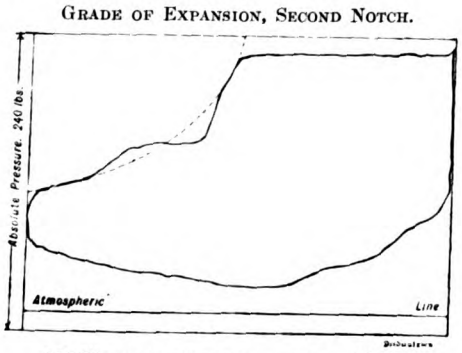
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late cut-off. The small amount of advance in the eccentrics required for the valve S^2, and the large amount required for the valve S^3 to obtain the early and late cut-off, is accomplished by means of the links W, which are attached to the lower side of the eccentric clips, and give the necessary variation in the movement of the link motion. The hot air chamber O consists of a vessel containing four sub-chambers, which communicate in due order by means of metallic valves with the atmospheric side of the piston and the furnace of the boiler.

The boiler consists of a cylindrical shell with a tapered flue and a nest of return tubes; these tubes are shown at the side of the flue in the drawing, but for large boilers they would be placed at the top, as in an ordinary marine boiler. The crown of the fire box has a fire clay—or other refractory material—lining, with an air space between it and the plates, in communication by means of the pipe F with the air pipe G from the valve chest O. In the uptake is fixed an air heater D, fitted with vertical tubes through which the waste gases are conveyed to the funnel; diaphragms are placed at intervals as shown, to deflect the incoming air and so absorb as much heat as possible from the tubes. The pipe F which connects the air pipe G with the air casing of the fire box is fitted with a double seated valve A in the valve box B, by means of which the air may be shut off from the furnace and led either to the funnel direct or to the waste pipe H. With a single flued boiler similar to the one illustrated, this operation is necessary each time of firing up; but with more furnaces the draught can be directed to those with the doors closed.

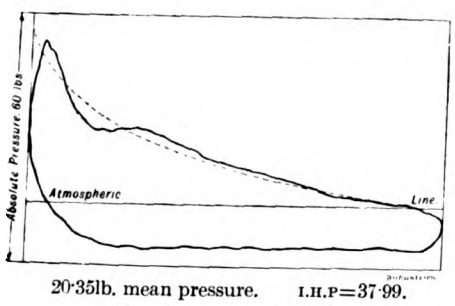
We understand that trials of many hours duration have been made with the engine described, with excellent results. These are shown by the following indicator diagrams (Figs. 3 and 4), and the tabulated data and results accompanying them. A powerful brake was attached to regulate the revolutions of the engine, and when the above diagrams were taken the stop valve was only half open. With the same brake load applied, the stop valve was opened fully, and the number of revolutions was increased to 480 per minute—equal to a piston speed of 840ft. per minute; with this high speed the boiler maintained, or rather gained upon, the normal working pressure. After a careful measurement of the coal, the designer states that the consumption was found less than 1lb. per i.h.p. per hour, which is an extremely low consumption.

GRADE OF EXPANSION, SECOND NOTCH.



129·9lb. mean pressure. I.H.P=26·86.

FIG. 3.—H.P. CYLINDER.



20·35lb. mean pressure. I.H.P=37·99.

FIG. 4.—L.P. CYLINDER.

TOTAL I.H.P.=64·85.

GENERAL PARTICULARS.

Diameter of high pressure cylinder (single acting)	6in.
Diameter of low pressure cylinder " "	17½in.
Ratio of areas	1 to 9
Total effective heating surface	88 sq. ft.
Total effective grate surface	2·92 sq. ft.
Steam pressure	222lb.
Vacuum	25in.
Revolutions	308
Heating surface per i.h.p.	1·35
Grate surface per i.h.p.	0·03
I.H.P per square foot of grate	22·26
Temperature in uptake	275°

Arrangements have been made for fitting this engine into a boat; and it will be interesting to note its performance during a long run at sea. The engine and boiler we now illustrate were made by Messrs. G. Bayliff and Sons, Wirral Foundry, Birkenhead.

TURNER'S IMPROVED STEAM ENGINE.

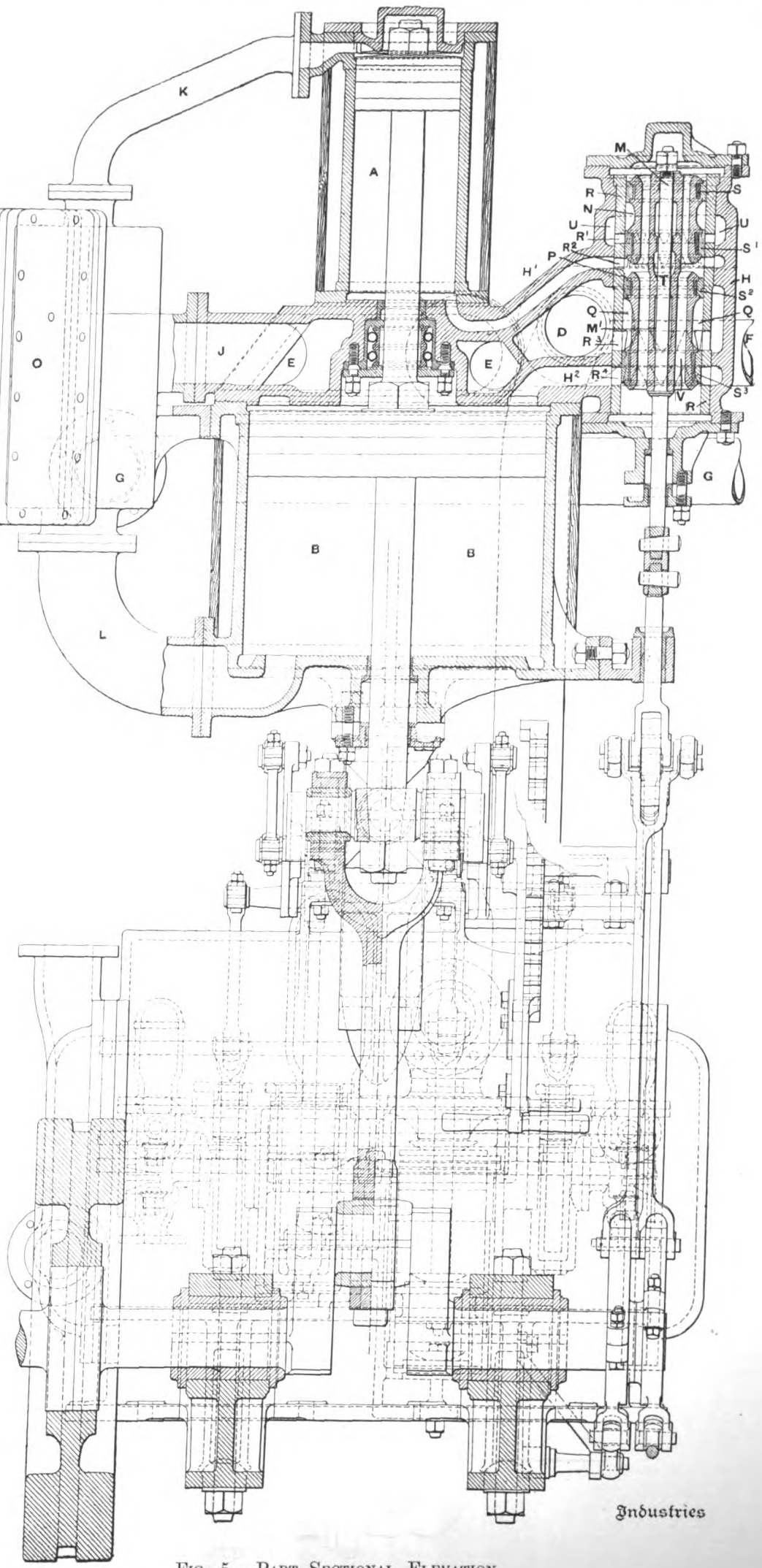


FIG. 5.—PART SECTIONAL ELEVATION.

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TURNER'S IMPROVED STEAM ENGINE.

(For description see page 560.)

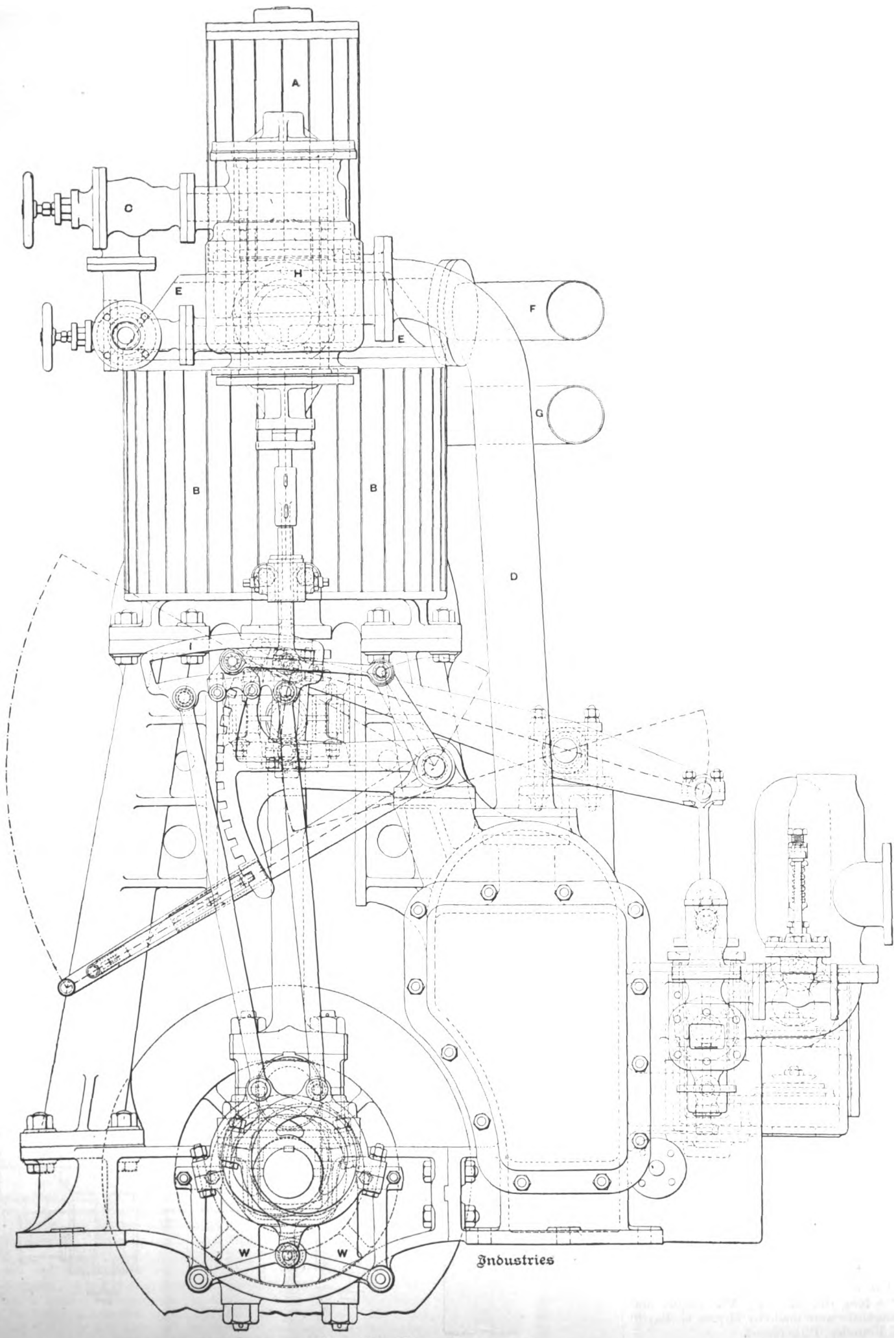


FIG. 6.—END ELEVATION.

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TURNER'S IMPROVED STEAM ENGINE.

(For description see page 560.)

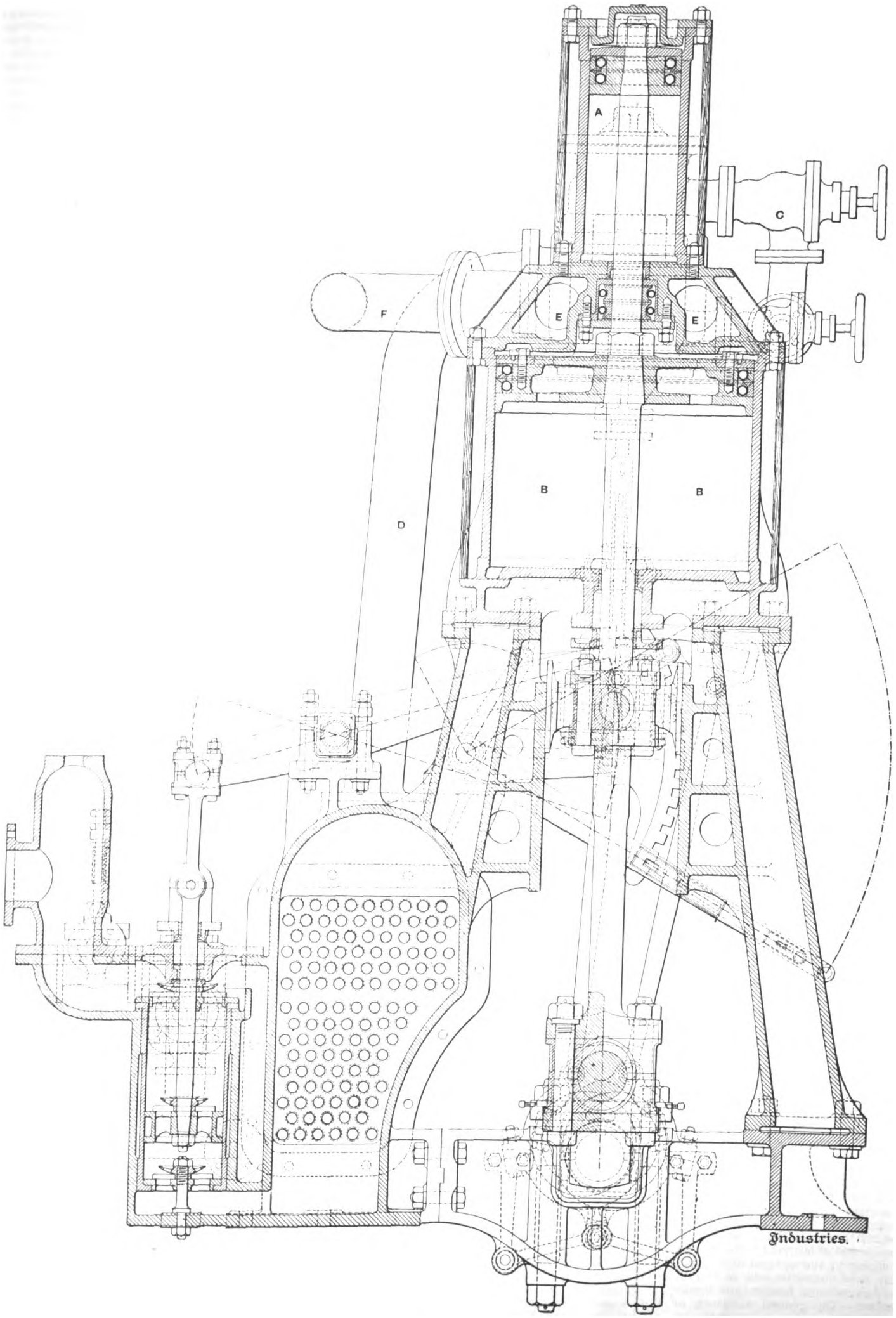


FIG. 7.—SECTIONAL ELEVATION.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 5TH JUNE, 1888.

THE IMPORT COAL TRADE.—The manifest tendency towards shrinkage in the import coal trade is a consequence, and in some degree a measure, of the steady development of the native mining industry. From the Customs returns, it appears that the deliveries of foreign coal for consumption in France amounted, for the first four months of the current year, to 2,658,084 tons, against 2,787,360 tons in the corresponding period of 1887. The decrease is mainly in the trade with Belgium. Of the quantity received this year, England furnished 45·34 per cent., Belgium 46·14 per cent., and Germany 8·47 per cent. The declared value of this imported coal was £1,586,600, against £1,821,520 last year. In 1882, the value reached £2,297,160. The average for the first four months of the last ten years is £1,905,840. The imports of coke, most of which is derived from Belgium, amounted to 340,641 tons, against 325,750 tons last year. The effects of the competition of the home industry are seen in the lower prices paid for foreign coke. Though the volume of the imports has increased 4½ per cent., the declared value is 21½ per cent. less, notwithstanding the fact that coke has for some time past been steadily advancing in price in all markets not open to foreign competition.

THE IRON MARKET.—The iron trade is beginning to feel the weaking influence of the disturbed state of the political atmosphere. Consumers hesitate and seem disposed to delay their purchases till the latest possible date. In Paris, business has for the moment shrunk within very narrow limits. Reports, however, received from the several centres of the iron industry state that though the markets are less animated there is still a brisk current of business, and prices outside Paris remain remarkably firm. Great activity prevails in the foundries, the produce of which is likely to advance in price shortly. The old stocks of pig are nearly exhausted, and as they cannot be replenished except at a considerable advance on former prices, founders will be compelled to increase their rates.

THE METAL MARKET.—The copper market retains the same features which have characterised it for some time past. The supply exceeds the demand, which has been greatly diminished by the high prices fixed by the syndicate, and as production is being pushed to the utmost, stocks continue to increase. To maintain its position, the syndicate is compelled to buy the surplus. Strong as the combination undoubtedly is, it must give way to the inexorable law of demand and supply. How soon the inevitable collapse will come is not easy to predict, but the event cannot be far distant. Consumers may expect the same tactics which were resorted to in the case of tin; that is, the syndicate will seek when the time comes to cover its losses by "bearing" the market. Business is growing animated in tin. Lead is dull. Spelter is in good demand, and prices remain at last week's level.

THE SUGAR BOUNTIES.—I have persistently held the opinion, founded on evidence not lightly to be set aside, that the French Government will not consent to the abolition of the bounties system. The facts as they appear on this side of the Channel are wholly opposed to the statements so freely and apparently so authoritatively made in England, to the effect that the proposals of the British Government have already been agreed to. Take, for example, the latest of these facts. At Laon Messrs. Floquet and Locroy have received a deputation from the syndicate of sugar manufacturers, and at the interview M. Mazurier, president of the syndicate, pointed out, and brought forward evidence in proof of his contention, that the abolition of the system of bounties would ruin the French sugar industry. M. Floquet is reported to have acknowledged the justice of the sugar makers' complaint, and he further assured the deputation that the plenipotentiaries sent by his Government to London had received instructions of a nature to safeguard the national interests. It would be interesting to know what these instructions were.

POPULATION RETURNS.—According to a return which has been published by the Statistical Bureau of the Paris Municipality, the total population of the department of the Seine at the end of 1886 was 2,961,089, of whom 2,344,450 lived in Paris. The population of the department has quadrupled since the beginning of the century, and shows an increase of 600,000 in the last ten years.

BERLIN, 4TH JUNE, 1888.

THE COAL MARKET.—Considerable quantities of lignite are being imported from Bohemia by barges down the Elbe, and the output of the Upper Silesian collieries finds also a more ready sale than was the case a few weeks ago. The report of the Dortmund Association of Coking Coal Owners and Manufacturers of Coke, shows considerable and increasing activity during the first quarter of the year. The sales of the association during that period amounted to 325,989 tons of coking coal and 615,140 tons of coke, as compared with 304,287 tons and 522,356 tons respectively sold during the same period of last year. The sales of coke by makers not belonging to the association amounted to 166,011 tons. Of the total quantities sold in the district, 32 per cent. was for Luxembourg, Lorrain, and France.

THE IRON MARKET.—The general tendency of the market is not so buoyant as it was a fortnight ago. It seems as though the depressed condition of the English market had produced the change, but there are also other influences at work. The high prices maintained by the various syndicates make it very difficult for German engineering works to get orders for export in competition with their foreign rivals, and even the home trade in steel rails is seriously threatened by the lower prices offered by English rail makers. In view of this state of the market, the proposal to re-constitute the international convention of rail makers is naturally received with much satisfaction by our rolling mill owners. It is also hoped that French mills will join the convention, if the English, German, and Belgian rail makers can come to an agreement. It is curious to note that whilst in this particular instance the policy of syndicating the trade is gaining ground, the same policy is losing ground in the wire nail trade. The Westphalian nail makers have definitively refused to join the syndicate of German wire nail makers, and in consequence of this opposition, the collapse of the latter is not improbable. The crude iron trade in Upper Silesia remains unchanged. Forge pig is quoted from 50s. to 54s., and foundry pig from 56s. to 58s. for medium, and 61s. for the best quality. Merchant bars are readily taken at 140s. to 142s., special sections 155s. to 157s.

SEWING COTTON.—The competition of English sewing cotton manufacturers has during the last five years been severely felt in Southern Germany. Recently, however, the sale of the English article has considerably decreased in consequence of the low prices obtainable, and our manufacturers are now doing a larger trade than they have been doing for the last five years. With the present depressed prices the profits are, however, by no means satisfactory.

TEXTILES.—The general tone of the Berlin market is quiet, as at present manufacturers have considerable stocks of raw materials to work up. The prices obtained for ready made goods show no improvement. A few parcels of French wool have been bought by commission houses here. The demand for worsted yarn is somewhat weaker, but prices have nevertheless slightly advanced. The rates for carded yarn have also been raised, and this step has called forth a protest on the part of manufacturers. Shoddy yarn is offered very cheaply, and cotton yarn is quiet. Business in piece goods is almost at a standstill, but fancy articles and hosiery goods are in good request.

PORTLAND CEMENT.—Tenders have recently been invited in Bremen for the supply of 1400 tons of Portland cement, to be used in works in the district of the Bremen free port. Twelve offers have been received, but the contract has not yet been given out. The prices quoted ranged between 40s. 4d. and 46s. 10d. per ton. Pozzuolana cement was offered at from 31s. 11d. to 35s. 6d. per ton. The contract will be settled in about ten days.

HOPS.—Reports from the province of Posen state that there is little demand for any but the best qualities of hops on the part of home breweries, and that the prices of the small lots sold are in favour of buyers. In medium qualities there is very little doing, and inferior kinds can hardly be sold at all. Present prices are 70s. for best qualities, medium sorts at from 35s. to 40s., and inferior qualities at from 12s. to 20s.

VIENNA, 4TH JUNE, 1888.

THE IRON MARKET.—Although prices are as yet fully maintained, the condition of the iron market during the past week cannot be described as buoyant. Owing to the dry season merchants are beginning to fear that the harvest will not be so good as was hoped a few weeks ago, and consequently the demand for agricultural machinery will fall short of previous expectations. As regards building iron, the season may also be considered as practically near its close. The greater portion of the iron required for building purposes has already been contracted for, and no transactions of any importance can be expected to take place after this month. In crude iron the firmer prices are fully maintained, and business in merchant bars and sheets remains normal. As yet engineering works are fully occupied, and rolling mills have even an abundance of orders on their books. This is mainly due to the somewhat more vigorous condition of railway enterprise, large quantities of rails being required for renewals, new lines, or duplication of old lines. Business in Hungary is fairly satisfactory, especially as regards the larger works, but smaller works are rather short of orders. There is still a good demand for building iron, but it is not expected that this will last much longer. In rails, and especially those of small section, business is very brisk, and prices have a rising tendency. The balance sheet of the Alpine Mining Company, which has just been issued, shows that the output of the works during 1887 was slightly larger as compared with that of the previous year. There were in work 591 coal pits, 61 iron ore pits, and 11 manganese ore pits. The total production in round figures was 324,000 tons of coal and 229,000 tons of iron ore. The total quantity of crude iron produced was 75,000 tons, and of steel in various forms 32,000 tons.

PETROLEUM.—A short time ago the Austrian petroleum refiners formed a syndicate, with a view to prevent the excessive cutting down of prices, as there was some danger of it taking place in this industry like in many others. According to the rules of the syndicate, no member is allowed to sell petroleum under 6fl. 50kr. per barrel. In connection with this syndicate is also the formation of a company which is now building a large warehouse for refined petroleum, at a suburban station of the Southern Railway, in the neighbourhood of Vienna. The warehouse will be divided into sections, each rented by one of the large petroleum dealers of Vienna. The petroleum refineries of Kronstadt, in Transylvania, which have hitherto worked up Roumanian oil, have been bought by the Fiume Petroleum Company, whose intention is to discontinue using Roumanian oil, and to treat at Kronstadt only Russian oils carried by the company in tank steamers and tank waggons *viâ* Fiume.

THE JUBILEE EXHIBITION.—As a general rule, exhibitions in recent years have become huge organisations for advertisement and business purposes; but the present Jubilee Exhibition, although not quite free from this reproach, is a more representative show of Austrian industries than many of its predecessors, and as such it is likely to be very successful. The collections of art metal work, carpets, furniture, glass, pottery, leather goods, trimmings, and other articles of a semi-artistic character, are very complete, and give the visitor a fair idea of the general state of these industries in Austria at the present time. The paper makers in this country have come forward with good collections of their wares, and their trophy, which is a tower placed in the centre of the Rotunda, and reaching nearly to the top, is a very attractive object. The engineering trades are also well represented, especially as regards high speed engines for electric lighting. There will be found three-cylinder engines, high speed double acting engines, small marine engines, a new benzine motor of Langen & Wolf, and the petroleum engine of Marcus. The latter is coming into favour in Vienna, because it can be worked with any kind of common petroleum. The design is compact and simple, and the workmanship very creditable. The igniting apparatus works with perfect certainty. Amongst the steam dynamos a 150 h.p. alternator, constructed by Ganz & Co., deserves special mention. The cylinder of the engine is 15¾in. diam. by 18in. stroke, and the speed is 250 revolutions a minute. The steam is distributed by a piston valve, and the cut-off is controlled by varying the angular position of the eccentric by a centrifugal governor mounted direct on the crank shaft. The dynamo is self exciting and self regulating. Of the belt driven dynamos, those exhibited by Messrs. Egger are fair representatives of modern electrical engineering. Two kinds are employed, viz., arc and glow light machines. Those for supplying glow lamps have an output of 300 ampères at 110 volts pressure, when driven at 600 revolutions per minute, the armature has a resistance of ·015 ohm, and the field, which is plain shunt wound, has a resistance of 19·466 ohms. The armature conductor is a copper tape, and the density of current in it is about 2000 ampères per square inch. The other type of machine used for arc lighting in parallel has an output of 450 ampères at 70 volts pressure, when the machine is driven at 500 revolutions per minute. The weight of these machines is 2 tons 16cwt.

BRUSSELS, 5TH JUNE, 1888.

THE METAL MARKET.—There is no change in the course of affairs, and prices remain very firm. The great pressure which has existed on account of the scarcity of pig may be gathered from the fact that whilst the imports of foreign pig in March, 1886, amounted to 14,000 tons, and in March, 1887, to 20,000 tons, they increased in the same month of the current year to 40,000 tons. Most of them came from England, about 10,000 tons being shipped direct to Belgian ports, and 15,000 tons *viâ* Holland. In view of the small demand from abroad it is a little doubtful whether the rise in the price of merchant iron fixed by the syndicate will prove of benefit, as it may serve to prevent orders being given out.

THE FLAX MARKET.—There has been remarkable activity in the flax market, buyers being eager to do business owing to the bad reports on the present season's crop, which is likely to prove insufficient unless there is a speedy change in the weather. Owing to absence of rain, the plants do not promise at all well at present.

SUGAR.—The market is very quiet, and notwithstanding the fact that in most other European markets there has been a rise, no change in price has taken place here. For home consumption, refined sugar finds a good sale; but the export has decreased.

THE EXHIBITION.—It is to be hoped that our Exhibition will be completed some day; in the meantime, it is being opened in instalments, and on Sunday the Italian section was inaugurated. The usual banquet took place, at which the Italian Minister, the Belgian Premier, and Count Mirafiore, the Italian Commissioner, were present.

ELECTRIC LIGHTING.—Important alterations are to be made in the installation at the Theâtre de la Monnaie, which has not been found quite satisfactory. The municipality will be concerned in the matter, the electric lighting section being placed in the hands of their engineer, M. Wybauw. The long distance system will be employed, the central station being at the town gas works. Owing, however, to the number of rival systems of transformers in the market it will probably be some time before a final selection is made.—Somzée accumulators are finding a very good sale for private house lighting, and they are also being used for part of the electric lighting of the Exhibition.

GAS LIGHTING.—Great progress is being made in the employment of regenerative gas burners in this country, especially in Liège, Ghent, Antwerp, and Brussels. The Wenham Company are doing such good business that it is difficult to obtain lamps from them for immediate delivery. Other inventors are also in the field, and the Fourneyse and Delhaise lamps both find favour. The Compagnie

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Franco-Belge of Anderlecht are finding a very ready sale for their Ezmos lamp, which gives a clear white light of great steadiness, and which has also the advantage of being comparatively small.

DÜSSELDORF, 4TH JUNE, 1888.

THE IRON MARKET.—A calm has come over the iron market, the result probably of the depression in England, as in the present relations the movement of the English market is at once and strongly reflected in that of Western Germany. Compared with last week, business in crude iron is dull. The demand is light for spiegel, and only moderately brisk for forge. The former may now be bought for 58s. for the 12 per cent. quality; the latter has oscillated in price between 50s. 6d. and 51s. 6d. There is a steady demand for Luxemburg forge at 38s. 9d. Bessemer and Thomas pig are less inquired after; foundry pig, however, is in brisk demand. The finished iron market is but little changed. Bars are not much inquired after for home consumption, while the export trade is utterly lifeless. With the present prices of the raw materials, there can be no thought of successful competition in neutral markets with Belgian and English goods. Manufacturers sell bars at a loss to the makers of machines for export, to enable the latter to meet foreign competition. Business in plates continues brisk. Boiler plates are likely to advance in price. The spring trade in sheets is disappointing, the expected revival failing to make its appearance. Prices of Siegen sheets are, however, firmly maintained at £7. 10s. to £7. 12s. Wire shows no improvement, as the impending collapse of the wire nail syndicate has checked for the moment the business in nails. Foreign competition keeps the rail trade in a depressed state.

THE HARDWARE AND OTHER SMALL GOODS TRADES.—The hardware and other small goods manufacturers of this locality have this year done a brisk spring trade, and are still very busy with orders on hand. Agricultural implements sell freely. The hay and dung fork makers' syndicate has been renewed. The coal shovel makers' syndicate has agreed to increase its prices from the 1st inst. The wrought iron saucepan makers' syndicate has fixed its prices at 20s. per cwt. All these associations have held meetings within the last week. At Solingen great activity prevails in the works for the manufacture of swords and bayonets.

THE MINING INDUSTRY.—The revived and constantly growing demand for coal has infused life into the coal mining industry of Western Germany. All collieries are now being worked full time, a circumstance unusual at this season of the year. In some cases the output has been sold to the end of the current year. Iron ore mining, too, is being prosecuted with vigour. From a report of the Minister of Public Works just issued, we learn that the total production of the Prussian mines of all classes increased from 47,000,000 tons in 1877, to 74,000,000 tons in 1887. This increase has taken place chiefly in coal and ironstone mining.

EXTENSION OF THE INLAND WATERWAYS.—All the industrial towns of Westphalia and the Lower Rhine have been in a state of festivity to celebrate the passing of the measure involving the construction of the Ems Canal by the Reichstag. This event is of the highest importance to the industry of Western Germany, especially to the coal and iron trades; and it is, moreover, one which will have an important bearing upon British trade. It is confidently expected that this waterway will enable the manufacturers of this locality to more successfully oppose English competition, not only at home, but also in neutral markets.

LILLE, 5TH JUNE, 1888.

TEXTILE MANUFACTURES.—The political event of the week, the Hungarian Minister's speech relative to the participation of Hungarian manufacturers in the Great Exhibition of next year, has increased in a notable degree the feeling of distrust which pervades the industrial world. Under such circumstances it is vain to look for improving trade. Last week's business shows the evil influence of the disturbed state of affairs. The markets generally are lifeless, and the prospect of more remunerative prices grows more and more remote. The linen goods trade has, however, shown greater activity within the last few days; but this renewed life is the result of numerous small purchases rather than of more important dealings. At Roubaix, the manufacturers are buying wool more freely, and prices show an upward tendency. The greater activity in the market for woollen stuffs, which I reported last week, is well maintained. Had no fresh political complications occurred, I should probably have had to mention a further improvement. It is now announced that the projected wool market for Roubaix has been definitively organised, and will open in July. Doubtless this will serve to promote the trade of the district. Business in cotton goods is dull. An official document recently published states that the steam power applied in France to the production of textile goods increased in the interval between 1876 and 1886 from 85,000 h.p. to 147,000 h.p.

FLAX AND YARN MARKETS.—The week has been one of considerable excitement in the flax and yarn markets. Spinners have eagerly bought up every lot of home grown flax offered, at only a small advance on the previous week's prices; but only a small quantity has been offered for sale, and in most cases holders have asked for a substantial advance in price. In the yarn market there has been still greater animation. Weavers have bought largely, in most cases at the prices of the preceding week, but in several instances at a slight advance on those rates. The bulk of the business was, however, transacted by merchants, who have dealt on a speculative account. The cause of this sudden animation is the state of the new crop. The absence of rain, together with the long spell of north-east wind, has, it is said, occasioned serious injury. Nothing more than an average crop is now possible, and it seems likely to fall much below the average. A large acreage is this year under flax in this district, for in many cases flax has been grown in the place of wheat; but notwithstanding this fact, which for a time kept the flax market dull, the production of 1888 is not likely to exceed that of 1887. At present the plant is very short, and the only hope of improvement lies in speedy and abundant rain.

THE IRON MARKET.—The iron market presents no new features. There is a steady current of business; but partly on account of the uncertainty of the political future, which weighs heavily on all industries, and partly on account of the ill feeling existing between our manufacturers and the merchants of Paris, there is wanting that buoyancy which is indicative of vigorous life. Prices are firmly maintained all round. Bars are quoted £5. 8s. to £5. 12s.; joists £5 to £5. 4s.: common plates £6. 12s. to £6. 16s.; and boiler plates £7. 8s. to £7. 12s.

AGRICULTURE IN THE NORD.—The Department of the Nord contains 1,404,390 acres of cultivatable land, about one-fourth of which is annually put under wheat. The yield of this land amounts, on an average, to nearly 9½ million bushels, a larger quantity than is produced by any other department of France. Oats are also grown in large quantities, amounting on an average to some 3¾ million bushels. The sugar beet covers some 36,000 acres, and large tracts of land are sown with flax and hemp. Hops and tobacco are also important objects of culture.

WINTERTHUR, 4TH JUNE, 1888.

INDUSTRIAL ESTABLISHMENTS.—A limited company has been formed under the title of the Société Zuricoise pour la Construction de Métiers à Tisser, with a fully paid-up capital of £2,400, to work the Wassermann-Haggenmacher patents for weaving looms. The engineering firm of Socin and Wick has been turned into a company under the title of the Maschinenbaugesellschaft Basel. Among the directors is the well known electrician, Herr Emil Bürgin. A new leather works on the Dongola system has been established at Wallenstadt. According to official statistics there are now 3687 factories in Switzerland, employing 150,702 hands.

VENTILATION OF WORK ROOMS.—With a view to determine whether the work rooms in mills and factories were sufficiently well ventilated, Dr. Schuler, one of the Swiss factory inspectors, has visited 130 establishments in this country. Samples of air were taken in each of these, and the following shows the quantity of carbonic acid contained:—

	Carbonic acid. Per cent.
In one sizing mill the air contained	·4
In four carding mills the average was	·68
In twenty-seven cotton spinning mills	·69
In five cotton twisting mills	·79
In six foundries and machine shops	1·24
In four calico printing works	1·35
In twenty-one cotton weaving mills	1·37
In thirty-six embroidery factories	1·63
In nine printing establishments	1·73
In sixteen silk winding and weaving mills	2·21

In order to reduce the quantity of carbonic acid contained in work rooms, Dr. Schuler proposes, where no ventilating appliances are at present employed, to make use of the double windows for this purpose by substituting a perforated sheet of metal for one of the panes of glass. By this means he considers that by the great difference of temperature between the interior and exterior of work rooms a sufficient current of air will be produced. Trials made with such a ventilator have shown that the speed of the air through the holes varied from ·633m. per second at a temperature difference of 17°C. to ·725m. per second at a temperature difference of 24°C.

MADRID, 4TH JUNE, 1888.

ELECTRIC LIGHTING.—With reference to the electric lighting of La Comedia Theatre, to which I recently referred, an injunction has been obtained by the neighbouring tenants on account of the noise. This proves what I have said on previous occasions, that there is an opening in Madrid for a large central electric light station, which ought to be profitable, as the price of gas here is 9s. per thousand. The owners of the theatre will probably appeal against the decision, on the plea that they are merely complying with the order respecting the lighting of theatres; but the installation cannot continue as it is, for there is not sufficient space to manage it properly, and it is certainly very noisy.

PETROLEUM.—The Bill raising the duties on petroleum to the extravagant rate of about 1s. 2d. per gallon has passed the Cortes, and although the duty was imposed partly with a view to an immediate increase of receipts, I do not consider this expectation will be fulfilled, as the imports have been so large lately, in anticipation of the increased duties, that there is sufficient supply in the country to cover a year's consumption, which amounts to 40,000 tons.

NEW YORK, 26TH MAY, 1888.

THE COAL MARKET.—Prices in the anthracite coal market are fairly well maintained, but production still exceeds the demand. The official figures for April show that the production for that month was nearly 70,000 tons more than in 1887, and that stocks of coal had increased 267,000 tons at the ports. The Lackawanna shipments have increased 538,000 tons for the year, while Lehigh Valley has fallen off the same amount, and Reading nearly 750,000 tons. This disparity causes considerable ill feeling, and the fact that Lackawanna still refuses to join the coal combination aggravates the matter. Complaints are also made that they are cutting down rates. When the demand for coal springs up, and the real business of the year begins, some arrangement will have to be made. Bituminous coal is quiet, with a slight tendency to lower prices; but the market is not likely to change much at present, as nearly the entire season's production is already contracted for.

THE IRON MARKET.—There is very little change in the condition of the iron market, which is still very dull, and there is no immediate hope of improvement. For about a year the demand has been decreasing, and although large compared with 1885, it is not enough to absorb all the iron offered. The pig iron market is still in an unsettled condition, and concessions even on small lots have been considerable. The Thomas Iron Company have intimated a reduction of $2 per ton; as at first announced, it was supposed that the reduction only amounted to $1, and this was not a surprise, as several of the leading companies had been quoting special rates to their customers until it was generally understood that $1 had been taken off since the first of the month. The reduction of $2 was a sharper cut than the trade were prepared for, and may not be met by other companies until the situation is more fully developed. Prices are now within $1 per ton of the lowest on record, and are $16, $17, and $18 per ton for the three grades; the lowest record, $15 for grey forge and $17 for No. 1 foundry, having been reached during a portion of 1877, 1878, and 1885. There is no probability of an increasing demand even at lower prices, consumers having bought all they want for the present. Business in manufactured iron remains much in the same condition as reported for several weeks past. Prices are kept at a point little, if anything, beyond first cost, even to mills that can run full. Many have shut down entirely, competition making it impossible for them to keep their men employed without cutting prices to a point which would involve serious loss.

THE METAL MARKET.—The copper market opened steady with but very little business, but towards the end of the week prices advanced slightly. There has been a slight improvement in tin, but little business has been done. Tin plates have been closely following pig tin in fluctuations. Stock is not plentiful, and spot commands a premium. The demand is good both for spot and futures. The importation of plates has increased 17 per cent. in the last nine months. The lead market is dull and weak; prices are unchanged, and but little has been sold. The spring trade has been 30 per cent. less than it should have been, and as long as the tariff agitation continues markets will be uncertain.

THE NAVY.—The Secretary of the Navy has approved of the modified plans for the machinery of the "San Francisco," to be constructed at the Union Iron Works in San Francisco. The plans are for triple expansion engines having cylinders 42in., 60in. and 94in. diam. and 36in. stroke, and are to develop 11,000 h.p. The principal parts of the engines are to be of steel, and wherever possible to be interchangeable. The condensing surface is 14,500 sq. ft., and the condenser is fitted with double independent air pumps. Four double ended cylindrical boilers are to be built, having a heating surface of 19,500 sq. ft., and an independent boiler for auxiliary purposes. Forced draught is to be used on the closed ash pit system. The gunboat "Yorktown" and the dynamite boat "Vesuvius" have been launched at Craups. The Richmond Locomotive Works will receive the contract for the engines of the battle ship "Texas," to be built at the Norfolk Navy Yard.

LAGGING FOR LOCOMOTIVE BOILERS.—At the Rhode Island locomotive works a number of new locomotives are being built, and are lagged all over the boiler and dome with a mortar whose principal ingredient is asbestos, making the covering all in one piece. The mixture is put on the boiler while it is under steam, and it takes several days to finish the operation. It is claimed that leaks will show plainly by discolouration, and all that will be needed to make repairs will be to cut out the covering over the leak, and after the repairs are finished to re-plaster the opening in the cover.

PORTABLE ELECTRIC LIGHT PLANT.—The Cumberland Valley Railroad is one of the first to have a travelling electric light car. It was fitted up to furnish light at picnics, camp meetings, and for removing wrecks at night. It is an ordinary box car, but strongly built, and is furnished with an 8½ h.p. engine and boiler, and a 15-light Thomson-Houston arc dynamo. The car carries poles and a reel (containing three miles of insulated wire), 3 tons of coal, and 1000 gallons of water. The car has more than paid for itself in the increased sale of tickets for picnics, &c., and has been hired by most of the connecting roads, from time to time, to be used when clearing away wreckage. It has also given an impetus to the introduction of the electric light in many of the smaller towns along the line of the road.

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THE "CYCLONE" PULVERISER.

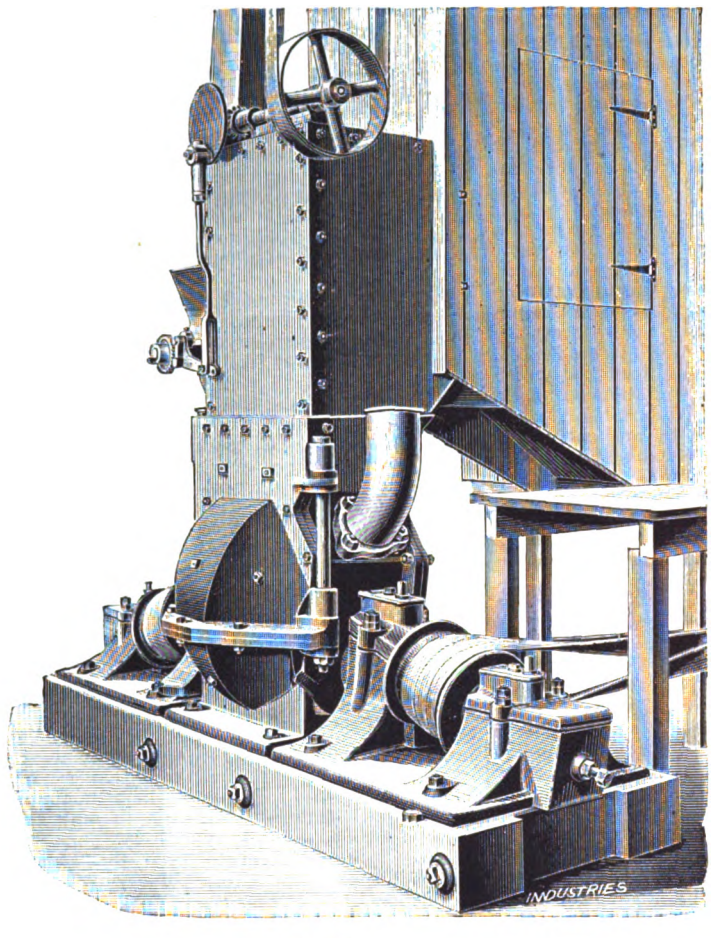


Fig. 1.

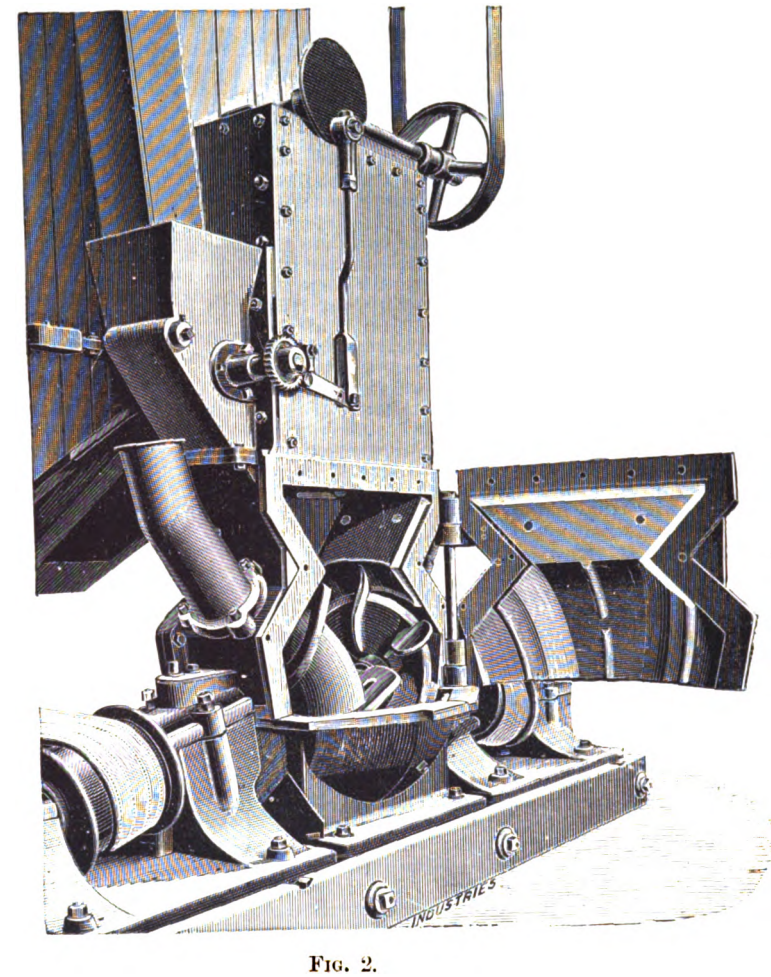


Fig. 2.

THE "CYCLONE" PULVERISER.

When the process of cutting hard surfaces by a sand blast first came into use, it was currently believed that the invention was due to an observation made by an officer of the American Federal army, who noticed that the glass panes in the windows of a cottage exposed to the wind from a sandy shore were blinded by the continual bombardment of sharp sand, and thus a natural and, to the owner of the cottage, certainly a very undesirable phenomenon brought about the development of a most valuable industrial process. Whether the dreaded cyclones which occasionally sweep over the American continent may be similarly credited with having stimulated inventive talent, we are unable to say; but there can be no doubt that a small artificial cyclone, properly applied, produces a marvellous result in the way of reducing the hardest substances to a fine powder. The reduction is due to the rubbing of the material on itself, and this principle has been made use of in the "Cyclone" pulveriser, now being introduced into this country by Messrs. Cowper, McCarnie, & Co., of Fenchurch Avenue, London, E.C. We recently inspected the machine, and also samples produced by it, at the Gun-street Mills, Spitalfields, E., and give herewith some illustrations. Fig. 3 shows the general arrangement of the pulveriser and the depositing chambers, whilst Figs. 1 and 2 are perspective views showing the machine closed and open. The small artificial cyclone is produced by two fans F revolving face to face but in opposite directions. The axes of these fans are slightly inclined to the horizontal, so as to produce an upward component in the air currents by means of which those particles which have been sufficiently reduced are carried off, passing either horizontally along over the receptacles F G, or first up the chimney on the left side and down on the right side of the central partition, after which the powder is deposited in the receptacles F G. If the material is to be deposited immediately after leaving the machine, the slide or shutter C, shown dotted in our sketch, is withdrawn; if the chimney is to be used, this shutter is inserted and one of the shutters E is withdrawn, thus regulating the length of the air column which holds the powder in suspension, and by this means the degree of fineness of the powder is partly determined. From the receptacles the material may be either delivered into sacks as shown at F, or as at G it may be led down a shoot to a lower floor. An exhaust fan K serves to take off any back pressure which might exist above the pulveriser. The material to be treated is fed in at the hopper H, and falls into a receptacle D, in which is a revolving drum with compartments (not shown in our sketch) which discharges at regular intervals a given quantity of the material into the space between the two fans, where it is taken hold of by the vortex of air and held in suspension until, through the attrition of the material against itself, the particles have been sufficiently reduced to be carried off by the upward current of air. The gear by which the feed drum in D is worked, is clearly shown in Figs. 1 and 2. The rate of feed is adjustable, and so is also the supply of air; the latter being regulated by slides in the air inlet pipes A A. At B B there are additional inlets for air, covered by wire gauze to prevent adulteration of the material, which might take place if extraneous matters were sucked into the apparatus through these openings. At first sight it might appear as if the material, upon being fed into the apparatus, would fall to the bottom and block the space where the two fans come closest together; but this is not the case. Upon opening the front door there is hardly any material found at the bottom, and this proves that the material, even when composed of heavy and fairly large pieces, is really held in suspension between the fans by the violent vortex action and upward draught of the air. As a further consequence, the wear on the blades of the fans is comparatively slight. In the machine we saw, the fans are chilled castings, with spoon-shaped blades about 2ft. in diameter over the tips. The fan casing is a cast iron box with chilled liners, and is provided with a door shown open in Fig. 2. The fans are driven by belting at a speed of from 2000 to 2500, and in a smaller size machine 3000, revolutions per minute.

Notwithstanding the great simplicity of the apparatus which we have here described, the means of adjustment for dealing with any material and obtaining reductions to any degree are very efficient. As already mentioned, the feed can be regulated by the gear shown in Figs. 1 and 2. This to a certain extent determines the degree of fineness to which the material is reduced; but a further adjustment is provided by the slides in the inlet air pipes, and by the shutters in the discharge chamber, as already explained. If the slides in the pipes A A be completely closed, all of the air drawn in by the fan blowers enters from below, and the general tendency of the current is upward, thereby producing a rather coarse product. If it be desired to produce a more granular or powder-like product, the inlet slides A are partly opened, thus checking to some extent the upward tendency of the air current, and forcing the material to remain for a longer time under the influence of the vortex currents. To judge from the collection of samples we saw at Gun-street Mills, nothing seems to come amiss to this pulveriser. It reduces with equal facility to granular or fine powder form, coal, plumbago, slag, phosphates, feathers, and even such hard substances as quartz, flint, and zircon, the powder of the latter substance being, as is well known, used in the manufacture of the Welsbach incandescent gas burner. From an official report, submitted by Mr. Richard H. Buel, C.E., of New York, we learn that the pulveriser with 24in. fans requires 17 h.p. when pulverising plumbago at the rate of 1030lb. per hour, and $8\frac{3}{4}$ h.p. when running empty with all the air inlets open. The rise of temperature of the air as it passes through the machine, when reducing plumbago, quartz, and anthracite coal, was from 20°F. to 23°F. A smaller machine having 12in. fans was found to absorb $9\frac{1}{4}$ h.p. when pulverising flinty quartz at the rate of 420lb. an hour. When running empty this machine absorbed $5\frac{1}{4}$ h.p.

THE TESTING OF MATERIALS.

The United States Government have just issued a volume which, if only regarded as a book of reference, possesses great interest for the industrial community. It is a report of the tests of metals and other materials for industrial purposes made with the United States testing machine at Watertown Arsenal, Massachusetts, during the year ended 30th June, 1885. In addition to tests for purely military purposes, steel wire, riveted joints, railway axles, locomotive gear, ropes, cotton cloth, bricks, &c., have also been dealt with, and the results tabulated in a very accessible way. The volume comprises more than 1100 imp. 8vo. pages, and contains, besides the tests made with the 400 tons Emery machine for the service, also records of tests undertaken for private firms. In accordance with United States law, the records of all tests have from time to time to be presented to Congress.

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THE "CYCLONE" PULVERISER.

(For description see opposite page.)

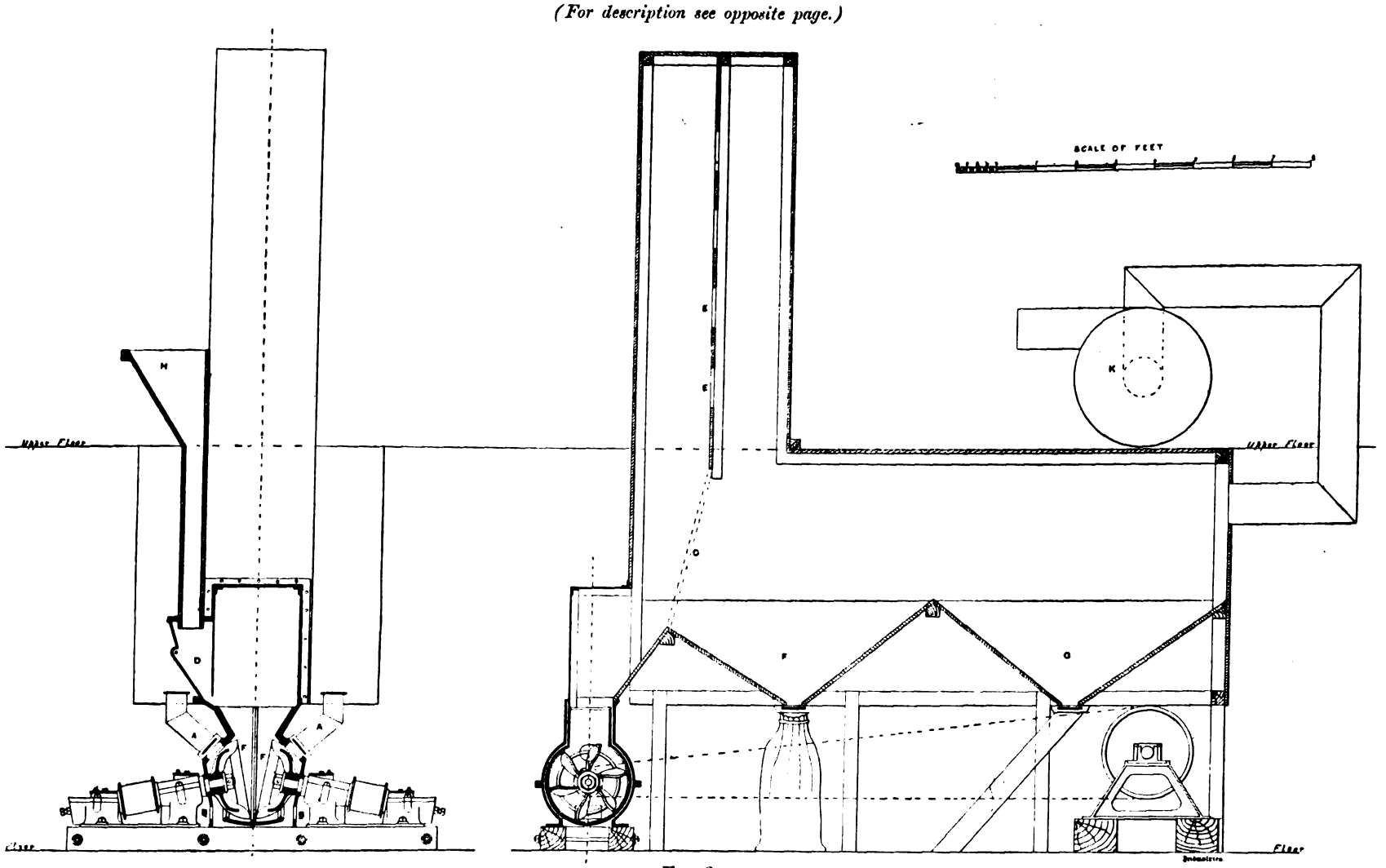


FIG. 3.

PRICES CURRENT, 7TH JUNE.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		31/7½	Cash
Scotch Warrants, m/n		37/10	"
Hematite Warrants, m/n		41/8½	"
Stocks in Stores. Scotch	990,102—Inc. for week,	3288	Tons
Middlesbro'	289,289—Dec. "	3795	"
Hematite	202,424—Dec. "	6470	"

Exclusive of stocks in makers' yards.

Market stronger, with an upward tendency.

Scotch shipments 7027 tons, against 6299 tons for same week last year.

	No. 1.	No. 3.	
Coltness	47/6	43/-	f.o.b. Glasgow.
Gartsherrie	44/3	41/6	" "
Dalmellington	39/6	37/9	" Ardrossan
Eglinton	38/3	37/-	" "
Glengarnock	43/3	39/3	" "
*Derbyshire	—	34/6	f.o.t. Works.
*Lincolnshire	—	31/6	" "
*Lancashire	—	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	4 15 0	5 5 0	f.o.t. wks
" Angles	4 12 6	5 2 6	"
" Plates	4 17 6	5 7 6	"
Staffordshire Bars	5 0 0	6 0 0	Manch'r.
" Angles	5 10 0	6 10 0	"
Crown Sheets	6 10 0	6 15 0	"
" Hoops	5 7 6	6 7 6	"
"Siemens-Martin" Steel Boiler Plates		7 17 6	"
" Ship and Girder		7 15 0	"

METALS.

Spelter: Ordinary	£16 10 0	to	16 12 6
Copper: British Cakes and Ingots	81 0 0	"	
" Chili Bars	82 10 0	"	83 0 0
" Manufactured (strong)	88 0 0	"	90 0 0
Lead: Common Pig	13 15 0	"	
" English Sheet	13 17 6	"	
Tin: Straits	83 10 0	"	84 0 0
" Australian	86 0 0	"	
" English Ingots	92 10 0	"	93 10 0

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	26 0 0
" Ceylon	"	23 0 0
Cottonseed	"	20 15 0
Cod	"	18 10 0
Lard	"	43 10 0
Linseed	"	18 7 6
Palm, Lagos	"	20 0 0
Rapeseed: English	"	24 10 0
Seal: Pale	"	22 10 0
" Brown	"	16 0 0
Sperm	"	41 0 0
Whale	"	14 0 0
Turpentine	per cwt.	1 1 6
Coal	per gal.	0 0 5½
Petroleum (Refined)	"	0 0 5½
" Spirit	"	0 0 7½

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

No. 1 Selected.	No. 3.	No. 4.
Prices, per ton 52/-	..... 43/6	..... 42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—The stocks have again increased about 5000 tons during the month, the total visible supply on the 1st inst. being 69,371 tons. The increase since the 1st of January is 27,120 tons. The present stock is the largest on record, and it is increasing very rapidly. At the same time the copper trade is in a state of almost complete stagnation, and there is no demand for export. Everybody is asking how long this state of things is to continue. The French syndicate are taking great pains to inform the public of the immense funds at their command, and of their determination to maintain prices. With this object they buy daily the spot copper which comes forward, and in this way the price is kept up. Many millions are thus locked up in the enormous stocks of copper, and the market artificially regulated thereby. Consumers still hold off, and the demand is now the smallest which has been known for years. It remains to be seen how long this state of things can continue.

TIN.—There has been an active demand, and stocks have been considerably reduced. Quotations have fluctuated from £85. 17s. 6d. to £83. 10s. per ton for spot parcels. Three months quoted from 15s. to 20s. per ton higher.

LEAD.—Quotations without alteration.

SPELTER is again lower. Warrants quoted £16 to £16. 5s. per ton, with a downward tendency.

CHEMICALS.

	£ s. d.		£ s. d.
Acid: Carbolic Crystals lb.	0 1 2½	to	0 1 3
" " Liquid gal.	0 1 2	—	0 1 9
" Citric lb.	0 1 7¾	—	0 1 8
" Oxalic "	0 0 3	—	0 0 3¼
" Sulphuric ton	1 5 0	—	1 10 0
" Tartaric lb.	0 1 6	—	0 1 6½
Alum: Lump (powder 10/- ex.) ton	4 7 6	—	5 0 0
Ammonia: Carbonate lb.	0 0 3½	—	.....
" Muriate (Grey) ton	23 0 0	—	.....
" " (White) "	26 0 0	—	.....
" Sulphate "	11 15 0	—	11 17 6
" Liquor lb.	0 0 3¼	—	.....
Bleaching Powder ton	7 7 6	—	7 12 6
Bisulphide of Carbon "	12 0 0	—	12 10 0
Borax "	30 10 0	—	32 0 0
Benzole (90%) gal.	0 2 6	—	0 3 0
" (50/90%) "	0 2 0	—	0 2 3
Copper Sulphate ton	20 10 0	—	21 10 0
Copperas "	1 10 0	—	2 0 0
Kieserit "	1 12 6	—	.....
Lead: Nitrate "	23 0 0	—	.....
" White Sugar "	26 10 0	—	27 0 0
" Brown " "	21 0 0	—	22 0 0
Potash: Bichromate lb.	0 0 4½	—	.....
" Caustic ton	20 10 0	—	21 0 0
" Carbonate "	17 10 0	—	17 15 0
" Chlorate lb.	0 0 5½	—	0 0 5¾
" Prussiate (Yellow) "	0 0 6¾	—	0 0 7
" Sulphate (Basis 90%) ton	8 17 6.	—	9 5 0
Precipitate: Red lb.	0 3 1	—	0 3 2
" White "	0 3 2	—	0 3 3
Salts: Epsom Bags ton	2 10 0	—	2 12 6
Epsom Casks "	3 5 0	—	3 10 0
" Glauber "	1 5 0	—	1 10 0
Sulphur: Sublimed Flowers "	8 10 0	—	9 0 0
" Recovered "	4 10 0	—	4 12 6
Soda: Ash deg.	0 0 1	—	0 0 1⅛
" Caustic (White, 70%) ton	6 12 6	—	6 17 6
" " " 60%) "	5 12 6	—	5 17 6
" " (Cream, 60%) "	5 12 6	—	5 17 6
" Crystals "	2 10 0	—	.....
" Bicarbonate "	5 10 0	—	.....
" Hyposulphite "	6 5 0	—	.....
Solvent Naphtha gal.	0 1 1	—	0 1 2
Tartar, Cream of cwt.	6 2 6	—	6 5 0
Zinc Sulphate ton	7 10 0	—	8 5 0

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HOME INDUSTRIES.

MANCHESTER, 7th June, 1888.

The Cotton Trade.—The state of business in the yarn trade has somewhat improved since the holidays; an increased number of sales have been made, and there are more inquiries in the market. The extremely low price of silver is, of course, telling against Eastern business, and it remains to be seen whether the offers from that quarter will approach the prices quoted by sellers, or whether the reverse will be the case. At the present time quotations are firm on account of the better tone in the cotton market. The recent advance in spinners' wages has also tended to stiffen prices. All classes of yarns are being firmly held, and there is no desire to yield in any way. Many spinners are still under contract, and therefore are not disposed to sell, except at the full rates. The results of the last quarter's stock-taking show very favourable results. Dividends ranging from 5 per cent. to 12½ per cent. have been declared in many cases, and in others the commencing adverse balances have been very considerably reduced. A question of considerable importance to fine spinners and producers of combed yarns is raised in some correspondence which has passed between the United Cotton Spinners and the Alexandria General Produce Association, with reference to the quality of Egyptian cotton as put into this market. All Egyptian cottons are not so clean as they might be, and the last named Association has rendered valuable aid in improving the marketable article in that respect. The attention of spinners is called to the fact that a new class of cotton, known as Mit-affifi, has been introduced within the last few years, and the cultivation of it is extending. The opinion of spinners on its merits is invited. In the cloth trade a steady business is being done at fairly steady prices. The trade in the Blackburn district is disturbed by the strike of the loomers and drawers, to which we have before alluded. It is not expected that any great inconvenience will be experienced, although it is admitted that if substitutes are not found for those on strike serious results might occur.

A New Development.—In Bolton and the surrounding villages a considerable advance has been made in the manufacture of hosiery. The Rothwell Hosiery Company, Limited, has been in existence three years, and now employs about two hundred hands in the manufacture of a class of goods which have hitherto been principally imported from Germany. The competition in these goods is severe, but it is fairly met by the company, who have been able to find ample employment during their existence. In the cottages in the villages surrounding Bolton there is a large number of machines at work, this being the same system as pursued in Saxony, where cottage labour is extensively employed. Apart from the advantage arising from the employment thus found at home for a number of work-people, there is the satisfaction of knowing that the goods so produced tend to displace others of foreign manufacture.

The Ship Canal.—An extraordinary meeting of shareholders, for the purpose of approving a Bill now before Parliament to authorise certain alterations in the plans of this work, was held on the 4th inst. In the course of the proceedings it was stated that there were 56 steam excavators, 73 locomotives, 2367 waggons, 50 steam cranes, 79 miles of temporary railroad, and 6000 men employed. The excavations during the month of May amounted to 21,371 cubic yards of rock and 1,009,052 yards of soil. The Bill provides for an alteration in the plans which gives 114 acres of water space, against 100 in the old scheme; the quay space being 152 acres, against 83; and the quay frontage 5⅛ miles and 4 miles respectively. There is thus a large increase in the accommodation provided, while the cost is reduced by £23,000. In the course of a few remarks, the contractor, Mr. Walker, said that he had 48,000,000 cubic yards of excavation to carry out, which would mean about 1,000,000 yards per month. This rate was now exceeded, and before the end of the summer he hoped to excavate 2,000,000 yards per month. The Bill was unanimously approved, and the general tone of the meeting was a confident one.

Engineering.—We understand that Messrs. Smith and Coventry, Limited, have purchased the sole right to make and sell in the United Kingdom Knowles' patent key-seating machine which is now being exhibited at the Glasgow Exhibition.

Gosling's Fuel Economisers.—Messrs. E. H. Birley and Co., engineers, Deansgate, Manchester, have been appointed sole agents for Lancashire for Messrs. R. Gosling and Co., of Ipswich, for the sale of their patent economiser.

LONDON, 7th June, 1888.

The Money Market.—The money market continues to be exceedingly easy, the continued flow of gold into this country tending to maintain the rates at a low level. The issue of two new Colonial loans has not had any appreciable effect upon the market, and the owners of capital experience some difficulty in obtaining employment for it at all. The two loans referred to—a New Zealand issue of two millions and the new Land Grant Loan of the Canadian Pacific Railway—are dealt in at considerable premiums; but this hardly represents the actual market estimate of the issues. The public is becoming rather shy about New Zealand borrowing, which has continued for some years on a most extensive scale, especially the commercial situation of the Colony is by no means so bright as might be wished. The dearth of business and the absence of energy on the Stock Exchange are even more pronounced than they generally have been in the height of what is the recognised dull season. Home Government Securities have improved considerably in price, but home railways are still remarkably quiet. The upward move in Great Western stocks, which has been expected for some time by those who have been watching the progress of this line, has now fairly begun. American stocks are still uncertain and spasmodic; but the general outlook in foreign securities has improved, and the stocks of some of the second rate States have gained considerably.

Companies.—The following new companies have been registered since our last report: Guayana Central Railway Company, Ld., with a capital of £800,000; The English Peat Moss Litter Manufacturing Company, Ld., with a capital of £10,000; Argentine Petroleum Coal Company, Ld., with a capital of £500,000; The Gunpowder Company, Ld., with a capital of £200,000; Hewett's Combustion and Steam Generating Company, Ld., with a capital of £150,000; The Foreign Roburite Company, Ld., with a capital of £250,000; John Crowley & Co., Ld., with a capital of £100,000, to acquire the engineering business carried on at the Kelham Iron Works, Sheffield, at Meadow Hall Iron Works, near Sheffield, and at Corporation-street, Manchester; John Tatham & Sons, Ld., with a capital of £100,000, to carry on business as mechanical engineers, cotton brokers and spinners, &c.; The East Acton Brick Works and Estates Company, Ld., with a capital of £50,000; Canada, La Crosse and South Western Railway Construction Company, Ld., with a capital of £200,000; New Balkis Company, Ld., with a capital of £555,000, to work gold and other mines in Africa; Mono Lake Gold Fields of California, Ld., with a capital of £400,000; The Oro Fino Mines, Ld., with a capital of £300,000; The Forssman Transvaal Company, Ld., with a capital of £500,000, to carry on the business of miners and smelters; The Nava Gold Mines Syndicate, Ld. (Spain), with a capital of £20,000; The Malayan (Pahang) Concession Company, Ld., with a capital of £60,000, to acquire mining concessions; The Luxulyan Consols, Ld., with a capital of £60,000, to acquire mining property in Cornwall; The Hermanos Gold Mining Company, Ld. (America), with a capital of £150,000; and The Seringapatam (Mysore) Gold Fields, Ld., with a capital of £200,000.

Metals.—Both tin and copper continue to show the same tendency as reported last week. According to the statistics of copper issued by Messrs. Henry R. Merton and Co., it appeared that the stocks in England and France on the 31st May amounted to 63,887 tons. Including the copper advised from Chili and Australia, the total amounts to 69,487 tons, as compared with 64,349 tons at the end of April this year, and 54,770 tons at the end of May last year.

Hemp.—Although the prospects of the hemp crop in Italy are not very promising, contracts are being made at previous prices. There has not been much business done in Baltic hemp; but owing to the rate of exchange having risen, buyers are now less favourably situated. Manilla hemp has declined in consequence of news having been received of a fall in prices at Manilla.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 27th May amounted to £1,314,665 on 15,854½ miles, as compared with £1,272,631 in the corresponding period of 1887, when the mileage was 15,737½ miles. An increase is thus shown in the mileage of 117 miles, or 0·7 per cent., and in the receipts of £42,034, or 3·3 per cent. The second portion of this Whitsuntide holiday receipts is included in this year's returns, whilst the first portion of last Whitsuntide traffic is included in last year's returns.

The Electric Light Installation at the Prudential Assurance Company.—This installation, which we illustrated and described in our issue of the 13th May, 1887, is about to be enlarged. The extension has been entrusted to Messrs. Drake & Gorham, the consulting electricians to the company, and who also designed and erected the installation in the first instance. A third similar engine of 100 h.p. and pair of dynamos are now being put down alongside the existing plant. A new battery, consisting of 264 Drake & Gorham cells, made by Messrs. Elwell-Parker, Limited, of Wolverhampton, is being erected, and will be used mainly in conjunction with the dynamos, thus acting as a regulator in times of heavy lighting.

Honours to Engineers.—Mr. George Barclay Bruce, the President of the Institution of Civil Engineers, has received the honour of knighthood, and Mr. Guildford Lindsay Molesworth, C.I.E., consulting engineer to the Government of India for the Indian State Railways, has been made a Knight Commander of the Order of the Indian Empire.

GLASGOW, 7th June, 1888.

Shipbuilding.—There has of late been a great dearth of orders. Within the last few days, however, inquiry seems to have been a little more active. It is reported that Messrs. Fleming & Ferguson, Paisley, have booked an order for a large screw steamer for the Straits Settlements.

Pig Iron.—On Wednesday, the 23rd ult., pig iron reached the extremely low price of 37s. 1d. per ton. From this point of extreme depression the price has since recovered with fairly rapid strides. The state of the Cleveland iron market, and the tendency to invest on account of the reduced quotations, are doubtless to be credited with having caused the advance. An additional furnace has been blown in. Stocks at Connal's stores are still increasing, and the indications generally do not point towards any substantial improvement. With the extremely low prices still prevailing, the market cannot be otherwise than uncertain.

Mineral Oil.—The combination among the Scotch mineral oil companies is bearing fruit in the declaration of dividends. The Pumpherston Oil Company, which last year had a debit balance of over £8,000, has this year been able to make a profit of £14,235. This suffices to provide for depreciation, &c., and to leave a dividend of 3 per cent. upon the ordinary shares.

Sugar Trade.—Messrs. Connal's report for May shows that prices have been fairly steady during the month. The American Tariff Bill having been set aside, and the disturbance of the American sugar trade by the important changes its adoption would have involved having been for the present avoided, the market seems to have fair prospects of steadiness for the future. The close of the Sugar Bounties Conference also, and its recommendations for the abolition of the bounties, have an important influence in confirming the favourable turn which has been made by the sugar trade during the past few months.

Important Agency Case.—The case of Fossick *v.* Macfarlane, Strang, & Co. has just been decided in the Court of Session by Lord Trayner. The question in dispute was the liability of the defenders for the payment of commission on orders procured through the instrumentality of the pursuer. The agreement between the parties terminated in 1885. It was alleged *inter alia* on behalf of the defenders that the pursuer had during the currency of the agreement acted for another company; but this defence was repelled on the ground of vagueness, and a decision was given against the defenders.

Glasgow Exhibition.—The popularity of the Exhibition still continues, the average daily attendance for the first twenty-four days having been 34,558. There has been some friction between exhibitors in the machinery section and the Executive Council about the placing of signs over exhibits. The Council, it would appear, authorised the removal over night of a number of signs attached to important exhibits, with the result that some of these were for a short time closed to public view by the exhibitors.

Proposed Glasgow Subway.—The promoters of this scheme are not satisfied with its rejection by two successive Parliamentary Committees. They are endeavouring to excite public interest in the question, and public meetings promoted on behalf of the subway scheme are being held in the districts of the city which are affected by the proposal. At a meeting in Hillhead, held last week, a proposal was carried to petition Parliament in favour of the re-committal of the Bill.

(From our own Correspondents.)

LIVERPOOL, 6th June, 1888.

The Shipping Trade of Liverpool in 1887.—From the annual statement of the shipping of the United Kingdom just issued, it appears that the number of ships entered at Liverpool from foreign ports last year was 4477, representing 5,186,393 tons; the number which cleared for sea being 4005, or 4,758,525 tons. Taking the coasting trade, 3408 vessels, or 410,792 tons, were entered at Liverpool, and 3487 vessels of 419,985 tons cleared for ports on the coast. The trade of the four preceding years is shown in the following table for comparison:—

	Vessels entered at Liverpool		Vessels cleared for sea.	
	Vessels.	Tons.	Vessels.	Tons.
1887	4477	5,186,393	4005	4,758,525
1886	4367	5,017,815	4019	4,714,654
1885	4668	5,173,330	4246	4,822,021
1884	4852	5,209,357	4499	4,966,936
1883	5219	5,467,274	4837	4,810,680

Although London stands first in the amount of trade, Liverpool is much ahead in shipowning; Liverpool owning 1488 vessels of 999,286 tons, while London owns 1241 vessels of 362,832 tons. During the last year five sailing ships of 8050 tons, and ten steamers of 2367 tons, were built at Liverpool.

The Cunard Steamer "Etruria."—This vessel on her last passage to New York accomplished the distance from Queenstown to New York in six days one hour forty-seven minutes, corrected time, or nearly three hours less than the previous record.

SHEFFIELD, 6th June, 1888.

Iron and Steel.—Trade prospects in Sheffield are encouraging. Though prices are low, and profits not nearly so large as they were some time ago, the total amount of work sent out is enormous, particularly in Bessemer steel in billet and manufactured into articles. Bessemer rails can now be bought at a very low figure, and the easy prices of all sections are tempting buyers. The chief demand for rails is from distant countries, and these are being sent out in large quantities. Home and Continental companies are still ordering tyres, axles, and railway springs extensively, and couplings are also in greater demand. Perhaps the only branch of Sheffield trade that is in comparative inactivity is the war material department. Armour plates are on very slow order, though it is believed the quietness in the mills is only temporary, and that in the autumn there will be several large orders placed. Firth's and Hadfield's are tolerably busy on projectiles. At Messrs. Vickers & Sons', shipbuilding material

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is yielding good employment, and Messrs. W. Cooke & Co. are busy on wire roping for pit use, and also for vessels. Picks, shovels, and edge tools are selling readily; and saws, both hand and circular, are in satisfactory request. Sheep shears are demanded by the Colonial markets; and best descriptions of cutlery find a brisk sale in London, Paris, and other cities. There is an unsatisfactory stagnation in manufactured iron, so far as the Sheffield demand is concerned. Angles can be bought at £5, bars £4. 17s. 6d., hoops £5, rods £5 to £5. 10s., sheets £6, and plates £6. 15s.; and there is comparatively little business being done even at these reduced rates.

NORTH STAFFORDSHIRE, 6th June, 1888.

The Pottery Trade. — The improved demand still continues in the china and earthenware branches of the pottery industry, although the selling prices do not show any alteration in the right direction. For the week ending May 19th—the last for which returns have been issued—there were 2277 packages shipped from Liverpool to the United States, as compared with 1168 in the corresponding week of last year. From January 1st to May 19th there were 38,185 packages, being an increase of 5173 as compared with the same period of 1887. At some future period the Americans will doubtless be in a much better position than at present to satisfy their own requirements in this direction, and it behoves manufacturers to look to the development of other markets rather than to lean entirely on the demand from the United States. At the present time, some good sales are being effected for the Colonies; but the Continental demand is limited, and the home trade continues dull. On the whole, however, there is a better feeling as to the future amongst local manufacturers.

Staffordshire Potteries Water Works Company.—The annual meeting of this company was held at Hanley last week, when a dividend at the rate of 6 per cent. free of income tax was declared. The chairman stated that in spite of the abnormally dry season of last year the whole district had been supplied as usual, while the rentals had increased, and extensive renewals had been made at the Wallgrange station. The company were congratulated on the recent successful application to Parliament for powers to increase their works, and the question of site for the new buildings necessary is now under consideration, attention being centred on one at Hatton and one at Cresswell.

BIRMINGHAM, 6th June, 1888.

The Iron Trade.—In the iron trade of this district the prospect is rather more favourable, and an increase in the output of iron has taken place during the past few weeks. Two furnaces have been blown in, and in consequence the make of pig iron has increased by some 400 tons per week; up to the present time, however, the increase has not resulted in any accumulation of stocks. There is a tendency towards the production of a lower quality of iron, the high class makes of Staffordshire having for some years been supplanted by cheaper makes from other districts. Foundry iron of high quality brings from £2. 17s. 6d. to £3. 15s., and lower grades from £1. 10s. to £2. 12s. 6d. The Old Factory Iron Works and the Hope Iron Works—two concerns which have been standing idle for ten years—have been re-started, and are now turning out manufactured iron. For the latter class of goods a fair demand is manifested; marked bars bring £7, and unmarked iron sells at about £5. A good trade is being done in sheets at £6 to £6. 5s. The steel trade continues to be good.

The Hardware Trade.—A fair demand exists for heavy castings for engineering purposes, and large quantities of this class of goods are being sent abroad. The recent revelations concerning the state of the War Department are tending to stir business. The lighter class of hardwares, such as small safes and bedsteads, are in a satisfactory condition; but the same can hardly be said of goods which are mostly bought for winter requirements. Electrical engineering concerns find no lack of orders, and some good orders have been taken for dynamos by local firms. A large meeting of manufacturers and others interested in the gun trade has been held in the Birmingham Town Hall to protest against the action of the Government in the matter of the Small Heath factory. Some hopes are entertained that the end of the copper ring is within measurable distance.

DERBY, 6th June, 1888.

Electric Lighting.—The lead of Messrs. Bardill and Co., who have now for some considerable time lighted their shop in Peter-street by electricity, is about to be followed on a much larger scale by Messrs. John Davis and Son, who contemplate putting down in their premises at All Saints' works, a large electric plant for the purpose of distributing light and power to neighbouring shops.

Claye's Waggon Works.—Considerable damage was done to this establishment at Long Eaton by a fire which broke out in the engine room at the iron works. The engine and a number of the lathes have been damaged, and many men have consequently been temporarily thrown out of work.

Bridge Work.—The Phœnix Foundry Company have been sending out some very large castings to complete their contract for the iron work of the Battersea Bridge. Messrs. Andrew Handyside & Cd. have secured the order for the Grange Town Bridge, Cardiff, the iron work for which is to cost £23,000.

LEICESTER, 6th June, 1888.

Wool Spinning and Yarn Trades.—There has been a slight increase in the trade transacted in the wool market during the past week, but the aggregate turnover is very limited. The uncertainty in prices continues, and there is not any likelihood of rates becoming at all fixed until after the local wool fair this month, when the new clip will be offered. Growers and country dealers are not pressing sales, and their rates are a fraction lower. Staplers are not operating at present, and for the next week or so they will remain inactive. The prevalent impression is that the prices of the new clips will hardly hold up to the present rates, unless there should be a considerable foreign demand. Very little new English wool has been offered, but some Irish has been sold at ½d. decline on late rates. Spinners are not doing a very heavy trade, and their orders are principally small ones, as the unsettled state of the market makes the undertaking of large contracts risky. Worsteds are in moderate demand; the best business is being done in cashmeres and fine yarns, and for these classes better prices are obtained, on account of stocks being low.

Hosiery Trade.—A healthier tone pervades this industry, and most departments of it are better employed. There is an improvement in fancy goods and specialties, and the tendency of prices is to harden. Some good contract orders have been booked, which will find employment for the machinery for some months to come. As orders for fancy goods are now coming to hand freely, business will be improved during the next month or two.

BARROW-IN-FURNESS, 6th June, 1888.

New Industries.—Much progress is being made in the construction of the extensive storage accommodation at Ramsden Dock, Barrow, for the import petroleum trade, and an early cargo of the oil in bulk is expected.—Although the prospectus of the new wood pulp company at Barrow has not yet been issued, arrangements are proceeding for the building of the works at the east end of the Cavendish Dock. Most of the capital required by this company has already been raised.—Although not much has been said lately about the Anglo-American Food Supply Company which is being developed in connection with the port of Barrow, the preliminaries which are incidental to so great an undertaking are proceeding satisfactorily, and next year will probably witness the inauguration of this very large and important trade to Barrow. Several subsidiary industries, such as soap and tallow works, tanneries, &c., are contemplated in connection with this new company.—It is rumoured that a new company is to be formed to take over the Vulcan Steel and Forge Company's works in a new trade. Some American capitalists have viewed the works, and in all probability one of the features of the industry to be centred at this place will be the construction of steel railway trucks on the bogie principle, for employment on the British railways. With all these schemes in the air, the future of Barrow seems to be well assured.

Iron and Steel.—There is a rather better tone in the iron and steel trades, and the inquiry is much more active, particularly for Bessemer samples; mixed numbers of the latter are quoted at 42s., and No. 3 forge at 41s. per ton net f.o.b. Steel rails are fairly brisk, with heavy sections at £3. 16s. 6d. and light sections at from £4 to £4. 7s. per ton. Ship plates are not so busy, but are still quoted at £6. 5s. per ton, and angles at £5. 17s. Iron ore is quiet, at from 8s. to 10s. 6d. per ton net at the mines.

MIDDLESBROUGH, 6th June, 1888.

Pig Iron.—The turning point seems to have arrived at last. Prices have not actually risen, but the tone is firmer and the tendency is undoubtedly in the direction of a rise. This has come about, however, more by the improved tone of the Scotch market than by the favourable influences at work in this district. The average quotation is still 31s. 1½d. for No. 3 G.M.B., the same as last week; but there is more activity and greater disposition to do business.

The Iron Masters' Returns.—These returns for the month of May are highly favourable, and are full of encouragement for the future. They show that the make of pig iron is much about the same, the slight increase of 4118 tons over that of April being more than counterbalanced by there being one working day more in May. The shipments form the great feature in those returns, having amounted to 107,826 tons, as against 90,641 tons in April, and 74,517 tons in May, 1887. The shipments for last month are the highest on record, the nearest being those of September, 1879, when they amounted to 101,154 tons. The 107,826 tons include 8326 tons of pig iron other than Cleveland. During the month 120,378 tons of Cleveland pig were made; in shipments there were disposed of 99,500 tons, and in local consumption and delivery by rail 58,609 tons, amounting in all to 158,109 tons. Thus a decrease was made on stocks to the extent of 37,731 tons. The total stocks are thus reduced from 586,492 tons at the end of April to 548,761 tons at the end of May. The average market price of No. 3 G.M.B. in May was 31s. 2d., as compared with 31s. 9d. in the previous month.

Manufactured Iron and Steel.—The returns of the accountant for the Board of Arbitration for the two months ending April 30th show that over the whole weight invoiced of rails, plates, bars, and angles, there has been an average advance of 5d. in the ton, as compared with the same months last year. The re-starting of the Newport Rolling Mills has been taken as a sign of revival. There are now no mills of importance in this district standing, the Ayersome Works having maintained the start made a short time ago.

Salt.—This industry is thriving, and extending its operations. During the past seven months 16,600 tons have been exported to both home and foreign ports. Dundee, Perth, and Peterhead are amongst the former; and Frankfort, Dantzic, Memel, Christiania, and Copenhagen amongst the latter. The stocks of salt are depleted, on account of the demand being greater than the supply.

NEWCASTLE, 6th June, 1888.

Trade Disputes.—Owing to the prevalence of trade disputes business in the leading industries of the district is in a most unsettled state. The fitters in several of the Mid-Tyne engineering shops have come out on strike for an advance in wages of 2s. per week, the present rate being 31s. per week; and the operatives in the remaining factories within the district named threaten to cease work a week hence, unless the advance is in the meantime conceded. The employers show a strong determination to resist the claim, the contracts now on hand having been taken at prices which preclude the possibility of allowing an increase in the cost of production to any material extent. In the shipbuilding trade wages questions are also causing much interest. The ship joiners have been on strike for more than a week; but as yet their absence from work does not seem to have caused much inconvenience to builders, as the most pressing work is being executed by the apprentices, who are, of course, more closely supervised than hitherto by the foremen. The platers' helpers have returned to work, having failed in their attempt to get the wages rate advanced; but the platers and other operatives engaged in the iron and steel work have now put in a claim to have their wages advanced 10 per cent. on 1st July, and thus a new trouble is provided for the employers to deal with. The occurrence of these wages troubles at this moment is particularly inopportune, as trade is only just recovering from a long depression, and it is to be feared that these unhappy differences between employers and employed will, for a time at all events, check any further progress towards prosperity.

Ordnance Works.—A large order for guns of 10-inch bore, as well as for carriages and other appliances, has just been secured for the Elswick Works of Sir W. G. Armstrong, Mitchell, & Co., and already a very marked increase of activity is to be noted in the various departments. For some months past discharges of men have been taking place weekly; but this state of things has been recently changed, and constant additions are being made to the number of hands employed throughout the establishment. In some shops where night work was discontinued a few months ago, arrangements are to be made for returning to the system of running the machinery night and day.

India-rubber Goods.—The demand from India for india-rubber goods required for engineering purposes is showing considerable improvement, and this week Messrs. Geo. Angus & Co., Limited, are sending a large consignment to Bombay.

The Coal Trade.—The coal shipments from Tyne Dock for the week ending June 2nd show an increase of several thousand tons over the shipments for the corresponding week of 1887. The steam coal collieries are just now working regularly, but the collieries where other qualities are produced are in most cases only working intermittently.

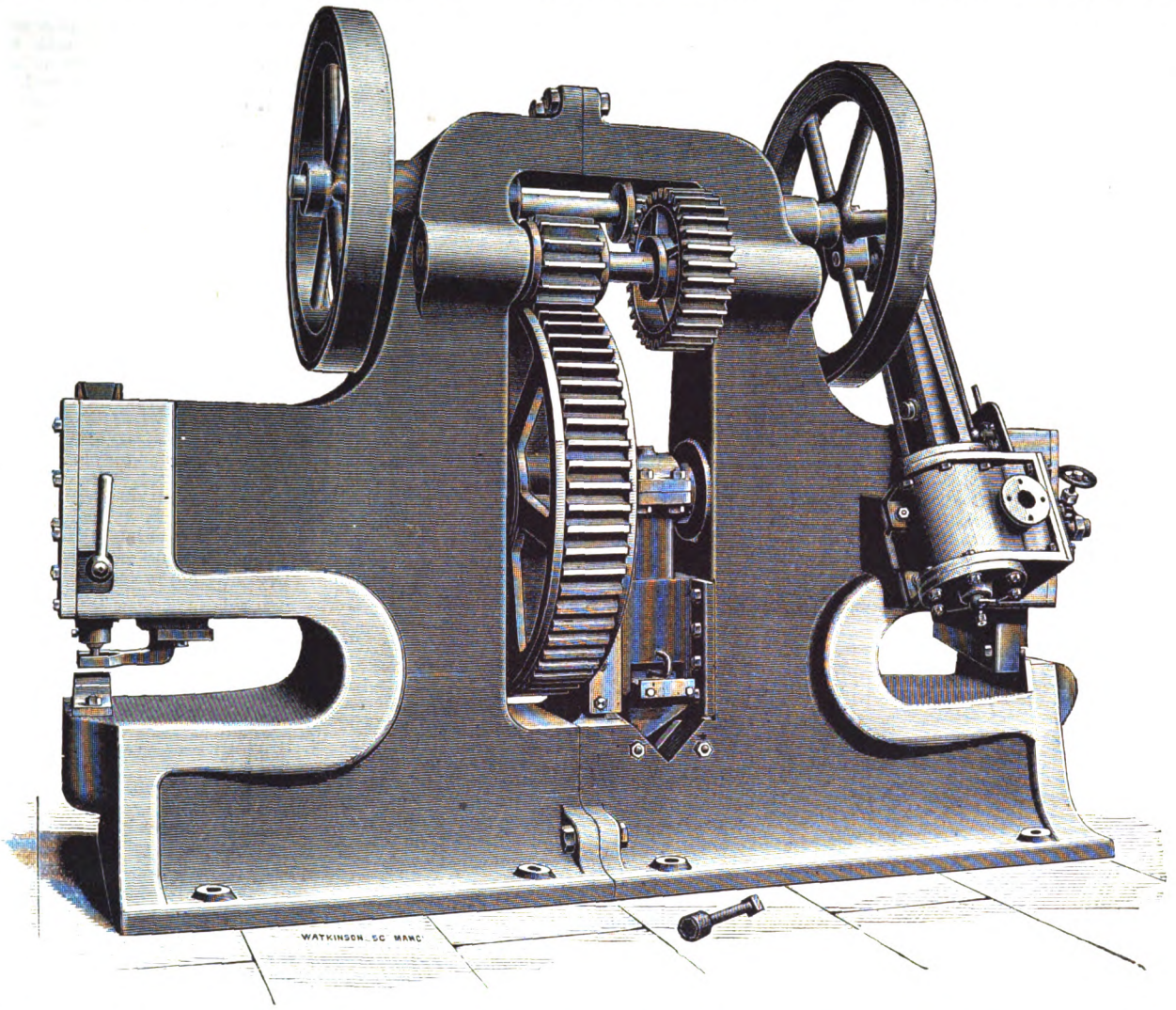
DUNDEE, 6th June, 1888.

Flax and Jute Trades.—The linen and jute trades in this district have been fairly active during the past fortnight. In flax, only a small spot business is being done, as spinners have full supplies to satisfy their present wants. On contract the tone is firm. The rise in exchange has caused the sellers to hold for an advance, and this to some extent checks business. Flax and tow yarns meet with a slow sale, and the business offering is only sufficient to take off the present production. Foreign wet spun yarns are offering freely in this market at low rates. There is only a moderate demand for linen; but makers of fine goods are still well employed. Sailcloth is in better request, but prices are not considered satisfactory. In jute there is an increased inquiry for the old crop, and the prices are maintained. A considerable business has been transacted in the new crop at firm prices. Calcutta telegrams report a strong market, and that balers are not disposed to make further contracts. The market for jute yarns is fairly active, and as spinners are well employed, prices are firm. In jute fabrics, most widths of Hessians are in request, and there is an upward tendency in prices. Sacking, bagging, and tarpaulin are in steady demand, without any material change in quotations.

The New Tay Bridge.—In a lecture on "Earthquakes, and How to Measure Them," delivered at the Royal Institution last week, Mr. J. A. Ewing, professor of engineering in University College, Dundee, gave the results of seismographic observations taken on the new Tay Bridge. The seismograph recorded motions during the whole time a train was on the bridge, and was placed on the southernmost of the great girders, where it was expected that the vibration would be greatest. Whenever a train went on the bridge at the Dundee end, a distance of 1¼ mile, oscillations were observable, and they gradually increased from $\frac{1}{100}$in. to a maximum of $\frac{1}{8}$in.

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PUNCHING AND SHEARING MACHINE.



PUNCHING AND SHEARING MACHINE.

We herewith illustrate a punching, shearing, and angle iron cutting machine, constructed by Messrs. George Booth & Co., engineers and machine tool makers, Central Iron Works, Halifax. The machine is of the ordinary eccentric type, and specially adapted for punching steel plates. The eccentric shaft is made of Bessemer steel, and is driven by powerful double gearing. The machine is actuated by a steam engine affixed to the framing, having a cylinder 8in. diam. One end of the machine is capable of punching holes 1¼in. diam. through plates 1¼in. thick 24in. distant from the edge of the plate, while the other end of the machine is constructed to shear plates 1¼in. thick 24in. from the edge of the plate. In the centre of the machine an arrangement is provided for cutting angle irons up to 6in. by 6in. The slides are fitted with large wrought iron case hardened dies, and the slides for the punching and angle iron cutting arrangement are provided with a stop motion for disconnecting them when not in use. Messrs. Booth are now engaged in constructing special machine tools for modern boiler works, which we hope to illustrate in a future issue.

THE IRISH EXHIBITION.

On Monday last, another exhibition was opened in London, which is suffering just now from a plethora of such enterprises. It might have been supposed that the Italian Exhibition at West Brompton, and the Anglo-Danish Exhibition at South Kensington, would have been sufficient for one season; but, in addition to these, we now have an Irish Exhibition at Olympia. The last named will probably be successful in bringing about the result desired by the promoters, viz., to place before the English public a clear view of the predominant industries of Ireland, and to awaken public interest in the efforts being made to revive her trade. It is almost unnecessary to mention that the Exhibition when opened was far from complete, as this is so generally the case that in the event of everything being in readiness at the time of inauguration, as was the case in Glasgow this year, and at Manchester last year, the fact is so exceptional that it creates surprise. Notwithstanding this condition of unreadiness, which is, however, more conspicuous in the grounds than in the business sections, sufficient is seen to demonstrate the interesting nature of the Exhibition from an industrial point of view. Many Irish industries are very well illustrated, and linen, lace, embroidery, and cloth are well to the front, to say nothing of Irish whisky, which is to be found in all parts of the building. Soap, candles, porcelain, printing, chromo-lithography, engineering, and shipbuilding are also represented; but it is to be regretted that no attempt has been made to effect any classification.

Mr. William Spence, of Dublin, has on view a 20in. gauge locomotive of Geoghegan's patent to work at 180lb. pressure, such as are used for indoor work at Guinness's Brewery. It has a wheel base of 3ft., and is capable of drawing a rolling load of 40 tons. Attached to it are a truck for carrying barrels and a tip waggon for malt, &c. The locomotive was exhibited last year at Manchester. Mr. J. C. Wallace, of Belfast, is erecting one of his flax scutching machines, and Messrs. Kennedy & Son, of Coleraine, are present with an "Empress" turbine. Some excellent work in wrought iron gates is shown by Mr. B. Watson, of Cork. The shipbuilding interest is represented by Messrs. Workman, Clark, & Co., of Belfast, whose exhibit consists of models of steamers and sailing vessels built by them.

At the stand of Acheson Harden, Limited, a good example is given of Irish domestic industries, hand loom weaving being in progress here, and the printing of the patterns is also done by hand. The importance of these manufactures may be gathered from the fact that this firm alone employs at its mills, and at their homes, over seven thousand hands. Close to this firm's exhibits are found Irish homespuns, made by Messrs. Boyd & Co., of Belfast; hand made socks and shirts, by Messrs. McHugh, of Belfast; and fine specimens of embroidery, by the Irish Linen Company, of Belfast, some of which are exceedingly valuable, £72 per dozen being asked for some embroidered handkerchiefs. A large display of Kerry homespuns and tweeds is made by Mr. J. Revington, of Tralee. At the stand of the Belfast Ropework Company, Limited, various kinds of cordage and rope are shown.

The Exhibition, which has the support of a number of influential gentlemen, is to remain open for five months.

IMPROVED CASING FOR LOCKS.

In former years, before the jerry builder had begun his operations, the doors of dwelling houses were made of sufficient thickness to take a mortise lock without being seriously weakened by the recess which had to be cut out to receive the body of the lock. Now, however, the low prices at which buildings are erected compel the builder to exercise economy in every direction, and especially where scantiness of material is not immediately apparent. Thus the doors are made of wood too thin to take a



mortise lock safely, and rim locks, which project on the face of the door, have to be adopted. These, however, are unsightly, and with a view to obtain the appearance of a mortise lock, and yet avoid the weakening of thin doors, Mr. Lewis W. Goold, of Birmingham, is now introducing a lock, which we illustrate herewith. In this lock the outer casing plate is extended up and down the stile of the door, thus forming a strengthening piece to make up for the wood cut away to receive the body of the lock. The material left on the outside is double as thick as would be the case were the lock mortised into the door in the usual way, with material left on either side. This extra thickness allows of the furniture being more substantially fixed. The casing plate also forms a finger plate, and obviates the necessity of cutting away a part of the door, as required for the bolt box of an ordinary rim lock.

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All accounts are payable to the Publisher, JAMES F. BUTTERWORTH, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, Wellington-street, Strand, London, W.C.
70, Market-street, Manchester.
62, St. Vincent-street, Glasgow.

Advertisements:
London: 22, Wellington-street, Strand, W.C.
Manchester: 70, Market-street.
Glasgow: 96, Buchanan-street.

Telegraphic address: "INDUS, MANCHESTER."
„ „ "INDUS, LONDON."
„ „ "JOURNAL, GLASGOW."
Telephone number: 684, MANCHESTER.
„ „ 2785, LONDON.

Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, 70, Market-street, Manchester, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

A few Copies, handsomely bound in half calf, gilt lettered, may now be had at the Head Office, 70, Market-street, Manchester, Price 20s. each.

Industries:

FRIDAY, 8TH JUNE, 1888.

OUR NAVAL DEFENCE.

THE subject of our national defences has recently been discussed in articles in newspapers and journals and at public meetings of various kinds, and judging from the general expression of opinion, it is evident that some definite plans for naval organisation, more in keeping with the requirements of the times than those at present existing, will be forced upon the Government. It is quite impossible for us to notice all that has been said upon the subject; but two meetings of special importance have recently been held, at which the speeches delivered are worthy of serious consideration, embodying as they do the opinions of men of wide experience and of all shades of politics. The first was the occasion of a lecture by Admiral Colomb, at the United Service Institution, on "The Naval Defences of the United Kingdom," and the second, of an address by Admiral Hornby, on the "Defence of Merchant Ships in Case of War," before the London Chamber of Commerce; and the subjects of these two addresses mark the distinction which should always be made in considering our naval strength—viz., the questions of the battle ships and the defence of the mercantile marine. The latter is the one which most directly affects the industries of the country, and therefore we will state shortly some of the views expressed by Admiral Hornby and those who took part in the discussion. The Admiral commenced by premising two things—first, that his subject being so large he could not describe it in detail; and second, that owing to the want of experience in steam warfare at sea he could quote no authority in support of his opinions. It was evident that the points of danger during war, to merchant ships, were those where they drew together, such as near straits and projecting capes. Their safety was in the vicinity of neutral Powers or of points occupied by friendly squadrons. Foremost among the former for us was the space between Cape Clear, Ushant, and the Land's End, because it covered the entrance to the English and Irish Channels. The next deep sea portion to be guarded was Cape Finisterre, and, going still further south, Cape St. Vincent—the turning point of the Mediterranean. After examining the various conditions affecting each of those stations, the Admiral said if he were to form a very moderate estimate—and looking at the number which our ancestors thought to be right in 1794, viz., five frigates—he thought fifteen cruisers at the Channel mouth would be very moderate, seeing that the gross tonnage of British vessels was now probably seven times as great as it was then. He would ask for one as a relief for one of the fifteen cruisers which might be reckoned on to be always coaling. At Cape Finisterre he would ask for four, and at Cape St. Vincent for three. Allowing for the proportion of additional vessels required to keep those effective, six and four would be required for these stations respectively, or ten in all. The number off Cape Verd Island must depend on that of the vessels stationed at Goree; but if he said arbitrarily that he should want four there and three on the line, he would have to detail in all eight for Goree, and say four for the line, or a total for the five squadrons of thirty-eight. Now, judging from the Navy Estimates, the number of effective ships — viz., ships that were supposed to make sixteen or more knots at sea—they proposed to keep was very small, for the number promised them by 1890 was forty-two, and many points of the globe required to be occupied. He said it might be objected that he did not propose to make any use of our corvettes, or of the armed merchant ships. As to the corvettes, with perhaps three exceptions, none were designed to go more than thirteen knots on the measured mile, and practically they could maintain a speed of eleven knots at sea. To send them to cruise against vessels that could go sixteen knots was, to his mind, as useless as to send a coach and four to catch the Great Northern express. As to the armed cruisers, they were not built to fight, while the duty of these squadrons would be to fight. He valued the armed cruisers too highly to misuse them. They were built for speed and to carry information, and at present their number seemed lamentably small. In 1794 we possessed 185 cruisers, irrespective of bombs and fireships; and if we multiplied that number by three, as he had done in proposing cruisers for the Channel mouth, we should have 555, and taking into account the vast area to be defended, he had no reason to suppose that that number would be in any way in excess, as he was of opinion that our organisation for protecting the mercantile marine during a European war would have to number its cruisers by hundreds if it would protect all the routes that were largely frequented by our ships.

The Earl of Carnarvon moved a resolution thanking Admiral Hornby for his address, and expressing the opinion that co-operation between Her Majesty's Navy and merchant shipowners would appear to offer a good basis for the immediate organisation of such a reliable scheme of defence as would inspire commercial confidence, and insure the maintenance of our food supply in the event of war between the United Kingdom and any foreign Powers. He gathered from the paper two considerations—first, the altered condition of naval warfare; and second, the total inadequacy of our present navy. He ventured to say that it was a widespread belief at the present moment in the nation that in the event of a European war there would be great danger for us abroad, and there would not be security for us at home. He condemned the present system of departmental management, and he said that support of his opinion was to be found in the endless reports which had been made from time to time condemning it, while the miscarriages which had taken place had shocked the public mind. He did not wish to advocate public extravagances. He thought that our expenditure was sometimes a great deal more than was necessary, just as our saving was frequently unwise. What he did say was that we had no continuous and well ordered policy in these matters. Such was not the case in foreign countries. France, with all her changes, did not change in her naval and military policy. Italy adhered to the lines she laid down. Germany accepted and admitted of no variation. We alone, who were more vulnerable than any of the other nations, drifted on, idly dreaming. He trusted, however, that before long the country would become alive to the importance of this question, and give its answer in clear and emphatic language. Lord Brassey seconded the motion, and said, while he sympathised with the Government in their desire to spare the taxpayers unnecessary burdens, he was not sure it would not

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lead to true economy, if it were the manifest determination of the nation not to be beaten in their state of preparation for the purposes of naval defence. He believed that if it were to go forth that for every cruiser which might be laid down by a rival Power we were prepared to lay down three, it would have a very valuable effect in reducing naval expenditure all round. Although this opinion was well received by the members of the Chamber of Commerce, we think it might turn out a dangerous and extravagant game, and trust that something more moderate will be proposed. We agree with the hope, however, which was expressed by several speakers, that the Government will endeavour to meet the shipowners, and by a liberal and judicious expenditure obtain the aid of their vessels; and, further, that more attention will be paid to the development of the Royal Naval Reserve.

Admiral Colomb's paper was scarcely of the same general interest as Admiral Hornby's, as he treated the subject almost entirely from the naval tactician's point of view, and argued for the advisability of making the fleet effective, rather than of spending money on land forts. He reviewed past naval history, and explained the policies followed by Lords St. Vincent and Howe. The former consisted essentially in blockading the enemy in his own ports, the latter in having squadrons stationed at the most vulnerable points, leaving the enemy free to take to the sea if he felt strong enough to encounter our fleet. With our immense mercantile fleet this would give the enemy a great advantage over us, and it is probable that the altered conditions of modern warfare and the developments of commerce would require a combination of the two systems; for as the First Lord of the Admiralty lately said, nothing but actual experience could justify any confident prediction as to how a thoroughly efficient protection can be given by any fleet to a commerce whose sea-going steam tonnage is double that of the rest of the world. This may seem a somewhat pitiful conclusion to come to, but it by no means indicates any inclination to stand still while our neighbours are advancing. Our land forts should receive some attention, and it is so far satisfactory to find Admiral Elliot declaring that the defences raised at our great depôts and in the Thames were such that no enemy would dare to attack them. We should, moreover, pay all attention to the developments of torpedo warfare. We should see that we have a sufficient number of fast cruisers to protect our commerce, although in many cases merchant ships might carry sufficient armament to protect themselves, at least against privateers. With regard to line-of-battle ships, it would be found both difficult and dangerous to blockade an enemy's harbours, as we have now to face the operation of torpedoes. Perhaps, as Sir George Elliot maintained, the best way of ending a war was by letting the enemy get to sea, and there giving him a thrashing.

YARROW'S "ZEPHYR" LAUNCHES.

One of the most interesting papers read at the last meeting of the Institution of Naval Architects was by Mr. A. F. Yarrow, on the possible advantage of using highly volatile liquids in lieu of water for the purposes of propulsion. This paper, of which we published an abstract at the time (see *Industries*, Vol. IV., page 339), elicited very little discussion, and it seemed almost as if the members of the Institute had failed to appreciate the great importance which any improvement in heat engines must necessarily have, not only for the propulsion of launches, but also for general work. Meanwhile, Messrs. Yarrow have continued to develop the new type of engine, and have brought it to a state of perfection which leaves no doubt that the advantages which Mr. Yarrow in his paper described as possible, have in actual practice been fully realised. The system is not new, as we learn that more than thirty years ago a French inventor suggested the use of highly volatile liquids instead of water for working engines; and if the records of the Patent Office were searched, it is very likely that the same idea will be found to form the subject matter of various patents. In its present form, or rather in the form which it had before Messrs. Yarrow introduced the improvements to be presently described, the engine is the invention of a Swede, and was first built in America. To that country also belongs the credit of having recently perfected the use of ammonia as a working fluid for engines (see *Industries*, Vol. IV., page 530); and we learn from Professor Forbes, who, whilst in America, has carried out some tests with this engine, that the saving in fuel when the engine is worked with ammonia is about 50 per cent., as compared with the amount of fuel used when the same engine is worked by steam. Theoretically speaking, the efficiency of a heat engine, and therefore the amount of power obtainable with a given expenditure of fuel, should, of course, depend only on the range of temperature, and should be independent of the working agent. Whether this be water, hydrocarbon, ammonia, or any other substance, the efficiency should for the same range of temperature be the same in all cases. But in practice this is not found to be the case, or rather there are modifying circumstances which are not taken into account in the theoretical formula for the efficiency, and which tell largely in favour of the liquid having a lower boiling point than water. It is not our present purpose, however, to deal with the theoretical part of this question. Our business is to describe the improvements recently introduced by Messrs. Yarrow in the hydrocarbon engine.

Messrs. Yarrow have set about their work in a very methodical and scientific way. At their works in Poplar they have an experimental room, in which there are three small engines, each with its boiler, which were used in this investigation. The smallest of these engines is a mere model, and Messrs. Yarrow soon found that no reliable quantitative results could be obtained with it. The next larger engine was used when testing the effect of a mixture of water and gasolene as a working agent. These results were also unsatisfactory, partly because of the small size of the apparatus used, but chiefly on account of the practical difficulties experienced with the boiler. Gasolene is exceedingly volatile and inflammable, and will find its way through pores in metal or through joints which, to all appearances, are perfectly steam and water tight. It is evident that when gasolene is contained, so to speak, in bulk inside the boiler, absolute tightness of the boiler fittings is of much greater importance than where the boiler is used with water alone, not only because of the loss of gasolene, but also on account of the danger of any escaping gasolene catching fire. It was also found difficult in the small engine to keep the glands sufficiently tight to prevent the escape of gasolene vapour without putting undue friction on the engine, which would, of course, vitiate the brake experiment. The trials with the largest engine of the series were, however, perfectly satisfactory, and we will briefly describe the arrangements. At one end of a table of convenient height, there stands a small vertical boiler with Field tubes fired by gas from a Fletcher burner. The quantity of gas was measured during each experiment, which lasted for about three hours. By the side of the boiler, and occupying the rest of the table, is a screen, against the back of which is fixed vertically the experimental engine; whilst various valves, tanks, and other apparatus used in the measurements, are fastened to the sides of the screen and at the top of the table. The boiler is filled with water to the usual working level, and within the steam space there is a copper coil, through which the gasolene is passed in order to be vaporised. A duplicate set of pipe connections is provided, so that the engine may be worked either by steam in the usual way or by gasolene vapour, in which case the steam pipe is closed, and the steam generated in the boiler merely serves to heat the coil by transmitting the heat from the burner to the gasolene, the steam continuously rising to come into contact with the coil, where it is condensed, and falls back into the boiler to be re-evaporated. The experiments were made at 50lb. steam pressure, which was kept constant both when steam was used direct as the working agent, and when hydrocarbon vapour was used in the engine; consequently, the initial temperature at which the working agent was supplied to the engine was approximately the same in both cases. The final temperature was, however, lower when the hydrocarbon was used, since its boiling point at atmospheric pressure is only about 180°F. We should, therefore, expect in this case a small gain in efficiency; but the gain practically observed is much greater than corresponds to the difference in range of temperature. Without going into exact figures, we may mention that, with the hydrocarbon vapour, the power developed on the brake was about twice that which could be obtained with steam for the same quantity of gas burned under the boiler. Thus there appears to be an absolute advantage in working steam engines not with vapour of water, but with that of some highly volatile fluid, and in the "Zephyr" launches this fact has been utilised.

In the first launch described by Mr. Yarrow in his paper, the fuel and the working fluid were the same, both being supplied from the same tank; but as the storage of large quantities of gasolene is not unattended with certain risks, and as this liquid cannot be readily obtained in all localities, Messrs. Yarrow have altered the original design in such a way that the light hydrocarbon is only used as the working agent, and any common petroleum of commerce is used as fuel. This can be obtained in any locality with almost greater facility than coal, and consequently the improvement is of great importance for pleasure yachts, which may often find themselves long distances away from home. A further advantage is the lower cost of the common petroleum. As in the older engines, the boiler in the latest form consists of a coil of copper pipe, below which is a burner. To start the engine a small petroleum lamp is lighted, which heats the petroleum and gasifies it before it issues from the burner; but after the engine is started the lamp may be extinguished, as this heat is supplied by the burner itself, somewhat on the same principle as in the lamps used by costermongers. The petroleum is carried in a small tank, distinct from the tank containing the gasolene, and by means of a small hand pump an air pressure of about 5lb. is first raised above the petroleum to force it to the burner. The hand pump must be worked from time to time to keep the pressure up, and with it the flow of oil. A valve in the pipe which carries the petroleum to the burner regulates the size of the flame and consequently the heat supplied to the boiler, which is evidently the only correct principle for regulating the power developed by the engine. The gasolene vapour generated in the coil of the boiler passes through the engine doing work, and is again condensed in a tube laid outside the boat close to the keel, this portion of the apparatus being the same as already described in Mr. Yarrow's paper.

The tank containing the gasolene is placed preferably in the bow of the boat, and divided from the central portion by a water tight bulkhead. Forward of this bulkhead there is a space open to the water, so that even in case of collision, when the tank might be broken, the gasolene will not find its way into the boat itself, but will flow out direct into the sea. The gasolene tank need not be opened except to replenish it so as to make up for the small amount of leakage which might have taken place through the glands of the engine; but to judge from the almost complete absence of smell, even close to the engine, this leakage seems to be very trifling. By the courtesy of Messrs. Yarrow's manager we had recently an opportunity of making a run in one of these "Zephyr" launches. As compared with an ordinary steam launch the passengers enjoyed very much more comfort. The machinery only occupies a small portion of the boat at the stern, and the whole of the central portion is available for passenger accommodation. There are no smuts, no smoke, no blowing off of steam, and there need be no noise, although in the boat in which we travelled the reversing gear of the engine was certainly somewhat noisy. This, however, is not the fault of the system, but merely of the particular engine employed. The system is evidently applicable to any type of launch engine. The most striking feature of the machinery is its light weight. The weight of the whole of the propelling machinery, consisting of boiler, engine, and the various pumps, amounts to only 3cwt., and the total weight of the boat in working order is 1 ton, whereas a steam launch of equal capacity would weigh about 2 tons. The engine is a triple single acting engine, with 3¼in. cylinders and 4in. stroke, and when running at 280 revolutions per minute it develops 4 h.p. It is certainly a great achievement in modern engineering to produce an engine and boiler weighing less than 1cwt. per actual horse power developed, and even if we include the weight of the oil tanks and oil, the total dead weight of machinery is far less than that of engine, boiler, and coal on a steam launch of equal size.

The cleanliness of a "Zephyr" launch may be inferred from the fact that a white handkerchief held over the funnel is not in any way blackened by the products of combustion. A further advantage of these launches is the short time in which they can be started. When everything is cold, the time occupied from the moment that the order is given to start until the boat is under way is only about five minutes; and when the machinery is warm, but the fire extinguished, the time scarcely exceeds one minute. To regulate the speed it is only necessary to adjust the size of the flame of the main burner. As regards the consumption of fuel, no very accurate data have as yet been obtained; but, roughly estimated, it varies in the launch we inspected from one to one and a half gallons per hour, the speed being eight miles per hour. Taking the specific gravity of common petroleum as ·82, we should thus have an average consumption of 2½lb. of petroleum per horse power hour, which, at 7d. per gallon, is less than 2¼d. per horse power hour. Although this figure is not quite so low as is claimed for gas engines, it is by no means prohibitive in cases where only small powers are required for work on land; and we think it highly probable that these "Zephyr" engines will find considerable application in such cases where hitherto explosive engines working with gas or petroleum have been employed.

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MINES (LIMITATION OF HOURS) BILL.

A Bill bearing this title has been introduced into the House of Commons with the object, according to the preamble, of limiting the hours of work underground of persons employed in mines. It is backed by Messrs. Cunningham-Graham, Abraham, Pickard, Conybeare, and Cremer, and is a short Bill consisting only of three clauses. It enacts that a person shall not in any one day of twenty-four hours be employed underground in any mine for a period exceeding eight hours, from the time of his leaving the surface of the ground to the time of his ascent thereto, except in case of accident or other emergency, and that any employer, or the agent of any employer, employing or permitting to be employed any person in contravention of this enactment, shall be liable to a penalty not exceeding forty shillings for each offence, to be recovered in the same manner in which any penalty under the Acts relating to factories and workshops is recoverable. It is admitted on all hands that the mining industry is passing through a depression hitherto unparalleled in intensity, and that there is practically little, if any, margin between the cost of production and the selling price. While, in common with other commodities, the value of coal and ironstone has fallen continuously for the past few years, the cost of raising has been materially increased by the operation of a variety of influences, amongst which the incidence of legislative enactments has been considerable. There is no doubt that the recent Coal Mines Regulation Act has increased the cost of getting minerals, and while we shall ever be ready to welcome restrictions or provisions which in their operation secure a higher degree of safety in the dangerous occupation of mining, we cannot but deprecate, in the interests of all concerned, the passing of measures which, while not actually attaining this end, hamper and impede the development of a national industry, and constitute a deterrent to competition with our foreign rivals. The promoters of the Bill under review cannot contend that its object is to increase the safety of working minerals; it appears rather to be framed with a view to a general and wholesale restriction of output under the authority of the State. We do not think such a scheme comes within the province of the Legislature, and the disastrous results which would follow the operation of this Bill are obvious. In order to meet the increased tension of standing charges, colliery proprietors have been forced to enlarge their output, and the effect of a sudden restriction in this respect would simply be to close many of the pits. The question then arises as to the necessity or advisability of this proposal in the interests of working colliers. The present custom is for shifts of men to be lowered and raised at times so arranged as to leave eight hours per day for actual work in the mines, sufficient time being allowed for colliers to reach their working face, to consult the firemen, and other necessary preliminaries. Striking an average, it may be said that half an hour elapses from the time of leaving the surface to the commencement of actual work, and another half hour from the cessation of work to the time of arriving at the bank, and the effect of this measure would, consequently, be to reduce the aggregate output of the country by at least 12 per cent., and the hours of work from eight to seven. It should be unnecessary to point out that the weekly amount of wages now possible to be earned by colliers would be necessarily reduced in proportion to the decrease of their productive capacity. We would also point to the friction which the smallest infraction of this law might cause between employers and employed. Under all the circumstances of the case, we have little fear as to the fate of this measure when public opinion generally, and that of the mining community, inclusive of colliery owners and miners, in particular, has been directed to its provisions; but there may be a danger of a short Bill of this description being passed through the House of Commons without due consideration being given to the enormous interests involved.

THE EMPLOYERS' LIABILITY BILL.

The Employers' Liability Bill, which has now passed through the second reading stage, is intended to replace the Act which was enacted in 1880, and marks the advance in public opinion on the subject since that date. When the original Act was passed a great many erroneous ideas on the subject prevailed, and an unnecessary fear of its probable consequences caused it to be so hampered in some of its requirements that a considerable amount of dissatisfaction with its provisions was engendered among the working classes. The definition of "common employment," as given in the Act, was looked upon as a mere subterfuge for sheltering employers from their just liability, and this opinion was openly stated by Mr. Broadhurst in his place in Parliament. On this, as well as on several other points in the Bill, the Government wisely took a position of compromise. The Home Secretary stated that while it was fair enough to call on employers to provide plant and machinery in good condition, it could not be considered right to hold them liable for the casual negligence or misconduct of a servant. He therefore proposed to make an alteration in the present interpretation clause, so that "common employment" should not include those cases in which employers delegate to managers the task of superintendence and control. This part of the subject is, however, likely to be further discussed in the committee stage of the Bill.

The next important question which was discussed dealt with the principle of contracting out of the Act. As we mentioned at the time, the Committee on Employers' Liability which sat last year agreed to recommend prohibition of contracting out, except on condition that some system of insurance were provided, not merely against accidents for which masters would be liable, but also against accidents of all kinds. The framers of the new Bill have adopted this proposal, and, moreover, have guarded it with many precautionary measures. It provides, for example, for all insurance schemes being submitted to the Board of Trade, so that their soundness and adequacy may be certified, and it makes employers liable for the solvency of the fund, and for the correctness of the actual calculations, so as to allow the claims of injured workmen being met.

The Bill proposes to extend the provisions of the Employers' Liability Act to seamen, subject to certain conditions. When this matter was being discussed in 1880, the Legislature was of opinion that the conditions of service at sea and service on land were so different that it would not be fair to bring ship owners under the Act. But in these days public opinion is subject to very rapid changes, and recently it has been said in various quarters that at least some of the principles of the statute should no longer be withheld from sailors. The Royal Commission on Loss of Life at Sea last year, however, reported that "the general results of the Act of 1880 in respect to other employments, by inducing greater care by employers and their agents or servants, have been so satisfactory that they felt no hesitation in recommending its extension to seamen, subject to some modifications to meet the special circumstances of ships." The Bill provides that ship owners shall be liable for accidents in home ports, just as manufacturers are liable in works; but when accidents occur in other ports there shall be no liability, unless the injury has been caused by a defect in the condition of the ship or its equipments. It proposes that "notice" may be given at any time before the expiration of three months from the termination of an engagement or voyage during which the injury was sustained, and that an action may be "commenced" at any time before the expiration of six months, or, in case of death, twelve months from the termination of that voyage or engagement.

We must confess that we have no great liking for the interference of Government between employers and employed more than is absolutely necessary, and we generally sympathise with the remarks of the Home Secretary when he said that by legalising the systems proposed in the Bill, he hoped that employers and employed may gradually be led to adopt a general scheme of insurance which would render all appeals to legal methods unnecessary. This should be the aim of all legislation. Unnecessary governmental interference simply irritates men who think for themselves, while it binds in official red tape those who do not. Wise legislation will endeavour to encourage a voluntary co-operation between employers and employed, which, while strengthening the consciousness of the rights of each, will also show that those rights can only be enforced when the one party recognises the just claims of the other.

THE WHITWORTH INSTITUTE.

In December last the residuary legatees of the late Sir Joseph Whitworth made certain proposals to the Manchester City Council for the purchase of a plot of land for a park and for the erection of a museum and technical school. The Council appointed a committee to confer with the residuary legatees for the purpose of maturing the scheme, and on Wednesday last they submitted a report of their deliberations. The legatees have still further extended their handsome offers, and it appears that no trouble or expense is to be spared in affording the rising generation the advantages of a complete course of technical education. The scheme proposed is most comprehensive, and the fact that Sir Joseph Lee, Sir H. Roscoe, Sir J. J. Harwood, Mr. William Agnew, Mr. Oliver Heywood, and Mr. Thomas Ashton are on the Whitworth Committee is, we think, a sufficient guarantee that the scheme will be carried out on broad, generous lines. In the first place, a plot of land in Oxford Road, commonly called Potter's Park, twenty acres in extent, and valued at £47,000, is to be acquired for the purposes of a pleasure park; on part of it is to be erected a museum of arts and industries, in which will be exhibited a collection of specimens of the fine and industrial arts, and the commercial productions of the chief countries of the world. Another part of the proposals relates to the present School of Art. The building is to be considerably enlarged, in order that instruction may be given in modelling, mechanical drawing, and architectural design, and in embroidery and art needlework. The present technical school is also much too limited for its requirements, so that the committee propose to erect an entirely new building on a more extensive site, and to develop the resources of the school in other ways. Instruction will be afforded in the industrial sciences, with the use of machinery, apparatus, tools, physical and chemical laboratories, museum and library, and also in mechanical and other drawing, in modern languages, and in various branches of commercial education. It is also intended to establish several manual training schools in different parts of the city, which may form a link between the public elementary schools and the proposed Central Technical School.

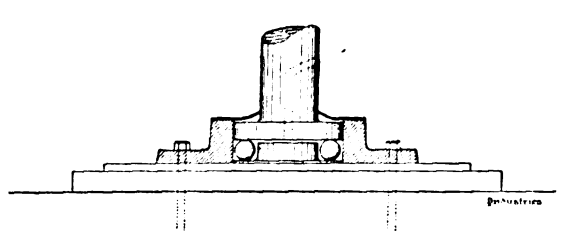
Such an extensive scheme will require a large amount of capital with which to commence operations; but there is little doubt that it will be found.

Letters to the Editor.

THE REPORT OF THE RESEARCH COMMITTEE ON FRICTION.

To the Editor of "Industries."

Sir,—Referring to the recent discussion on "Friction" at the last meeting of the Institution of Mechanical Engineers, and of which you have published a report, I beg to send you herewith a sketch and short description of a method I have introduced for supporting heavy vertical and thrust shafts, in lieu of ordinary footstep bearings. The system, briefly described, consists in extending the base of the shaft, and causing it to revolve on balls or rollers confined in



an oil chamber. The balls have a circular traverse, are made smooth and hard, and their pathway is turned. The bearing is covered in with a cap through which oil can be supplied, or in certain cases a hole can be drilled up the shaft for the same purpose. By extending the base of the shaft the pressure is distributed, and by using the balls or friction rollers in an oil bath the friction is very largely reduced. I may add that I have had a vertical shaft, carrying several tons, running for some time, without giving any trouble whatever.

Yours, &c.,

London, E.C., 1st June, 1888. M. Powis Bale.

PROPOSED FUEL TESTING STATION FOR LONDON.

To the Editor of "Industries."

Sir,—Will you allow me to put before your readers the following proposition for the establishment of such a station, the desirability of which has been much impressed upon me within the last few years? So far as I know, there does not exist anything of the kind in this country, whereas on the Continent coals can be tested for their evaporative power, the gases of combustion analysed, and all the results carefully reported on by experts. I subjoin a few details of the proposed station, with probable cost. It should, I consider, be placed on a perfectly independent footing, and managed by experts, under a small committee appointed by those who assist with money or otherwise. It might follow generally the lines of existing coal testing stations, but with all modern improvements.

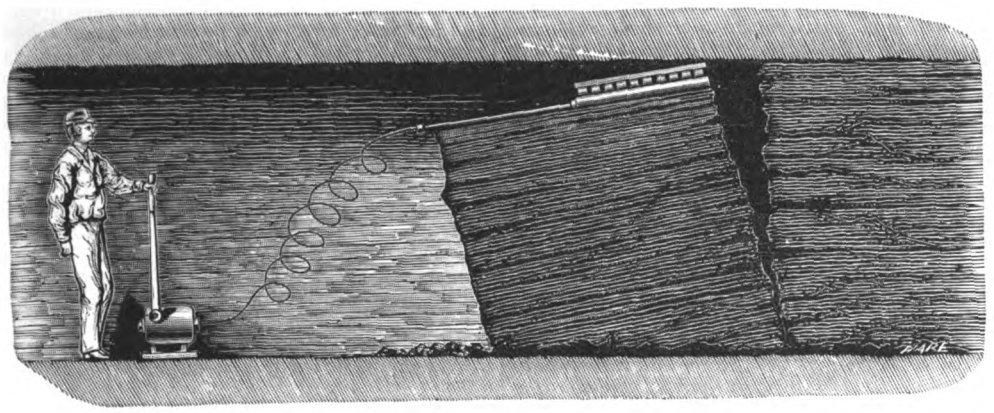
In this country it is remarkable that neither the sellers of coal take the trouble to find out how much heat they are offering, nor the purchasers how much they are getting for their money, and this notwithstanding the hundreds of million tons of coal changing hands yearly. Colliery owners and coal merchants, as well as the large consumers, know very little about coal calorimeters, although the former sell so much heat, and the latter try to utilise it to the best advantage. How few of the latter weigh their coal regularly, or keep any weekly record of the quantities of ashes and clinkers, to find out how much dirt and incombustible matter they are paying for. How few know what it costs them in fuel to evaporate one thousand gallons of water into steam, which is one of the best standards of comparison in a given district.

Locality.—The station might be in close proximity to a river, canal, or railway station, so that the coals could be delivered easily and cheaply, and the steam allowed to escape under pressure without causing annoyance. A small piece of land doubtless could be obtained in such a situation at a low rent. The boiler shed should be about 35ft. by 20ft., with a small additional shed for storing the fuel.

Cost.—It would be desirable to allow at least £700 for a start to cover the cost of the boiler shed, chimney, 20 h.p. boiler (if such were considered large enough), and the special arrangements for measuring the feed water with tanks, scales, feed pump, injector, gas and coal analysing apparatus, calorimeters, &c. Seeing that until the objects of the station become known it would probably not pay expenses, the help of guarantors would no doubt be necessary.

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HYDRAULIC COAL GETTING MACHINE.



Yearly Expenses.—The charge for testing and reporting upon each combustible would probably more than cover eventually the salaries of a technical manager, his assistant, and the stoker. Some arrangement might possibly be made by which the manager and his assistant should only attend when required, at any rate at first, in order to diminish expenses. The station would require to be advertised and made known in various ways. Colliery owners would, no doubt, find it to their advantage to have their different kinds of coal tested and reported upon, so as to offer them to their customers with their ascertained heating value or evaporative power. Large consumers of coal (railway companies, water works, and others) should know the heating value of the coal they are paying for, and the percentage of incombustibles.

I now add a few notes on the temporary and permanent experimental heat stations known to me. (1) The earliest fuel testing station was established in 1847, at Brix, in Germany. (2) Sir H. de la Beche and Dr. Lyon Playfair made a series of experiments before the year 1851 with different coals suitable for the navy. These trials were conducted near London under a small marine boiler at atmospheric pressure. (3) At the English Government dockyards various interesting experiments have been made under small marine boilers, and the results published in Blue Books. (4) Messrs. Armstrong, Londridge, & Richardson published in 1858 an account of some valuable experiments they had made of the steam coals of the Hartley district of Northumberland, under a small marine boiler, for the local steam colliery association. (5) At Wigan, many excellent experiments were made by Messrs. Richardson and Fletcher about 1867, to test the value of Lancashire and Cheshire steam coals for use in marine boilers. The water was evaporated under atmospheric pressure from a small marine boiler. This station was afterwards abolished. (In none of the above do the gases of combustion appear to have been analysed.) (6) A fuel testing station was working at Danzig, in 1863. (7) An important station was opened at Brieg on the Oder by the colliery owners of Lower Silesia, in April, 1878, with the primary object of testing the value as fuel of the important coal seams of that province. After working with the most satisfactory results for two years, and establishing the superiority of the Lower Silesian coal, the experiments terminated in 1880. The testing boilers had each 40 sq. m. of heating surface. Gases and coals were analysed.

Existing Continental Stations.—(8) The Imperial Naval Administration Coal Testing Station at Wilhelmshaven, Germany, was established in 1877. (9) Dr. Bunte's Coal Testing Station, erected at Munich about 1878, particulars of which have been published in Proceedings Inst.C.E., Vol. 73. Here some hundreds of trials have been reported on and published, much valuable work has been done, and many fuels tested, including coals of the Ruhr valley, Saar basin, Saxon and Bohemian coal fields, and those of Silesia and Upper Bavaria. The boiler of the station has about 450 sq. ft. of heating surface. The gas and coals are analysed, and all particulars carefully noted. It is one of the most complete stations I have seen. (10) In Belgium, near Brussels, there is a Government station for testing fuels, under the administration of the Belgium State railways. Locomotive boilers are used. The establishment has been at work for the last two years; but no results are published, as they are considered the property of the Government. Private firms can, however, have their coals tested and reported upon. (11) The Imperial Marine Station at Danzig. (12) The Boiler Insurance Company at Magdeburg.

The above is a slight outline of the work already done in this direction. With the view of obtaining the opinions of those interested in starting a fuel testing station, I ask you kindly to give this letter publicity. If the necessary sum can be raised, we may hope to have before long a practical and useful establishment in London, and to gain from it many interesting practical results respecting the combustion of fuels.

Yours, &c.,

BRYAN DONKIN, JUN.

Bermondsey, London, S.E., 1st June, 1888.

HYDRAULIC COAL GETTING MACHINE.

ON Tuesday last, we had an opportunity of witnessing some interesting experiments at Kiveton Park Colliery, near Sheffield, in connection with a new hydraulic coal getting machine, which is the patented invention of Messrs. Roberts-Horsfield & Porter, and made by the North London Engineering Works, Caledonian Road, London, N. Briefly described, this machine consists of a steel bar containing a number of circular cavities into which are fitted a series of small rams, which are forced out simultaneously by water pressure. The lower end of each ram is attached to another bar by screws, while the upper end is fitted with an ordinary cup leather fixed by a screw and washer. The whole of the rams are actuated by water supplied through a flexible copper tube from a force pump, as shown in our illustration. The mode of operation is somewhat as follows: After a bore hole has been made in the upper part of the working face large enough to allow the coal getting machine to be inserted, the under part of the face is cut away and supported by temporary sprags. As soon as the bottom has been sufficiently removed, the sprags are taken away and the pump is started. The water gradually forces the rams out —a maximum distance of $1\frac{3}{4}$in.—and exerts, if necessary, a combined pressure of 70 tons, which has been found sufficient in every case to bring down the coal. The coal brought down is not crushed or broken, and much less slack is produced than in the case of blasting, while the men can work in absolute safety. The amount of coal displaced at each operation averages from 14 tons to 24 tons, and the operation of pumping takes on an average four minutes. The weight of the press used in these experiments was only 40lb. In an early issue we hope to be able to give a further description of this invention, which, judging from the experiments thus far carried out, would appear to give extremely satisfactory results.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AT the last meeting of this Society, Professor S. P. Thompson read a paper on "The Influence Machine from 1788 to 1888." The author stated that on the 5th of June, 1788, Nicholson's revolving doubler was announced to the Royal Society, in a letter from the inventor to the President, Sir Joseph Banks, so that the 5th of June of the present year would be the hundredth anniversary of the invention of the influence machine. The existence of electrical influence was discovered in 1753 by John Canton, of Stroud, a man of great ability, but one who, like many men of exceptional genius, lived to a great extent apart from the other scientific men of his day, with the result that his ideas were not expressed in the ordinary scientific terminology of the time, and it was, therefore, somewhat difficult to understand his more or less obscure explanations. He accounted for the phenomenon which he observed by assuming the existence of a kind of electrified atmosphere surrounding every charged body. Further researches in the same direction very soon followed. Franklin, Wilkie, and Epinus were among his immediate successors in this field, and the results were expressed by them in terms of the mathematical conception of direct action at a distance. The Italian physicist, Beccaria, was the first to observe that the behaviour of a body carrying a certain charge depended on the neighbouring bodies, and that by varying the positions of the latter, it could be made to act in the same manner as if its charge had been either increased or diminished. To this action he gave the latin name *Vinder*, for which it was difficult to find an intelligible English equivalent. In 1762 Wilkie discovered the principle of the electrophorus. His instrument consisted of a glass table having on its under surface a piece of cardboard, to which an electric charge could be given. Another insulated sheet of cardboard, above, and parallel to the glass, could be moved towards or away from it, by means of cords and pulleys. Wilkie found that a charge could be communicated to the upper sheet of cardboard by simply lowering it down close to the glass, touching it, and then raising it again. Volta afterwards re-discovered the electrophorus in its present well known form of a plate covered with a sheet of some resinous substance, and a metal plate or cover, attached to a glass handle. In 1778 Volta devised a condensing arrangement which he used in conjunction with the electrophorus, as well as independently. In 1780 Lichtenberg, whose name is familiar in connection with the well known Lichtenberg figures formed by a mixture of red lead and sulphur dusted on a resinous surface, previously touched at different points with a charged body, devised a double or reciprocal electrophorus. This consisted of a board about 2ft. long by 1ft. broad, provided with a wooden rim and covered with a compound of pitch and turpentine. One end of the surface was electrified by friction, a metallic plate was placed on this part and touched, by which it became oppositely electrified. It was then removed by means of an insulating handle and placed upon the other end of the surface, communicating a charge opposite to the first. While there it was touched, which gave it a charge similar to that at the other end of the surface. It was then replaced upon this end, increasing its charge, then touched, by which it received an increased opposite charge, and by continuing the series of operations, the opposite charges at the ends of the surface, and therefore those obtainable in the metal plate by induction, could be increased to a considerable extent.

In the meantime Erasmus Darwin, the father of Charles Darwin, had become interested in Volta's electrophorus, and in 1778 he made an attempt to perform a series of operations similar to those of Lichtenberg by mechanical means. The author had found many allusions to Darwin's apparatus, but for a long time he was unable to find any accurate description of it, as it did not appear to have been published; but ultimately he was successful in discovering Darwin's original notes and drawing, bearing date 1778. The apparatus consisted of a fixed glass disc with a pair of movable metal discs, one on each side of it, which could be made to approach and recede from the glass by means of crank levers. This apparatus was communicated to Nicholson through a Mr. Partington, and evidently gave him the idea of the revolving doubler. In the meantime, in the year 1787, Bennett read a paper at the Royal Society on an electrical doubler for the smallest possible charges to such an extent as to render them perceptible by means of an ordinary electroscope. His apparatus consisted merely of three metal discs attached to insulating handles, by means of which considerable opposite charges could be obtained by successive inductive action from a small initial charge; but the charge was certainly not doubled each time, and there was no arrangement for effecting the operations automatically. Its method of action was as follows: Calling the plates A B and C, a charge, say + 1 was given to A; C was then placed near it, and earth connected, so receiving by induction a charge slightly less than −1, but which for simplicity we may call −1. C is then placed close to B, and the latter earth connected, thus receiving a charge + 1. B is then placed in contact with A and brought close to C, which is earth connected, and receives a charge −2, and this series of operations is repeated as often as desired.

Within the next twelve months Tiberius Cavallo, an Italian physician living in London, devised an arrangement consisting of four metal plates placed vertically on insulating rods. One plate was fixed at one end of the stand and received the initial charge; two were at the other end, forming a condenser, and a fourth plate could be moved by a lever to and fro. The inventor and others engaged in these researches were greatly puzzled at finding that this instrument would develop a charge without any initial electrification, and they concluded that a charge was produced whenever two metal plates were brought into contact. Nicholson's instrument was the next, and consisted of a metal disc fixed at the end of a glass rod, and capable of rotating in its own plane about an axis passing through the centre of the rod, in front of a pair of plates fixed in a plane parallel to that of the revolving plate, and close to it, on opposite sides of the axis. The requisite contacts were made automatically by means of springs. Calling A and B the two fixed plates, and C the revolving one, an initial charge, say positive, is given to one of the fixed plates. When C comes opposite to A, A and B are connected with each other, and C is earth connected, receiving a negative charge by induction. When C comes opposite to B, A and B are disconnected, and B is earth connected, receiving a positive charge by induction from C. When C again comes opposite to A, the positive charge on B is drawn to A, and C, being again earth connected, receives a stronger negative charge, and so the operation may be continued until sparking takes place between the fixed and movable plates. This instrument is also found to excite itself without initial charge. An objection which

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was urged against it as soon as it was brought out was that, owing to the discs approaching edgeways, there would be a great superficial density on the edges of the discs, and a consequent loss of electrification, and also that there would be a loss from the springs. In 1798 Bohnenberger, a German pastor, published a book in which he described a number of different patterns of doublers acting on a similar principle. In 1823 Sir Francis Ronalds devised a doubler in which the moving plate had a pendulous motion, and the two fixed plates, as in Nicholson's instrument, were similarly charged. The instruments devised since then have all had the fixed plates oppositely charged, on Lichtenberg's plan, and the author calls them field plates, from their analogy with the field magnets of a dynamo.

In 1831 Belli devised an instrument of this kind. Two metal discs (Fig. 1) fixed to the ends of a glass stem

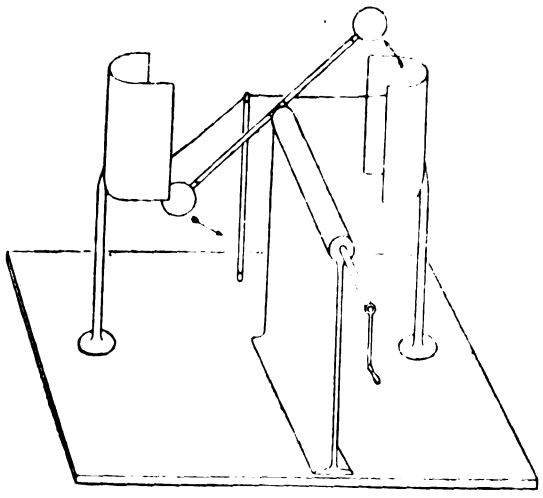


Fig. 1.—Belli, 1831.

passed between two field plates, and were earth connected just before passing out of their influence, and touched by collecting brushes just after entering, as in the modern influence machines.

In 1846 Svanberg devised another form of double electrophorus, which was described by Billet in 1851. From this time no further attempts were made to improve influence machines, until in 1860 Varley patented a machine in which a series of metal conductors or carriers were attached to a disc of vulcanite capable of rotation about an axis. The carriers passed between two pairs of insulated field plates, and when opposite them they were touched by earth connected conductors. Spring contacts connected the carriers with the field plates just as they entered within their influence. When a small initial charge was given to one of the field plates, the other field plate, therefore, became oppositely electrified, and the opposite charges on the two field plates could in this way be increased until the limit of insulation was reached.

Shortly after, Toepler invented a machine in which single field plates were used, and which is represented diagrammatically in Fig. 2. Simultaneously, Holtz brought out a machine which consisted of two glass plates, one

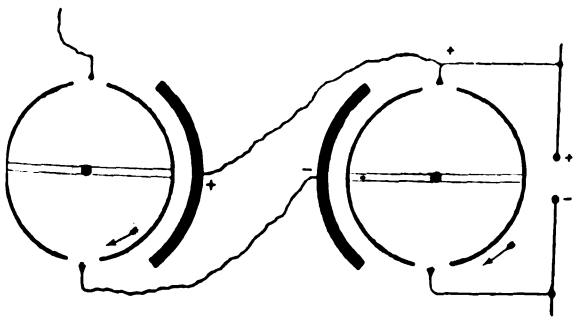


Fig. 2.—Toepler, 1865.

fixed and one rotating. Two windows are cut in the fixed plate on opposite sides of the axis. These windows are difficult to cut, and make the plate rather costly. Two pieces of varnished cardboard which act as the field plates are attached to the fixed plate on the side opposite to the rotating plate above one window and below the other, and they are furnished with narrow tongues which project through the windows and nearly touch the revolving plate, which must turn in the direction opposite to that in which the tongues point. In front of the rotating plate, opposite the forward edges of the field plates, is a diagonal metallic conductor, provided at its ends with metallic combs facing the moving disc. Two horizontal insulated metal combs joined to metal rods terminating in metal balls face the rotating disc on each side, and form the discharging apparatus. The action of the machine is as follows: A small charge, say positive, being given to one of the field plates, the charge, carried forward by the glass, acts inductively through the glass on the comb of the diagonal conductor which it first passes. The comb being thus negatively charged, discharges a negatively electrified wind upon the front surface of the rotating plate, while the repelled positive passes to the comb at the other end of the diagonal conductor, so that positive electrification is here communicated to the glass. This acts by induction on the second field plate, charging the point opposite the comb negatively, and repelling positive to its further extremity, viz., the tongue, whence it is slowly discharged on to the back of the rotating plate. As the plate revolves this charge is carried round until it gets opposite the tongue of the other field plate, into which it discharges, and so increases its positive charge. The negative charge acts in a similar manner on the other comb, increasing its positive discharge, and drawing electricity through the diagonal conductor. The two combs on the diagonal conductor therefore throw opposite charges on to the glass, and the back of the rotating plate is at the same time similarly charged; and the latter charges, carried round by the glass, increase the charges on the field plates. The charges thrown upon the front surface of the rotating disc from the combs of the diagonal conductor are collected by the horizontal combs of the discharging apparatus. The machine was improved by Poggendorff by the introduction of two fixed plates in the centre, with a rotating one on each side. Holtz devised a second form of machine in which the fixed plate and paper field plates were dispensed with, and two moving plates rotating in opposite directions were employed.

In 1868 Sir William Thomson, without knowing of what had been already done, devised his replenisher, which was similar in action to Varley's machine. In 1880 Voss devised a machine which was a sort of combination of a Toepler and a Holtz machine. The author also exhibited a specimen of Sir William Thomson's mouse-mill replenisher, in which metal carriers and multiple field

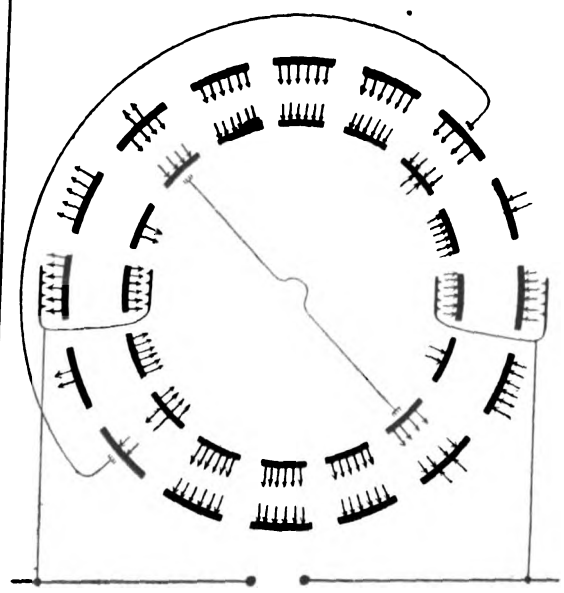


Fig. 3.—Wimshurst, 1881.

plates are used, and he pointed out the exact analogy which this instrument bears to a dynamo. The author then explained the action of Sir William Thomson's water dropping electrophorus. Two pairs of insulated metal cylinders are respectively connected with the internal coatings of two Leyden jars. Two of these, the inductors, are simply cylinders open at each end, while the receivers consist of similar cylinders partially closed in the middle by small funnels opening downwards, and with their narrow mouths a little above the centres of the cylinders. An inductor and a receiver are in connection with each jar, the inductor of the first jar being vertically over the receiver of the second, and *vice versa*. Two fine streams of water from earth connected vessels are allowed to fall through the inductors, which are so placed that the streams break into drops near their centres, and these drops, passing through the inductors, fall into the funnels of the receivers. If a small positive charge is given to the first jar, its inductor produces a negative charge on each drop as it forms; this negative charge is almost entirely given up to the receiver, as the stream breaks into drops at the mouth of the funnel which is in the interior of a conductor. The negative electrification thus produced in the second jar acts through its inductor on the receiver of the first jar and augments its positive charge, and this in turn increases the negative electrification of the second jar, and so the process continues.

The author also showed a compact form of this apparatus which he had devised, and had recently exhibited to the Physical Society. He then went on to state that Mr. Wimshurst, trying to find a substitute for the windows in the Holtz machine, made the fixed plate in two sections, each rather less than a semi-circle, so that when put together there was a space between, and behind this he pasted the paper field plates. He then determined to make both the plates revolve in opposite directions, and was thus led to the Wimshurst machine in its present form, consisting of two glass plates rotating in opposite directions. Each plate carries a number of strips of tin foil which serve both as field plates and carriers, or armatures, as Professor Thompson calls them, to indicate their analogy with the armature of a dynamo. At the front and back are a pair of uninsulated diagonal conductors, and on each side is a pair of insulated collecting combs connected with the discharging apparatus. Fig. 3 is a diagrammatical view of this machine. The arrows show the character of the inductions, being directed to the plate for positive and from the plate for negative charges. As each armature passes the opposite charged carrier of the other disc, the latter acts as a field plate and induces a charge in the former, which itself acts as field plate to the other as armature. If combs only are used in an influence machine, it will not excite itself, and, on the other hand, if brushes only are used, it is liable to reverse on discharge. Brushes should therefore be used for neutralising, and combs for collecting the charges, which arrangement has been adopted in the Wimshurst machine. The e.m.f. of influence machines is practically constant, whatever the speed, but the internal resistance diminishes as the speed is increased, which shows that a series of moving charges is equivalent to a current. The author also exhibited some specimens of Clarke's and other gas lighters, in which the spark producing apparatus consists of small influence machines. The following is a list of inventors in chronological order:—

Canton	1753	Goodman	1841
Wilkie	1762	Svanberg	1846
Volta	1776-82	Billet	1851
Darwin	1778		
Lichtenberg	1780	Varley	1860
Bennett	1787	Holtz	1865-67-83
Cavallo	1788	Toepler	1865-80
Nicholson	1788-97	Morton	1866
Read	1794	Thomson	1867-68
Bohnenberger	1798	Carré	1868
Hachette and Desormes	1804	Kundt	1868
		Schwedoff	1871
Ronalds	1820-23	Voss	1880
Belli	1831	Wimshurst	1881-88

The discussion was opened by Professor Ayrton, who thought that the author, while giving an admirable account of the development of the influence machine, had not dwelt sufficiently on the remarkable number of times that re-invention, in ignorance of previous work, had taken place. Sir William Thomson's replenisher was not a development of any known influence machine, for in the year 1867 Sir William did not know that such a thing existed. The object he had in view was to devise a machine capable of charging the ink of a syphon recorder, and at the same time be worked easily enough to be driven by clock work, instead of requiring continuous manual labour, as one of the old frictional machines would. It was not until Mr. Bottomley and he himself had been asked by Sir William to consult the patent registers, when he was preparing to patent the replenisher, that he heard of Varley's machine, although Varley had been his partner. He did not think the use of combs overcame the difficulty of reversal, which was the great difficulty in Thomson's original machine; and he stated that a Wimshurst machine, in use at the Central Institution, was frequently found to reverse. This might be due to its small capacity. He pointed out the very high efficiency of influence machines relatively to the old frictional machines.

Mr. Mordey asked why it was necessary for each charge to be carried so far round unchanged, as was shown by a diagram exhibited.

The author, in replying, said that a Wimshurst machine, with both brushes and combs in the discharge, used always to reverse, but no longer did so after the brushes had been entirely replaced by combs. In the case of the large 8-plate Wimshurst machine which was exhibited, he had been unable to get a reversal until Mr. Wimshurst had shown him a way of doing it, by charging a Leyden jar from one side, putting the knobs together, then separating, and putting the charge in at the other side. In reply to Mr. Mordey's question, the author pointed out that if the range were diminished it would diminish the insulation, and therefore lessen the maximum length of spark obtainable from the machine.

Mr. Wimshurst expressed surprise at Professor Ayrton's finding that one of his machines reversed. He felt sure there must be something wrong with it, and he would examine it and point it out; for in his own experience he had never got a reversal, either with large or small machines.

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NICOLA TESLA'S ALTERNATING CURRENT MOTOR.

In our issue of the 18th May, we gave an account of a very interesting investigation made by Professor Galileo Ferraris, of Turin, which had for its object the production of mechanical rotation by the electro-dynamic action of alternating currents. The fundamental principle of the apparatus devised by Ferraris, is a revolving resultant magnetic field produced by two coils, which carry alternating currents, and the axes of which are at right angles to each other. We said in our account of this investigation, that this principle may be applied in the construction of electricity meters to be used on an alternate current supply system, and possibly also in that of motors; though on this point we would not prophesy. It is significant of the enterprise and inventive skill of American electricians, that at the time these lines were being printed, Mr. Nicola Tesla brought before the American Institute of Electrical Engineers an actual solution of the problem which we on this side of the Atlantic merely foreshadowed as possible at some future time. The solution may perhaps not be perfect in its present form; but as far as it goes, it is a long step in the direction of applying alternating currents for motive power purposes, and as such it will be appreciated by those of our readers who are interested in the distribution of electricity from central stations. Owing to the importance of the subject, we give herewith Mr. Tesla's paper in full.

In the presence of the existing diversity of opinion regarding the relative merits of the alternate and continuous current systems, great importance is attached to the question whether alternate currents can be successfully utilised in the operation of motors. The transformers, with their numerous advantages, have afforded us a relatively perfect system of distribution, and although, as in all branches of the art, many improvements are desirable, comparatively little remains to be done in this direction. The transmission of power, on the contrary, has been almost entirely confined to the use of continuous currents, and notwithstanding that many efforts have been made to utilise alternate currents for this purpose, they have, up to the present, at least as far as known, failed to give the result desired. Of the various motors adapted to be used on alternate current circuits the following have been mentioned: (1) A series motor with subdivided field. (2) An alternate current generator having its field excited by continuous currents. (3) Elihu Thomson's motor. (4) A combined alternate and continuous current motor. Two more motors of this kind have suggested themselves to me: (1) A motor with one of its circuits in series with a transformer, and the other in the secondary of the transformer. (2) A motor having its armature circuit connected to the generator, and the field coils closed upon themselves. These, however, I mention only incidentally.

The subject which I now have the pleasure of bringing to your notice is a novel system of electric distribution and transmission of power by means of alternate currents, affording peculiar advantages, particularly in the way of motors, which I am confident will at once establish the superior adaptability of these currents to the transmission of power, and will show that many results heretofore unattainable can be reached by their use: results which are very much desired in the practical operation of such systems, and which cannot be accomplished by means of continuous currents.

Before going into a detailed description of this system, I think it necessary to make a few remarks with reference to certain conditions existing in continuous current generators and motors, which, although generally known, are frequently disregarded.

In our dynamo machines, it is well known, we generate alternate currents which we direct by means of a commutator—a complicated device, and, it may be justly said, the source of most of the troubles experienced in the operation of the machines. Now, the currents so directed cannot be utilised in the motor, but they must—again by means of a similar unreliable device—be re-converted into their original state of alternate currents. The function of the commutator is entirely external, and in no way does it affect the internal working of the machines. In reality, therefore, all machines are alternate current machines, the currents appearing as continuous only in the external circuit during their transit from generator to motor. In view simply of this fact, alternate currents would commend themselves as a more direct application of electrical energy, and the employment of continuous currents would only be justified if we had dynamos which would primarily generate, and motors which would be directly actuated by such currents.

But the operation of the commutator on a motor is twofold—firstly, it reverses the currents through the motor; and secondly, it effects, automatically, a progressive shifting of the poles of one of its magnetic constituents. Assuming, therefore, that both of the useless operations in the system, that is to say, the directing of the alternate currents on the generator, and reversing the direct currents on the motor, be eliminated, it would still be necessary, in order to cause a rotation of the motor, to produce a progressive shifting of the poles of one of its elements, and the question presented itself, how to perform this operation by the direct action of alternate currents. I will now proceed to show how this result was accomplished.

In the first experiment a drum armature was provided with two coils at right angles to each other, and the ends of these coils were connected to two pairs of insulated contact rings as usual. A ring was then made of thin insulated plates of sheet iron and wound with four coils, each two opposite coils being connected together so as to produce free poles on diametrically opposite sides of the ring. The remaining free ends of the coils were then connected to the contact rings of the generator armature so as to form two independent circuits, as indicated in Fig. 9. It may now be seen what results were secured in this combination, and with this view I would refer to the diagrams Figs. 1 to 8a. The field of the generator being independently excited, the rotation of the armature sets up currents in the coils $c\,c$, varying in strength and direction in the well known manner. In the position shown in Fig. 1 the current in coil c is nil while coil c^1 is traversed by its maximum current, and the connections may be such that the ring is magnetised by the coils $c\,c$, as indicated by the letters N S in Fig. 1a, the magnetising effect of the coils $c\,c$ being nil, since these coils are included in the circuit of coil c.

In Fig. 2 the armature coils are shown in a more advanced position, one-eighth of one revolution being completed. Fig. 2a illustrates the corresponding magnetic condition of the ring. At this moment the coil c generates a current of the same direction as previously, but weaker, producing the poles n_1 s, upon the ring; the coil c also generates a current of the same direction, and the connections may be such that the coils $c\,c$ produce the poles $n\,s$, as shown in Fig. 2a. The resulting polarity is indicated by the letters N S, and it will be observed that the poles of the ring have been shifted one-eighth of the periphery of the same.

In Fig. 3 the armature has completed one-quarter of one revolution. In this phase the current in coil C is a maximum, and of such direction as to produce the poles N S in Fig. 3a, whereas the current in coil c_1 is nil, this coil being at its neutral position. The poles N S in Fig. 3a are thus shifted one-quarter of the circumference of the ring.

Fig. 4 shows the coils $c\,c$ in a still more advanced position, the armature having completed three-eighths of one revolution. At that moment the coil c still generates a current of the same direction as before, but of less strength, producing the comparatively weaker poles $n\,s$ in Fig. 4a. The current in the coil c is of the same strength, but of opposite direction. Its effect is, therefore, to produce upon the ring the poles n_1 and s_1, as indicated, and a polarity N S results, the poles now being shifted three-eighths of the periphery of the ring.

In Fig. 5 one-half of one revolution of the armature is completed, and the resulting magnetic condition of the ring is indicated in Fig. 5a. Now, the current in coil c is nil, while the coil c yields its maximum current, which is of the same direction as previously; the magnetising effect is therefore due to the coils $c\,c$ alone, and referring to Fig. 5a, it will be observed that the poles N S are shifted one-half of the circumference of the ring. During the next half revolution the operations are repeated, as represented in the Figs. 6 to 8a.

A reference to the diagrams will make it clear that during one revolution of the armature the poles of the ring are shifted once around its periphery, and each revolution producing like effects, a rapid whirling of the poles in harmony with the rotation of the armature is the result. If the connections of either one of the circuits in the ring are reversed, the shifting of the poles is made to progress in the opposite direction; but the operation is identically the same. Instead of using four wires, with like result, three wires may be used, one forming a common return for both circuits.

This rotation or whirling of the poles manifests itself in a series of curious phenomena. If a delicately pivoted disc of steel or other magnetic metal is approached to the ring it is set in rapid rotation, the direction of rotation varying with the position of the disc. For instance, noting the direction outside of the ring, it will be found that inside the ring it turns in an opposite direction, while it is unaffected if placed in a position symmetrical to the ring. This is easily explained. Each time that a pole approaches it induces an opposite pole in the nearest point on the disc, and an attraction is produced upon that point; owing to this, as the pole is shifted further away from the disc, a tangential pull is exerted upon the same, and the action being constantly repeated, a more or less rapid rotation of the disc is the result. As the pull is exerted mainly upon that part which is nearest to the ring, the rotation outside and inside, or right and left, respectively, is in opposite directions. When placed symmetrically to the ring, the pull on opposite sides of the disc being equal, no rotation results. The action is based on the magnetic inertia of the iron; for this reason a disc of hard steel is much more affected than a disc of soft iron, the latter being capable of very rapid variations of magnetism. Such a disc has proved to be a very useful instrument in all these investigations, as it has enabled me to detect any irregularity in the action. A curious effect is also produced upon iron filings. By placing some upon a paper, and holding them externally quite close to the ring, they are set in a vibrating motion, remaining in the same place, although the paper may be moved back and forth; but in lifting the paper to a certain height, which seems to be dependent on the intensity of the poles and the speed of rotation, they are thrown away in a direction always opposite to the supposed movement of the poles. If a paper with filings is put flat upon the ring, and the current turned on suddenly, the existence of a magnetic whirl may be easily observed.

To demonstrate the complete analogy between the ring and a revolving magnet, a strongly energised electromagnet was rotated by mechanical power, and phenomena identical in every particular to those mentioned above were observed.

Obviously, the rotation of the poles produces corresponding inductive effects, and may be utilised to generate currents in a closed conductor placed within the influence of the poles. For this purpose it is convenient to wind a ring with two sets of superimposed coils, forming respectively the primary and secondary circuits. In order to secure the most economical results, the magnetic circuit should be completely closed, as shown in Fig. 10, and with this object in view the construction may be modified at will.

The inductive effect exerted upon the secondary coils will be mainly due to the shifting or movement of the magnetic action; but there may also be currents set up in the circuits in consequence of the variations in the intensity of the poles. However, by properly designing the generator, and determining the magnetising effect of the primary coils, the latter element may be made to disappear. The intensity of the poles being maintained constant, the action of the apparatus will be perfect, and the same result will be secured as though the shifting were effected by means of a commutator with an infinite number of bars. In such case the theoretical relation between the energising effect of each set of primary coils and their resultant magnetising effect may be expressed by the equation of a circle having its centre coinciding with that of an orthogonal system of axes, and in which the radius represents the resultant and the co-ordinates both of its components. These are then respectively the sine and cosine of the angle α between the radius and one of the axes (OX). Referring to Fig. 11 we have $r^2=x^2+y^2$; where $x=r\cos\alpha$, and $y=r\sin\alpha$.

Assuming the magnetising effect of each set of coils in the transformer to be proportional to the current—which may be admitted for weak degrees of magnetisation—then $x=Kc$ and $y=Kc^1$, where K is a constant and c and c^1 the current in both sets of coils respectively. Supposing further, the field of the generator to be uniform, we have for constant speed $c^1=K^1\sin\alpha$ and $c=K^1\sin(90°+\alpha)=K^1\cos\alpha$, where K^1 is a constant (see Fig. 12). Therefore

$$x=Kc=KK^1\cos\alpha;$$
$$y=Kc^1=KK^1\sin\alpha, \text{ and}$$
$$KK^1=r.$$

That is, for a uniform field the disposition of the two coils at right angles will secure the theoretical result, and the intensity of the shifting poles will be constant. But from $r^2=x^2+y^2$ it follows that for $y=0$, $r=x$; it follows that the joint magnetising effect of both sets of coils should be equal to the effect of one set when at its maximum action. In transformers and in a certain class of motors the fluctuation of the poles is not of great importance, but in another class of these motors it is desirable to obtain the theoretical result.

In applying this principle to the construction of motors, two typical forms of motor have been developed. First, a form having a comparatively small rotary effort at the start, but maintaining a perfectly uniform speed at all loads, which motor has been termed synchronous. Second, a form possessing a great rotary effort at the start, the speed being dependent on the load.

These motors may be operated in three different ways: (1) By the alternate currents of the source only; (2) by a combined action of these and of induced currents; (3) by the joint action of alternate and continuous currents.

The simplest form of a synchronous motor is obtained by winding a laminated ring provided with pole projections with four coils, and connecting the same in the manner before indicated. An iron disc having a segment cut away on each side may be used as an armature. Such a motor is shown in Fig. 9 The disc being arranged to rotate freely within the ring, in close proximity to the projections, it is evident that as the poles are shifted it will, owing to its tendency to place itself in such a position as to embrace the greatest number of the lines of force, closely follow the movement of the poles, and its motion will be synchronous with that of the armature of the generator; that is, in the peculiar disposition shown in Fig. 9, in which the armature produces by one revolution two current impulses in each of the circuits. It is evident that if, by one revolution of the armature, a greater number of impulses is produced, the speed of the motor will be correspondingly increased. Considering that the attraction exerted upon the disc is greatest when the same is in close proximity to the poles, it follows that such a motor will maintain exactly the same speed at all loads within the limits of its capacity.

To facilitate the starting, the disc may be provided with a coil closed upon itself. The advantage secured by such a coil is evident. On the start the currents set up in the coil strongly energise the disc, and increase the attraction exerted upon the same by the ring, and currents are generated in the coil as long as the speed of the armature is inferior to that of the poles. Considerable work may be performed by such a motor, even if the speed be below normal. The intensity of the poles being constant, no currents will be generated in the coil when the motor is turning at its normal speed.

Instead of closing the coil upon itself, its ends may be connected to two insulated sliding rings, and a continuous current supplied to these from a suitable generator. The proper way to start such a motor is to close the coil upon itself until the normal speed is reached, or nearly so, and then turn on the continuous current. If the disc be very strongly energised by a continuous current, the motor may not be able to start; but if it be weakly energised, or generally so that the magnetising effect of the ring is preponderating, it will start and reach the normal speed. Such a motor will maintain absolutely the same speed at all loads. It has also been found that if the motive power of the generator is not excessive, by checking the motor the speed of the generator is diminished in synchronism with that of the motor. It is characteristic of this form of motor that it cannot be reversed by reversing the continuous current through the coil.

The synchronism of these motors may be demonstrated experimentally in a variety of ways. For this purpose it is best to employ a motor consisting of a stationary field magnet, and an armature arranged to rotate within the same, as indicated in Fig. 13. In this case the shifting of the poles of the armature produces a rotation of the latter in the opposite direction. It results therefrom that when the normal speed is reached, the poles of the armature assume fixed positions relatively to the field magnet, and the same is magnetised by induction, exhibiting a distinct pole on each of the pole pieces. If a piece of soft iron is approached to the field magnet, it will at the start be attracted with a rapid vibrating motion produced by the reversals of polarity of the magnet; but as the speed of the armature increases, the vibrations become less and less frequent, and finally entirely cease. Then the iron is weakly but permanently attracted, showing that the synchronism is reached, and the field magnet energised by induction.

The disc may also be used for the experiment. If held quite close to the armature it will turn as long as the speed of rotation of the poles exceeds that of the armature; but when the normal speed is reached, or very nearly so, it ceases to rotate, and is permanently attracted.

A crude but illustrative experiment is made with an incandescent lamp. Placing the lamp in circuit with the continuous current generator, and in series with the magnet coil, rapid fluctuations are observed in the light, in consequence of the induced currents set up in the coil at the start; the speed increasing, the fluctuations occur at longer intervals, until they entirely disappear, showing that the motor has attained its normal speed.

A telephone receiver affords a most sensitive instrument;

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NICOLA TESLA'S ALTERNATING CURRENT MOTOR.

(For description see opposite page.)

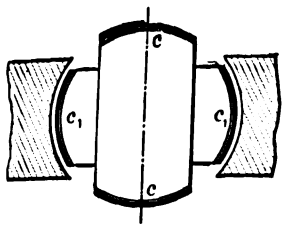


Fig. 1.

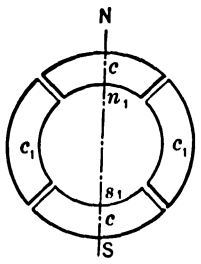


Fig. 1a.

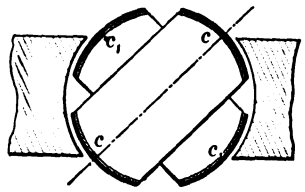


Fig. 2.

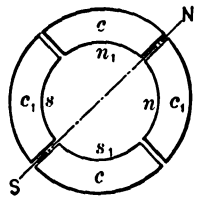


Fig. 2 a.

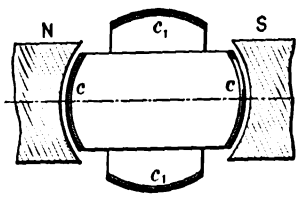


Fig. 3.

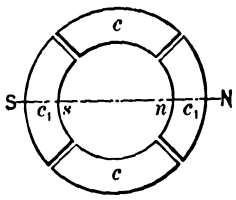


Fig. 3 a.

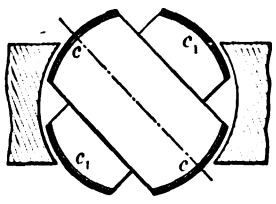


Fig. 4.

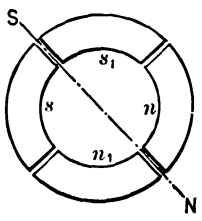


Fig. 4 a.

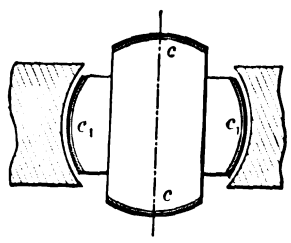


Fig. 5.

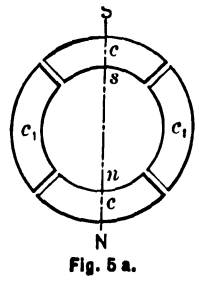
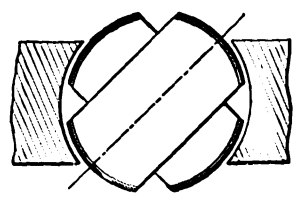


Fig. 5 a.


Fig. 6.

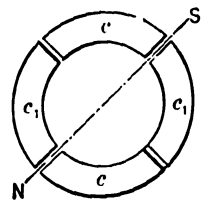


Fig. 6 a.

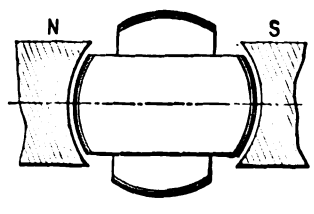


Fig. 7.

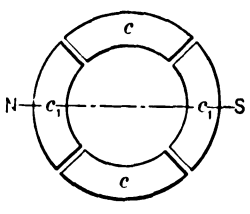
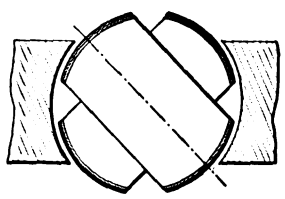


Fig. 7 a.


Fig. 8.

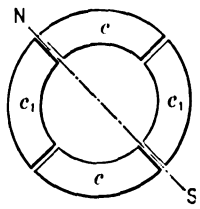
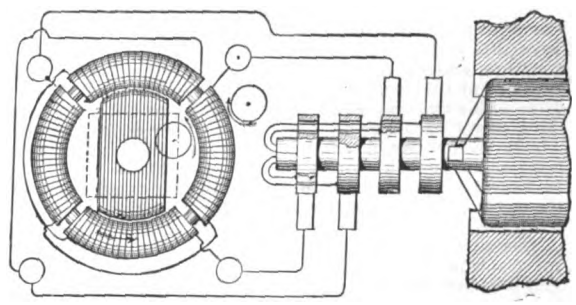
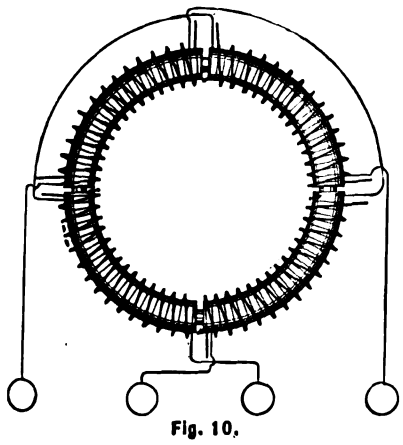


Fig. 8 a.


Fig. 9.


Fig. 10.

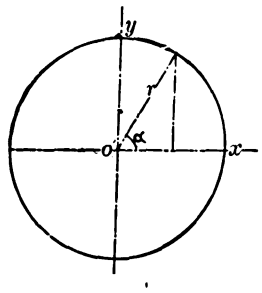


Fig. 11.

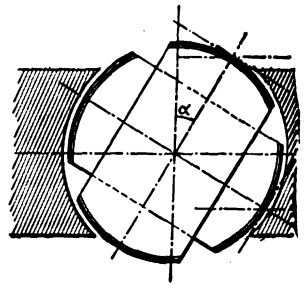
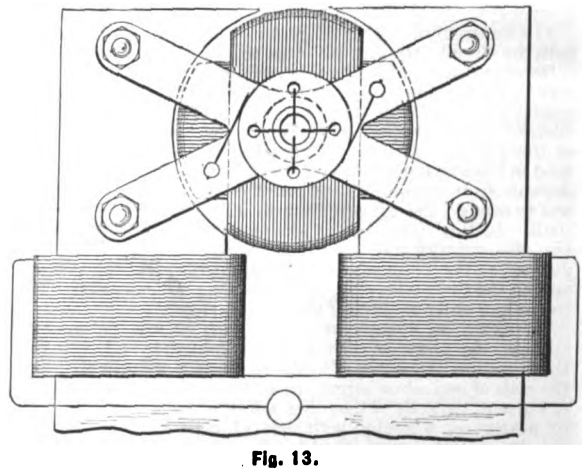
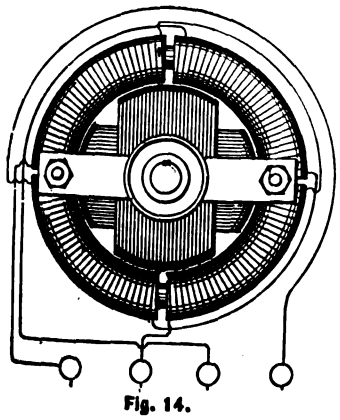


Fig. 12.


Fig. 13.


Fig. 14.

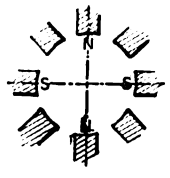


Fig. 15.



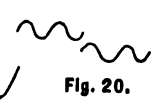
Fig. 16.

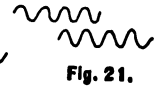


Fig. 17.


Fig. 18.


Fig. 19.


Fig. 20.


Fig. 21.

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when connected to any circuit in the motor the synchronism may be easily detected on the disappearance of the induced currents.

In motors of the synchronous type it is desirable to maintain the quantity of the shifting magnetism constant, especially if the magnets are not properly subdivided.

To obtain a rotary effort in these motors was the subject of long thought. In order to secure this result it was necessary to make such a disposition that while the poles of one element of the motor are shifted by the alternate currents of the source, the poles produced upon the other element should always be maintained in the proper relation to the former, irrespective of the speed of the motor. Such a condition exists in a continuous current motor; but in a synchronous motor, such as described, this condition is fulfilled only when the speed is normal.

The object has been attained by placing within the ring a properly subdivided cylindrical iron core wound with several independent coils closed upon themselves. Two coils at right angles are sufficient; but a greater number may be advantageously employed, as in Fig. 14. It results from this disposition that when the poles of the ring are shifted currents are generated in the closed armature coils. These currents are the most intense at or near the points of the greatest density of the lines of force, and their effect is to produce poles upon the armature at right angles to those of the ring, at least theoretically so; and since this action is entirely independent of the speed—that is, so far as the location of the poles is concerned—a continuous pull is exerted upon the periphery of the armature. In many respects these motors are similar to the continuous current motors. If load is put on, the speed, and also the resistance of the motor, is diminished, and more current is made to pass through the energising coils, thus increasing the effect. Upon the load being taken off, the counter e.m.f. increases, and less current passes through the primary or energising coils. Without any load the speed is very nearly equal to that of the shifting poles of the field magnet.

It will be found that the rotary effort in these motors fully equals that of the continuous current motors. The effort seems to be greatest when both armature and field magnet are without any projections; but as in such dispositions the field cannot be very concentrated, probably the best results will be obtained by leaving pole projections on one of the elements only. Generally, it may be stated that the projections diminish the torque, and produce a tendency to synchronism.

A characteristic feature of motors of this kind is their capacity of being very rapidly reversed. This follows from the peculiar action of the motor. Suppose the armature to be rotating, and the direction of rotation of the poles to be reversed. The apparatus then represents a dynamo machine, the power to drive this machine being the momentum stored up in the armature, and its speed being the sum of the speeds of the armature and the poles. If we now consider that the power to drive such a dynamo would be very nearly proportional to the third power of the speed, for this reason alone the armature should be quickly reversed. But simultaneously with the reversal another element is brought into action—viz., as the movement of the poles with respect to the armature is reversed, the motor acts like a transformer in which the resistance of the secondary circuit would be abnormally diminished by producing in this circuit an additional e.m.f. Owing to these causes the reversal is instantaneous.

If it is desirable to secure a constant speed, and at the same time a certain effort at the start, this result may be easily attained in a variety of ways. For instance, two armatures, one for torque and the other for synchronism, may be fastened on the same shaft, and any desired preponderance may be given to either one, or an armature may be wound for rotary effort; but a more or less pronounced tendency to synchronism may be given to it by properly constructing the iron core, and in many other ways.

As a means of obtaining the required phase of the currents in both the circuits, the disposition of the two coils at right angles is the simplest, securing the most uniform action; but the phase may be obtained in many other ways, varying with the machine employed. Any of the dynamos at present in use may be easily adapted for this purpose by making connections to proper points of the generating coils. In closed circuit armatures, such as used in the continuous current systems, it is best to make four derivations from equi-distant points or bars of the commutator, and to connect the same to four insulated sliding rings on the shaft. In this case each of the motor circuits is connected to two diametrically opposite bars of the commutator. In such a disposition the motor may also be operated at half the potential and on the three-wire plan, by connecting the motor circuits in the proper order to three of the contact rings.

In multipolar dynamo machines, such as use the converter systems, the phase is conveniently obtained by winding upon the armature two series of coils, in such a manner that while the coils of one set or series are at their maximum production of current, the coils of the other will be at their neutral position, or nearly so, whereby both sets of coils may be subjected simultaneously or successively to the inducing action of the field magnets.

Generally the circuits in the motor will be similarly disposed, and various arrangements may be made to fulfil the requirements; but the simplest and most practicable is to arrange primary circuits on stationary parts of the motor, thereby obviating, at least in certain forms, the employment of sliding contacts. In such a case the magnet coils are connected alternately in both the circuits; that is, 1, 3, 5 in one, and 2, 4, 6 in the other, and the coils of each set of series may be connected, all in the same manner, or alternately in opposition; in the latter case a motor with half the number of poles will result, and its action will be correspondingly modified.

The employment of multipolar motors secures in this system an advantage much desired and unattainable in the continuous current system, and that is, that a motor may be made to run exactly at a pre-determined speed, irrespective of imperfections in construction, of the load, and, within certain limits, of e.m.f. and current strength.

In a general distribution system of this kind the following plan should be adopted: At the central station of supply a generator should be provided having a considerable number of poles. The motors operated from this generator should be of the synchronous type, but possessing sufficient rotary effort to insure their starting. With the observance of proper rules of construction, it may be admitted that the speed of each motor will be in some inverse proportion to its size, and the number of poles should be chosen accordingly. Still exceptional demands may modify this rule. In view of this, it will be advantageous to provide each motor with a greater number of pole projections or coils, the number being preferably a multiple of two and three. By this means, by simply changing the connections of the coils, the motor may be adapted to any probable demands.

If the number of the poles in the motor is even, the action will be harmonious, and the proper result will be obtained; if this is not the case, the best plan to be followed is to make a motor with a double number of poles, and connect the same in the manner before indicated, so that half the number of poles result. Suppose, for instance, that the generator has twelve poles, and it would be desired to obtain a speed equal to $\frac{2}{3}$ of the speed of the generator. This would require a motor with seven pole projections or magnets, and such a motor could not be properly connected in the circuits unless fourteen armature coils would be provided, which would necessitate the employment of sliding contacts. To avoid this, the motor should be provided with fourteen magnets, and seven connected in each circuit, the magnets in each circuit alternating among themselves. The armature should have fourteen closed coils. The action of the motor will not be quite so perfect as in the case of an even number of poles, but the drawback will not be of a serious nature.

However, the disadvantages resulting from this unsymmetrical form will be reduced in the same proportion as the number of the poles is augmented.

If the generator has, say, n, and the motor n_1 poles, the speed of the motor will be equal to that of the generator multiplied by $\frac{n}{n_1}$.

The speed of the motor will generally be dependent on the number of the poles, but there may be exceptions to this rule. The speed may be modified by the phase of the currents in the circuits or by the character of the current impulses, or by intervals between each or between groups of impulses. Some of the possible cases are indicated in the diagrams Figs. 18, 19, 20, and 21, which are self explanatory. Fig. 18 represents the condition generally existing, and which secures the best result In such a case, if the typical form of motor illustrated in Fig. 14 is employed, one complete wave in each circuit will produce one revolution of the motor. In Fig. 19 the same result will be effected by one wave in each circuit; in Fig. 20 by two, and in Fig. 21 by four waves.

By such means any desired speed may be attained; that is at least, within the limits of practical demands. This systen possesses this advantage besides others, resulting from simplicity At full loads the motors show an efficiency fully equal to that of the continuous current motors. The transformers present an additional advantage in their capability of operating motors They are capable of similar modifications in construction, and will facilitate the introduction of motors and their adaptation to practical demands. Their efficiency should be higher than that of the present transformers, and I base my assertion on the following:—

In a transformer as constructed at present, we produce the currents in the secondary circuit by varying the strength of the primary or exciting currents. If we admit proportionality with respect to the iron core, the inductive effect exerted upon the secondary coil will be proportional to the numerical sum of the variations in the strength of the exciting current per unit of time; whence it follows that for a given variation any prolongation of the primary current will result in a proportional loss. In order to obtain rapid variations in the strength of the current, essential to efficient induction, a great number of undulations are required and employed. From this various disadvantages result. These are increased cost and diminished efficiency of the generator, more waste of energy in heating the cores and also diminished output of the transformer, since the core is not properly utilised, the reversals being too rapid. The inductive effect is also very small in certain phases, as will be apparent from a graphic representation, and there may be periods of inaction, if there are intervals between the succeeding current impulses or waves. In producing a shifting of the poles in the transformer, and thereby inducing currents, the induction is of the ideal character, being always maintained at its maximum action. It is also reasonable to assume that by a shifting of the poles less energy will be wasted than by reversals.

Notes.

CHEAP MATCHES.

"Indian Engineering" states that Japan is making rapid progress in the adoption of foreign machinery for cheaply manufacturing matches, as over 1,200,000 parcels of matches, valued at 300,000 dollars, were exported during the last year. It is believed that there is room for a similar industry in India.

PROPOSED FUEL TESTING STATION FOR LONDON.

In another part of the present issue will be found an important letter from Mr. Bryan Donkin, jun., on the above subject, in which he calls the attention of the coal producing and coal consuming public to the advantages which would follow the establishment of a systematically organised fuel testing station. Considering the vast quantity of coal yearly produced and consumed in England, it is surprising that this subject has never been brought before the public, especially as such stations have been in existence on the Continent for some time, and we hope that the scheme which our correspondent advocates will meet with the support of all those interested in the matter.

RECLAMATION OF LAND.

Our contemporary, *Indian Engineering*, states that an interesting work is about to be commenced in Northern Egypt. It is proposed to reclaim from the sea an area of land extending over 31,000 acres, and for this purpose works and steam pumps have already been erected at Abou-Kir.

BOILER EXPLOSIONS.

The Marine Department of the Board of Trade have issued their report on the working of the Boiler Explosions Act of 1882, for the year ended 30th June, 1887. During that period there were thirty-seven boiler explosions, causing twenty-four deaths, both figures being a little under the average of the years during which the Act has been in operation. In addition to the twenty-four persons killed by boiler explosions in 1886-87, forty-four were injured.

AGRICULTURAL MACHINERY IN ITALY.

The British Consul-General at Florence states that the small farmers of this district are opposed to innovations, and that improved ploughs, sowing and reaping machines, are but little known in the province. The nature of the ground also makes the use of machines difficult. Chaff cutters, however, have been generally adopted, owing to the increase in the number of stall fed animals. Thrashing machines, which are usually purchased by the landowners, are largely in use, and in the mountains which are difficult of access for steam engines, hand thrashing machines are used. All portable engines and thrashing machines supplied to the district should be fitted with efficient brakes.

BRITISH TEXTILES IN MEXICO.

In reporting on the trade of Vera Cruz, Consul Baker states that England has 63 per cent. of the trade in cotton goods, which form over 45 per cent. of her total imports at that port. France supplies 15 per cent., Germany 10 per cent., and the United States 10 per cent. The duties on cheap calicoes and prints were reduced last year, and an increase in the imports has consequently taken place. The Consul thinks that our proportion of the trade could be increased, as the French and Germans find a market for their goods not on account of greater cheapness, but because they consult the tastes of the consumers. Of the linen goods imported over 70 per cent. are British, but the trade is not very important. Of the imports of woollens, 50 per cent. are from France, and 26 per cent. from England, although British woollens are on the average cheaper. The reason given for this is that our rivals push their goods by means of clever salesmen in Mexico.

MANUFACTURE OF ALPHA-NAPHTHYLAMINE.

Dr. Otto N. Witt has recently described the methods used for successfully manufacturing this important base. It is essential that pure naphthalene be used, and a convenient charge consists of 250 kilo. mixed with 200 kilo. of nitric acid of 40° Bé., 200 kilo. of sulphuric acid, and 600 kilo. of the acid used in a former nitration. The operation is performed in cast iron cylinders, fitted with a cooling jacket to prevent the temperature from rising above 50°C. After twelve hours, the contents are transferred to leaden vats to cool, the waste acid run off, and the product washed with water until it is no longer acid. The reduction is effected in plant similar to that used for preparing aniline from nitrobenzene, iron borings and hydrochloric acid being the reducing agent employed. The temperature in this operation should not exceed 50°C. After about seven hours the reduction is complete, and milk of lime is added to the mixture. It is next distilled in a current of superheated steam, and the black oil is subsequently rectified in wrought iron stills. Naphthylamine prepared in this way is a colourless oil, solidifying to nearly white crystalline cakes, containing no β-naphthylamine, but small quantities of another base which is probably paranaphthylene-diamine. α-naphthylamine has been used for some time in the manufacture of "martius" or Manchester yellow, which is a salt of dinitro-(α)-naphthol, and is obtained from α-naphthylamine by the action of nitric acid. The sulphonate of this salt is obtained by the Schöllkopf Aniline and Chemical Company from α-naphthol-disulphonic acid by the action of nitric acid, and is known under the name of brilliant yellow. α-naphthol sulphonates are also used for the preparation of Tropœolin 0000 and scarlet G, which are azo colours obtained from them by means of the diazo compounds of aniline. When toluidine is substituted for the aniline, cochineal scarlet 2R is produced, and with xylidine the dyes formed are called azococcin 2R and cochineal scarlet 4R. Naphthylamine is also used for other dyes which are not at present the subject of any patent, and the demand for it is gradually increasing. It forms with sulphanilic acid and nitrous acid a red colouration which affords a very delicate test for minute quantities of nitrites.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

25th May, 1888.

7654. Bohler, F. ..... Rail raiser.
7659. Ellis & Wilkinson ... Ejector mechanism of small arms.
7663. Smith, F. ..... Wire drawing.
7667. Finch, B. ..... Liquid fuel furnace.
7670. Harrison, J. ..... Sawing stone.
7672. Ormerod & Galloway Shedding motion of looms.
7686. Lake, H. H. ..... Manufacture of nails (*Cavalli*).
7692. Falkenstine & Varley Manufacture of screws, screw rivets, bolts, terminals, and other fittings used in connection with electrical appliances.
7698. Janiot, Madame ..... Gas engines.

26th May, 1888.

7704. Fawcett, F. B. ..... Manufacture of carpets.
7709. Thompson, W. P. ..... Ribbed tubes for boilers (*Serve*).
7710. Shackleton, R. ..... Additionally heating steam generators and feed water heaters by the application of hot air.
7711. Stott, A. H. ..... Mechanical stokers for marine boilers.
7716. Thompson, T. ..... Feed mechanism for cutting out and piercing tools.
7718. Watson, T. ..... Machinery for moulding dough.
7719. Mosley, T. ..... Apparatus for raking and loading hay.
7721. Brook, T. ..... Self lubricating revolving shafts.
7724. Chapman, G. ..... Propelling vessels.
7725. Igel, H. ..... Hosiery machines.
7729. Thomas, P. ..... Raising the temperature of the feed water supplied to the steam generator.
7733. Watson, R. F. ..... Yarn stretching and dyeing machine.
7734. Pass, E. de ..... Combing machines (*Imbs*).
7742. Brooke, R. G. ..... Injectors.
7752. Davis, S. ..... Car trucks.
7755. Kinipple, R. W. ..... Caissons and bridges to bridge across dock entrances.
7758. Baihe, C. R. ..... Waggon weighing apparatus.
7759. Barnaby, Sir N. ..... Battle ships.

28th May, 1888.

7764. Robinson, H. ..... Quick speed expansive fluid engines.
7766. Jackson, A. ..... Flue tubes of high pressure boilers.
7767. Fielding, J. ..... Pumping engines.
7769. Needham, W., & others. Manufacture of hollow fire bars.
7770. Bean, E. J. ..... Ships' steering gear.
7773. Gubbins, R. R. ..... Manufacturing wrought iron.
7785. Lock, C. ..... Couplings for railway vehicles.
7786. Werner, R. ..... Propulsion of boats.
7787. Boult, A. J. ..... Grain sorting machines (*Reitter*).
7790. Tate, G. ..... Propulsion of ships.
7791. Nordenfelt, T. ..... Automatic guns.
7794. Braun, J. ..... Lawn mowers.
7799. White, R. A. ..... Appliances for effecting the change of gauge of railway vehicles.

29th May, 1888.

7804. Gedge, W. E. ..... Propelling cars by compressed air (*The Auto-pneumatic Car Motor Co.*).
7808. Cocker, B. F. ..... Bearings for axles.
7813. Bullock & Bullock ... Extractor mechanism for drop-down small arms.
7822. Wilke & Schott ..... Manufacture of cut pile fabrics.
7823. Bonehill, C. G. ..... Breech-loading small arms.
7835. Rongier, H. ..... Weldless chains.
7836. Schuckert, S. ..... Machine for producing spherical, para boloidal, hyperboloidal, and ellipsoidal surfaces.
7837. Rae, R. J. ..... Ships' windlasses.
7845. Boult, A. J. ..... Saw mills (*Gowen*).
7859. Brook, E. ..... Arrangement of card cylinders in looms.
7861. Baker & Huyck ..... Concentric piston steam engines.
7868. Newton, H. E. ..... Delivery mechanism for web printing machines (*R. Hoe and Co.*).
7869. Lake, H. H. ..... Web printing machines (*Fowler and Henkle*).
7873. Lake, H. H. ..... Apparatus for drilling pipes containing fluids under pressure (*Roelants*).
7875. Joy, D. ..... Ordnance.
7877. Yarrow & Hilditch ... Fire engines.
7879. Whitehead, R. ..... Launching torpedoes.

30th May, 1888.

7886. Burke, J. M. ..... Securing railway rails to sleepers.
7893. Schnell, J. F. ..... Gas engines.
7895. Whitwam & Taylor ... Self acting mules.
7896. Michaelis, E., & others Gig mills.
7903. Sturgess & Towlson... Rotary engines and pumps.
7906. Pitt, H. H. ..... Pressed glass machine.
7908. Needham, N., & others.. Locking miners' safety lamps.
7912. Wentscher, E. ..... Type setting machine.
7918. Cary, F. ..... Pocket type writer.
7919. Quick, G. ..... Breech-loading ordnance.
7927. Stubbs, W. T. ..... Gas engines.
7928. Wootton & Clifton ... Manufacture of lace.
7934. Southall, J. ..... Gas engines.
7935. Tyler, E. H. ..... Submarine vessels.

31st May, 1888.

7941. Shalders & Thorman. Electromotive fountains and engines.
7945. Fairclough, G. ..... Lubricator.
7949. Higginson, A. ..... Pulleys and blocks.
7952. Rogers, J. E. ..... Frames for working pumps.
7953. White & Hardy ..... Condensing "exhaust steam" and supplying water to steam boilers.
7964. Thomson, W. ..... Axles of tram cars.
7965. Barnes, T. ..... Looms.
7967. Drage, J., & others..... Railway switches.
7969. Johnson, F. ..... Rotary knitting machines.
7970. Halot, E., & others ... Kneading or mixing machines.
7973. Bentall, F. W. ..... Lawn mowers.
7978. Bowen, T. ..... Engine pistons.
7982. Armstrong, J. W. ..... Fish joints for railways.
7983. Kortenbach & Rauh ... Machinery employed in the manufacture of umbrella ribs.
7991. Endicott & Abbey..... Starting gear for vehicles.
7995. Lake, H. H. ..... Converting iron into steel (*Hardmeyer, Hatch, & Jackson*).

ELECTRICITY.

25th May, 1888.

7655. Crompton, R. E. B..... Underground conductors of electricity.
7679. Sowerby & Chubb ..... Electric lamps.
7696. Coad, T. ..... Incandescent electric safety lamps.

26th May, 1888.

7720. Boardman, H. ..... Electric tell tales for checking watchmen.
7748. Hoppe & Hoppe ..... Electric motor for clocks, watches, and other apparatus.
7750. Dulait, J. ..... Electric arc lamps.

28th May, 1888.

7761. Burdon, C. B. ..... Applying electricity to a general system of traction.

29th May, 1888.

7805. Allison, H. J. ..... Distribution of electric currents (*Fritts*).
7826. Cox, H. B. ..... Galvanic generators.
7848. Thompson, W. P. ..... Indicators for alternating electric currents (*Westinghouse*).
7849. Thompson, W. P. ..... Detecting and locating faults in alternate electric circuits (*Westinghouse*).
7850. Thompson, W. P. ..... Alternate current electric distribution (*Westinghouse*).
7851. Thompson, W. P. ..... Switches for electric circuits (*Westinghouse*).
7852. Thompson, W. P. ..... Central station apparatus for system of electric distribution by alternate currents (*Westinghouse*).
7853. Thompson, W. P. ..... Storage batteries (*Gibson*).
7876. Willcox, B. ..... Electric batteries (*Abakanowicz and d'Arsonval*).

30th May, 1888.

7910. Schmidt, F. T. ..... Holders for incandescent lamps.
7916. O'Brien, T. ..... Transmitting written characters, and indicating and recording the indications of registering instruments by electricity.
7924. Boult, A. J. ..... Electric apparatus for firing mines (*Manet & Manet*).

31st May, 1888.

7977. Morris & Salom..... Filling secondary battery plates.

CHEMISTRY.

25th May, 1888.

7685. Forster, W. G. ..... Aluminium.
7687. Pitt, S. ..... Paint colours from nitrosophenols and their sulphonic acids (*Cassella & Co.*).

26th May, 1888.

7708. Goggs & Irvine ..... Metallic paints.
7746. Hardingham, G. G. M.. Manufacture of soap (*Magrini*).
7754. Tricket & Noad ..... Soda crystals and chlorides and oxides of various metals.

28th May, 1888.

7768. Spencer & Lord..... Apparatus for forcing and drawing chemical liquids.

29th May, 1888.

7830. Taylor, J. ..... Manufacture of soaps.
7867. Crookes, W. ..... Treatment of auriferous ores.

30th May, 1888.

7900. Bennett, J. E. ..... Treatment of metallic chlorides for extraction of metals therefrom.

31st May, 1888.

7997. Lake, H. H. ..... Colouring matters (*Oehler*).

MISCELLANEOUS.

25th May, 1888.

7656. Tattersall, A. A. ..... Increasing the draught in fire places.
7658. Birch & Baker ..... Door fastenings.
7661. Lee, C. ..... Gas burners.
7662. Lee, C. ..... Barometers.
7664. Fearon, H. S. ..... Fire proof flooring.
7671. Ormerod, B., and others Shuttle guards for looms.
7674. Lane, H. ..... Appliances for measuring air, gas, and other fluids.
7675. Gomm, F. R. ..... Ammunition.
7676. Moore, W. ..... Oil lamp.
7677. Wacks, W. ..... Utilisation of small coal or pit slack.
7682. Ashworth, J. A. ..... Chairs.
7683. Clarke & Williams... Systems of banding for spinning or twisting frames.
7684. Edwards, E. ..... Apparatus for damping and affixing postage stamps to letters (*Schneider & Schopf*).
7688. Nordenfelt, T. ..... Time fuses.
7689. Greatbach & Crake ... Igniting the fuses of blasting charges.
7690. Pitt, W. ..... Grab buckets.
7691. Chandler, S., & others. Washing and scrubbing gas.
7693. Kinslow, C. J. E. ..... Drain trap.
7695. Coad, T. ..... Lens for intensifying light.

26th May, 1888.

7703. Warrington, H. J..... Igniting fuses for blasting purposes.
7705. Bruce, A. ..... Three-way cocks.
7707. Thompson, W. P. ..... Aerating or storing natural mineral waters and other liquids (*Bravais*).
7713. Baker, F. R. ..... Oil lamps.
7715. Baker, F. R. ..... Extension lamps.
7723. Thurman, W. ..... Threading screws.
7726. Stead & Lancaster ... Purifying and softening water.
7727. Hawks, N. S. ..... Metallic packing for piston rods and valve spindles.
7728. Harrison, A. W. ..... Fire bars for circular grates.
7731. Forster, J. R. ..... Extracting corks from bottles.
7735. Moore, F. ..... Mordanting, dyeing, and washing wool and other materials.
7739. Jennings & Badère ... Stoppering bottles.
7740. Spong, C. W. ..... Supplementary door fastener for railway carriages.
7741. Tabrar & Dingwall ... Hermetically sealing bottles.
7744. Foster, C. F. ..... Stoppers for bottles.
7747. Snelus, G. J., & others... Cement.
7753. Adamson, T. A. ..... Cooling the bearings of machinery.
7756. Heartfield, H. ..... Stoppering bottles.
7757. Bell, F. ..... Bicycles.

28th May, 1888.

7763. Innes, T. ..... Printing blocks and type.
7765. Lehmann, A. J. ..... Drawing corks.
7776. Lotz, W. F. ..... Combined presser foot and tension regulator for sewing and embroidering machines (*von Pittler*).
7777. Scott, G. L. ..... Oil lamps.
7781. Smith, J. C. F. ..... Manufacture of cement.
7792. Ford, A. H. ..... Sliding doors.
7796. Bohringer, C. ..... Dyeing, washing, and drying fibrous or textile materials.
7798. Belmor, G. E. ..... Treatment of bituminous rock to adapt the same for paving.

29th May, 1888.

7800. Stuart, C. ..... Spanners and pipe wrenches.
7802. Smith, C. H. ..... Subjecting printed fabrics to the action of steam.
7806. Rae, J. ..... Forcing beer or other liquids.
7807. Gregory, G. F. ..... Oil tank (*Hutchins*).
7810. Miller, S. ..... Fire grates.
7811. Orr & Brown ..... Glazing.
7812. Cary, R. E. ..... Cycles.
7814. Turner, W. H. ..... Placing ware in enamelling kilns.
7815. Champion, J. K. ..... Lock bricks.
7819. Woodville, G. ..... Knives for cutting hay.
7820. Shelley, T. R. ..... Glazing.
7821. Rose & Daltry ..... Fire hose couplings.
7824. Yeadon & Sutcliffe... Healds employed in looms.
7846. Alexander, C. J. ..... Dyeing wool tops (*Alexander*).
7857. Day, C. A. ..... Jacks (*Warren*).
7858. Bommer, L. ..... Spring hinges.
7862. Parcelle, A. L. ..... Clocks.
7864. Day, S. P. ..... Self closing valve boss.
7865. Sutcliffe, M. ..... Stoppering bottles.
7866. Savage, F. ..... Extinguishing lamps.
7870. Klein, N. ..... Registering apparatus.
7872. Chapman, F. M. ..... Taps.
7878. Hobson, G. A. ..... Metal floorings or roofings.

30th May, 1888.

7883. Barry, J. H. ..... Purification of sewage.
7884. Trotter, A. P. ..... Transmitting the indications of thermometers.
7887. Grisenthwaite, J. ..... Combined swivel rowlock and fixed pin for feather oars and pin oars.
7889. Waterhouse, J. ..... Drain traps.
7890. Scotson & Willis ..... Anti-corrosive enamel for propeller blades.
7897. Homan, E. J. ..... Stencilling apparatus.
7899. Day, St. J. V. ..... Drying yarns and cloth (*Swan*).
7905. Dougall & Harries ... Artificial stone.
7909. Parkinson, J. ..... Parallel vice.
7913. Henderson & Wood ... Fastener for beltings.
7914. Löffler, H. L. ..... Locks.
7915. Fleiner, A., & others... Portland cement.
7917. Gritton & Whitherington ..... Removal of dust and sludge.
7920. Price, W. H. ..... Revolving lamps.
7925. Holloway & Holloway Block floors.

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7929. Garton & Barkley ... Black varnish or enamel.
7936. Christophe, L. ..... Making roads.

31st May, 1888.

7943. Miller, A. T. ..... Arrangement of ships' yards, masts, rigging, and sails.
7946. Rowley, J. W..... Withdrawing corks from bottles.
7947. Jagger, B. ..... Purification of sewage.
7948. Greenwood, H. ..... Shuttle guards of looms.
7950. Vaughan & St. Aubin. Locks.
7955. McGlashan, A. ..... Valve for engines used for raising and forcing fluids.
7956. Griffin, J. ..... Springs for vehicles.
7957. Tonge, J. B. ..... Preventing down draught in chimneys.
7959. Ballardie, D. ..... Lamps.
7971. Fletcher, W. ..... Cleaning tramway lines.
7976. Margetts, W. G..... Portland cement.
7979. Staeber, G. ..... Pedomotive carriage for common roads.
7980. Undén, G..... Canoes.
7981. Abel, C. D..... Sieving apparatus (*Stringer*).
7992. Sault, L. A. ..... Transport and preservation of ice.
7993. Faller, F..... Clocks.
7996. Schladetz, H. W..... Velocipedes.
7998. Holman, F..... Shades and reflectors for incandescent electric lamps.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

2nd June, 1888.

5989. Pohl, O. E. ..... Steam engines.
6643. Brierley, J. H. ..... Looms.
7726. Deacon, R. W..... Centrifugal drying machines (*Maxwell*).
8164. Hickling, W. E. ..... Sewing machines.
8449. Wehrstedt, A. R. J.von Magazine fire arms.
8497. Hax, C. F..... Automatic sharpening of saws.
8629. Robertson, J. ..... Shaping metal rings.
9284. James, J. W. H. ..... Transverse sleepers.
9568. Jochumsen, N. C. F. ... Furnaces for melting iron (*Hansen*).
9780. Whiteman, W. T. ..... Weighing and weight printing machinery (*United States Machine and Inventions Co.*).
9819. Hornsby, J., & others.. Sheaf binding harvesting machines.
10072. Mason, S. ..... Stone breaking machines.
10176A. Hahn, E. J. ..... Carburetters for gas motors. (This Application having been originally included in No. 10176, dated 20th July, 1887, takes, under Patents Rule 23, that date.)
10285. Adams, J. ..... Anti-friction apparatus for land and road rollers.
10325. Anderson, W. ..... Loading apparatus for breech-loading guns.
10327. Platt, J. ..... Machines for printing designs in correct register on both sides of a fabric at one operation.
10387. Wailes, J. W. ..... Open hearth steel melting furnaces.
10431. Farmer, Sir J..... Machinery for printing textile fabrics.
10434. Heys, W. E. ..... Lubricators (*Verny*).
10450. Godsal, P. T. ..... Breech-loading fire arms.
10459. Donovan & Wigham ... Combined disc stop and reversing valve applicable to steam winches and similar structures.
10460. Griffin, S. ..... Double cylinder gas motor engines.
10476. Holdsworth, G..... Machine for moulding cylinders and pipes.
10482. Reynolds, O. ..... Hydraulic brakes for causing and measuring resistance on rotating shafts.
10501. Long, J..... Metal ships.
10503. Guhl, H. A. H..... Type writers.
10579. Trueman & New..... Platen printing machines.
10590. Murgatroyd, E..... Securing the bosses of split pulleys upon shafts.
10596. Petrie & Dowell ..... Valves of steam engines.
10691. Savill, A. S..... Feeding steam generators.
10871. Galloway, C. J. ..... Steam boilers.
11214. Jackson & Martin..... Lock stitch sewing machines.
12696. List, G. A., & others ... Petroleum engines.
12863. Körting, E..... Gas engines.
13954. Irish, W. E..... Electrical railways.
15880. Vogt, H. C. ..... Propelling ships by means of air propellers.
16044. Hopton, A..... Platform for cooling wheel tyres.
18018. Burckhardt & Weiss... Surface condensers for steam engines.
18031. Hignette, J. J. ..... Centrifugal grinding mill. (Received 8th March, 1888. Ante-dated 18th October, 1887, under International Convention.)
248. O'Brien, J. O. ..... Rock boring machines. (*Bornet*).
1208. Martins & Rocha. ..... Operating railway switches and signals.
4038. Alexander, A. E..... Polished sheet iron. (*Craig*).
4273. Boult, A. J. ..... Increasing the frictional contact between the wheels and rails in railways. (*Ries*).
5293. Martin, B. D. ..... Manufacture of chill rolls.
5310. Thompson, W. P..... Fluid pressure motors and speed regulating devices therefor (*Benham*).
5709. Mauser, P. ..... Cartridge expellers for breech-loading fire arms.
5720. Cowburn, T., & others.. Continuous brake apparatus.
5914. Lake, H. H. ..... Hydrocarbon engines (*Spiel*).
6058. Robinson, C. H. ..... Tube expanders.
6163-4. Daniels, F. H..... Reeling apparatus for rod rolling mills.
6181. Hollingworth, E..... Shedding and taking-up motions of looms (*Hutchins*).
6211. Witthöfftt, L. ..... Circular saws.
6249. Okes, J. C. R. ..... Pumps.
6286. Anderson, A. ..... Sewing machines (*Singer Manufacturing Co.*)
6306. South & Bursch ..... Couplings for railway cars.
6352. Yaryan, H. T..... Purification of water in steam boilers.
6443. Sutro, L. ..... Knitting machines.
6445. Granville, B. ..... Type writing machines.
6473. Thompson, W. P..... Screw vessels (*Sylven*).
6886. Bookwalter, J. W..... Malleable iron or steel (*Robert*).
7050. Lake, H. H. ..... Universal shaft couplings (*Robes and Haskell*). (This Application was originally numbered in error 18037, 1887.)

ELECTRICITY.

2nd June, 1888.

7865. George, F..... Dynamos.
9191. Scott, G. A..... Type printing telegraphs.
9843. Goolden & Evershed.. Compensating electric measuring instruments for temperature.
10606. Gerard, L. ..... Distribution, storage, and regulation of electric currents.
10748. Schanschieff, A..... Portable batteries for electric light.
12645. Sandwell, W. D..... Electrical batteries for driving tramway vehicles.
1406. Turton & Turton ..... Combined electric and mechanical clock alarum.
4524. Barber-Starkey, W. J. S. ..... Portable galvanic batteries.
6237. Millar, A..... Cells for electric batteries.
6416. Hoppe & Hoppe ..... Galvanic elements.
6481. Lake, H. H. ..... Electrical transmission of power (*Tesla*).
6502. Lake, H. H. ..... Generation and distribution of electric currents (*Tesla*).

CHEMISTRY.

2nd June, 1888.

9690. Leuchtenberger and Moiske..... Purification of saccharine solutions.
10260. Kolbe, C. ..... Salols.
3793. Johnson, J. Y..... Metallic alloys (*La Société Anonyme Le Ferro-Nickel*).
6460. Lake, H. H. ..... Aluminium (*Seymour*).
6428. Thompson, W. P..... Preventing the decomposition of organic substances (*Moro*).

MISCELLANEOUS.

2nd June, 1888.

8056. Fiechter, L. B. ..... Separating dust from air (*Hardenbergh*).
8148. Breden, A. ..... Automatically extinguishing lamps.
8761. Munro, S. C. ..... Locks.
9109. Ewart, W. D. ..... Driving chains.
9285. James, J. W. H. ..... Lock nuts for screw bolts.
9367. Gibault, A. C..... Stop cocks.
10305. Hutchinson, E. H..... Compressing sea salt.
10383. Ashberry, P. ..... Sheep shears.
10395. Macdonald, J. K. ..... Shuttles and shuttle carriers for sewing machines (*Singer Manufacturing Co.*).
10410. Gillman & Spencer ... Bottling liquids.
10468. Burt & Edmonds ..... Lamps.
10477. Bosshardt, F. ..... Grinding grain (*Ricci*).
10490. Marston, R..... Lamps.
10512. Stewart & Charlton.. Storing volatile liquids.
10513. Stewart & Charlton.. Storing and transporting volatile liquids.
10591. Robertshaw, J. ..... Dyeing, sizing, washing, and wringing hanks.
10628. Mackenzie & Moncur.. Radiators for heating purposes.
10684. Grahn, E..... Treating gas liquor.
10893. Smith, M. H..... Separating iron from other substances.
10939. Tullis & Malcolm..... Joints of leather belting.
11096. Laurent, P. A..... Driving gear for velocipedes.
11438. Cantle, J. A. ..... Fire proof holders for joists.
12959. Goyder & Murray..... Nozzles for producing spray.
15035. Smith & Smith..... Screws for operating fallers.
16310. Graetz, M. ..... Lamp burners.
18038. Uhlenhuth, H. ..... Joining bands. (Received 11th April, 1888. Ante-dated 26th October, 1887, under International Convention.)
18034. Thomson, J. ..... Dwell cams. (Received 5th May, 1888. Ante-dated 12th October, 1887, under International Convention.)
926. Tomson, W. H..... Freezing machines.
1851A. Johnson, J. Y..... Sound conveying tube for telephones and graphophones (*The Volta Graphophone Company*). (This Application having been originally included in No. 1851, dated 7th February, 1888, takes under Patents Rule 23, that date.)
2093. Lee, F., & others..... Dyeing wool, cotton, and other fibrous substances.
2218. Stevens, J..... Compasses.
2575. Thompson, W. P..... Heat regulating apparatus (*Johnson*).
3336. Morrall, A. E..... Hand sewing needle.
3438. Thompson, W. P..... Supplying heat to buildings (*Johnson*).
4052. Shedden, L. W. ..... Wiring corks in bottles.
4137. Tucker, H. C. ..... Unicycles.
4602. Tilden, H..... Hot air tubes.
4808. Bulpitt, W. H..... Lamps.
4943. Deevy, P. ..... Wheeled scrapers.
5102. Williams & Thomas..... Gas burners.
5620. Willis & Willis..... Enamelled earthenware articles.
6212. Tellier, C..... Producing cold.
6225. Pullin, A. R. ..... Signs and signals.
6324. Newton, E. ..... Roofs of greenhouses.
6337. Perret, R. A. ..... Velocipedes.
6354. Knoop, A..... Manufacture of aerated liquids.
6386. Lee, J. ..... Spades.
6444. Sutro, L. ..... Knitted fabrics.
6483. Miles, P..... Pickets and fences.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 26th February, 1888, inclusive.)

Year 1884.

3612, 3613, 3615, 3617, 3620, 3621, 3622, 3624, 3628, 3629, 3630, 3637, 3643, 3644, 3645, 3652, 3655, 3657, 3658, 3659, 3660, 3661, 3663, 3664, 3665, 3668, 3669, 3670, 3671, 3674, 3678, 3681, 3682, 3685, 3688, 3690, 3691, 3692, 3693, 3694, 3696, 3698, 3699, 3700, 3705, 3706, 3709, 3712, 3716, 3717, 3718, 3719, 3721, 3724, 3725, 3726, 3728, 3730, 3731, 3732, 3734, 3736, 3738, 3739, 3741, 3742, 3744, 3745, 3747, 3750, 3751, 3754, 3759, 3760, 3762, 3763, 3765, 3766, 3767, 3768, 3770, 3771, 3772, 3773, 3774, 3777, 3779, 3780, 3784, 3785, 3786, 3787, 3788, 3789, 3790, 3792, 3794, 3797, 3798, 3799, 3803, 3806, 3812, 3815, 3817, 3818, 3822, 3823, 3825, 3826, 3828, 3829, 3832, 3835, 3837, 3838, 3840, 3845, 3846, 3849, 3850, 3853, 3863, 3864, 3865, 3866, 3870, 3878, 3880, 3881, 3885, 3886, 3894, 3896, 3898, 3903, 3905, 3907, 3912, 3914, 3917, 3919, 3920, 3924, 3927, 3929, 3930, 3936, 3937, 3939, 3943, 3944, 3945, 3946, 3948, 3956, 3958, 3960, 3964, 3970, 3971, 3972, 3977, 3978, 3980, 3981, 3982, 3983, 3985, 5249.

Year 1883.

916, 952, 959, 963, 983, 1006, 1021, 1028.

Year 1882.

811, 853, 854, 905.

Year 1881.

744, 756.

Year 1880.

823, 835.

Year 1879.

791.

Year 1878.

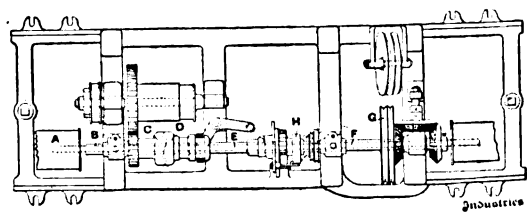
747, 756.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Mules.—*E. Edwards, London.* (*R. Schneider, Biala, Austria.*)—In order to alter the direction of rotation of the spindles on an ordinary mule, the driving belts have to be altered or crossed. This invention is intended to obviate this disadvantage, and to effect the alteration by a special mechanism. The accompanying figure is a plan of the middle part of the spindle carriage and of the driving gear. The driving pulley G is mounted upon the hollow shaft F, which fits freely upon the solid shaft E. Motion is transmitted to the inner shaft by means of two bevelled toothed wheels, one being fixed upon the hollow shaft, and the other upon the solid shaft near one end; a third bevelled

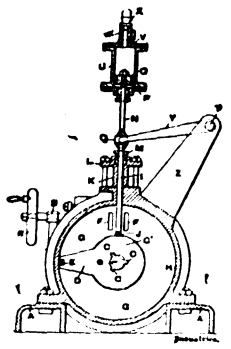


wheel is arranged between them upon a separate shaft at right angles to the main shaft. By means of the movable couplings at the two ends of the hollow shaft, the two shafts may be connected and disconnected at will. If the two shafts are coupled, and the intermediate wheel thrown out of gear, the driving cord pulley will drive the spindle drums upon the ends of the inner shaft in the same direction. If the couplings are disconnected, and the three bevelled wheels thrown into gear, the driving pulley will continue to turn the outer shaft in the same direction, but that of the inner shaft and spindle drums will be reversed. The uncoupling and coupling is effected by means of sliding clutches. One claim is made.—No. 5837. April 21st, 1887. 8*d*.

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Refining Iron.—*G. Lindenthal, Pittsburgh, Pennsylvania.*—In the ordinary Bessemer process the silicon and carbon are burned out first, and the sulphur and phosphorus leave the iron afterwards in the presence of basic material. According to this invention, after the desiliconisation and decarbonisation has been effected, a certain quantity of aluminium is added to the molten iron in order to increase the fluidity of the metal. The metal is then transferred to a rotary furnace, having an iron ore or basic lining. As the aluminium has reduced the melting point of the metal, the action of hardening takes a longer time, and thus a greater opportunity is allowed for dephosphorisation. The best proportion of aluminium for effecting this object, without at the same time introducing any other disadvantageous property, is about one-tenth per cent. The inventor makes three claims for the addition of aluminium for the purpose of delaying the hardening of the molten iron, in order to allow a longer time for dephosphorisation.—No. 4951. April 3rd, 1888. 6*d.*

Rotary Engine.—*T. T. Kemp, Bristol.*—The special features of this invention consist of a sliding abutment in the piston chamber, whose movements are effected by steam, and of a check valve for preventing the waste of steam during the withdrawal of the abutment. The arrangement of the rotating disc and other parts is shown in cross section in the figure. The disc C' and plate D are fixed to the shaft B by means of the keys C. The packing piece E insures a tight joint between the plate D, and the sides of the cylinder H. The steam ports are shown at F, and the sliding abutment at I. The piston rod N is connected to the piston O, which works in the cylinder U, and the lever Y works at one end in the box Q, and is fixed at the other to the shaft T, which works in bearings in the projection Z. In working the engine, steam is admitted through one of the ports F, and the piston is consequently driven round; when it reaches the sliding abutment I the steam is cut off, and a cam on a boss on the shaft outside the cylinder causes the lever Y to be raised by suitable



links and levers, and by the simultaneous admission of steam into the cylinder U. The abutment will thus be raised and the plate D will be allowed to continue its travel, the exhaust steam passing out at the other port. The steam enters the cylinder through a check valve, which is adapted to prevent a waste of steam during the time that the sliding abutment is temporarily raised to allow the piston to pass. This valve is operated by an eccentric on the main axis, so that the steam is cut off during the above mentioned part of the revolution of the disc. In the descent of the abutment, the steam under the piston in the cylinder U acts as an unbreakable spring; the check valve performs also another duty, viz., to make the engine act expansively. Six claims are made for this arrangement of disc, ports, and abutment, and for the combination of the parts for operating them; and for the use of the check valve for the purposes described.—No. 7654. May 26th, 1887. 1*s.* 1*d.*

Cap Spinning and Twisting Frames.—*L. Binns, Philadelphia.*—In order to prevent the driving bands of the whirl tubes prematurely losing their power and tightness, the inventor applies an automatic adjustment to them. An endless band connects and drives the whirl tubes or their whirls, and traverse bars on opposite sides of the frame are given a reverse alternate motion simultaneously with each other. The bobbins have a uniform motion up and down. The whirl tubes are accordingly constantly giving and receiving more length of band as is necessary, without stretching the band or straining the spindles. Two claims are made.—No. 3153. March 1st, 1888. 8*d.*

Valve Gear.—*J. M. MacCulloch, Garston, Lancashire.*—The link motion here described is operated by a single eccentric, and the slotting action of the block in the link is also much reduced. The curved slotted link is connected to the eccentric strap by means of two rods pivoted at each end; and another shorter rod connects the eccentric strap with a fixed point on the frame. The reversal of the engine can be effected by moving the link up or down, so as to make the block assume different positions in the slot. Two claims are made.—No. 8057. June 4th, 1887. 8*d.*

Stone Working Machines.—*F. Trier, London.*—The circular rotating cutters are placed on the slides of planing machines with tables which are driven by a crank action. When the length of stone to be dressed renders the direct action inconvenient, the table is driven by a crank in connection with a log and plank motion similar to that employed in printing machines. The tool holders can have the necessary skew imparted to them, and may be reversed as required by the alternating movement of the table. Another improvement relates to the method of cutting out internal angles; two cutters are mounted on separate converging slides, and their axes may be placed either in the same plane or in different planes. Seven claims are made.—No. 7036. May 13th, 1887. 8*d.*

Pneumatic Tram Locomotive.—*W. P. O'Neill, Longford, and F. O'Neill, Dalkey, near Dublin.*—The locomotive here described combines the characteristics of horse power tram engines, viz., that extra power shall be available for starting the engine and for ascending inclines. A petroleum motor actuates an air compressing pump, and the compressed air passes to a receiver and afterwards to a double acting motor cylinder. There is a vapour producer for moistening the air before entering the compresser, in order to reduce the loss of power owing to the rise of temperature of the compressed air. There is also a reducing valve between the compresser and the motor cylinders, by means of which the supply of air may be adjusted to requirements. Six claims are made for moistening the air and for the construction of the compresser and receiver.—No. 4813. March 29th, 1888. 11*d.*

Hydrocarbon Furnaces.—*C. R. Hoopes, Philadelphia.*—The oil supply pipe is led through a hot air chamber, which is provided with a blast nozzle close to the oil nozzle. A pressure blower forces air through a series of pipes in the furnace, in order to heat it before it issues through the blast nozzle. The highly heated air while in the hot air chamber surrounds the oil supply pipe, and thus imparts some of its heat to the oil. The vaporised oil, on mixing with the hot blast of air, burns completely, and no deposition is left in the tube, nor does any spray of oil fall unconsumed to the bottom of the furnace. Thirteen claims are made.—No. 3910. March 13th, 1888. 8*d.*

Slide Valves.—*A. Tolhurst & H. Skinner, Gravesend.*—The object of this invention is to provide improved means for relieving the back of the slide valves from the pressure of steam, and thus to reduce the wear of the bearing surfaces. Fig. 1 shows the application of this method to a single slide valve. The back of the slide valve A is faced as well as the front, and a plate C is held against the back, and is adjustably carried

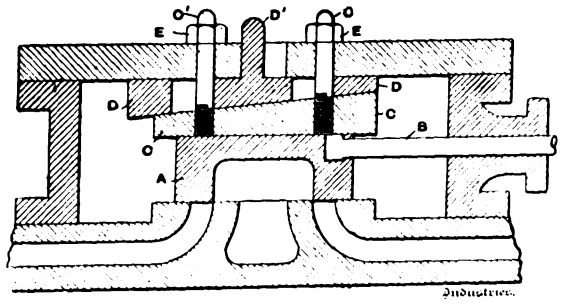


Fig. 1.

by the cover of the chest. The upper surface of C is somewhat inclined, and between it and the cover is interposed another wedge D, which can be moved endwise in order to shift the plate C towards or away from the valve. The plate has pins projecting from its upper side, and passing through slots in the wedge D, and through holes in the cover. A pin D' also projects

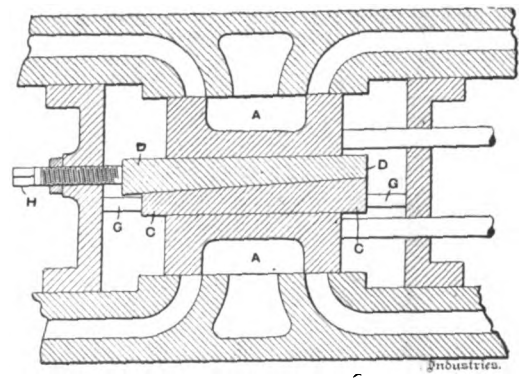


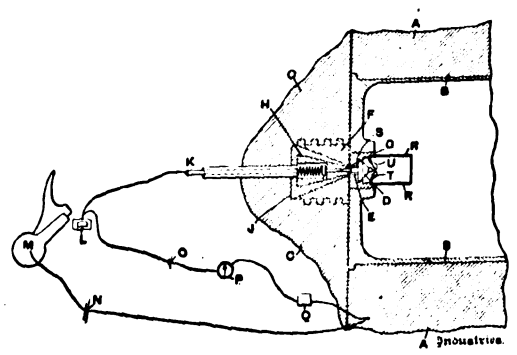
Fig. 2.

from the back of the wedge through a slot in the cover, and by means of this pin the wedge can be moved longitudinally. Fig. 2 illustrates the application of the same principle to a valve chest containing a pair of slide valves working back to back. Two wedge plates C and D are interposed between the two valves A. The plate D can be moved longitudinally by means of the screw H, and the other plate is prevented from similar motion by the stops G; but it can, however, be moved towards or away from the valve on which it bears. Four claims are made for the ways of carrying out this invention, described in the specification, by preventing the steam exerting its pressure on the back of the slide valve.—No. 8097. June 4th, 1887. 8*d.*

Plate Bending Machines.—*J. Barrow, Johnstone, Renfrew.*—It is sometimes necessary to construct the vertical plate bending machine in such a way that after a plate is bent to a complete circle the third driving roll may be lifted clear of the work, to allow of the removal of the plate. The object of the present invention is to obviate some of the disadvantages incident on the ordinary method of lifting the third driving roll. The journals of the roll are carried in blocks, which act as nuts, and screws are fitted into these nuts, to regulate the distance apart of the bending rolls. A rack gearing with a pinion is attached to the bottom block, and the top framing is arranged so as to allow the top block a free exit and entrance. The foundation plate is extended at the place where the lower block is fitted. With this arrangement, the two adjusting screws can be screwed out of the nuts after the plate has been bent to a complete circle, and the motion of the third roll can be continued by means of the rack and pinion until it is clear of any obstruction; the roll can then be either lifted clear of the work, or the work itself can be removed. The inventor claims: In vertical plate bending machines, arranging one of the rolls in bearings fitted in horizontal slides in the upper and lower parts of the framing, so that the roll or the work may be removed sufficiently far outwards for being lifted vertically upwards.—No. 13945. October 14th, 1887. 11*d.*

ELECTRICITY.

Firing Ordnance by Electricity.—*T. Nordenfelt, London.*—The accompanying figure shows a longitudinal section of the fuse and part of the gun and breech block, and also the arrangement of circuits in diagram. The cartridge case B carries a tube R containing the priming. T is a plug of vulcanite, and U is a loop of platinum wire, whose ends are connected to the tube R. The metallic button D is carried by the rear of the plug T, and is in contact with the loop of the wire U; the shoulder of



the button rests against the disc S at the base of the priming tube, being separated from it by a minutely thin layer of vulcanite, mica, or other insulating material; and its stem passes partially out at the rear of the priming tube, and is surrounded by an insulating collar. The priming is forced into the tube R under great pressure in order to insure its mechanical contact with the platinum wire, and the end of the priming is then soaked in varnish to render it secure and water tight. The steel plug F is screwed into the breech block, and is made hollow to contain a spring pin G, which is surrounded by the metal box H and the insulating material J. The insulated wire K is in electrical connection with the spring pin G. The insulated contact L enables the trigger M to close the circuit from the low resistance firing cell N through the gun. O is the indicator cell, P is a galvanometer in the indicating circuit, and Q is a switch which may or may not be used. The inventor makes six claims for the combination of the disc S, button D, and thin layer of insulating material; for the combination of the tube R, plug T, and button D; for the hard plug F and spring pin G, and metal box H, as described.—No. 8710. June 16th, 1887. 8*d.*

Regulating Dynamos.—*F. George, Uley, Gloucestershire.*—For the purpose of regulating dynamos, a shunt coil is wound upon the electromagnets, whose magnetisation may thus be diminished or increased according to the direction of the current in the shunt. By means of this current a secondary battery is introduced into parallel arc with the dynamo, and the current from it, being sent through the shunt coil in either direction according to the requirements of the case, serves to regulate the e.m.f. of the dynamo. A similar arrangement is applicable for maintaining a uniform e.m.f. between two or more dynamos coupled in parallel. In this case the secondary battery is omitted, and the dynamos act as regulators for each other, by being connected at the brushes, and by the connections being carried as shunt coils round the field magnets of each in such a manner that, should the e.m.f. of any exceed that of the others, the direction of the current would cause the magnetisation of its field magnets to be diminished, and that of the others to be increased. If the e.m.f. of any fell below that of the rest, the reverse action would take place. Three claims are made: (1) For the use of a coil or coils on the field magnets carrying a reversible current, increasing or diminishing the magnetisation according to the direction of the current; (2) for the use of accumulators coupled in parallel with the dynamo by means of such a coil; and (3) for coupling two or more dynamos in parallel by means of such a coil or coils.—No. 7553. May 25th, 1887. 4*d.*

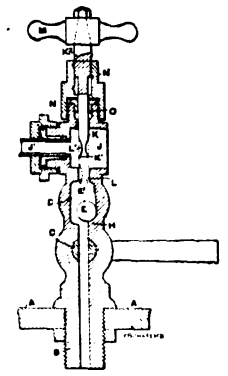
Voltmeters.—*J. A. Fleming & C. H. Gimingham, London.*—The instruments, constructed according to this invention, depend upon the principle that when a coil encircles an electromagnetic pole, there will be a force brought into play tending to displace the movable coil relatively to the fixed pole. The force required to bring back the coil to its original position is proportional to the product of the strengths of the current traversing the two windings. A bar carries a coil at each end, and is mounted at its centre on a needle point. Each of the coils encircles the poles of the two electromagnetic helices in line with each other; and all the helices are joined in series with each other, and with the encircling coils, the windings being such that the ends of the electromagnetic helices presented to each other where the encircling coils surround them are of like denomination. The bar, which carries the encircling coils, has a coiled steel spring fixed to one end, and the other end of the spring is secured to a bracket. The electric circuit through the instrument is so arranged that the movement of the encircling coils does not interrupt the circuit; the circuit is, therefore, made to pass through the bracket and the spring to one of the encircling coils, then round the other encircling coils to the seating which receives the pivot, and round the helices. A scale and pointer are fixed on the instrument; the pointer is fixed to a part of the apparatus, by the motion of which the spring can be displaced from its normal position. Attached to the coils is another pointer, which points to zero when the instrument is adjusted. When a current traverses the instrument, the encircling coils move on their supporting pivot and compress the spring. To take the measurement, the first pointer is moved round until the second points to the zero mark; the first pointer then indicates the e.m.f. When the instrument is required for use as a watt meter, the encircling coils are wound with a fine wire, ending in one pair of terminals for attachment on either side of the lamp or other device, so that the coils are in a shunt from the line. The helices are wound with coarse wire, and like poles are encircled by the coils as before; this coarse wire is carried to the terminals on the instrument to which, while

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testing, the line is attached; the windings of the helices are thus in series with the line. Five claims are made.—No. 10963. August 10th, 1887. 11*d*.

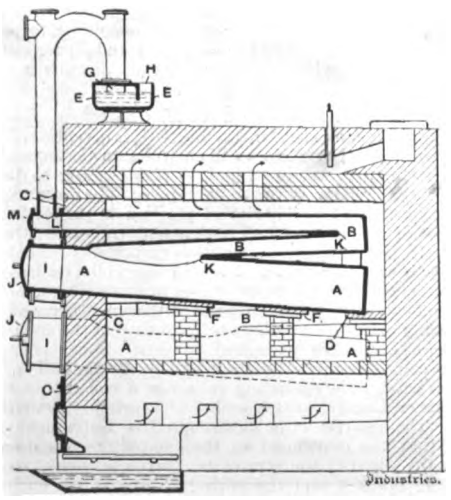
MISCELLANEOUS.

WATER GAUGES FOR STEAM BOILERS.—*S. Matthews, Sunderland.*—This invention relates to that class of water gauges in which a ball valve is used; the modifications here introduced will be understood by reference to the accompanying figure. A is the end plate of the boiler, and C is the ordinary gland cock for controlling the connection between the inside of the gauge with the boiler. The ball valve E works in the chamber D, to which access is gained from the outside by a screwed plug for the purposes of cleaning. The bottom of the chamber D is sloped towards the boiler, so that the normal position of E shall be at the lowest point at H. The gauge glass J¹ is fitted into the chamber J, and the area of the aperture L is governed by the position of the spindle K. The end K¹ is hollowed out to the radius of the ball valve, and its diameter for a short distance from that end is reduced and fluted. The outer end of the spindle is made of a somewhat larger diameter than the inner end, and the nut N, through which the spindle passes, is arranged



with a quick pitched thread, so that a half turn of the handle M gives a horizontal travel to the spindle accordingly. The nut N also screws the gland O upon its packing. This arrangement of the double nut, with threads of different pitch, allows the spindle to be removed without the nut and the glands being disturbed. Under ordinary conditions, the cock C is open, the valve E rests on its seat at the bottom of the chamber D, and the spindle is in the position shown in the figure. When it is necessary to blow through the apparatus for the purpose of cleaning the glass, the ball is forced into the position E¹, and the spindle is not only arranged with sufficient travel to hold the ball off its seat, but its fluted ends afford a passage for the steam and water past the spindle and through the port L. When a gauge glass bursts, the ball E is immediately forced by the steam into the position E, which effectually prevents the egress of steam and water from the boiler; the attendant having closed the cock C, the ball returns to its seat by gravitation, and a new glass can then be fitted. The inventor makes two claims for the combination of the inclined seating, the adjustable plug, the spindle K, and nut N, as described.—No. 3347. March 5th, 1888. 6*d*.

MANUFACTURE OF GAS.—*J. H. R. Dinsmore, Liverpool.*—The objects of this invention are to cause the heavier hydrocarbons to become more permanently suspended, and to arrest a great portion of the tar before it reaches the hydraulic main. For



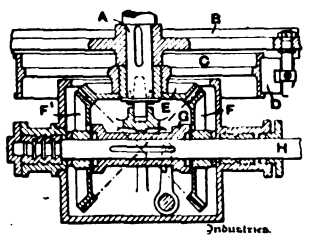
these purposes the retorts and apparatus are arranged as shown in the accompanying figure. A is the main cast iron retort, and B is a duct through which the distilled gases pass, after their evolution in the retort. The retort door is shown at J; the seating consists of the front wall C and the pedestal D. In practice three retorts may be used, and their settings are such that they shall be protected from the destructive effect of the flames, and maintained at equal temperatures. This is done by shielding those parts nearest the fire by brick work, and by the slabs F. In order to allow of all the parts being cleaned, the retort and duct are so constructed that they may all be scraped from their mouths, and the parts K are formed as a feather edge. The ascension pipes lead to a hydraulic main E, whose dip pipes G are inserted into the liquor for a small depth only. The gas is thus allowed to pass freely out and into the main, and little back pressure is caused in the retort. The main is open at E² to the atmosphere, and any undue pressure is thus prevented within it. It is claimed for this arrangement of the retort and duct, and flues surrounding them, that a greater lighting power of the gas is obtained by the heavy hydrocarbons being more thoroughly utilised by their subsequent heating in the duct. Two claims are made for the retort and duct, and for the arrangement of the hydraulic main as described.—No. 1767. February 4th, 1887. 8*d*.

JACQUARD CARDS.—*W. Martin & W. T. Martin, Nottingham.*—In the process of selecting and punching patterns in jacquard cards, the inventors use a bed with a pair of perforated punch plates, which work up and down by means of eccentrics and connections from a revolving shaft. The punch plates are grooved so as to allow the cards to pass between them, and the cards are fed from a bottomless box by means of endless bands. These bands are studded the exact width of the cards, and they travel under the bottomless box and between the punch plates by means of an arrangement of rocking apparatus. Above the bed is a block, which is perforated horizontally for the selecting keys, and vertically for the punches; the block is also fitted with perforated slays, which together with the block carry the selecting keys and the punches. On each key is a spring, which returns the key to its proper position after being drawn back by the string in the ordinary way. When the bed containing the punch plates is at its lowest point, the bands travel the width of one card; but while the bed and plates ascend and lift the card to the punches, the bands do not move. The punches, being held in their proper position by the keys, perforate the card; immediately afterwards the bed and the plates descend, and the same motion which takes the blank card into the plates brings the punched card out of the plates, and propels it down a slope into another box. The arrangement of rocking apparatus above mentioned consists of a ratchet wheel and pawl, with a connection lever and spring worked by a cam on the eccentric shaft. By this invention, only one attendant is required to select the keys. Four claims are made.—No. 6389. May 2nd, 1887. 8*d*.

DUST COLLECTOR.—*C. R. Grundig, E. Löwe, & F. Zahn, Dresden.*—The apparatus is in the form of a spiral passage, through which the current of dusty air passes. There are a number of slotted tubes arranged along the outer sides of the passage for the purpose of catching and evacuating the suspended matter. The centrifugal force imparted to the air current in the curved passage causes the matter to be deposited on its outer sides, and the slotted tubes afford an escape for it. The dust is collected in bags as it falls from the apparatus. Four claims are made for the spiral channel and slotted tubes.—No. 4269. March 20th, 1888. 6*d*.

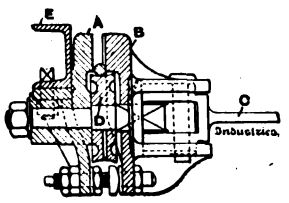
GERMAN PATENT ABSTRACTS.

REVERSING GEAR.—*C. Daevel, Kiel, and the firm Benz & Co., Mannheim.*—The operating shaft A is fitted with a fly wheel B, to which the brake strap D is connected. The brake drum C is firmly connected to the bevel wheel E, but C and E are free to



rotate on the shaft A. The bevel wheel E gears with two bevel wheels F and F¹, and either of them may be connected to the shaft H by the coupling G. The interposition of the brake drum C and the strap D avoids the shock when reversing the motion of H by engaging the coupling G with F or F¹.—No. 42819. September 1st, 1887.

CABLE TRAMWAYS.—*T. Otto, Schkeuditz.*—This invention relates to an improved apparatus for connecting the cars to the wire



rope. The rope is gripped between a vertical jaw A, fixed to the frame E of the car, and a movable jaw B. B is actuated by the lever C. Between the two jaws a roller D is arranged for supporting the wire rope.—No. 43000. January 25th, 1887.

UNITED STATES PATENT ABSTRACTS.

COLLECTING LINT.—*J. W. Shell, Evening Shade, Arkansas.*—The receiver for the lint rolls upon a track, and is provided with a foraminous door at one end and sliding doors at the end adjacent to the gin. After the receiver has been filled from the gin flue it is rolled back to the press. The foraminous door is then removed, and the sliding door is drawn through the receiver, compressing the lint in its passage. Two claims are made.—No. 382775, dated 15th May, 1888.

LOOMS.—*Z. T. McKinney, Piedmont, South Carolina.*—This invention relates to the shuttle relief mechanism. One of the swords of the lay carries a bell crank lever which is connected at one end to one of the lay pitmen, and carries an anti-friction roller at the other end. This roller bears upon an arm connected to a rock shaft, which carries a finger, and a spring in proximity to the shaft normally presses the finger against the guard. Just before the forward movement of the lay the levers release the pressure of the finger from the shuttle binder. Three claims are made.—No. 382995, dated 15th May, 1888.

CONSTRUCTION OF IRON ROOFS.—*H. C. Hodges, Detroit, Michigan.*—The inventor here introduces an improved method of joining together the roof sheet, the purlin, and the rafter. Two blocks of metal D and E are employed; the upper surface of D is rounded to conform with a corrugation in the roof sheet C and its lower surface grasps the purlin B. The block E is grooved

FIG. 1

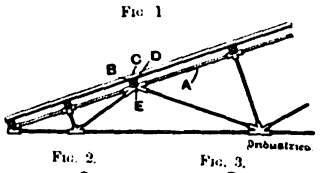


FIG. 2.

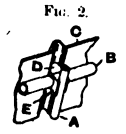
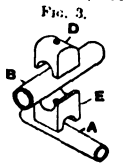
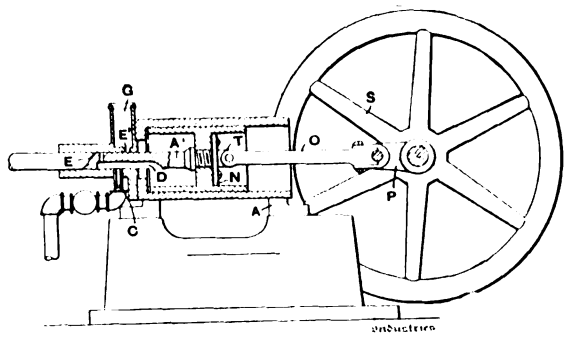


FIG. 3.



on the upper and lower sides with two channels at right angles to each other, to receive the purlin B and to rest on the rafter A respectively. Holes are drilled through the blocks in order to allow a bolt to pass through, for the purpose of holding the parts together. Four claims are made for the use of these blocks.—No. 381137, dated 17th April, 1888.

GAS ENGINE.—*G. W. Stewart, New York.*—This invention relates to a method of introducing the gas into the cylinder of the engine, and the accompanying figure illustrates the mechanism employed for that purpose. The piston has an extension A¹, which passes through the hinder end of the cylinder. In this circular rod is a groove D, which allows the gas to find access to the cylinder from the gas supply pipe C. There is also a narrow



port E in the rod A¹, and a port E¹ in the surface on which the rod bears. When these two ports register with each other the flame in G is communicated to the charge in the cylinder, and the explosion takes place. The air supply and the exhaust mechanism are not shown in the drawing. Four claims are made for the extension A¹, and for the grooves in it, as described.—No. 381488, dated 17th April, 1888.

COTTON BATTING.—*E. Walker & D. Williams, Cohoes, New York.*—In this method of making cotton batting the fleeces from several carding engines are obliquely deposited upon an apron travelling at right angles to the front of the engines. A bat is thus formed of layers whose fibres lie obliquely to the direction of the length of the web, and the fibres of each layer lie across the fibres of the layer beneath. The bat is afterwards folded in a direction parallel with the edges, the best grade of stock being used for the outside layer. Three claims are made.—No. 382916, dated 15th May, 1888.

ETCHING GLASS.—*E. Nienstadt, New York.*—This process for etching glass and porcelain consists in first stamping the design upon the surface with a sticky compound of resin and fatty oil, and afterwards spreading the stamped portion of the surface with pulverised hydrofluorate of ammonia, which contains a portion of free hydrofluoric acid. The material when in this state is subjected to the action of slightly warmed moist air. The advantage of this process is that the action of etching is delayed until the preparation of the surface is completed, as the etching materials cannot commence their action until the warm moist air has affected them. One claim is made.—No. 382318, dated 8th May, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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GLASGOW INTERNATIONAL EXHIBITION.

English Steel Exhibits.—The English steel manufacturers are fairly well represented, though several eminent firms, such as Sir Joseph Whitworth & Co., Messrs. Firth, the Butterley Company, and others, which have been prominent exhibitors in recent years at other places, are conspicuous by their absence. All the larger steel exhibits are situated in the main avenue of the machinery section, and adjacent to the trophies of the leading Scotch firms. Taking them in the order in which they are approached by the visitor entering the section from the main building, there is first the splendid exhibit of the Hadfield Steel Foundry Company, Sheffield. This large and varied display, comprising hundreds of different articles, weighing in all some 50 tons, seems intended to illustrate almost every possible purpose to which cast steel can be applied. An idea of the general character of the exhibit will be best conveyed by a rough classification of the different specimens according to their intended uses. The supply of castings for colliery, mining, and contractor's plant was, we believe, the earliest branch of Messrs. Hadfield's business, and in this department are shown various descriptions of wheels and axles—several of them being patented specialties—pedestals, rollers, cage guides, pulleys, crossings, stamps, cams, levers, and, in short, everything required in connection with mining which can be cast in steel. The magnitude of this branch will be realised when it is mentioned that considerably over 2,000,000 Hadfield cast steel wheels and axles are now in daily use in different parts of the world. A pair of trolley wheels mounted on an axle, which fell down a colliery shaft 1770ft. deep, without suffering any further injury than bending of the axle, and a small wheel with the arms forged out into a knife, fork, &c., as well as other specimens of interest, testify to the strength and toughness of the material used. Hydraulic engineering is represented by a group of eight cast steel cylinders, which are, perhaps, the most striking feature of the exhibit. They range in length from 6ft. to 20ft., with internal diameters of from 6in. to 36in.; and the soundness of the metal is proved by the turned and polished portions of their exterior surfaces. The requirements of railway and tramway engineers have been well considered, and locomotive wheel centres up to 8ft. diam., cast steel roof stay bars, horn blocks, axle boxes, motion plates, crossheads, and the well known "Hecla" patent railway and tramway wheels are shown in a great variety of forms. Some "Hecla" wheels, cast entirely in one piece without any rolling or forging, have proved when tested under express locomotives, practically equal in durability to the best rolled steel tyres, while for tramway purposes these wheels are favourably known all over the world. We may here mention that since the opening of the Exhibition Messrs. Hadfield have been successful in obtaining large orders for general locomotive castings from Glasgow builders in face of severe home and foreign competition. For rolling mills and general gearing purposes are shown a number of pinions, spindles, anvils, &c., and every description of spur, bevel, mitre, segment, and worm wheels, with both straight and helical teeth, and either machine moulded or made from full patterns. Marine engineers and shipbuilders' castings are not so largely represented; but there are several good examples of crank, lever, crosshead, and propeller blade castings, as well as a number of requisites for dredgers, including Hadfield's patent cast steel buckets, bucket backs, lips, links, tumblers, &c. War material forms another specialty of this firm, and they give some interesting exhibits of their patent cast steel projectiles, shells, and machine gun carriages. A cast projectile for a 9·2in breech-loading gun, which penetrated two "Cammell" wrought iron armour plates, with a combined thickness of 24¾in. and 2ft. of wood backing, and a 6in. projectile which has passed through an 8in. wrought iron plate, both remaining practically uninjured, are especially worthy of notice. A forged 6in. steel projectile is also shown, which penetrated a 9in. compound "Cammell" plate. This is claimed to be the first English projectile that has successfully pierced the compound armour plates. Our space will only permit a passing allusion to the numerous and instructive collection of test bars of both unhammered and forged cast steel, giving tensile strengths ranging from 26 tons to 125 tons per square inch, with corresponding elongations from 40 per cent. to 1 per cent. With a brief reference to the patent manganese steel specimens contained in the cases on the south side of the stand, we must close our notice of what is undoubtedly the finest display of steel castings in the present Exhibition. Full abstracts of the two able papers entitled "Manganese in its Application to Metallurgy," and "Some Novel Properties of Iron and Manganese," were published on page 250 of our present volume. Those papers were read by Mr. Robert A. Hadfield before the Institution of Civil Engineers, the samples alluded to above being used to explain and illustrate his remarks. One of the many remarkable properties of this metal is its small susceptibility to magnetisation, and some of the specimens are arranged to show the diminution of the magnetic qualities as the percentage of manganese increases. Professor W. F. Barrett has stated that its peculiarity in this respect indicates a large employment of manganese steel for the construction of dynamos and other electric appliances.

The ponderous exhibit of Messrs. Charles Cammell and Co., Limited, next invites inspection. The gigantic three-throw crank shaft, resting upon the top of the specimen armour plates, at once strikes the eye as being among the most imposing objects in the machinery section. The effect it produces is somewhat lessened by the discovery that it is only a well finished wooden model of a shaft, weighing nearly 60 tons, made for the steamship "Aurania," of the Cunard Line. At the front of the stand lies a splendid forging of about 24 tons weight, intended for the core of a 68-ton gun. It is turned and polished on the exterior, the interior being rough bored, ready for finishing; and is in every respect a creditable specimen of ordnance manufacture. Smaller gun pieces are disposed behind; the entire assortment representing forgings for guns from 6in. B.L.R. up to 13·5in. B.L.R. In the centre of the stand is placed a large gun trunnion ring, with a glass case containing a neat arrangement of files, tool steel bars, &c., fitted into the end facing the spectator. Armour plates, as may be expected from the well known reputation of the firm, form a prominent feature of the exhibit. The great superiority of compound armour over solid iron armour is demonstrated by two heavy tested plates which are exhibited. In the one case the projectile, though broken, has penetrated the iron plate, while the steel faced plate, under precisely similar conditions of testing, has sustained comparatively little damage. A full sized model of the 10½in. compound plate tested at Portsmouth on the 24th March last, is also shown. This plate was struck by three Holtzer forged steel projectiles and two Palliser chilled cast iron projectiles, fired at the close range of 10 yards, but all completely failed to penetrate it; and the makers claim that it is the finest piece of compound armour ever made. The methods of securing the armour plates to the backing are illustrated by sections cut through actual plates and bolts. A variety of steel projectiles, forged shells, various marine and railway castings, sections of rails and fish plates, and assortments of bearing, volute, conical, and spiral springs, tastefully grouped among the larger objects, give completeness to this effective exhibit.

Messrs. John Brown & Co., Limited, Atlas Works, Sheffield, occupy a larger floor space than any other steel firm. They have a frontage of 60ft. in length on the south side of the main avenue, and show a number of large and interesting examples of their well known manufactures. This firm has long been famous for armour plates, and one of the most instructive sections of the exhibit consists of five plates of different periods, showing the advances made in this branch of defensive warfare. The first plate (No. 1) shows the early type of solid iron armour, and the impression made on it by the now obsolete spherical cast iron shot. Another iron plate (No. 2) demonstrates the superior penetrative power of the pointed chilled cast iron Palliser projectiles which superseded the spherical shot. Plate No. 3 is machined off an iron plate 22in. thick, the heaviest armour ever actually used; and plates No. 4 and No. 5 are specimens of the compound or steel faced armour plates presently manufactured by the firm under the patents of Mr. J. D. Ellis, now one of the leading partners. The severe tests which these compound plates have successfully withstood can leave no possible doubt as to their superiority over the older description of armour. The great feature of this exhibit, however, is an immense Siemens steel propeller shaft forging, 60ft. long and 19in. in diameter, with a 23in. collar and a 42in. coupling flange. This truly magnificent piece of work, which takes up the full length of the front of the stand, has been entirely executed under the large hydraulic forging press recently erected by Messrs. Brown & Co. This is probably the largest forging appliance in existence, and enables the firm to produce with ease the very heaviest classes of marine and ordnance forgings. The Atlas works has also an exceptionally complete equipment of machine tools for dealing with heavy masses of steel, and but for want of time the propeller shaft would have been shown bored through from end to end. Another prominent object occupying the west end of the stand is a huge marine boiler front plate, with four Purves patent ribbed steel flues attached in position. The merits of these flues, of which Messrs. Brown & Co. are the sole makers, will be more fully discussed at another time; but we may mention here that, though only of recent introduction, they have met with such favour that over 1200 have already been ordered. The flanging of the four furnace holes and sides of the front plate is effected at one heat by special hydraulic plant. At the back of the stand is a very large steel boiler plate, which is sure to attract attention. It is said to be the largest plate yet rolled, and measures 28ft. in length, 9ft. in width, and is 1⅛in. thick. It is one of a considerable number made for the Fairfield Shipbuilding Company, Limited; and it is noteworthy that several of the Sheffield houses do a good trade in boiler plates with the Clyde, none of the Scotch steel makers being as yet in a position to supply them of the required dimensions for the largest class of marine boilers. A large chemical pan, 9ft. 4in. in diameter, 2ft. 4in. deep, and ⅜in. thick, pressed by hydraulic power from a solid steel plate, and a super-heater plate of Siemens-Martin steel, are also interesting to boiler makers, and display excellent workmanship. Among the steel castings exhibited, a powerful propeller tube stern bracket for a twin screw steamer, and a large propeller blade intended for one of the two Inman and International vessels at present being built by Messrs. J. & G. Thomson, at Clydebank, are noticeable for solidity, finish, and general excellence. We may conclude this notice by calling attention to the fine collection of locomotive crank axles, tyres, springs, buffers, pressed wheels; to a large weldless steel hoop for a chemical furnace; and to the two suspension bridge chain links, similar to those made for the new Hammersmith Bridge. These massive links, with their enlarged heads, may be considered unique products of the rolling mill, as they leave the rolls in a finished state, without requiring any subsequent forging or machining.

Messrs. John Spencer & Sons, of Newburn Steel Works, Newcastle-upon-Tyne, whose steel castings are so widely and favourably known among engineers, have only a very small stand, chiefly occupied by patented specialties such as crank shafts, &c. These are dealt with under the head of marine engineering; and it only remains for us to state that a cast steel locomotive driving wheel centre, 6ft. 6in. diam., and some specimen castings, forgings, &c., will repay examination, and to make some allusion to Messrs. Spencer's latest specialty in the shape of what are called "Newburn homogeneous iron" castings. This homogeneous iron is, according to the makers, a special kind of very soft steel, with a tensile strength of from 22 tons to 25 tons per square inch, and an elongation of 30 to 40 per cent. It is particularly adapted for making castings to replace small and complicated forgings, and for many details of engine work it has a decided advantage over ordinary cast steel in that it will case harden, also in that it generally requires no annealing. The material can, moreover, be forged and welded like wrought iron. The makers keep the process of manufacture a secret; but we understand that they have discovered a method of making castings of soft iron by the addition of a small quantity of some metal—other than aluminium—to the iron scrap in the crucibles. A considerable number of these castings are shown, and to all appearance they seem likely to come into competition with "Mitis" castings, especially as their price is moderate.

Mr. T. Nordenfelt exhibits on the next stand a large and interesting assortment of the well known "Mitis" castings. Mitis metal results from the addition of from 0·05 to 0·1 per cent. of aluminium to melted malleable iron or steel, and by varying the percentage of carbon the metal is obtained of any desired degree of hardness. The effect of the small addition of aluminium is to render the molten metal remarkably fluid, so that it will run freely into the smallest impressions of the mould, while at the same time gaseous bubbles, which would otherwise be a cause of unsoundness, are allowed to escape. The cast material possesses great strength and toughness; and the numerous excellent specimens shown on the stand illustrate the multiplicity of uses to which these castings may be applied. They will, no doubt, meet with wide adoption, in spite of their somewhat high price.

(To be continued.)

BALANCED HYDRAULIC LIFTS.

We illustrate on pages 584 and 585 several forms of hydraulic lifts which are the patented inventions of Mr. Samuel Chatwood, of Chatwood's Patent Safe and Lock Company, Limited, Manchester, the well known firm of safe makers. These lifts are constructed on novel and ingenious principles invented by Mr. Samuel Chatwood, whose mechanical skill and ingenuity will be, no doubt, known to many of our readers. The leading feature of the invention is the introduction of a separate cylinder, fitted with a plunger, and known as the balancing cylinder. This cylinder is connected by means of a pipe with the lift cylinder, and the plungers are so arranged that when one is out to the fullest extent the other is forced home. A fixed quantity of water, which is practically incompressible, is contained within the two cylinders and the pipe connecting them, so that if one plunger or ram is pushed in the other is necessarily pushed out, as the volume of water remains the same. The action is thus like a lever with the fulcrum between the power and the weight—as one end moves up the other end moves down—the extent of motion depending on the position of the fulcrum, while in this arrangement it depends on the relative areas of the two cylinders. The balancing cylinder being weighted, or such pressure being

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BALANCED HYDRAULIC LIFTS.

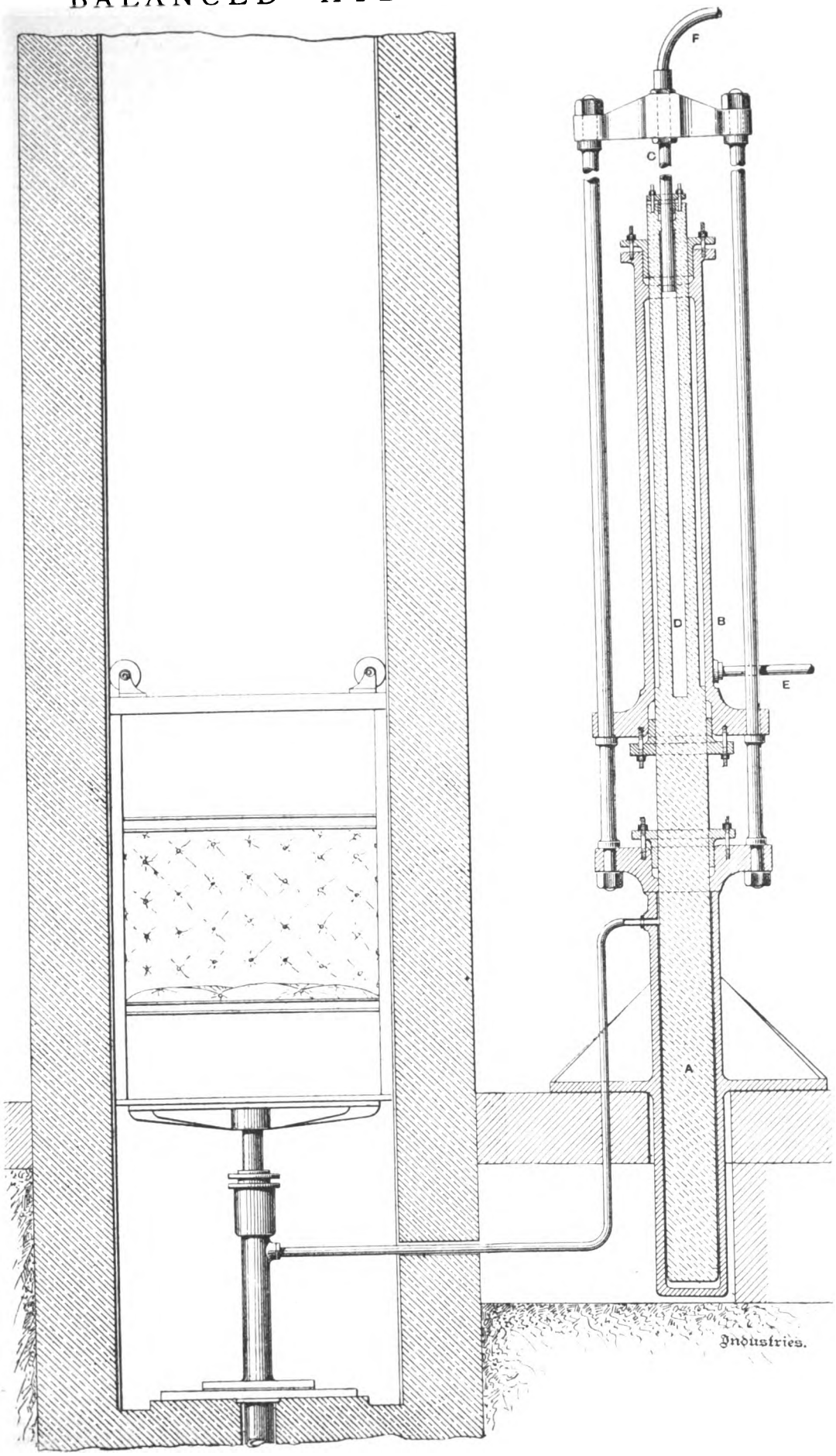


FIG. 1.

applied to one surface of its ram that the weight of the cage and its appliances is just balanced, it is only necessary to apply just sufficient pressure to overcome the friction of the leathers, guides, &c., in order to produce motion of the cage upwards, and to withdraw double this additional slight increment of pressure to bring down the cage. This comparatively slight pressure may usually be obtained from the town water mains. The arrangement is especially useful where a large and tolerably constant load requires to be lifted or lowered when desirable, as in the case of books or cash in bankers' safes. The arrangement is also very useful as applied to passenger lifts. Among the incidental advantages possessed by this system we may mention that it avoids all overhead chains and balance weights, which are not only inconvenient but often dangerous. Another advantage is that the cylinders and rams may be made as small as may be desired, consistent with the necessary strength and stiffness, by properly proportioning their respective diameters. Of course, a great saving of water is effected by this arrangement, as the fixed quantity enclosed between the two pistons or rams is used over and over again, only the small quantity required to produce the difference of pressure being wasted.

Before describing the illustrations in detail it may be well to give a general account of the apparatus and its

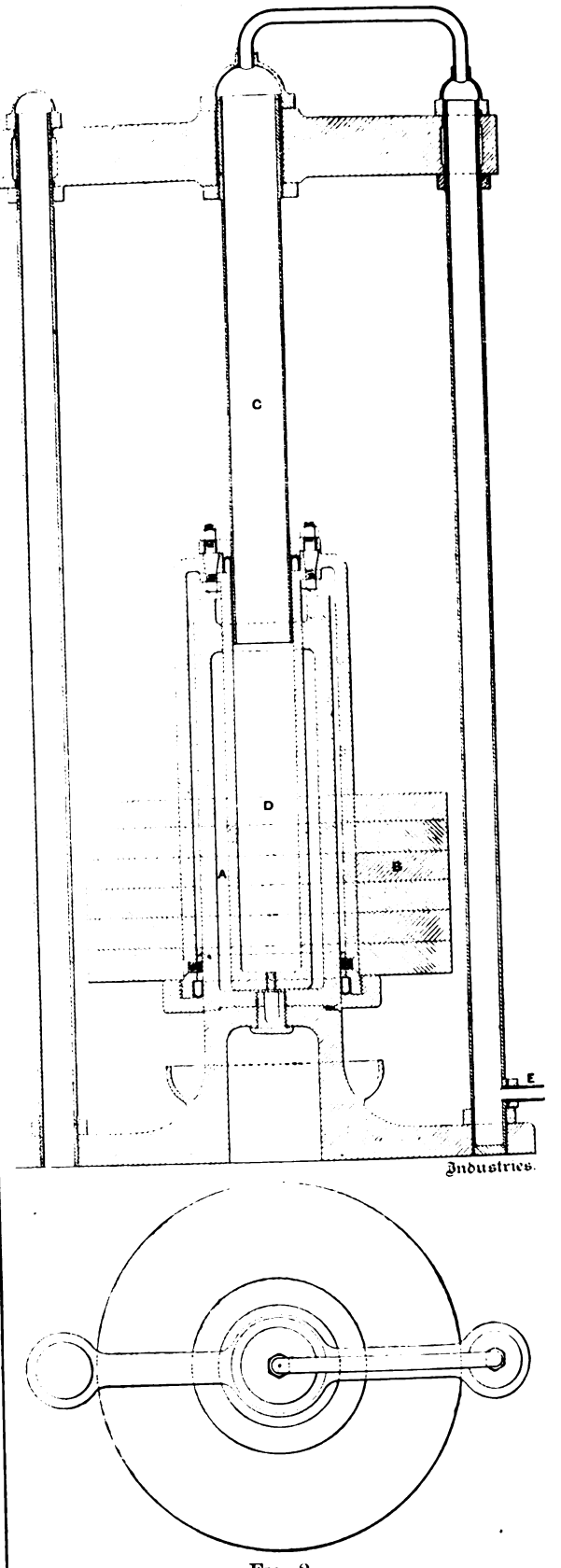


FIG. 2.

action. The cylinder of the lifting ram is connected with the balancing cylinder by a pipe, the respective areas of the two cylinders being suitably proportioned. When the ram of one cylinder is raised, the ram of the other is lowered in exactly the same way as the weights on a scale beam. Suppose the weight on the lifting ram is 1 ton, then to balance it, such a weight must be placed on the ram in the other cylinder as the proportion of the areas of the two cylinders requires. If the ram of the lifting cylinder is in its lowest position, and it is desired to raise it, a further weight must be applied to the ram of the balancing cylinder, so as to overcome the friction of

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the packings of the two cylinders and the other resistances. The weight having been applied and the ram of the lifting cylinder raised, when it is desired to lower it again the extra weight that has been applied to the balancing cylinder must be removed and a corresponding increase of weight must be brought to bear on the ram of the lifting cylinder, in order to overcome the friction of the machinery. This extra balancing weight may

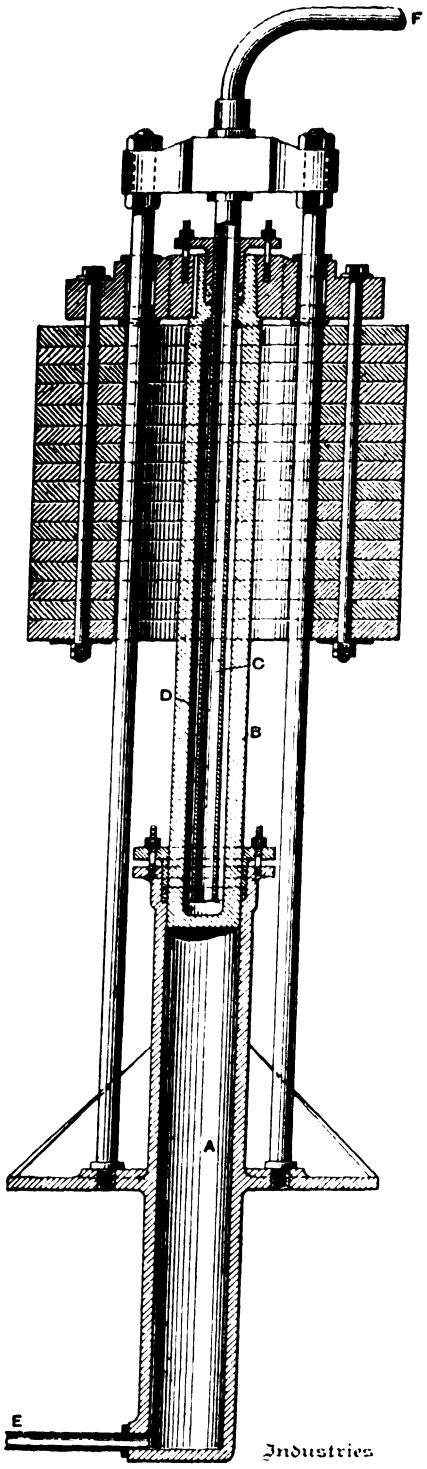


Fig. 3.

virtually be applied to the lifting cylinder by removing a corresponding weight from the balancing cylinder, without altering the weight on the lifting cylinder. Now, if it be supposed that the ram of the balancing cylinder in passing out of its gland is attached to another cylinder, and that this other cylinder is inverted in such a way that it covers, or partially covers, the balance cylinder proper, and at the same time let the upper portion of the balance cylinder be enlarged outside, so as to form a water tight joint with the interior of the inverted cylinder. Then, if the inverted cylinder which is carried by the ram of the balancing cylinder is made very thick, or is arranged so as to carry weights, its weight can be so adjusted that it will always raise the lifting cylinder ram. If the ram of the lifting cylinder has been raised in this manner, and it is desired to lower it again, then in order to remove some of the weight from the ram of the balancing cylinder, water at a suitable pressure is admitted into the space between the bottom of the inverted cylinder and the top of the balancing cylinder. Since this inverted cylinder must, from its position, have an area greater than that of the ram in the balancing cylinder, which latter area must be subtracted from the former so as to give the effective area, a considerable upward pressure is exerted by the pressure water introduced into the inverted cylinder; this water pressing upwards and virtually removing a portion of the weight from the ram of the balancing cylinder, thus causing the lifting ram to descend. Or instead of taking off the unbalanced weight by admitting pressure water into the annular space between the ram and the sides of the converted cylinder, the ram may be used as a small supplementary cylinder open to the available water pressure, which on being open to waste will remove the portion of the lifting weight due to the area of the hollow ram, which serves also as a supply pipe, and by which it is worked. In the former case, the lift will descend when the valve is open to pressure; and in the latter case, when it is open to discharge. The inverted cylinder may or may not be used, according to circumstances. A convenient method of doing this is to use the plunger as a cylinder, and to allow it to work on a hollow ram attached to a fixed crosshead, when the weight on the lift cylinder will be balanced and raised, partly by the fixed weights and partly by the hydraulic pressure on the interior of the ram. By this arrangement it is obvious that a small fixed weight will be required. Fig. 2 shows the weighted inverted cylinder with its plunger used as a small supplementary cylinder. Fig. 1 represents a sectional elevation of one form of cylinder. A is the balancing cylinder, in which a solid ram works through a water tight collar, the ram being continued into another cylinder B vertically over the balancing cylinder A, and working through another water tight collar at the top of this second cylinder. At its upper end the ram is bored

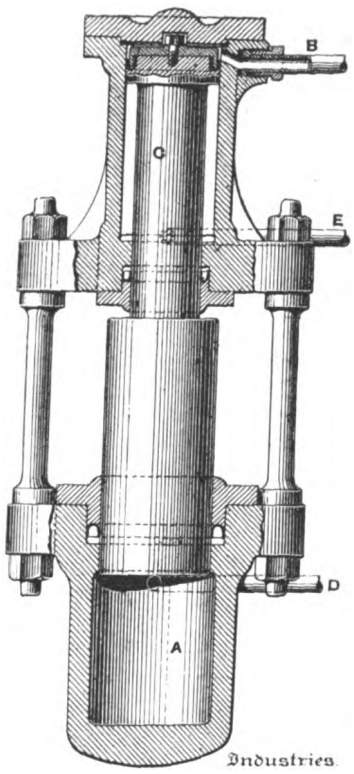


Fig. 4

out so as to form a hollow cylinder, and as the ram is raised, a pipe attached to a fixed crosshead and working through a water tight collar enables water to be supplied to this inner cylinder for raising or lowering the lift. This pipe thus forms a fixed ram for the sliding supplementary cylinder. An annular space round the ram, in the cylinder B, enables such pressure to be exerted on the ram as is required to balance the lift and its load—less friction. The cylinder A is connected by the pipe shown with the lift cylinder, and in this system a fixed quantity of water always remains. Into the cylinder at B water at a high pressure is admitted, which acting on the ram produces a pressure downwards which balances the lift and its luggage or load. The steel tube C supplies water to the small supplementary cylinder which is formed inside the ram, and on being opened to the supply will exert a pressure downwards on the ram and thus raise the lift, while on opening it to discharge the lift will be lowered. Fig. 3 shows an alternative arrangement for balancing the lift and its weights or load by means of fixed weights attached to the ram. Here, as before, A is the balancing cylinder, in which the ram B works. To a crosshead at the top of the ram the weights are attached, which balance the lift and its ram minus friction; these weights taking the place of the cylinder B in Fig. 1. The ram is hollow, thus forming a supplementary cylinder D which has a water tight collar working on the steel supply pipe C. If this pipe is open to supply the lift is raised, and if it be open to discharge the lift is lowered. Fig. 5 shows another arrangement of the cylinders. In this case also, A is the balancing cylinder, and is connected with the lift cylinder by the pipe shown. The ram is continued upwards into a smaller cylinder B, which is always open to the accumulator or service of supply, and balances the dead load minus friction. A crosshead attached to the upper part of the ram is connected by side bars, with a crosshead attached to a ram in a third cylinder C placed vertically under the two cylinders A and B. The cylinder C is open to the accumulator when the lift is being raised, and is open to the discharge when the lift is descending. Fig. 4 shows an arrangement in which only two cylinders

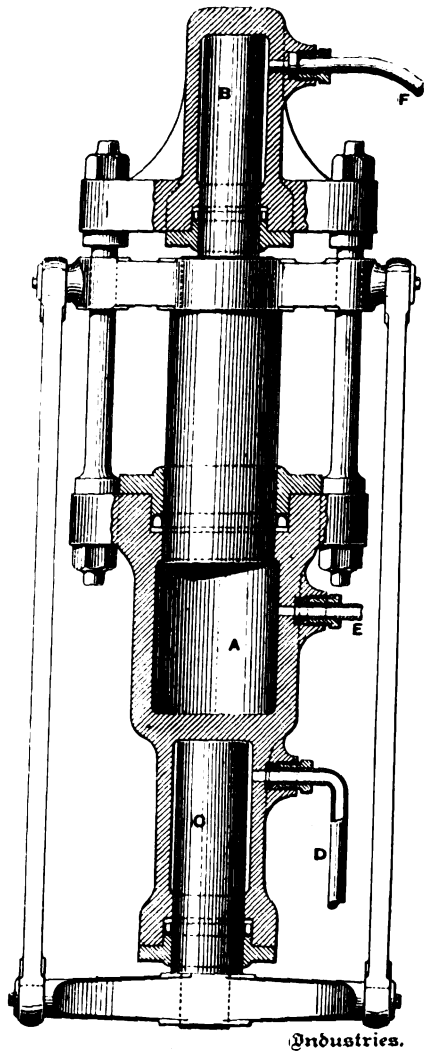


Fig. 5.

are employed. As before, A is the balancing cylinder, and is in free communication with the lift cylinder. The ram is continued upwards into the cylinder C, and at its upper end it is fitted with a piston. The space above the piston is always open to the accumulator or service of supply, and lifts the total load. When the space under the piston is open to the accumulator the lift will descend, and when it is open to the discharge the lift will ascend. Mr. Chatwood's invention, of which various forms have been described above, was patented by him in 1878. Hydraulic lifts constructed on these principles were shown by Mr. Chatwood at the Paris Exhibition, 1878, and several forms were shown at the Manchester Royal Jubilee Exhibition last year, including working models of Chatwood's patent hydraulic balance applied to a banker's strong room, to a passenger elevator, and to a jeweller's window; together with various other models of the hydraulic balance.

THE INSTITUTION OF CIVIL ENGINEERS.

The annual general meeting—to receive and deliberate upon the report of the Council on the state of the Institution, with the annual statement of the accounts, and to elect the Council and officers for the ensuing year—was held on Tuesday, the 29th ult., Mr. George B. Bruce, President, in the chair. It will be within the recollection of the members that a special general meeting was held on the 16th of November, 1886, at which a petition was adopted praying the Queen in Council to grant to the Institution a supplemental charter. In answer to this application, the Institution had received Letters Patent, dated the 3rd of August, 1887, under the great seal of the United Kingdom, extending the power to acquire and hold a hall, messuages, lands, tenements, and hereditaments, from £1,000—as authorised by the original charter—to a sum not exceeding

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HODSON'S PORTABLE DRILLING MACHINE.

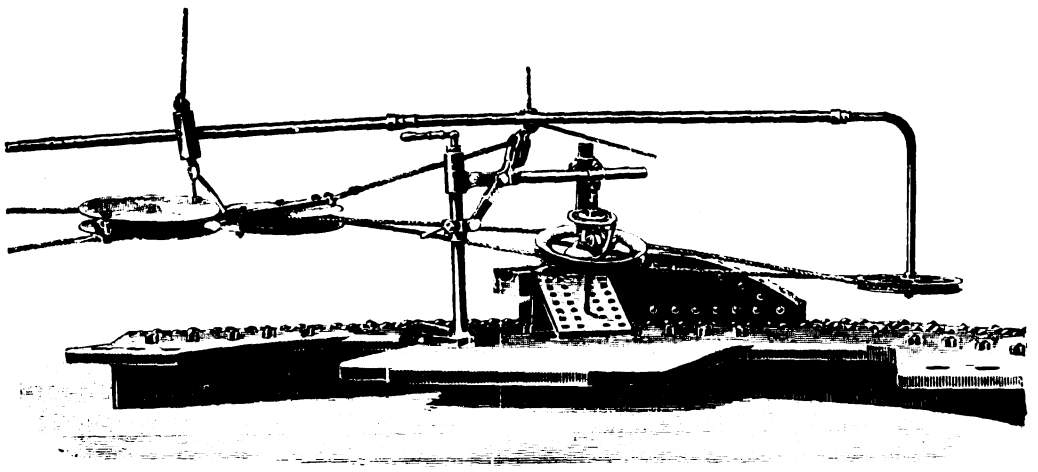


FIG. 1.

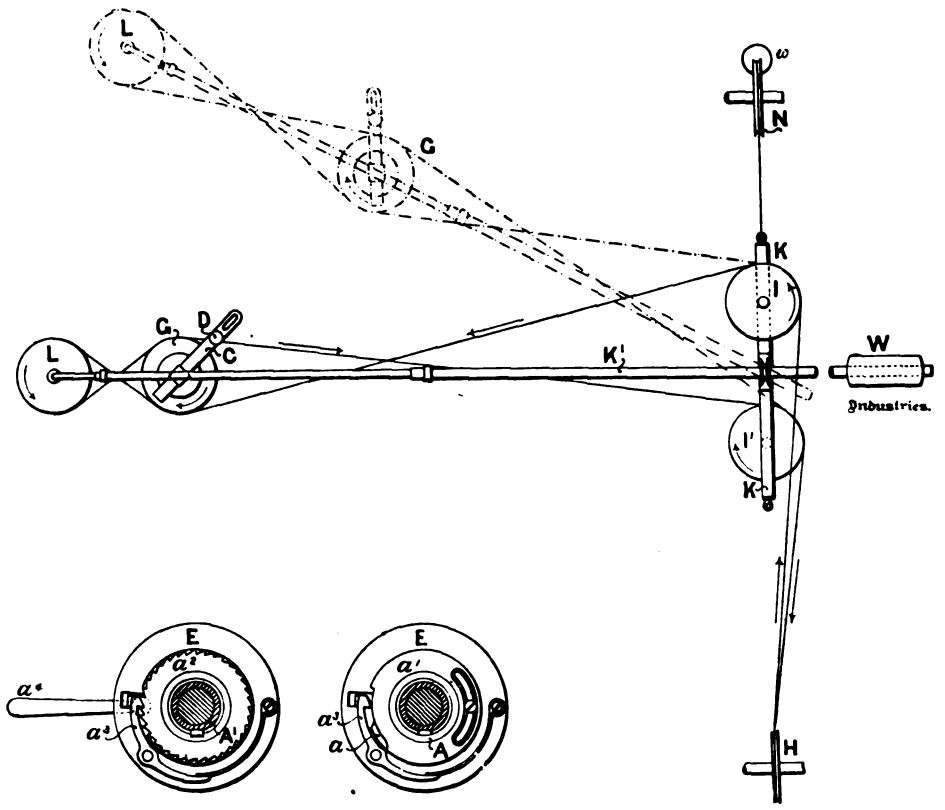


FIG. 2.

£8,000 in annual value. A copy of this supplemental charter had been sent to every member, together with the biennial issue of the original charter, by-laws, and list of members. At midsummer last, the freehold of No. 24, Great George-street, embracing the portion of the premises already occupied on lease, was purchased for £15,000. The Institution was now the owner of three contiguous houses, obtained at a cost of £40,000, exclusive of legal and incidental expenses. In accordance with the recommendation of the last Council, openings had been made between the basements, the ground floors, and the first floors of Nos. 24 and 25. The Council had presented a petition against the Westminster (Parliament-street, &c.) Improvements Bill, which contemplated taking by compulsion the freehold premises above referred to. The result of this petition was the insertion in the Act—which received the Royal Assent on the 23rd August, 1887—of clauses for the protection of the Institution, the substance of which was as follows: The conveyance to the Institution of the fee simple in possession of a plot of land on the northern side of Great George-street, having an area of 11,000 sq. ft.; the payment of a sum of £35,000 as full compensation for the buildings, and for all consequential damage; the use of the present premises for eighteen months after possession had been given of the substituted site and the above payment had been made; and unless within one month after the expiration of twelve months from the passing of the Act a sum of £10,000 should be paid to the Institution as security, the powers of the Act, so far as the Institution was concerned, would lapse. Up to this time, no intimation had been received whether the powers of the Act were to be put in force. Communications having been received from a committee promoting the registration of architects, engineers, and surveyors, inviting the Council to offer suggestions upon a draft Bill to be brought forward this session, that committee was informed that the Council did not intend to take any part in furthering the proposed measure. Later on, however, it became evident that active steps must be taken to oppose the Bill, which vitally affected the interests of the Institution, as well as those of the cognate bodies representing architects and surveyors. On behalf of the Institution a statement of reasons against the measure was drawn up, and this formed the basis of a petition to the House of Commons, which was duly presented by Mr. A. Giles, M.P., V.P.Inst.C.E. As the provisions of the Bill became better known, opposition increased in various other quarters, and, on the second reading, the opinion of the House was so clearly opposed to the Bill that its promoters withdrew it rather than risk a division. During the twelve months ended the 31st of March, 1888, there had been an addition to the roll of 49 members and 183 associate members, the number of non-corporate associates being reduced by 23. The increase had been 4·6 per cent. per annum, as compared with 4·19 per cent. for the previous twelve months. The students had increased by 25. At the date named there were on the books 1617 members, 2458 associate members, 461 associates, 20 honorary members, and 974 students—together 5530. The receipts on account of income during the twelve months under review were £16,071. 12s. 2d.; on account of capital, £4,248. 11s. 2d.; and from trust funds, £433. 15s. 1d. The general expenditure had amounted to £13,956. 10s. 10d., of which more than one moiety constituted the cost of the publications. A sum of £6,476. 18s. 9d. had been invested in the purchase of £5,000 London and North-Western Railway 4 per cent. debenture stock, and the outlay on account of the trust funds amounted to £476. 6s. 11d. These figures constituted the ordinary receipts and disbursements. Owing, however, to the purchase of No. 24, Great George-street, it had been necessary to sell railway debenture stocks of the nominal value of £9,000, and to transfer from the yearly receipts a sum of £4,617. 11s. 3d., to meet this outlay. The papers read at the ordinary meetings had been of more than usual interest, and had given rise to animated discussions and to much correspondence. For some of the papers the Council had awarded medals and premiums to Messrs. R. A. Hadfield, P. W. Willans, Dr. Edward Hopkinson, Messrs. E. B. Ellington, Josiah Pierce, jun., Sir Bradford Leslie, K.C.I.E., and the Manby Premium to the late Mr. Hamilton Goodall. For papers printed in the "Proceedings" without being discussed a Watt Medal and a Telford Premium had been awarded to Professor Dwelshauvers-Déry, and Telford Premiums to Messrs. W. M. Thompson, J. W. Wyatt, and D. Drummond. Advantage had been taken of the increased accommodation to hold exhibitions of models, appliances, instruments, and specimens in connection with some of the subjects which came under discussion, viz.: "Accidents in Mines," "Manganese Steel," and the "Use of the Plane Table in Topographical Surveying." The success of these exhibitions had formed a most acceptable feature of the Tuesday evening meetings of last session, and it was hoped that they might be repeated and further developed as opportunity occurred. There had been twelve supplemental meetings for students, held on Friday evenings, generally at fortnightly intervals. Three of the papers read and discussed had already appeared in the "Proceedings," and five others had been deemed worthy of publication. The Council was glad to notify a distinct advance in the general care and attention devoted to the preparation of these papers, and in the thoughtfulness manifested, as a rule, by those of the students who had taken part in the discussions. Miller Prizes had been awarded to Messrs. D. S. Capper, L. Gibbs, H. M. Martin, J. H. Parkin, A. Chatterton, J. Holliday, A. W. Metcalfe, and R. J. Money. In conclusion, the Council had noticed with pleasure the part taken in the discussions at the ordinary meetings during the past session by the younger members of the profession, which promised well for the future reputation of the Institution and of its proceedings.

The adoption of the report was moved, seconded, and carried, and it was ordered to be printed in the minutes of proceedings. Hearty votes of thanks were then passed to the President, to the Vice-Presidents, and other members of the Council, to the auditors, to the secretaries and staff, and to the scrutineers.

The ballot for Council resulted in the election of Mr. G. B. Bruce, as President; of Sir John Coode, Mr. G. Berkley, Mr. H. Hayter, and Mr. A. Giles, M.P., as Vice-Presidents; and of Mr. W. Anderson, Mr. B. Baker, Mr. J. W. Barry, Sir Henry Bessemer, F.R.S., Mr. E. A. Cowper, Sir James N. Douglass, F.R.S., Sir Douglas Fox, Mr. C. Hawksley, Mr. J. Mansergh, Mr. W. H. Preece, F.R.S., Sir Robert Rawlinson, K.C.B., Sir E. J. Reed, K.C.B., F.R.S., M.P., Mr. W. Shelford, Mr. F. C. Stileman, and Sir William Thomson, F.R.S., as other members of the Council. The session was then adjourned until the 16th November.

HODSON'S PORTABLE DRILLING MACHINE.

THE increased size of iron structures, and the greater accuracy in workmanship required, render the advantages of portable drilling machines obvious. The days when the rivet holes in boiler plates were brought to meet by drifting, prising, and rimering may be said to have passed, and for the best modern work the holes in the two plates must be drilled together, which necessitates either the bringing of the work to the drilling machine, or the employment of some kind of portable apparatus, the latter expedient being evidently preferable, because not requiring the handling of heavy masses. We illustrate herewith an apparatus devised for this purpose by Mr. Richard Hodson, manager at the Thames Iron Works, for drilling, boring, tapping, or screwing holes in boilers, bridges, pontoons, and other structures. Figs. 1 and 2 show the general arrangement of the machine, and the rope gear by which it is driven, and Figs. 3 and 4 show details of the drilling machine itself. We will first describe the latter, and then pass on to notice the ingenious method by which Mr. Hodson transmits the power from a countershaft to the drilling machine without interfering with its perfect portability. In Figs. 3 and 4, A A¹ is a compound drill spindle bored out to receive the drill B, the cylindrical part of which is notched, and fastened in the usual way by a locking pin. The holder A, which has not been cross sectioned in Fig. 4 for the sake of clearness, is threaded internally to receive the threads of the screw spindle A¹, which is centred by means of a conical head held in an abutment C¹, and the collar F. To prevent the spindle from dropping out, the head is undercut, and held in place by the collar pin *c*. The abutment C¹ is carried, and can slide, on the arm C; it is, moreover, connected by means of the bar F¹ to the bearing F. The abutment C¹ can be clamped in any position on the bar C by means of the screw and handle on the top. The bar C itself can be placed at various angles by means of the screwed sleeve C², the fulcrum D², and connecting link C⁴. The inclination of the bar C is set by simply turning the handle on the top of the sleeve C², and thus a horizontal and angular adjustment is provided in addition to the vertical adjustment of the drill. The upright D¹ is clamped to the piece of work operated upon. Motion is transmitted to the drill by means of a rope passing on either side of the grooved pulley G. The rope does not lie at the bottom of the groove, but takes its bite against the inclined surfaces. Within the rope pulley, which is made in halves, there is the speed reducing gear, consisting of four spur wheels, the wheel 1 being keyed to the drill holder A, the wheel 2 forming part of the sleeve E, whilst the wheels 3 and 4 are cast in one, and revolve loose on a stud S, which is fixed to the pulley. When this pulley rotates and the sleeve E is held tight in the bearing F, rotary motion is communicated to the drill holder by reason of the wheel 2 acting as a fulcrum over which the wheel 4 rolls, thus causing the rotation of the wheel 3, which, being in gear with wheel 1, causes it to revolve at a slower rate than the pulley G,

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HODSON'S PORTABLE DRILLING MACHINE.

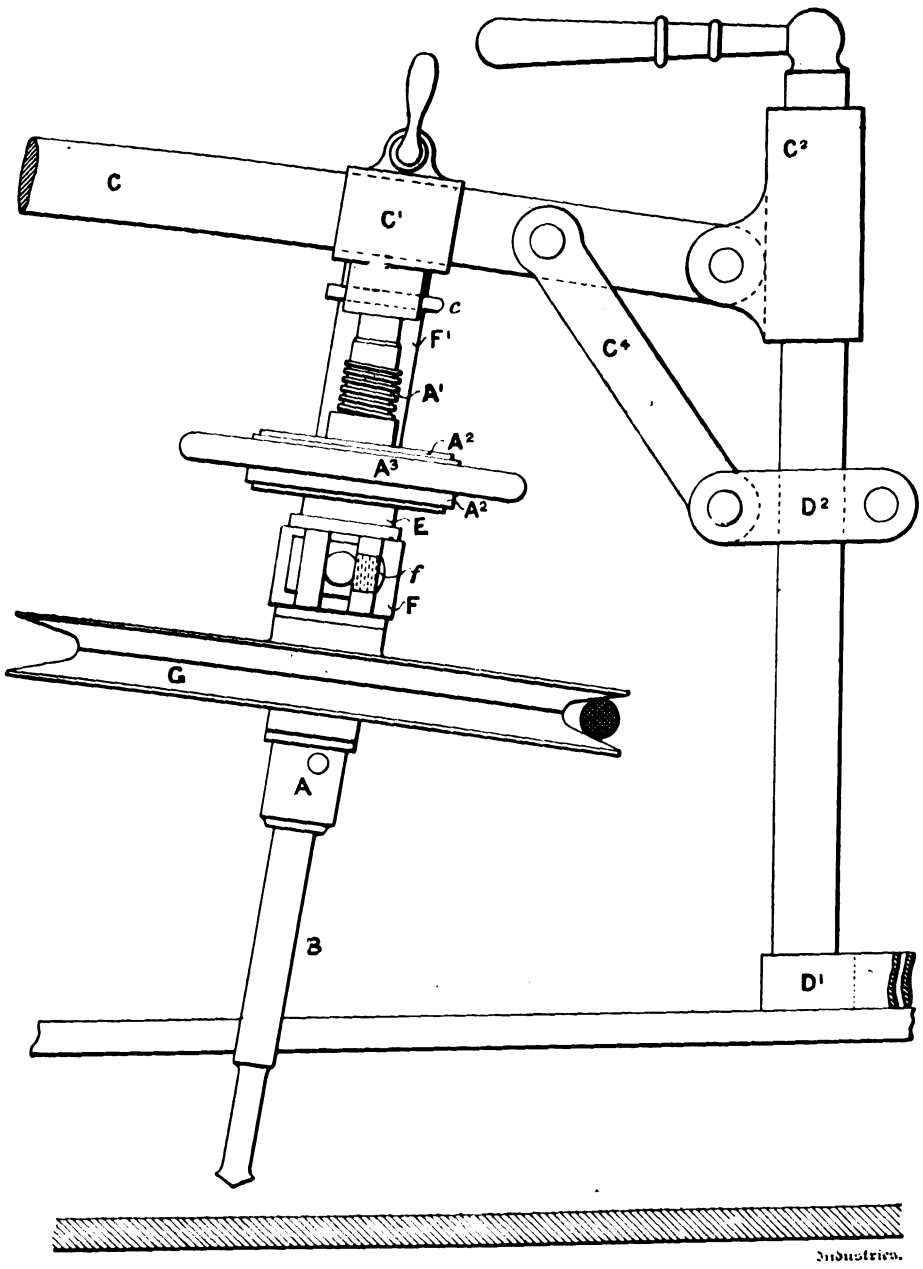


FIG. 3.

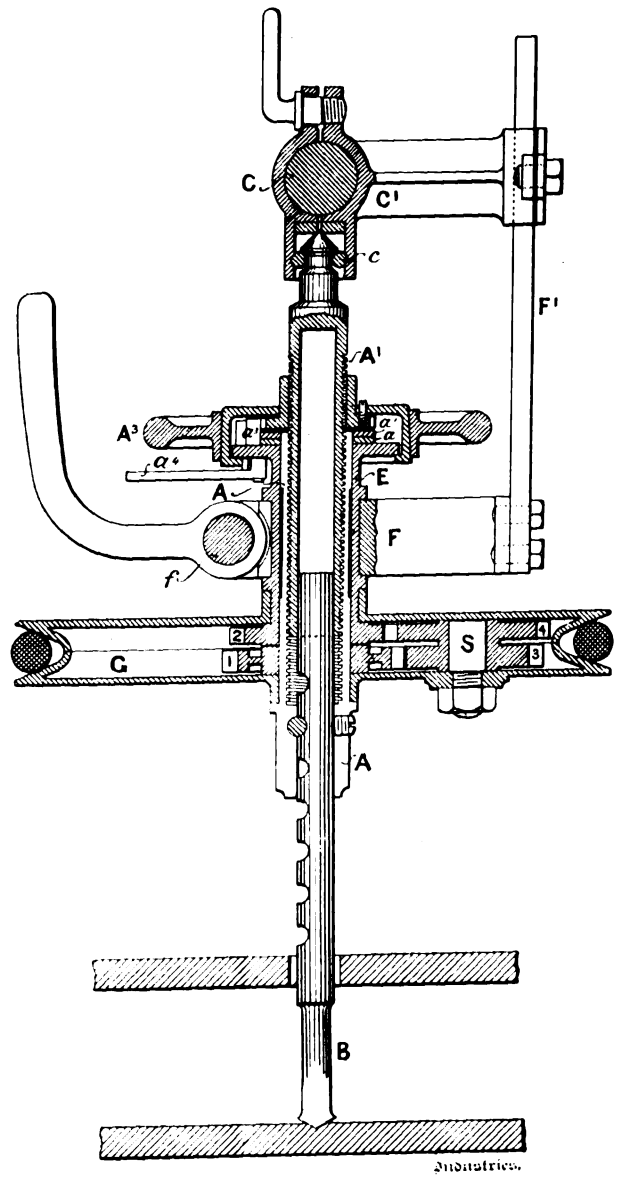


FIG. 4.

the reduction in speed being determined by the number of teeth in the wheels. The speed of the drill is varied by inserting another set of wheels into the pulley G. To stop the drill without stopping the rope, it is only necessary to move the curved handle above the rope pulley on its pin *f*, which slackens a screw, and thus takes off the friction between the bearing F and the sleeve E, allowing the latter to revolve with the pulley G. It is thus possible to instantly stop and start the drill as may be required by the simple movement of a lever. The feed motion may be given either by hand or automatically. The upper part of the screwed spindle A^1 is provided with a longitudinal groove in which slides a feather made fast to the sleeve of a ratchet wheel a^2 (Fig. 2) situated immediately above the two notched discs $a\,a^1$. The disc a^1 is keyed to the upper end of the tool holder A, and the disc a is made fast to the disc a^1. The ratchet wheel is free to slide up and down the screwed spindle, but must participate in its rotation, and it is locked in position by means of a pawl a^3, which is pivoted in a flange of the sleeve E and controlled by a lever a^4. The parts just described are enclosed within a cover made in halves, over which is placed a hand wheel A^3. By turning this hand wheel the drill can be advanced or withdrawn, as desired. The apparatus, however, serves also for the automatic feed motion. While the pawl is engaged with the ratchet wheel the tool holder A advances the drill slowly to its work; but on tripping the pawl within the gear by means of the lever a^4 this advance ceases. For automatically tripping the pawl during the operation of feeding, the notched discs $a\,a^1$ are used. Whilst these discs are in the position shown in Fig. 2 the pawl is in gear with the ratchet wheel a^2, and feeding takes place; but during the continued rotation the notch of the disc a^1 raises the pawl a^3 out of gear with the teeth of the ratchet wheel a^2, and thus interrupts the feed motion until the notch of the disc a has come round and allowed the pawl again to drop and engage with the teeth of the ratchet wheel, when feeding will again take place. The action is thus precisely similar to that of an ordinary ratchet brace, where from time to time the workman advances the tool holder by a definite amount. In the present case the amount of advance is determined by the length of the notch, which is regulated by the angular position of the two discs $a\,a^1$. This position is fixed by means of a screw working in a slot, as shown in Fig. 2. The feed motion is also automatically stopped when the rotation of the drill is stopped by turning the bent lever already mentioned. In this case the sleeve E will be carried round until the cam lever a^4 strikes the upright F^1, and thus lifts the pawl out of gear.

Mr. Hodson's portable drilling machine is specially adapted for drilling holes in line through two plates some distance apart, as shown in Fig. 4, such, for instance, as the shell and furnace plate of a boiler. The hole is first drilled through the shell, the drill is then liberated, advanced through the holder, and fixed again in position to drill the furnace plate. When this operation has been performed the drill can be replaced by a tap, which is, however, not fixed in the drill holder except in so far as it is forced to participate in its rotation. By this means two holes may be drilled and tapped without moving the apparatus from its position.

The arrangement of the rope driving gear will be understood from the general view (Fig. 1) and from the diagram (Fig. 2). Power is supplied from a countershaft and rope pulley H, the rope passing over the pulley I^1, partly round the pulley of the drill G, then round the pulley L at the end of a telescopic arm K^1, then partly round the pulley G on the other side, over the pulley I, and back to the pulley H on the countershaft. The pulleys I I^1 are mounted upon the cross piece K, which also carries the telescopic arm K^1 with its counterbalance W, and the rope is kept in tension by means of a weight *w* passing over a pulley N, which tends to draw the cross piece K away from the countershaft. The telescopic arm K^1 is carried in a cross piece K by means of a swivel joint, so that it may be shifted into any convenient position, as indicated by the dotted lines. By this means the drill is rendered portable within a radius of from 20ft. to 30ft. without shifting the pulley H on the countershaft or altering the length of the driving rope.

The advantages of this drilling machine are its extreme portability and lightness, one man being able to carry it about and fix it; its great power, due to the multiplying gear within the rope pulley, so that large holes may be drilled with only a few pounds tension on the driving rope; its accuracy, there being no unbalanced tension from the rope on the drill spindle; and its automatic action and facility of control. This machine is in use at the Thames Iron Works, where we had recently an opportunity of seeing it.

ITALIAN CUSTOMS DUTIES.—The Foreign Office has received information that a notification has been issued by the Italian Director-General of Customs, that invoices will no longer be accepted as proof of the origin of goods imported into Italy. All goods, in order to enjoy conventional treatment, must be furnished with a certificate of origin, except such as have come straight from the country of production or have been merely transhipped in a French port.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 12TH JUNE, 1888.

THE IRON MARKET.—The iron market is calm, but not dull. There is a steady current of business arising from the present needs of consumers, but the speculative spirit has wholly disappeared from the market. This state of things is likely to continue. The insecurity of the political situation tends to check the expansion of trade, and as no immediate improvement is to be looked for in this respect, the year will probably pass away without bringing that degree of activity which the events of the third and fourth months led us to hope for. The situation, however, is not one to complain of. Trade has recovered in a sufficient degree to make it fairly remunerative to the manufacturer, and this recovery is likely to be maintained. It is safe to predict a steady current of business till the end of the year. The Paris market is still unsettled, merchants offering bars at £5. 12s. and joists at £5. 4s.; but in the provinces the rates are firmly upheld. Old rails fetch £3. 6s. a ton.

THE GOVERNMENT AND THE WORKING CLASSES.—The acts, both of the Legislature and of the Executive, evince a desire on the part of the Government to conciliate the working classes. Some of the concessions accorded, however, are of a nature to cause discontent among the employers of labour, and to obstruct the natural development of industry. Thus, the *Journal Officiel* has published a decree regulating the conditions according to which associations of working men are to be permitted to execute Government work. Such associations may tender publicly, or enter into contracts privately. They are relieved of the necessity of providing caution money for contracts below £2,000. When there is equality in the tender between a workmen's association and a contractor, the former is to have the preference, and the association may draw money on account every fortnight.

THE EXHIBITION OF 1889.—The Minister of Commerce has just been informed that Finland will take part in the great Exhibition of next year. An influential syndicate of Finnish manufacturers has been formed to promote this object. It is also officially announced that the United States will exhibit on a large scale. American manufacturers of mining machinery will be strongly represented. In bringing this class of machinery to Paris, the exhibitors are, it is said, aiming not so much at the European as at the South American, South African, and Australian markets. In electric motors, and systems of transmitting power by electricity, the United States section will be particularly strong. It is proposed by an American firm to put up a 100-stamp mill at the Sheba Mine at Barberton, South Africa, and to drive it by electricity generated at a waterfall ten miles distant. It is probable that a working model of this mill will be exhibited here.

PROSPECTS OF THE HOP CROP.—The hop market is becoming agitated. The dry weather following on a cold spring is beginning to tell unfavourably upon the new crop. The bines are yellow and weak, and growers are becoming alarmed at the prospect before them. In consequence of these apprehensions, a brisk demand has sprung up for old hops, for which higher prices are readily paid. From Alsace it is reported that a large proportion, fully half the possible yield, of the growing crop has already been sold at prices varying between 60fr. and 70fr. (55s. and 63s.) per cwt. These sales are evidence of a want of money on the part of the growers, a want which is more felt every year.

THE DECANVILLE LIGHT RAILWAY.—Visitors to the Laon Exhibition will find something to interest them in the light railway or steam tramway laid down by M. Decanville from the railway station to the exhibition building, a distance of a mile and a quarter. The gradients are as steep as 6 in 100, and some of the curves have a radius of only 26 metres. The rails are laid on the highway; their weight is 9·5 kilo. per metre run, and the gauge of the line is 60cm. The whole distance was laid by forty men in four days. A compound locomotive on the Mallet system is used, weighing 12 tons, inclusive of water and coal. There are three cars in the train, each constructed to carry thirty-two passengers.

BERLIN, 11TH JUNE, 1888.

THE COAL MARKET.—The steady improvement in the price of all classes of coal and coke still continues, and as regards coke the immediate effect has been to increase the number of ovens at work. A change of considerable importance has taken place in the Upper Silesian coal industry, viz., the purchase by Messrs. Friedländer & Co. of the extensive colliery hitherto belonging to Count Henckel von Donnersmarck, which has an annual production of 800,000 tons. The same firm has also acquired the colliery of Count Schaffgot in the same district, and as these two collieries are amongst the most important in Upper Silesia, the firm is likely in future to control the market.

ACTIVITY IN THE COAL TRADE.—The official report of the Dortmund Coal Club on the state of the market says that business is still animated, and in some directions increasing, though we have arrived at a season when trade is usually dull. It is further stated in confirmation of this remark that many colliery companies have sold the whole of their output for the present year.

THE IRON MARKET.—The general tone of the iron market is firm, but the amount of business being done is less than in the corresponding period of the previous year. The rolled iron syndicate of Mid-Germany have decided at their last meeting to maintain the present prices. The most important reason for the refusal of the society of Westphalian wire nail makers to join the German wire nail syndicate, to which I referred last week, has now transpired. It appears that the Society has a specially good foreign connection, and does not want its customers' names to become known to the syndicate. The industrial importance of the present crisis in the wire nail trade may be inferred from the fact that if the Society succeeds in breaking up the syndicate, the present average price of 160s. per ton for wire nails would inevitably recede to its former low level of 120s. The loss would be most felt by the wire nail makers of Hamm, who produce collectively about 24,000 tons of nails annually. In Upper Silesia business is normal, and the output of crude iron is quite up to the demand. The erection of new blast furnaces and accessory apparatus at the works of the Falvahütte and Friedenshütte is making rapid progress, owing to the favourable weather. The rolled iron syndicate contemplate a further rise in prices for the third quarter of the year, and a new sales bureau at Frankfort-on-the-Main is also projected. The recent tenders for steel rails and steel sleepers invited by the Bavarian railway administration are instructive. The supply was for 13,500 tons of rails and 11,100 tons of sleepers, and the order has been divided amongst the following firms: For rails, Messrs. Stumm Brothers, of Neunkirchen, 3600 tons at 117s. 5d.; the Aachener Hütten Aktien Verein, 3600 tons at 117s. 5d.; Bochum, 3000 tons at 117s. 9d.; the Rheinische Stahlwerke, of Rührort, 1800 tons at 117s. 7d.; and the Phœnix Company, of Laar, 1500 tons at 117s. 8d. For sleepers, Messrs. Stumm Brothers, 3000 tons at 119s. 6d.; Bochum, 2640 tons at 119s. 5d.; De Wendel & Co., 1500 tons at 119s. 10d.; the Phœnix Company, 1320 tons at 119s. 6½d.; the Hösch Works, of Dortmund, 1320 tons at 119s. 7d.; and the Rheinische Stahlwerke, 1320 tons at 119s. 3d. These prices are free on rails in Mannheim, and the greater part of the orders must be filled between March and July next year, the remainder before December. No foreign firms have tendered in this competition. The Cologne railway administration have asked tenders for fourteen tender locomotives and fifty-nine waggons of various sizes. The offers received from private firms were throughout lower than those of the State railway shops. For three coupled tender locomotives, Henschel, of Cassel, tendered lowest with £965 each.

GERMANY'S FOREIGN TRADE DURING APRIL.—The statistics recently issued concerning the import and export trade during the month of April of this year are by no means encouraging to German industry. In nearly all branches of the iron trade the exports have receded as compared with the same month of the previous year, the deficiency being most felt in crude iron, bar iron, iron and steel wire, and zinc. For rolled iron and wire nails the returns are somewhat more favourable, but the decrease in the export of crude iron is very great. In April, 1887, there were exported over 25,000 tons of pig, whereas in the same month of the current year only 9000 tons were exported. The exports of cement, coke, and iron ores have, however, increased. The imports show an increase in rye, oats, copper, tin, and cotton.

VIENNA, 11TH JUNE, 1888.

PAPER.—The present position of the paper industry throughout Austria is by no means satisfactory. One of the largest mills was forced a short time ago to go into liquidation, and another large mill, which used in former years to pay good dividends, is now unable to pay its shareholders any dividends at all. Generally speaking, the paper mills manage with difficulty to pay even the interest on their capital expenditure, to say nothing of profits, and this state of things is ascribed partly to overproduction, and partly to excessive competition and cutting of prices, which are, to a certain extent, encouraged even by the Government and public administrations. It has of late become the rule to give the orders to those firms who have sent in the lowest tenders, quite irrespective of the reputation and standing of these firms, and the result is that the quality of the paper supplied under these contracts becomes worse from year to year. I have recently heard of a case where a Government office had to spend a large sum on mending official documents written on paper which was supplied only three years ago, and thus the saving effected in the acceptance of the lowest tender becomes to a great extent illusory. Some of the more respectable paper mills are now trying to mend matters by forming a syndicate of paper makers, which would regulate quality, prices, and quantity produced; and a circular has been issued to the paper mills in Austria-Hungary with this object. Of the 267 mills applied to, only twenty-two have, however, agreed to the proposal, and thus the project must be considered as having failed. It is now proposed to form six local syndicates in various parts of the country, each to select a representative, who will join the general syndicate, and this proposal seems to be more favourably received.

THE IRON MARKET.—The general tendency of the market is quiet, and there is every indication that business will not revive again during the summer season. On the whole the spring season has been bad, and has not fulfilled the expectations which were entertained at the beginning of the year. The sudden demand for building iron which then set in was only of a temporary nature, and the sales of girders, joists, and special sections for building purposes have been less this year than during the same period in the previous year. As a set off for the smaller volume of business, the prices have on the whole ruled rather higher; but the difference was not sufficient to make up for the loss in volume. The present demand for crude iron, merchant bars, and fine sheets is very feeble. On the other hand, heavy sheets still continue to be in good request. Engineering works, especially those in Bohemia and Moravia, are busy with plant for sugar factories, being either new machinery or repair jobs. Some small orders for railway waggons have been distributed during the last week amongst a few of the Austrian waggon works. These orders will help them to tide over the dull season.—The proposed railway line (Eisenerz-Vordernberg) has at last passed the Parliamentary stage, and will soon be taken in hand. When completed, this line will form a very valuable aid to the Styrian iron industry, which has for the last few years been very much depressed.—On the 1st of this month an agreement was arrived at between the Austrian makers of wire and wire nails, under which the price of both articles will be raised 10fl. (about 16s.) per ton. The agreement is equivalent to syndicating this trade, a measure which appeared almost inevitable in view of the steady decline of prices which has taken place within the last ten or twelve years. In 1875, the average price of wire was 232fl. per ton, and in 1878 it was 178fl., whilst in 1881 it had sunk to 157fl. In the following two years there was a slight recovery to 167fl., but then prices again began to drop until last year, when they reached, for wire and nails, the low level of 148fl. From these figures it will be seen that the rise resolved upon by the syndicate will only bring the price back to the average of 1881.

EXPLOSIVES.—The manufacture of explosives has assumed considerable proportions in this country, especially as regards gelatine dynamite and an explosive called rhexite. The first is made by the Nobel Company, and the latter by Messrs. Borkenstein & Co., of St. Lamprecht. The composition of these explosives is, according to a technical committee instituted by the War Office, as follows:—

GELATINE DYNAMITE.	Per cent.
Nitro-glycerine	64
Dinitro-cellulose	2·47
Soda saltpetre	24·85
Wood pulp	7·73
Soda	·57
Ferruginous clay	·38

RHEXITE.	Per cent.
Nitro-glycerine	61·4
Nitrated wood	9·1
Wood pulp	12·6
Potash saltpetre	16·9

Both of these explosives are similar in action and require treatment similar to the old form of kieselguhr dynamite.

PORTABLE ELECTRIC LIGHT PLANT.—Messrs. Siemens and Halske, of this town, have constructed an electric light car containing boiler, steam dynamo, and accessories, which weighs without coal or water 3 tons 8cwt. Steam is supplied by a vertical boiler of 90 sq. ft. heating surface. The dynamo is direct driven by an inverted engine developing 9 h.p. It has a Gramme armature, with internal poles of the type which you illustrated some time ago. The output is 90 ampères at 55 volts pressure, and the makers claim that they obtain one electrical h.p. with an expenditure of 44lb. of feed water per hour.

BRUSSELS, 12TH JUNE, 1888.

THE COAL MARKET.—Coal for industrial purposes and for coking is dear, and stocks generally are smaller than is usual at this season. The demand for household coal has, however, decreased. At Charleroi and in the central districts unscreened industrial coal is quoted at 6s. 5d. to 8s., and coke at 12s. At Liège rates are rather higher. From that district considerable quantities of coal are being sent to Paris. At Mons unscreened coal is quoted at 7s. 7d. to 8s. The situation is very favourable, and promises well for the period when contracts will have to be renewed. The contracts for briquettes for the Ostend mail steamers have been given to M. Felix, of Haynin, and to the Houillères-Unies, at 9s. 11d. and 10s. 4d. per ton respectively.

THE METAL MARKET.—There is now less difficulty in obtaining pig iron, and stocks are becoming larger. Sellers, in consequence, have to make concessions. This is fortunate, as the exceptionally high prices which have been ruling have had an injurious effect on the export trade in finished iron. The prices of 38s. 5d. to 40s. for white pig, and 43s. 2d. to 44s. for grey pig, are now looked upon as the maximum rates. Luxemburg pig is quoted at 38s. 5d., or about 42s. 8d. delivered at Charleroi. The syndicate price of merchant iron is maintained, no sales being made in the home market at less than 96s., or for export under 92s. The price of No. 2 sheets is 120s., and of large plates, 112s; steel sheets are 140s. Business in sheets is active, but for small iron the demand has decreased. Large quantities of iron ore from the Haute Moselle are being imported into the Charleroi district. It forms about 25 per cent. of the total ore used, and this proportion is likely to increase. With respect to the contract for Goliath rails, to which I referred in a recent letter, although some complaints have been made in industrial circles at part of the contracts having gone to the French works, there is no doubt that had our Government declined to accept the tender, the French would have retaliated when an opportunity offered. The Dyle-Bacalan works have received a contract for fourteen locomotive tenders for the State railways at £2,740; La Métallurgique Works quoted £2,869.

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THE EXHIBITION.—The inauguration of the Exhibition by the King took place on Thursday last, when speeches were made by the Foreign Minister, and by the President of the Exhibition, in reply to which His Majesty pointed out the importance of promoting the interests of home industries. The King then went through the various sections, and was presented by M. Muzet, the French delegate, with a magnificent Sevres vase. In the Belgium section he was received by Comte A. d'Oultremont, the Commissioner-General. He was taken through the machinery gallery by the engineers, Messrs. D. Robinson and H. Delchambre, two of the large engines being at work. The first engine which was ready in this department was one of 50 h.p., made by M. Heinrichs, of Hodincourt-lez-Verviers. The King showed considerable interest in the exhibits of Messrs. Westinghouse. The electrical section was under the charge of M. Bandsept. A part of the electric lighting, viz., that of the Electrique Company, was ready. The Thomson-Houston Company have an 80 h.p. high speed engine, two dynamos respectively for 45 and 35 arc lamps of 10 ampères, and a plant for electric welding. Messrs. Ganz & Co. have a high tension alternator of 25 ampères and 1000 volts, supplying 200 glow lamps. The Khotinsky Company show two of their storage batteries, each for 250 lamps, and a Toury dynamo. Buckaert & Schuckert have six dynamos and a military search lamp. The Société Industrielle exhibit various sizes of the Lahmeyer dynamo, some in conjunction with 7 ampère arc lamps. In the English section, which looks very well and which is complete, Mr. Lee Bapty received the King. This section is lighted by the Brush Corporation. The honours of the German section were done by M. Corneli, those of the Austro-Hungarian section by Consul-General Duckers, and of the Italian section by Conte Miraflore. There were 50,000 visitors on this day, and the Exhibition promises after all to turn out a success.

DÜSSELDORF, 11TH JUNE, 1888.

THE COAL TRADE.—Though we are in the midst of what is usually the dullest season of the year, the coal trade is characterised by great activity and rising prices. The demand for present consumption is strong, and consumers and merchants are seeking to contract far forward, in anticipation of larger requirements. Production is being pushed to the utmost of what the pits are capable, hampered only by an insufficient supply of railway trucks. The quantity of coal daily dispatched from the Ruhr district averages about 9000 truck loads. This strong demand for fuel in the summer season is the best possible evidence of reviving trade throughout the country. Notwithstanding the larger output of the home mines, more foreign coal is being purchased. The imports in the first four months of the current year amounted to 2,226,778 tons, against 2,053,731 tons in the corresponding period of 1887, an increase of 8·43 per cent. This increase is chiefly in the trade with England. The shipments of British coal to Germany down to April 30th, amounted to 631,580 tons, against 576,157 tons last year. The exports of German coal in the four months reached a total of 3,242,318 tons, against 3,182,759 tons last year, an increase of 1·87 per cent. The ratio of imports to exports is for the current year 0·687; that is, for every ton of German coal sold to foreign consumers, 0·687 ton of foreign coal has been purchased for consumption in Germany. Last year the ratio was 0·645 ton.

THE IRON MARKET.—The iron market is on the whole steady, the current of business being fairly strong, and prices firmly maintained; but the trade in pig is dull, and there are indications of greater languor to come. Consumers, who, for the most part, have provided for their probable wants in the next four months, exhibit an unwillingness to speculate further; yet, as the cost of ore and coke continues to increase, higher prices for pig are expected. The circumstances of the finished iron trade, however, do not justify another advance; on the contrary, they call for lower rates. It has become painfully clear that if relief be not speedily afforded, the export trade will be utterly ruined. An incident of some significance occurred last week. A Frankfort firm offered to sell 10 per cent. spiegel pig 10s. a ton below current rates for delivery at the end of the year. This fact points to a belief, on the part of these merchants at least, that the inevitable collapse is not a very distant event. The manufacturers, however, have shown their determination to maintain their prices to the last moment, by combining to boycott the Frankfort firm during the remainder of the year. The consumption of pig iron in Germany in the first four months of the year, estimated from the production and imports, less the exports in that period, amounted to 1,400,305 tons, against 1,157,847 tons last year, an increase of 242,458 tons, or about 21 per cent. Makers of bars and sectional iron are busy on old orders, but new work is being booked slowly. The trade in joists is animated. A somewhat brisker demand has sprung up for wire, both on home and foreign account. Efforts, likely, it is said, to prove successful, are being made to save the wire nail syndicate, by inducing the outstanding Westphalian firm to join it.

LILLE, 12TH JUNE, 1888.

TEXTILE MANUFACTURES.—There is not much that is new to report in the state of the trade in textile goods, dulness continuing to prevail. Here and there, however, we see a partial recovery. Thus, at Armentières the week has been a good one in the linen goods trade, a fairly brisk demand having sprung up within the last few days. This revival is probably due to the activity prevailing in the flax and yarn markets since it became evident that the growing crop must be a light one. There is but little life in the cotton goods trade. In spite of favourable weather, business at Rouen is very dull. The buying is not sufficient to absorb the production, which is already considerably restricted. Manufacturers complain bitterly of the languid tone of affairs. In woollens there is scarcely more life, considered from a point of view embracing the whole trade. In one or two classes of goods, fancy articles, there is some activity, but the long expected revival is delayed. The Lyons silk goods trade is dull and languid. Manufacturers are altogether dissatisfied with the amount of business transacted in the month of May. The favourable accounts received from nearly all the silk-producing localities point to lower prices for the raw material. This circumstance tends to restrict the trade in woven goods.

FLAX AND YARN MARKETS.—The activity which characterised the flax and yarn markets last week is maintained, and even increases. The prospects of the new crop are very discouraging. It is stated by a competent authority that even with favourable weather the yield must be much below the average. Rain has fallen in considerable quantity in the last two or three days. All home grown flax offered for sale has been eagerly bought at prices in every case above those quoted last week. Large transactions, too, have taken place in Russian produce. The change in the weather has checked the upward tendency of the market; but, whatever the season may now be, a return to former prices is now impossible. Yarns have been in brisk demand. In most cases spinners have been able to obtain some advance in prices. They are, however, by no means eager to commit themselves to important contracts for long forward delivery, the outlook being yet uncertain. The general impression is that prices will go higher. Jute yarns have shared in the activity of the last week, and prices have become very firm.

THE IRON MARKET.—The iron market preserves the even tenor of its way. There is no speculation, and nothing that can be described as animation; but fresh orders to hand are numerous if not large, and manufacturers are without difficulty able to maintain their prices. The Northern Railway Company are purchasing Vignoles rails, 12 metres in length, and weighing 43 kilo. per metre. Several miles of line have been laid with these rails, with highly satisfactory results. The "way" possesses greater stability, and jolting is much lessened.

AMSTERDAM, 12TH JUNE, 1888.

THE MAILS.—In connection with the popular route between England and the Continent, *viâ* Queenboro' and Flushing, negotiations have taken place between the German and Dutch Governments, as far as the mail trains are concerned which run between Germany and the Dutch port. Hitherto the route chosen was by Boxtel and Wesel. The German authorities do not consider this the most direct and best, and have therefore suggested another route, *viâ* Crefeld and Venlo. The Dutch Government did not agree to this, and dispatched two delegates to Berlin, in order to negotiate with Herr Stephan, the German Postmaster-General. They do not seem to have entirely succeeded, for it is announced that the German Government is only willing to continue the use of the route *viâ* Boxtel and Wesel for North Germany, particularly Hamburg and Bremen; but for Berlin and Central Germany Herr Stephan insists upon the route by Crefeld and Venlo.

MADRID, 11TH JUNE, 1888.

THE BARCELONA EXHIBITION.—Notwithstanding the fact that the Exhibition has been formally opened by the Queen, it is still in an incomplete state. During the hottest of the summer months it will be closed, and will be re-opened again in September. By that time there will be some novelties of general interest representative of Catalan industries.

IRON ORE.—Stocks of iron ore are accumulating at Carthagena, shipments having been smaller than the quantities raised, and complaints as to the state of business are being heard in consequence.

IRON WORKS.—The iron works at Beasain, which include two charcoal blast furnaces and a Siemens-Martin furnace, are for sale. The owners have found it advisable to transfer their plant for the manufacture of tin plates and for general purposes to Bilbao; but the works are very suitable for making the best pig iron for special steel, and for mitis castings.

ELECTRIC LIGHTING.—Some theatre proprietors, whose arrangements are not sufficiently far advanced to allow of their installing the electric light by next September, as required by the present regulations, have agreed to petition the Government for an extension of time. In the meantime two of their number have been deputed to visit France and England, to inquire into the best system to be adopted; but as they are not technical men, the probabilities are that they will return about as wise as they were when they started. The Gülcher Company are going to light part of Madrid, the installation being one of about 4000 lights. It is quite clear that a large central station of 20,000 to 30,000 lights would be a profitable speculation in Madrid, as the light could be sold at a high price. The mistake made by those who took the matter up was in aiming at making a profit on erecting the installation instead of on supplying the light.

NEW YORK, 2ND JUNE, 1888.

THE COAL MARKET.—The anthracite coal market shows a better tone than it has done for some time past, but the quantity of business is no greater. Individual operators who have been doing the heaviest cutting in prices have in some cases advanced their rates a little, having taken orders which will keep them employed for some time, and being in consequence more independent. Bituminous coal is still dull, but the market is nearly sold out. There are a few large buyers who are still waiting for lower prices, but this is not likely to occur.

THE IRON MARKET.—The principal topic of interest to the iron trade has been the reduction made by the Thomas Iron Company, and there is no doubt that there will be a re-adjustment of prices all around. Until this is done trading will be limited to the small lots of iron required for immediate use. Prices of pig iron are all lower, but sellers are not generally inclined to meet the Thomas Company's prices. Good No. 1 foundry iron cannot now be bought in the market at less than $19 per ton, and the Thomas Company will only sell to their own customers at $18. The market is still a waiting one, and it is by no means certain that competition is at an end. A month ago the iron masters told the railroad managers that they must have lower rates or shut down, and having been granted part of the reduction asked for, they have now reduced the price of iron, hoping that that will increase the demand; with regard to manufactured iron a decided improvement is noticeable in the number of inquiries, and in the case of a few leading mills a moderate addition has been made to the orders in hand. Prices are very low, however, and give no indication of improving; but with fuller employment and cheaper material manufacturers are disposed to think that the worst is over. Some very large orders have been taken within the past week, and it is understood that other contracts are only waiting the completion of financial arrangements, which, with the present easy money market, ought to be easily done. The general market rates are about 1·8c. to 1·9c. per lb. for bars, and 2·0c. to 2·1c. for plates and angles; but special rates can be obtained for large orders. There has been no new business in steel rails, but prices remain at $31 to $31·50 per ton at the mill.

THE METAL MARKET.—The most noteworthy thing in the copper market has been the pool sale to consumers. Though nominally made by the combination of mining companies, it was practically made by the syndicate. The sale amounted to about £9,000,000, and covered deliveries for June, July, and August, at 16½c. per lb. Instead of selling to customers in a body, as has heretofore been done, contracts have been made with individual consumers, who are not allowed to part with more than a small quantity of their purchases, and that only at ¼c. above the price paid by them. There has been little inclination to speculate in near deliveries, but some sales have been made for January delivery at 16c. The tin market at the beginning of the week was dull; but the situation is becoming stronger, as the stocks of dealers and consumers are getting very low. Closing quotations are at 21½c. per lb. for spot. There has been a little more business in lead, sales amounting to about 300 tons at prices as low as 3·95c. per lb. The price is likely to decline during the coming summer months, and consumers are looking for it to reach 3½c.

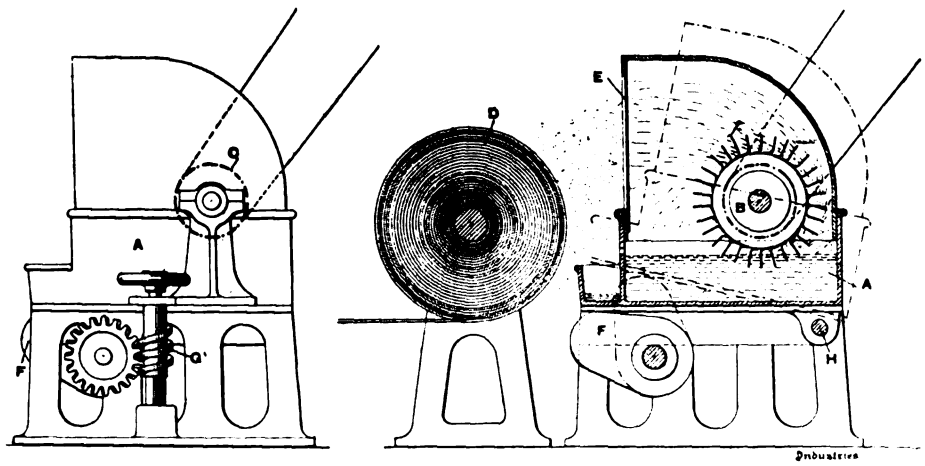
ELECTRIC LIGHTING.—The Westinghouse Electric Company are engaged in making experiments to obtain data regarding the long distance distribution of electric lighting on their system. A number of lights were put up at a distance of four miles from the dynamo, and as a result of their trial several changes were found necessary in the methods used. The firm is now erecting two plants, one at Bernardino and the other at Riverside, California.

THE PHONOGRAPH.—The Edison Phonograph Company has been incorporated at Newark, New Jersey, with a capital of £60,000. It is stated that the factory at Bloomfield, N.J., is turning out phonographs at the rate of twenty per day, and unless something unexpected occurs the first order will be filled by the middle of June or sooner. The price of the commercial phonograph, which Mr. Edison expects will take the place of the short hand clerk, is £17.

THE DISTILLATION OF SEA WATER.—The Government is fitting a distilling apparatus in many of the new ships, which has several features to recommend it. It has been necessary heretofore to have a donkey boiler, or to set one main boiler aside for use in distilling, and either plan has its inconveniences. As steam will be used constantly in the new ships for power purposes, with the new arrangement, the same boiler can also be used for making fresh water without the oily unpleasantness that usually accompanies distilled water made from a boiler fed from a surface condenser. Steam from a special boiler is led through a series of coils, which are contained in a vessel supplied with sea water. The steam is condensed, or partly so, and falls into the condenser. A portion of the sea water is evaporated and is carried into a second coil in which it is also condensed, and this water is of excellent quality. The first vessel is fitted with blow-off and brine cocks, and occupies very much less floor space than a donkey boiler of the necessary capacity would do. A test made with one of these arrangements, having 52 sq. ft. heating surface in the evaporator, maintained a pressure of 51lb., and had a capacity of 900 gallons of water per day.

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BREADNER'S COPPER DAMPING BRUSH.



BREADNER'S COPPER DAMPING BRUSH.

THE above illustrations show an improved copper damping brush, introduced by Mr. E. Breadner, Ogden's Chambers, 134, Deansgate, Manchester, which has been designed with a view to furnish paper makers, calico printers, and bleachers with an apparatus for thoroughly and evenly damping materials. As will be seen from the illustrations, the machine consists of a tank A, in which a roller B is revolved by means of a belt on the pulley C. The roller B is provided with a great number—about 14,000—brush points, which take the water from the tank A and throw it against a sheet of wire gauze E, thereby producing a fine and evenly distributed spray, which damps the roll D of the material under operation. The tank A is pivoted at H, and may be raised into the position indicated by the dotted lines by means of a cam F, which is actuated by the worm G and a worm wheel. By thus raising or lowering A a finer or coarser spray is accordingly produced. The advantages claimed for this machine are, that the damping is done more thoroughly and more evenly than with the apparatus now in use, and that the copper brush does not wear to the same extent as fibre or bristle brushes, which, when worn, distribute the water unevenly, besides being a source of constant trouble and expense.

EMERY TESTING MACHINE.*

ALMOST from the commencement of modern engineering practice, the need has been recognised of obtaining accurate knowledge of the strength of materials as a basis for all work of design and construction; and the earlier engineers addressed themselves to this object with an earnestness and intelligence which will always command admiration, especially in view of the fact that the circumstances of their times required all such work to be done at their own expense, and usually with their own hands and heads. The ability which they brought to bear upon it, and the thoroughness with which it was accomplished, are best evidenced by the fact that the determinations of Tredgold, Buchanan, Rennie, and many others, were accepted by the engineering profession at large for more than half a century, and have only recently been superseded by the more accurate and extensive determinations of later investigators, assisted by modern appliances, and often aided materially by governmental support. Nearly all the earlier determinations of the strength of metals, whether made by the older authorities above named, or by the succeeding group, represented by Fairbairn, Stephenson, Clark, Kirkaldy, and many others, were based upon small specimens, of which the greatest transverse dimension rarely exceeded 1in. The co-efficients determined from these small specimens were for a long time accepted as a true index of the resistance per unit of section in all structural members composed of the same material, whether of large or small size. In recent years, however, engineers have had forced upon their attention the fact that material produced and used in large masses does not generally possess the same physical qualities as in the smaller and carefully prepared forms that were usually adopted in making the earlier experimental investigations. All doubts on this point were speedily dispelled, as soon as testing appliances were provided, however crude, of capacity sufficient to test specimens of even the smallest sizes usually employed in engineering construction. As a result the present tendency is towards the multiplication of testing machines, for enabling every large engineering works to test the whole of its important material; and is still more markedly in the direction of employing machines of such capacity and strength as to enable material of all kinds and of nearly all dimensions used in practice to be tested up to the point of deformation or destruction. In the United States, the importance of this matter was early recognised and discussed, with the result that in 1875 a committee was appointed by Congress for the special object of conducting investigations in regard to the strength of materials, and funds were appropriated for the purpose. This body, which became known as the United States Board for Testing Iron, Steel, and Other Materials, entered upon their work in 1875, and during that and the succeeding three or four years made a great number of experimental investigations, which were subsequently published by the United States Government, and have been of great value. One of the most important actions of the Board, and the one which probably constitutes their chief monument, was the acquisition of the 400-ton (American ton of 2000lb., 400 tons American = 357 tons English) testing machine erected at the United States Arsenal at Watertown, Massachusetts, and still situated there. From the commencement of their work, the Board recognised the importance of securing a testing machine possessing a degree of accuracy far greater than had previously been attained, and enabling it to be justly ranked as an instrument of precision. A machine of 800,000lb. or 357 tons capacity, was accordingly ordered from Mr. A. H. Emery, of New York, which was guaranteed by the maker to possess the stipulated qualities of precision, endurance, and general adaptability to the work. The machine was completed and put into use in 1879, since which year it has been in constant service, having tested up to the present time more than 15,000 specimens, of dimensions varying throughout the entire range of its capacity. It was subjected originally to a test load of 1,000,000lb., or 25 per cent. beyond its intended limit. The largest section of wrought iron that has been broken in it had a diameter of 5·04in., or an area of 20 sq. in. The machine will test in tension specimens up to 28ft. long by 30in. wide, and in compression columns up to 30ft. long. Its sensitiveness is such as to show distinctly on the indicator a force of only one pound applied to the specimen. During all its years of constant service it has maintained unimpaired its efficiency, accuracy, and sensitiveness, and is to-day as perfect in its action as when first erected: its mechanism is remarkable as well for originality as for perfection. During the past five years the construction of testing machines on the Emery system has been regularly carried on in the works of the Yale and Towne Manufacturing Company, Stamford, Connecticut, under the direction of the writer, where numerous machines have been built of various dimensions and capacities adapted to the requirements of commercial work. It is therefore believed that a description of one of these machines, including what is novel and worthy of remark in its details, will not be without interest to English engineers. The designs selected for description are those for a vertical testing machine of 300,000lb., or 133 English tons capacity, two of which have already been built and have proved exceptionally excellent in actual service. The illustrations given hereafter clearly show the construction of this machine.

Principles of the Emery Machine.—In the broad principles of construction on which the Emery system of testing and weighing machinery rests are included two radically new and highly important elements, viz.: (1) An arrangement of hydraulic chambers and diaphragms, capable of receiving without injury pressures and shocks of great intensity, and of transmitting these simultaneously, without loss from friction, to a convenient point for the purpose of measuring and recording them; and capable also of reducing them to such lower term or degree as may be desirable. (2) A means for flexibly uniting a vibrating scale beam either to a fixed abutment or to another beam of the same system, in such manner as absolutely to eliminate friction, and to preserve indefinitely the fulcrum intervals or distances precisely as first adjusted, and to resist and transmit all the pressures and shocks to which the fulcrums are subjected, without in the slightest degree impairing their sensitiveness or durability.

Hydraulic Chambers.—The hydraulic construction is such that through it the load or strain put on the specimen is transmitted without loss to a hydraulic chamber or "support," in which is confined a thin film of liquid, usually 0·015in. in thickness, the plane of which is normal to the axis of the machine and to the direction of strain. The area of this film is such that the maximum strain applied to the specimen, and through it to the hydraulic support, shall not be more than can be borne with safety in its most exposed part by the thin diaphragm which seals the chamber. There may be several of these supporting chambers, as in the case of the Watertown machine, where the load is received upon four such supports; or there may be only one, as in the case of the machine now to be described. The pressure per square inch on the liquid within the hydraulic support is transmitted through a small copper tube, without loss from friction or otherwise, to a much smaller chamber or "reducer," containing a similar thin film of liquid. The acting area of the liquid in the reducer is less than that in the larger chamber or support, in the proportion in which the load on the specimen is desired to be reduced before it is received upon the beams in the scale case where it is measured or weighed. In the present machine this reduction is as 30 to 1. The maximum load of 300,000lb. on the large support is thus reduced to a maximum of 10,000lb. on the reducer; and this latter strain is all that is transmitted to the beams in the scale case. The elastic resistance to bending of the sealing diaphragm in the hydraulic support causes a slight reduction of the pressure transmitted to the liquid under the sealing diaphragm of the reducer. As the diaphragms, however, are of very thin sheet brass, usually not more than 0·005in. thick, and as the maximum motion of the piston of the support is less than 0·001in. while the free span of the diaphragm is 0·10in., this reduction in pressure is very slight, and is practically immaterial, for the reason that it is fully taken account of in the adjustment of the weighing mechanism.

Levers.—In the scale case containing the weighing mechanism, the pressure transmitted from the reducer is received at one end of a system of levers, and is accurately measured by means of devices described later on. It is first received upon a single lever having a ratio of 20 to 1, whereby one-twentieth of the pressure is transmitted to a second lever, from which is suspended a series of poise rods arranged to carry the balancing weights for weighing the load. This second lever, having a ratio of 25 to 1, is also connected to a third lever or indicator bar, the arms of which are as 40 to 1. The motion of the point of the indicator bar is consequently 20,000 times that of the reducer piston, and therefore 600,000 times that of the piston in the main support, which is directly connected with the specimen under test. As the force required to move any one of the poise weights for showing a change of balance will vary directly as the square of the velocity of its movement, it follows that, since the poise weights move only one-fortieth as much as the indicator, their resistance to the movement required by the indicator for showing a change of balance is only $\frac{1}{1600}$th part of what it would be, if, as in other scales, the same extent of movement had to be made by the very lever carrying the weights. A movement of one six-millionth of an inch at the specimen produces a motion at the indicator point of one-tenth of an inch, which is easily visible; and being resisted by no friction, and having only so slight a resistance of inertia from the poise weights, the indicator shows clearly any slight or sudden change in the balance of the scale. It thus enables the exact point to be detected at which the load falls off slightly, as in the case of a tension specimen when a strain is reached which gives it a slight permanent set; the sudden change in the balance of the machine, shown by the vibration of the indicator, at once denotes the point at which the limit of elasticity in the specimen is reached. This is due to the fact that a slight reduction in the strain always occurs at that point, owing to the sudden elongation of the specimen, which is practically instantaneous, while the movement of the straining press for taking up this slack requires a sensible length of time.

Fulcrum Plates.—Each of the supporting and connecting fulcrums in the system of levers consists of a thin plate of tempered steel, and acts absolutely without friction or back lash. Each fulcrum plate offers a slight elastic resistance to bending, but this resistance is recognised and fully balanced in the adjustment of the poise weights; in other words, if this and the other elastic resistances of the mechanism amounted to one-thousandth part of the load, the poise weights would then need to be one-thousandth part lighter than if the mechanism offered no such resistance. The poise rods which carry the balancing weights are also suspended by thin steel plates, which give no frictional resistance. In common scales there is unavoidably a large frictional resistance, whereby more or less of the pressure transmitted by the load is absorbed, and thus fails to reach the balancing weights. This defect is magnified by the tendency of the frictional resistance, first to hold the balancing bar from moving forward until the pressure has accumulated somewhat; and then, after it has moved forward under this impulse and has been carried too far, to hold it in that advanced position and not allow it to recede and come to rest at the true point corresponding with the load. The Emery system of construction is such that none of these frictional resistances occur. Certain elastic resistances are developed at various points, but these are all duly considered in adjusting the poise weights as above stated. The distinction may be briefly stated thus: Frictional resistance and elastic resistance both absorb power, but the former absorbs it finally, whereas the latter simply stores it up and subsequently gives back whatever power or impulse it has received. This difference is one of great importance in any mechanism for weighing. The thickness of the fulcrum plates varies from 0·004in. to 0·06in. When they are 0·01in. thick or more, they are used in compression; but when of less thickness, they are usually employed in tension. When used in compression, they are held by being forced, under pressures generally of 60,000lb. to 120,000lb. per square inch of section, into grooves planed or sawn in the pieces they are to unite; when used in tension, they are generally clamped in position. The maximum working strains on the fulcrum plates, whether in tension or in compression, are usually limited to 50,000lb. per square inch. The exposed or free portion of each fulcrum plate varies in length from 0·1in. to 0·2in., this being the interval separating the two parts that are connected by the plate. The angular motion of the lever causes a bending of the fulcrum plate which carries it; but this bending is very minute, except only in the case of the fulcrum plates carrying the last lever or indicator, and these are thin and long. The resistance of the fulcrum plates to bending is very considerable, but is always well within the elastic limit of the material; so that their resistance is entirely elastic, and not frictional, and is provided for as above explained. The above devices, whereby pressures of high intensity are received, transmitted, rendered visible, and measured, are made available for their intended purposes by means of other details, equally novel and important, whereby the parts that receive and transmit the load are securely held against displacement or derangement in any direction save only one, which is parallel to the true line or axis of strain: in which direction they are left entirely free to move, without friction of any kind, and without any resistances except such as are taken account of in the total resistance of the weighing mechanism.

(To be continued.)

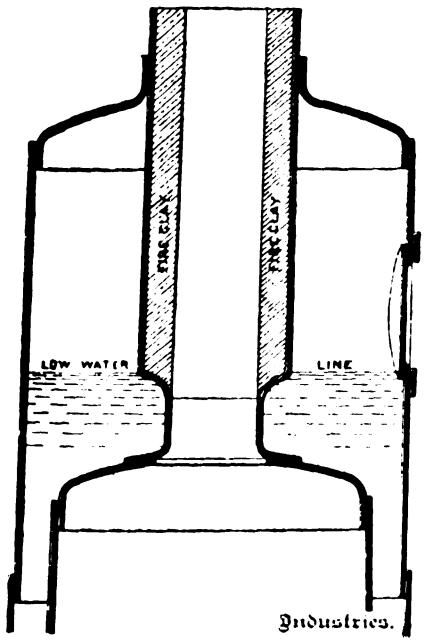
* Paper read by Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A., before the Institution of Mechanical Engineers, on the 3rd ult.

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SOME RECENT OFFICIAL REPORTS ON BOILER EXPLOSIONS.

Report No. 258 refers to the explosion of a small vertical boiler, 2ft. 8in. diam., on board the trawl boat "Pioneer," about 57 tons register, which occurred at 11-40 p.m. on the 5th January, while under sail in Botany Gut, in the North Sea. The boat was owned by Messrs. Morgan Brothers, Gorleston. This explosion is precisely similar in character to that which is reported to have occurred on board the "Pilot," and described recently, but more serious in its character and results, the skipper being severely scalded. The uptake above the water line was corroded so much that it partially collapsed at the ordinary working pressure, although only 8in. diam. and originally $\frac{3}{16}$in. thick, rupturing the plate and allowing the steam to escape through the fire hole door. The Engineer Inspector observes that "the conditions under which these boilers (of trawl boats) are worked render it most desirable that frequent examinations of them should be made by a competent person. When subjected to similar treatment to that received by this boiler, where steam was raised and the pressure allowed to fall at least twice daily, it must be expected that parts subject to the action of the fire will soon decay."

There is no doubt that had this uptake been examined by a competent person its dangerous condition could not have escaped notice; and the necessity for examination, not only of these but any other steam boilers, is generally admitted. But the concluding portion of the Engineer Inspector's remarks is not quite so clear, and no suggestion is offered for the prevention of similar accidents in future. The rapid deterioration of plates exposed to the action of fire on one side, and steam on the other, has long been known, and the effect can easily be provided against in the case of vertical fire box boilers, by the simple device of protecting the uptake by a fire clay, or, if sufficiently large to admit it, fire brick lining; or in the case of boilers already made, by the introduction of a cast iron sleeve or lining of $\frac{3}{4}$in. to 1in. thick. If the uptake of such boilers were constructed as shown in the sketch below, accidents arising from unequal and special corrosion in this part would be prevented; the uptakes would also be protected from the chronic state of over-heating to which they are subject, grooving of the flanges, crown of the shell, or top of fire box—according to mode of construction—would also be obviated, and the safety of the boiler greatly increased.



Report No. 259 describes the explosion of a small saddle boiler, such as is usually adopted in hot water circulating arrangements, at the smithy of Mr. W. Thomson, Alloway, near Ayr. The boiler was 5ft. 4in. long, 3ft. 4in. wide, curved to a radius of 2ft. 6in., and about 15in. deep. It was not provided with any stays, and it had been made of $\frac{3}{8}$in. plate, about twenty-five years ago, and used for heating purposes at the Ayr county prison, but removed and sold to Mr. Thomson for £2. 5s. about eighteen months before the explosion. Despite its age, no particular defects were discovered in the boiler by the Engineer Inspector, and the explosion, which resulted in the slight injury of five persons, was due to working the boiler at a pressure for which it was never intended.

On the 13th inst. the Town Council of Brighton decided to retain the electric railway.

Great Northern Telegraph Company.—Traffic Returns.—Receipts in May, 1888, £23,200; 1st January to 31st May, 1888, £108,400; corresponding months, 1887, £103,520; corresponding months, 1886, £100,960.

Notices of Meetings.

NEXT WEEK.

Society of Architects.—Tuesday, 19th June, 7 p.m. Fifth annual general meeting.

Royal Meteorological Society.—Wednesday, 20th June, 7 p.m. Papers to be read: "First Report of the Thunderstorm Committee; On the Photographs of Lightning Flashes," drawn up by the Hon. Ralph Abercromby, F.R.Met.Soc.; "The Cold Period from September, 1887, to May, 1888," by Charles Harding, F.R.Met.Soc.; and "Observations on Cloud Movements near the Equator, and on the general character of the Weather in the Doldrums," by the Hon. Ralph Abercromby, F.R.Met.Soc.

Royal United Service Institution.—Friday, 22nd June, 3 p.m. Paper to be read on "Fire Discipline and the Supply of Ammunition in the Field as provided for by Foreign Powers," by Captain W. H. James, F.G.S.

PRICES CURRENT, 14th June.

Quotations at per ton, unless otherwise specified.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	26	0	0
" Ceylon	"	22	10	0
Cottonseed	"	20	0	0
Cod	"	18	10	0
Lard	"	43	10	0
Linseed	"	18	10	0
Palm, Lagos	"	20	0	0
Rapeseed: English	"	24	10	0
Seal: Pale	"	22	10	0
" Brown	"	16	0	0
Sperm	"	41	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	11	0
Coal	per gal.	0	0	5½
Petroleum (Refined)	"	0	0	5½
" Spirit	"	0	0	7¼

PIG IRON.

Middlesbro' Warrants, No. 3	31/4½	Cash	
Scotch Warrants, m/n	37/10½	"	
Hematite Warrants, m/n	41/11½	"	
Stocks in Stores. Scotch	992,704—Inc. for week,	2602	Tons
Middlesbro'	287,261—Dec. "	2028	"
Hematite	200,661—Dec. "	1763	"

Exclusive of stocks in makers' yards.

Market quiet; little business offering.

	No. 1.		No. 3.	
Coltness	46/9	.....	43/3	f.o.b. Glasgow.
Gartsherrie	44/	.....	41/3	" "
Dalmellington	39/	.....	37/6	" Ardrossan
Eglinton	38/	.....	36/9	" "
Glengarnock	42/9	.....	38/9	" "
*Derbyshire	—	.....	34/6	f.o.t. Works.
*Lincolnshire	—	.....	31/6	" "
*Lancashire	—	.....	37/6	" "

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £	s.	d.		Best. £	s.	d.	
Middlesbro' Bars	4	17	6	.....	5	7	6	f.o.t. wks
" Angles	4	10	0	.....	5	0	0	"
" Plates	4	17	6	.....	5	7	6	"
Staffordshire Bars	4	17	6	.....	5	7	6	Manch'r.
" Angles	5	17	6	.....	5	7	6	"
Crown Sheets	6	10	0	.....	6	15	0	"
" Hoops	5	10	0	.....	6	10	0	"
"Siemens-Martin" Steel Boiler Plates					7	17	6	"
" Ship and Girder					7	15	0	"

METALS.

Spelter: Ordinary	£16	10	0	to	16	12	6
Copper: British Cakes and Ingots	81	0	0	"		——	
" Chili Bars	82	10	0	"	83	0	0
" Manufactured (strong)	88	0	0	"	90	0	0
Lead: Common Pig	13	15	0	"		——	
" English Sheet	14	10	0	"		——	
Tin: Straits	80	10	0	"	80	15	0
" Australian	81	5	0	"	81	15	0
" English Ingots	89	0	0	"	90	0	0

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/-	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—Quotations for Chilli gobs have been steady during the past week. Spot parcels £82. 10s. to £83 per ton; three months, £79 to £79. 10s. per ton. The market is kept steady by the operations of the syndicate. The consumptive demand continues to be very light, and the copper trade generally is without life.

Tin.—Straits sharp cash parcels are fully £3 per ton lower since our last, quotations are £80. 10s. to £80. 15s. per ton. English is also lower, £89 to £90 per ton; there is a fair business doing at the above prices.

Lead.—Steady. Spanish, £12. 5s. to £12. 7s. 6d. per ton.

Spelter.—Quiet, at £16 to £16. 5s. for warrants.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	9
" Citric	lb.	0	1	7½	—	0	1	7½
" Oxalic	"	0	0	3	—	0	0	3½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	5⅞	—	0	1	6½
Alum: Lump (powder 10/- ex.)	ton	4	7	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	15	0	—	.....		
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	5	0	—	7	10	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	30	10	0	—	32	0	0
Benzole (90%)	gal.	0	2	6	—	0	2	9
" (50/90%)	"	0	2	0	—	0	2	3
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	10	0	—	.....		
Lead: Nitrate	"	23	0	0	—	.....		
" White Sugar	"	26	10	0	—	27	0	0
" Brown "	"	21	0	0	—	22	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	20	10	0	—	21	0	0
" Carbonate	"	17	10	0	—	17	15	0
" Chlorate	lb.	0	0	5½	—	0	0	5¾
" Prussiate (Yellow)	"	0	0	6¾	—	.....		
" Sulphate (Basis 90%)	ton	8	17	6	—	9	5	0
Precipitate: Red	lb.	0	3	1	—	0	3	2
" White	"	0	3	2	—	0	3	3
Salts: Epsom { Bags	ton	2	10	0	—	2	12	6
{ Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	8	10	0	—	9	0	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	12	6	—	6	17	6
" " { " 60%)	"	5	12	6	—	5	17	6
" " (Cream, 60%)	"	5	12	6	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	3	6	—	6	5	0
Zinc Sulphate	ton	7	10	0	—	8	5	0

SHIPBUILDING NOTES.

The screw steamer "Spindrift," built by Messrs. Russell and Co., Greenock, and engined by Messrs. Dunsmuir and Jackson, of Govan, was recently subjected to an official trial. The "Spindrift," which is of 3500 tons gross register, has been built under the superintendence of Mr. David Pollock, consulting naval architect, and will form an important addition to the fleet of the China and Japan Shippers Union.

On Saturday, the 9th inst., Messrs. Wm. Doxford & Sons, Pallion, launched the screw steamer "Callisto," which was built to the order of Messrs. Pinkney, Sons, & Clare, of London. Her dimensions are 250ft. by 36ft. by 18¼ft., and she carries 2400 tons dead weight all told. The triple expansion engines were built by the same firm, with cylinders 18in., 29in., 48in., by 33in. stroke. She is built of steel, with all the latest improvements, including lap jointing of the shell under water. The "Callisto" has been sold by Messrs. Pinkney, Sons, & Clare to Messrs. Hudig and Veder, of Rotterdam.

On Saturday, the 9th inst., the steamer "Henry," of Liverpool, 1550 tons dead weight capacity, was taken out for her trial trip. The vessel belongs to Messrs. Curwen Brothers, of Liverpool, who contracted at the beginning of the year with Messrs. Westgarth, English, & Co., of Middlesbrough, to fit her with completely new triple expansion engines. Considerable improvements and alterations to the ship have been carried out by Messrs. R. Craggs & Sons, of Middlesbrough, and both the ship and engine work has been done under the superintendence of Mr. W. C. Lang, of Liverpool. The engines have cylinders 15in. by 23½in., and 39in. by 33in. stroke, and throughout the day their work gave entire satisfaction to the owner and engineers on board. The vessel was in ballast trim, and made a speed of 10¾ knots.

The s.s. "Zancla," one of the Mediterranean fleet of Messrs. John Glynn & Son, went for her official trial trip last Saturday, the 9th inst., after having had her engines converted from the ordinary compound to the triple expansion type. The high pressure cylinder is 19in., the intermediate 30in., and the low pressure 49in. in diameter, each having a stroke of 33in. The boiler is of steel, 15ft. 3in. diam. by 10ft. long, fitted with four of Brown's patent ribbed furnaces, 3ft. 2in. internal diameter. With a steam pressure of 150lb. per square inch, and seventy-eight revolutions per minute, 770 h.p. was indicated, the vessel attaining a speed of 11½ knots per hour. The whole of the work of conversion has been executed by Messrs. D. Rollo & Sons, of Liverpool, under the superintendence of Mr. S. Hepburn, the company's consulting engineer.

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HOME INDUSTRIES.

MANCHESTER, 14th June, 1888.

The Ribble Scheme.—At a special meeting of the Preston Town Council, held on the 7th inst., the report of Mr. James Abernethy, C.E., on the present condition of the Ribble works, was presented and read. The report first dealt with the variations of the works which were authorised by the Act of 1883. These were principally the enlargement of the dock area from 30 to 40 acres, the lengthening of the lock 50ft., the provision of a greater depth on the sill of 2ft. 6in., which gave 23ft. 6in. of water in neap tides, the construction of an entrance dock and a timber pond, and the dredging and deepening of the river as far as Lytham. Mr. Abernethy disapproves of the enlargement of the dock, and expresses the opinion that the lock should be widened as well as lengthened. He also recommends the construction of an invert to the lock instead of a thin layer of concrete only being placed on the sandstone rock. The next subject referred to in the report was the formation of a channel to the sea. Beyond Lytham, where the dredging is to end, there are a range of sandbanks six miles wide and seven miles long, which are exposed to the full force of the westerly winds. Mr. Abernethy therefore recommends that the channel seven miles in length beyond Lytham should be formed, not through the shifting sands, but along the north or shore channel. This channel would be protected seaward by the Salthouse Bank, which is in some parts 18ft. above the level of low water, and would have a hard foreshore as its landward bank. This work, it is estimated, would take four years to carry out, and an approximate expenditure of £300,000 would be incurred in addition to the cost of dredging at present contracted for. No discussion of the report took place; but it is already quite clear that the works sanctioned in the last Act will for the present be suspended.

The Engineering Trade.—The condition of business amongst stationary engine builders still continues to be satisfactory, and in some cases a higher price is being obtained than has previously been possible. There are better reports on all sides, and it is scarcely probable that there will be any lack of work during the present year. Millwrights, boiler makers, and locomotive builders are better off for work, although the improvement in the condition of the last mentioned is not very noticeable as yet. Machine tool makers are gradually filling their order books, and are in a more satisfactory condition than for some months past. A good many special tools are being made, and even where ordinary types are used changes in details are frequent. Messrs. James Spencer and Co., of Hollinwood, have considerable orders on hand for the Indian States Railways, and are also constructing a special plant for making finished nuts for Messrs. S. Marsden & Co. Messrs. Hetherington & Co. have a planing machine in hand for planing steel plates for bridge work, the bed being over 50ft. long, and also a special machine for milling up the ends of girders instead of chipping them. The latter machine can be used for ending up a number of plates together if so desired. The same firm are constructing two wheel lathes with 9ft. face plates. Machine makers are all well sold, and are extremely busy generally. Carding engines of the modern type are largely ordered, and improvements of their details continue to be made. Messrs. Ashworth Brothers have recently adopted a plan by which the pull of the belt is received by the boss of the pedestal on which the driving pulley revolves, and the cylinder is driven by means similar to those employed to revolve a shaft in the lathe. This improvement is intended to prevent forward wear in the cylinder bearings. Mr. Thomas Knowles, of Bolton, has patented an improved method of sustaining the flats during the grinding of the wire, by which the "heel" is accurately maintained, and Mr. John Tatham is making the apparatus. Loom makers are not obtaining fresh orders at the rate they would desire, and are not in quite such a good condition as they were. Constructional iron work is in poor demand, and generally speaking iron founders are in a very bad condition. Electrical engineers are busy generally, and the same may be said of gas engineers. The West Gas Improvement Company, Limited, are busily engaged in the construction of machines for charging the retorts of gas works.

Cotton Trade Wages.—The Bolton cotton spinners have decided to grant an advance of 5 per cent. in the wages of operative spinners and card room hands, and 10 per cent. to strippers and grinders and blowing room hands. This decision affects 30,000 workpeople. The loomers and drawers in Blackburn have resumed work on the understanding that an increased price be paid on certain classes of goods, and that the remainder be subject to an arrangement to be made by a joint committee of the employers and operatives.

LONDON, 14th June, 1888.

The Money Market.—But for the requirements of the Stock Exchange for account purposes, the money market would have been duller than ever this week. The lowering of the Bank rate last week was followed at once by a corresponding drop in other rates, which are now almost as low as they can possibly be. The stock markets are dull, and devoid of tone. Home railway stocks are fairly healthy; but the dividend anticipations are not particularly hopeful, and with the exception of Great Westerns, and a few others, they are not being extensively bought. The recent new loan issues have called attention to Colonial stocks; the older issues are cheap in comparison with the new ones, and hence there has been some buying. The American market is very lifeless, and there is no support from New York at all. Mining shares do not offer a very hopeful channel for investment, and the course of prices in the principal speculative departments of this market is so singular as to puzzle the most acute. A breakdown in copper is expected, but the French syndicate seems to be still confident. There has been a remarkable collapse in diamond shares.

Companies.—The following new companies have been registered since our last report: Tulladega Iron and Steel Company, Ld., with a capital of £100,000, to carry on business as iron masters, &c., at Alabama, U.S.A.; The International Cotton Seed Cleaning Company, Ld., with a capital of £75,000; The Wimbledon District Brick and Tile and Pottery Manufacturing Company, Ld., with a capital of £50,000; Joseph Ashforth & Co., Ld., with a capital of £50,000, to carry on business at the Bruce Works, Sheffield, as manufacturers of steel, files, nuts, bolts, tools, &c.; The Austro-Hungarian Petroleum Company, Ld., with a capital of £16,320; The Santa Fé and Cordova Great Southern Railway Construction Company, Ld. (Argentine Republic), with a capital of £500,000; Fleming's Oil and Chemical Company, Limited, with a capital of £50,000; The Highfield Tanning Company, Limited, with a capital of £30,000; The Anglo-Indian Fibre Company, Ld., with a capital of £25,000; The Manchester Patent Box Company, Ld., with a capital of £50,000; The Wood Top Loom and Power Company, Ld., with a capital of £20,000; B. Vickerman and Co., Ld., with a capital of £200,000, to carry on business as woollen manufacturers; W. T. Beesley & Co., Ld., with a capital of £40,000, to purchase rolling and wire mills in Sheffield and Rotherham; The Coventry Machinists, Ld., with a capital of £100,000; The Zuid Afrikaansche van Outplofbare Stoffen Company, Ld., with a capital of £84,000, to manufacture gunpowder, dynamite, &c.; The Petroleum Engine Company of America, Ld., with a capital of £150,000, to acquire the patents for the United States of the Priestman Petroleum Engine—a description of which appeared in our issue of the 18th ult.; The Taquah and Abosso Gold Mining Company, Ld. (Gold Coast), with a capital of £100,000; The Douglas Head Mining Company, Ld. (Isle of Man), with a capital of £20,000; The Venezuelan Mines, Ld., with a capital of £2,000,000; The Roman Gold Mines, Ld., with a capital of £200,000; The Golden Chance Mining Company, Ld., with a capital of £400,000; The Orense Tin Mining and Smelting Company, Ld. (Spain), with a capital of £250,000; and The Swan River Gold and Silver Mines, Ld., with a capital of £200,000. The total capital of the companies registered during May amounted to £84,749,644.

Railways—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending 3rd June, amounted to £1,235,847 on 15,861¼ miles, as compared with £1,322,257 in the corresponding period of 1887, when the mileage was 15,741 miles. An increase is thus shown in the mileage of 120¼ miles or 0·7 per cent., and a decrease in the receipts of £86,410 or 6·5 per cent. This decrease is due to an ordinary week's traffic being compared with a week which included part of the Whitsuntide traffic of last year.

The Navy.—The keel plates of two new war vessels, the "Barrosa" and the "Beagle," have been laid down at Portsmouth. The former is a protected cruiser 220ft. long, 35ft. broad, and with a mean load draught of 14ft. She is of the "Blanche" class. The "Beagle," which is of the "Buzzard" type, will be 195ft. long, 30ft. broad, and with a mean draught of 12ft. 5in. A new set of boilers is to be provided for the coast defence vessel, the "Glatton." Orders have been received at Sheerness dockyard to prepare for building the "Barracouta," a cruiser of a new type designed by Mr. W. H. White. She will be 233ft. long, 35ft. wide, and have a displacement of 1580 tons, and is to have triple expansion engines of 3000 i.h.p. Four ships of this class are to be laid down. Two other vessels of a somewhat similar type, the "Barham" and the "Bellona," are also included in this year's building programme. The new twin-screw composite sloop "Daphne" has been launched at Sheerness Dockyard. Her length is 195ft. between perpendiculars and 212ft. over all, with a breadth of 30ft., and a displacement of 1090 tons. The Greenock Foundry Company will supply the engines, which, when working under forced draught, are to develop 2000 i.h.p., and to propel the ship at the rate of 14½ knots. The total cost of the "Daphne," when completed for sea, is estimated at £63,087. The twin screw second class cruiser "Medea" was launched at Chatham on Saturday last. She has a steel turtle back deck, 2in. thick in the sloping parts, and 1in. in the horizontal parts. She is 265ft. long over all, 42ft. beam, with 23ft. depth of hold. The engines, which are by Messrs. Humphreys, Tennant, & Co., of Deptford, are triple expansion of 9000 h.p., with horizontal cylinders, 34½in., 51in., and 76½in. respectively, and 3ft. stroke. The vessel is intended to have a speed of 20 knots.

Parliamentary.—The Electric Lighting Act (1882) Amendment Bill has passed through Committee in the House of Commons.—The first meeting of the Standing Committee on Trade was held on Monday last, the Bill remitted for their consideration being the Railway and Canal Traffic Bill.

The International Geological Congress.—The next meeting of this Congress, which assembles once in about three years, will be opened in London on the 17th September next. So far, 395 geologists have intimated their intention of being present, 210 of these being British, and 185 foreign; whilst the number of countries represented will be twenty-two, so that the meeting will be the largest yet held. Professor Huxley will be the honorary president, and Professor Prestwich the president.

The British Association.—The fifty-eighth annual meeting of this Association will begin at Bath on Wednesday, 5th September, under the presidency of Sir Frederick Bramwell.

GLASGOW, 14th June, 1888.

Pig Iron.—There has been considerable movement in the local pig iron market. English iron is held in this market with some firmness. Shipments for last week were fairly brisk. The leading items in the return show considerable advances, although as far as Italy and the United States are concerned there is room for much improvement before the figures of last year are reached. Last week, however, the shipments abroad were generally increased; the United States, Canada, and Australia took large quantities, while the shipments coastwise increased from 2000 tons to 4856 tons for the week.

Institution of Naval Architects.—The summer meeting of the Institution of Naval Architects will be held in Glasgow, on the 24th July and the three following days. A large and influential local committee has been formed, under the secretaryship of Mr. W. J. Miller, who is the secretary of the Institution of Engineers and Shipbuilders in Scotland.

Local Taxation.—An important increase in local taxation has just been decided upon. The School Board of Glasgow have found themselves with an income of £158,866 face to face with a deficit of nearly £10,000. The Board has therefore resolved to increase the school rate from 6¾d. per £1 of rental to 7¾d. per £1. This additional 1d. per £1 on the rental of Glasgow means an addition of £12,000 a year to the amount raised in taxation.

The Exhibition.—In spite of extremely unfavourable weather, the Exhibition is still keeping up a high average attendance. On Monday last, the thirtieth day during which the show has been open, the total number of visitors, including attendants, reached the total of 1,006,221. The average daily attendance during the period was 33,540. On Saturday, though the weather was unfavourable, the presence of a large number of excursionists brought up the number to 50,615.

(From our own Correspondents.)

LIVERPOOL, 13th June, 1888.

The Timber Trade.—There has been very little improvement in the trade of this port during the last month, and any slight rise in prices has not been permanent. The new period of imports of Quebec pine has now commenced, and there is now a stock of about 108,000 cub. ft. of waney and square on hand. The 1000ft. of St. John wood which was in stock last month has not been sold. The consumption of N. B. and N. S. spruce deals has been in excess of the imports, and the stock is consequently very low; the sales have all been by private treaty. The small stock of red pine has not been altered since last month, there having been no fresh imports, and practically no consumption. The stock of oak on hand now is only 62,000 cub. ft., the consumption having been 40,000 cub. ft., or nearly double the amount in the corresponding month of last year. 15,000 cub. ft. of oak were imported last month by steamer from the United States. There has been a fair import and consumption of oak planks, the stock now amounting to 191,000 cub. ft., or nearly four times the amount held this time last year. The prices of first class planks have fallen considerably, and cannot well improve unless there is a restricted import. The fresh imports of elm have not yet commenced, but there is sufficient in stock to meet present requirements. There have been large deliveries of birch, and the stock now stands at 6000ft. The stock of cedar, satinwood, and rosewood is very light, and there is a good demand. The market is overstocked with pencil cedar, and there is little demand.

University College, Liverpool.—Mr, Thomas L. Miller, Assoc.M.Inst.C.E., who has been for several years with Messrs. Fawcett, Preston, & Co., marine and general engineers, Liverpool, has been appointed to the post of Superintendent of the Walker engineering laboratories. Mr. Miller is well known in Liverpool as the late hon. secretary of the Liverpool Engineering Society. He has recently been awarded the special prize of £10 by the Polytechnic Society, for his paper on "The Use of Wrought Iron Mains."

SHEFFIELD, 13th June, 1888.

Iron and Steel.—The inquiry for heavy material is more encouraging. Orders for ordinary ship plates are being received, and there is a better inquiry for propellers and other maritime work. Bridge chains, girders for building, and roofing iron work also yield good employment. At the armour plate mills there is no great activity, but it is hoped the comparative quietude is only temporary. Colliery plant is selling well, particularly steel rope for hauling purposes. In railway material the demand keeps up. Tyres, axles, and springs are on large order; and all the rail makers are busy, the output being for foreign markets—chiefly Brazil, Japan, and India. The railway development in Japan is a striking example of the vigour and enterprise of that country. In addition to lines already in construction, many others are contemplated, and in the

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next few months some large additional orders are expected. Engineers are tolerably well employed on heavy machinery, and in the boiler shops there is a satisfactory amount of work. One or two good orders have recently been placed for agricultural machinery; but on the whole this branch of trade is quiet. A brisk trade is being done in circular and hand saws. The dispute at Messrs. Slack, Sellars, and Co.'s is over. The men struck against a proposal to fix the week at fifty-four hours. They start work this week at fifty-two hours as the duration of the industrial week. In all descriptions of edge tools business is brisk, and there is a healthy tone in nearly all markets. The Merchandise Marks Act has already had the effect of increasing the prices of Sheffield made goods in some foreign markets. A profitable trade is being done just now in best descriptions of cutlery, and one or two Sheffield houses are kept busy in the surgical instrument branches, the trade in which is steadily increasing. There has been a decided increase in the demand for Bessemer and crucible within the past fortnight, and iron of all sorts finds a readier market, though the quotations show little change to the advantage of the merchants. Foundry pig can be bought at the furnace at from 33s. to 40s.; angles are selling at £5 to £5. 10s.; bars from £4. 10s. to £5 and £5. 10s.; hoops, £5 to £6; plates, £6 to £6. 15s.

Coal.—Many contracts have been concluded at old prices, and the pits should now be busier. Manufacturing, shipping, and railway needs are all large, and there is every prospect of an increasing demand for all sorts, with the exception, of course, of house coal. It is hoped that the dispute at the Hoyland Silkstone Colliery will be settled; the miners have claimed an extra 3d. per ton because the "end on" system of coal getting has been introduced. The extra price was not granted, so that the men came out, and left the Silkstone workings idle. The owners have given all the men a fortnight's notice, and unless an agreement is speedily come to the pits will cease to work altogether.

LEEDS, 13th June, 1888.

Iron and Steel.—Reports are rather better in the manufactured iron trade. There is no improvement in prices, but the demand is more satisfactory. At the furnaces and foundries work is more plentiful: in fact, since the Whitsuntide holidays, a steady and improving trade has been done. Some progress has been made also in the local steel manufacture, and it is probable that before long the consumers will not have to go elsewhere for their billets. The producers of heavy machinery have not been so busy for a long time. Messrs. Kitson's are busy on locomotives; Tannett & Co. on hydraulic machinery and other work; and Fowler's on engines for electric light supply, and other purposes. Some firms here are also doing well in railway material, and in tramway rails and engines. The agricultural machinery trade is quiet. Mill fittings are on better order, and engineers' tools continue in good request.

Coal.—The pits are only being worked four or five days a week, and the coal for shipment is scarcely up to the average. Still, manufacturing sorts are selling steadily; house coal is in slow demand, with falling prices.

NORTH STAFFORDSHIRE, 13th June, 1888.

North Staffordshire Railway Company.—A special meeting of this company was held at Stoke last week, when the shareholders approved the incorporation of the Shropshire Railways Company, and an Act for empowering them to acquire the Potteries, Shrewsbury, and North Wales Railway, and to carry out other arrangements. They also approved the construction of the railway from Cresswell to Cheadle. In neither case will any capital expenditure on the part of the North Staffordshire Company be involved, but mutual running powers have been agreed upon.

Newcastle Corporation Gas Works.—A report of the past year's working has now been issued, which shows a profit of £4,412, which enables the committee, after providing repayments of loans and sinking fund, to hand over £1,000 in relief of the rates. In the previous year a reduction of 6d. was made in the price of gas, and this has resulted in an enormous increase in the quantity of gas supplied. For the current year, contracts for coal have been secured on more favourable terms, and an advanced price is being obtained for residuals.

SOUTH WALES, 13th June, 1888.

Foreign Meat Industry.—This trade is assuming such large proportions in this district that at Newport new storage houses are in contemplation. A line of steamers engaged in this traffic trades regularly between Newport and the Brazils.

Coal Shipments.—The total shipments of coal, both foreign and coastwise, during the month of May, compare very favourably with the quantity exported in the same month of 1887. Taking Cardiff, Newport, Swansea, and Llanelly together, the total shipments last May amount to 1,290,275 tons, being an increase of 119,732 tons on May, 1887. Llanelly is fast rising into importance, having shipped 20,182 tons, showing an increase of 8110 tons over May, 1887. An experiment is now being tried with steamers trading between the Black Sea and the Belgium ports, which is likely to lead to a material increase in the sale of Welsh coals for bunkering purposes. Hitherto these steamers have had to purchase a large portion of the coal necessary to take the vessels home at something like 30s. a ton either at Malta or Gibraltar. By bunkering at Swansea, they will be able to take in sufficient coal for out and home voyages, which they are unable to do from the northern ports.

Cardiff and South Wales Exhibition.—The erection of the building for this Exhibition has already begun in the Howard Gardens, and will be completed by the 20th August. The reception of exhibits will then immediately commence. Mr. Philip Shrapnell, the manager, has obtained the certificate of the Board of Trade that the proposed undertaking is an international exhibition, which protects unregistered designs and unpatented inventions that may be sent in for exhibition, provided that the exhibitor gives the Comptroller the prescribed notice of his intention to exhibit, and that application for the patent or registration be made within six months from the date of the opening of the Exhibition.

BARROW-IN-FURNESS, 13th June, 1888.

The "Great Eastern."—Rumours have been afloat for some time that arrangements have been in progress for the beaching of the "Great Eastern" at Barrow, preliminary to the breaking up of the vessel. It is now announced that the dock authority has refused to allow her to be brought up Walney Channel, owing to the risk of her grounding in the harbour.

New Shipbuilding Orders.—The Pacific Steam Navigation Company, Limited, have entrusted the Naval Construction and Armaments Company, Limited, with an order for two large steamers for their mail service with the Pacific *viâ* the Straits of Magellan. These steamers are to be 430ft. long, 49ft. broad, 37ft. depth of hold, and they are to steam at the rate of 16 knots per hour. Other large orders are pending, including the thirteen steamers required by the Argentine Republic, the provisional contract for which has been signed.

Iron and Steel.—There is no change to note in the iron and steel trades. The improved tone reported last week is fully maintained; but there is no further increase in activity, or improvement in prices. There is reason to believe, however, that the consumption of pig iron will be maintained, and that the output of the district will not be reduced. There are upwards of 200,000 tons of hematite held in warrants in the North-west of England, and although these stocks have been reduced by about 6000 tons during the past few weeks, the great accumulation will prevent any increase in prices. 42s. per ton is still the price of mixed numbers of Bessemer pig iron net f.o.b., and 41s. is the value of No. 3 forge and foundry iron. There is no change to note in the industrial activity of the steel trade: makers are in receipt of as many orders as they can possibly cope with. Rails are in full output, as also are plates and angles, and the latter are again in fuller demand. Last week's prices are ruling. Iron ore remains very quiet, with prices ranging from 8s. to 10s. 6d. per ton net at mines for ordinary sorts.

MIDDLESBROUGH, 13th June, 1888.

Pig Iron.—The Cleveland pig iron market is firm, and prices are on the rise. That of No. 3 G.M.B. is 31s. 6d. for prompt delivery, and 31s. 9d. has been paid for the third quarter. Warrants are 31s. 7d. buyers and 31s. 9d. sellers cash for Connal's No. 3 G.M.B., and 42s. 6d. for Connal's hematite mixed numbers. Connal's store continues to decrease. The shipments have declined, but they are still much in advance of those of the similar period of last year. Those to Scotland have fallen off materially, and Germany and Holland still take the most.

Wrought Iron and Steel.—No change can be reported in these departments of trade. The mills are going steadily, with a fair amount of orders. The Darlington Iron and Steel Works Company have just issued their annual report; the preference shareholders get 7 per cent. per annum, and the ordinary 3s. per share. The Darlington Forge Company are enlarging their works, and the Newport Rolling Mills are to be started in the beginning of July, so that, so far as the amount of work is concerned, the prospect is encouraging. Prices are much the same—iron plates, £4. 17s. 6d.; angles, £4. 12s. 6d.; bars, £4. 15s.; steel plates, £6. 2s. 6d.; rails, £3. 15s., heavy sections. The strike at the ship yards has not affected the mills in the meantime.

Shipbuilding.—The ship yards are at a standstill. The men are much blamed, even by some of their own number, for not following the action of their own Executive. By their present attitude they are seriously risking the withdrawal of the 5 per cent. offered by the masters. The Stockton men would gladly go in on the masters' terms, but the Hartlepool men prevent them. They have already thrown away by their cessation from work a considerable portion of the good they would have obtained if they had continued. There is a growing inclination on the part of the men to resume work if the masters will agree to refer the matter to arbitration. As the men have abated their claim to 7½ per cent., and the masters have offered 5 per cent., this should not be a difficult matter to arrange.

SUNDERLAND, 13th June, 1888.

Shipping.—The trade of the last week was about the average; 75,441 tons of coal were shipped, of which 40,793 tons went coastwise and 34,648 tons were exported. 1742 tons of coke, 200 tons of patent fuel, 443 tons of cement, fire clay, and two cargoes of lime were also shipped. The imports for the week consisted of twelve cargoes of props, deals, oak and fir timber, three cargoes of silver sand, and two cargoes of iron ore.

Iron and Steel Works.—These works continue to be well employed. It is probable that a local limited liability company will be floated to re-start the Castletown Iron Works. It is proposed to erect two or four blast furnaces, so that the entire operations of iron and steel manufacture of plates, bars, &c., may be carried on. The works are situated on the north bank of the river, and have good deep water quayage. It is calculated that 200,000 tons of iron ore per annum will be required for these works.

Engineering.—Although the boiler makers obtained an increase of 1s. 6d. per week in their wages at the beginning of the present year, they are now demanding an additional 1s. per week, which the employers decline to grant. There is a feeling that at any moment there may be an entire stoppage in the establishments, owing to the various demands from the employés throughout the North-East Coast.

NEWCASTLE, 13th June, 1888.

Iron.—Though the orders in the hands of iron manufacturers are sufficient to keep the works in steady operation for some weeks to come, specifications for new contracts come in very slowly, and a period of dulness is expected. Prices do not show the degree of firmness that characterised them a short time ago, and in respect of new contracts that are now being negotiated, slightly reduced rates are likely to be accepted. Scrap iron is unusually plentiful at present, and the price has receded to 40s. per ton. Those manufacturers who are exceptionally well provided with prospective work for their rolling mills are taking the opportunity to accumulate scrap while it is cheap, and this circumstance must, of course, tend to bring about a reaction in favour of holders of the commodity. The announcement which was made in *Industries* some weeks ago, with reference to the early re-starting of the Walker blast furnaces, has now been verified, for one of the two furnaces has been put in operation, and the other will shortly be blown in. The re-starting of these furnaces has taken place at a most opportune moment, for the stocks of pig iron in the Cleveland district are being steadily reduced, and prices are tending upwards.

Steel.—The older steel manufacturing establishments, as well as those which have only recently commenced operations, are all somewhat overburdened with orders for the various classes of shipbuilding steel, and at Consett the pressure of work is particularly great. Should a stoppage of work take place in the Tyne shipyards, the activity in the steel works will be temporarily lessened, and manufacturers will have an opportunity of clearing off some of their most pressing engagements before taking upon themselves any new responsibilities.

The Chain and Anchor Trades.—The strike of chain makers at Messrs. Abbot's works, Gateshead, still continues, and it is understood that the firm are obtaining cable chain from Staffordshire to complete ships' outfits for which they had contracted. The firm have just put up in their anchor shop, a new and powerful steam hammer by Messrs. Davis & Primrose, of Leith, which is to be specially employed in the manufacture of Tyzack's patent anchors. Negotiations for fitting with these anchors a large fleet of steamers belonging to a foreign company are now in progress.

BELFAST, 13th June, 1888.

Shipbuilding.—Shipbuilders still continue to be fully employed, the stocks and finishing berths being well filled; but work has been greatly impeded during the past fortnight by bad weather. The riveters' strike for higher piece work rates in Messrs. Workman, Clark, & Co.'s yard still continues, and as the men are receiving support from their Society, they do not show any signs of yielding. There are several extensive repairs on hand.

Engineering.—The various branches of engineering are better employed than they have been for some time past. Marine shops are very busy, and are working overtime. Boiler makers are well stocked with work, and in some cases they hold large orders. Millwrights and machine makers are gradually extending their business, which was rather dull during the winter.

General Trade.—A slight improvement has been felt all round during the past month, and the number of men out of employment is at present small. Builders and contractors are very busy, and hold several important contracts. Manufacturers of aerated waters are doing an increasing business; and owing to the growing reputation of Belfast mineral waters, orders from abroad are larger and more numerous than they have ever been before.

Linen Trade.—The market has somewhat improved. The home trade has increased, both in volume and rates, and shipments are also becoming more regular. The higher numbers of yarns are in good demand, and prices are hardening. There is not, however, a corresponding advance in manufactured goods, though some firms have sought a slight advance without effect. An increase in prices all round may be expected at once; makers are growing firmer, as the stocks are small, and large orders are in hand. Handkerchiefs, both hand loom linen and cambric, have increased in price, and are difficult to obtain. Dyed and embroidered cambrics for costumes are in fair demand, and command a good price.

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NEW LIGHTNING MAGAZINE RIFLE.

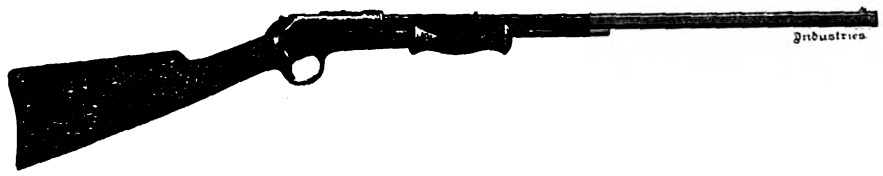


Fig. 1.

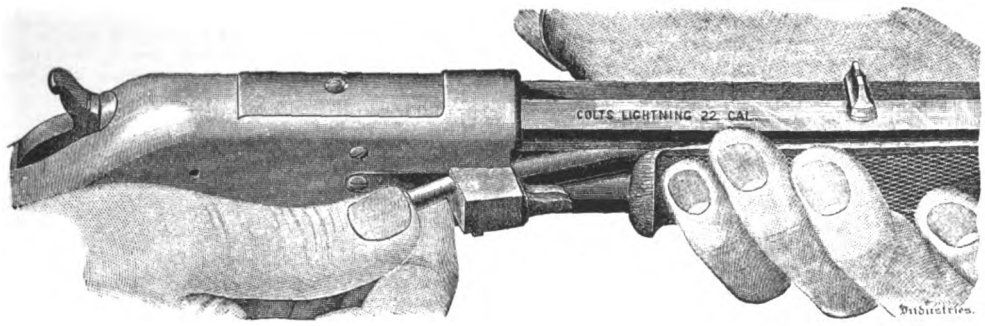


Fig. 2.

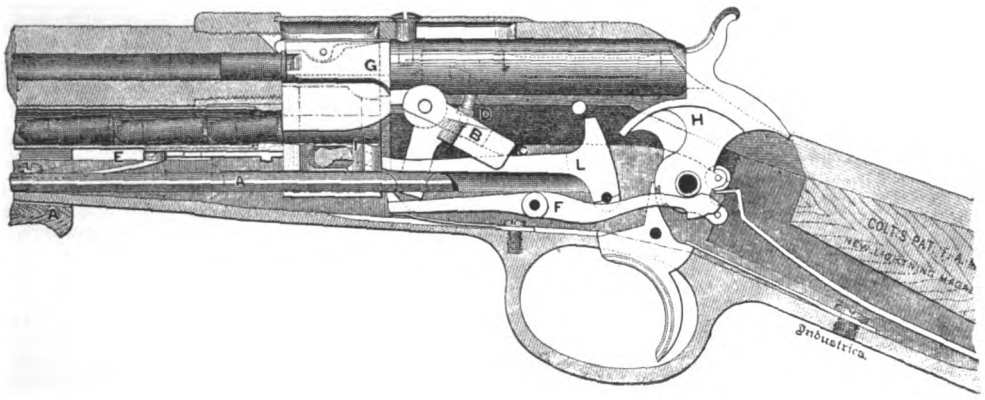


Fig. 3.

NEW LIGHTNING MAGAZINE RIFLE.

We are indebted to our American contemporary the *Iron Age* for the accompanying illustrations, showing a new lightning magazine rifle, ·22in. calibre, which has recently been brought out by Colt's Patent Fire Arms Manufacturing Company, Hartford, Connecticut. Fig. 1 gives a general view of the rifle, Fig. 2 illustrates the method of charging the magazine, and Fig. 3 gives a detailed view of the mechanism. One peculiar feature of this rifle is that either long or short ·22in. calibre cartridges may be used, the magazine holding fifteen of the former or sixteen of the latter kind. The magazine is either octagon or round, 24in. long, and weighs 5¾lb. and 6lb. respectively. The method of charging the magazine, as illustrated in Fig. 2, is as follows: The breech bolt being forward, and the hammer at half-cock or down, the left side of the magazine block is forced to the right with the thumb of the left hand, thereby exposing the mouth of the magazine. The cartridges are then introduced into the magazine tube in the manner shown in the illustration, each cartridge being pressed forward until its head rests against the loading spring just in the rear of the magazine block. When the required number of cartridges have been introduced, the magazine block is pressed back into its original position. The carrier I (Fig. 3) slides vertically, and is slightly raised by a cam on the slide A when the handle and breech bolt G are drawn back for opening the breech. By this arrangement the cartridges are held in the magazine after one cartridge has entered the carrier chamber, thereby obviating the use of a magazine gate. The forward end of the breech bolt G is fitted with a projection extending downwards, against which the cartridge rests when the bolt is drawn back, allowing the cartridge to move only in the same measure as the bolt. In this way the jumping of the cartridge through its entire length is obviated, and the danger of premature explosion greatly reduced. The spring E serves to lock the slide A in its forward position when the magazine block *e* has been moved outwards for charging the magazine; but when *e* has been returned to its position, the slide A is again unlocked. An empty cartridge is ejected and a new one introduced into the chamber in the following manner: The slide A is moved backwards by means of a wooden handle, thereby lifting the brace B and raising the carrier I to close the magazine. The same movement unlocks and draws backwards the breech bolt G, cocks the hammer H, ejects the empty cartridge, and raises the carrier lever L together with the carrier I, thereby bringing a fresh cartridge in line with the chamber. Now the slide A is moved forward, which motion pushes the breech bolt G forward and the

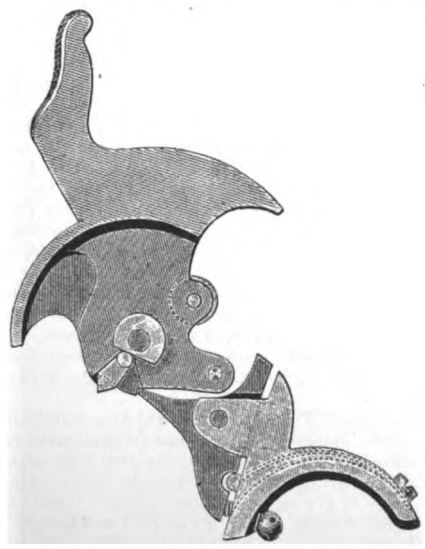


Fig. 4.

cartridge into the chamber, locks the breech bolt by the brace B, lowers the carrier, and opens the magazine for supplying a fresh cartridge to the carrier. The rifle is then ready for firing. The most important improvement is the automatic locking and unlocking of the hammer and the handle. Fig. 4 represents a patent set trigger used in the lightning rifles of ·44in., ·38in., and ·32in. calibre. The adjustment is made by means of a screw just above the place where the finger presses on the trigger. The action of this set trigger will be readily understood from the illustration.

COAL, IRON, AND COGNATE INDUSTRIES.

The Board of Trade Returns for the month of May must be regarded from a general point of view as being thoroughly satisfactory, though somewhat unfavourable in connection with the industries under review. The declared value of the imports shows an increase of £2,449,454, as compared with May, 1887, and of the exports an increase of £2,778,389, or nearly 17 per cent The total quantity of iron and steel exported last month was 388,403 tons, a decrease of 5021 tons, as compared with May of last year, the value showing an increase of £148,497. During the five months of the present year there has been a decline in our exports of pig iron amounting to 52,452 tons, and in value £232,820, as compared with the corresponding period of 1887. During May there was a large demand for crude metal from Norway and Sweden, and shipments showed an appreciable increase over April. The falling off to which we have frequently directed attention in the demand from America still continues, our exports to the United States being 20,000 tons less than in May, 1887. A decrease of 12,975 tons in quantity, and £46,266, or 9 per cent. in value, in railroad iron, is the most discouraging factor of the Returns; but on this point there is reason to believe that the apparent stagnation of foreign railway enterprise will not be prolonged. The figures relating to the copper markets are not very encouraging for the syndicate now controlling prices. It is a significant circumstance that unusually large supplies are being derived from unspecified and minor sources. On the export side of the account there is a falling off for the month of no less than 53 per cent. in quantity, representing at current rates a diminished value of over 21 per cent. We append our usual tabular statement:—

	Month of May.		Five months.	
	1888.	1887.	1888.	1887.
	£	£	£	£
Pig and puddled ...	250,458	280,721	855,613	1,088,433
Bar, angle, &c.	147,970	135,677	695,146	549,002
Railroad	443,753	490,019	1,996,481	1,555,176
Cast and wrought.	409,022	327,661	1,965,466	1,669,726
Hoops, sheets, &c.	372,415	239,721	1,661,413	1,229,396
Steel, unwrought...	166,592	176,147	596,468	905,567
Tin plates	507,583	526,444	2,286,707	1,958,600
Unwrought copper.	66,904	71,007	319,387	446,619
Coals	958,156	844,286	4,023,251	3,841,496

With regard to the home markets, the most noticeable feature has been the large shipments of Cleveland pig iron, the quantity dispatched during last month from the port of Middlesbrough being 107,826 tons, an increase of over 17,000 tons as compared with April, and of 33,300 tons as compared with May, 1887. Prices have been somewhat stronger, but remain on a low level in sympathy with Scotch warrants. In South Staffordshire the iron workers have argued their case for an advance in wages before the arbitrator to the Wages Board; but in face of the complete collapse in that centre of the revival of last autumn, both as regards prices and demand, their position is untenable and inopportune.

NAVAL ARCHITECTURE AT THE BRUSSELS EXHIBITION.

At the Brussels Exhibition a small but interesting sub-section is devoted to naval architecture, the exhibits in which will no doubt command both attention and admiration; the models in nearly all instances being beautiful specimens of the ship model maker's art. Messrs. Hawthorn & Co., of Leith, exhibit one full model and three half models. Two of their models represent the latest types of fishing trawlers. The Great Eastern Railway Company contribute exquisite models of the Harwich steamers "Norwich" and "Cambridge," built by Messrs. Earle, of Hull. The most interesting display of models are exhibited by the eminent Clyde shipbuilders, Messrs. William Denny & Brothers, of Dumbarton. This firm has five full models on exhibition, representing various types of vessels, from fast passenger and mail boats to light draught paddle steamers, specially constructed for river service. Their collection consists of: (1) A full rigged model of the s.s. "Mararoa," owned by the Union Steamship Company of New Zealand. The "Mararoa" is 320ft. long and 42ft. broad, and is at present engaged in the mail service between Auckland and San Francisco. (2) Model of the Peninsular and Oriental mail and passenger steamer "Clyde." The dimensions of the "Clyde" are: Length between perpendiculars, 390ft.; breadth, 42ft.; and depth, 35ft.; tonnage, gross register, 4100. (3) Model of the dispatch paddle steamer "Lucinda," owned by the Queensland Government. (4) Model of the two-decked light draught paddle steamer "Do-woon," owned by the Irrawaddy Flotilla Company. (5) Model of the "Elk," which was for some time employed in the Belfast mail service. Messrs. William Denny & Brothers have also a large number of models in the Glasgow International Exhibition.

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To Correspondents.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 15TH JUNE, 1888.

COAL GETTING MACHINES.

THE illustration and brief description of a new coal getting machine which we gave last week, directs attention to a question of no little importance, viz., the breaking down of a mass of coal from the seam, with a view to its extraction. It is one of considerable interest even outside the world of mining men. A great colliery explosion is a disaster of sufficient magnitude to disturb the whole nation, and it is a well ascertained fact that the greater number of these explosions have had their origin in a "shot" fired to break down the coal. Out of feelings of mere humanity, then, we cannot withhold our sympathy with the efforts which are being made to render these calamities of less frequent occurrence. But the question has an industrial as well as a humanitarian aspect. The cost of coal is largely affected by the means and methods employed in breaking it from the seam, and irrespective of the necessities imposed by the keen competition of rival producers, this fact is of general industrial importance, the cost of fuel being a weighty factor in every manufacturing undertaking. From another point of view the question invites attention. In no other branch of engineering, probably, has there been of late greater progress made than in this. Changes have occurred with kaleidoscopic variety and rapidity. These changes have been brought about by new discoveries in science, and by the necessity of lessening the risks to which coal miners are exposed. As they have followed so quickly one upon another, we find most of the expedients devised in simultaneous operation. Time has not yet removed the least fitting among them. In this state of things we have thought it desirable to set forth briefly the improvements made in recent years, so as to be able to form an accurate estimate of the situation. Without this knowledge, it is scarcely possible to appraise at its true value such machines as that of Messrs. Roberts-Horsfield & Porter, to which we have already alluded.

For the information of those of our readers who may have no practical knowledge of mining, we may state that the work of coal getting involves two distinct operations, each of which is performed by a special set or gang of men. The hewers, who are the most highly paid workmen in the mine, hew away, or "hole," as it is technically called, the under clay, on which the coal seam usually rests, for the purpose of leaving the latter unsupported. The "holing" extends inwards to a depth of about 3ft. To perform this hewing, the miner lies on his side, and towards the end of the operation is partly beneath the projecting or unsupported mass of coal. When the latter is of a weak character, it is apt to fall and crush the hewer. Here lies the danger of the work, and the long lists of killed and maimed annually published in the Government Inspector's reports show that the risk to which the hewer is exposed is no trifling one. There is no remedy for this evil but the substitution of machine for hand labour. Hitherto but little progress has been made in this direction, on account of the great practical difficulties encountered. The work of the "getters," who follow the hewers, involves dangers of another character. Their task is to break down, or "fall," the coal which has been undercut. In former times this was effected by means of wedges driven in above, between the seam and the overlying rock or roof. But this process was slow and tedious, and consequently costly, especially when the coal was hard and strong. Very soon then it became the practice to blast down the coal by means of gunpowder. To effect this, a hole is drilled in the upper part of the coal, or in the roof clay above, charged, and fired, this "shot" being sufficient in most cases to break down the mass. But if the coal be very strong, or the hole badly "tamped," the shot will "blow out" like the charge from a gun, projecting a long tongue of flame into the dust laden and sometimes fiery atmosphere of the working places. Here lies the danger of the work of the getters. A large proportion, in the opinion of many competent judges the greater number of the disastrous colliery explosions which have occurred, have owed their origin to a "shot." It was demonstrated by the German experimenters at Neunkirchen that a "blown out" shot is capable of igniting, not merely an atmosphere rendered explosive by the presence of fire damp, but one that is laden with coal dust only. These results have been verified by the British Royal Commission on Accidents in Mines. The acquisition of this knowledge led to legislative action, and restrictions were imposed on shot firing. The inconvenience arising from these restrictions, and the danger which still existed when every possible precaution had been taken, forced mining engineers to look about them for a substitute for blasting. The want served as a stimulant to inventive genius, and various devices have been offered. First we had the lime cartridge. This is a charge of quicklime, which when placed in the bore hole, and wetted by means of a pump to force in water, generates great heat and expands. If the coal is not very strong, the lime cartridge is effective. But not being generally applicable, and being besides less simple in its application than powder, it has not come into common use. The attention of inventors was thus perforce turned back upon the wedge. The outcome of their efforts is to be seen in three machines now competing for public favour. The first of these, in the order of time, is Burnett's roller wedge, described in our issue of the 13th August, 1886. This is a machine worked by lever and screw, the wedge acted upon moving over rollers to diminish friction. Experience has shown that Burnett's invention fulfils all the conditions in a very satisfactory manner. Next we have Herr von Walcher's hydraulic coal getter, also described by us in our issue of the 8th October, 1886. In this machine the expansive power is obtained by hydraulic pressure through the medium of a small hand pump, the whole apparatus being easily portable. Walcher's machine is being used with very satisfactory results in a number of collieries in Austria, the country of the invention. Lastly, we have the Roberts-Horsfield & Porter machine, the first public trial of which we briefly chronicled last week. This is another hydraulic machine, differing, however, considerably in construction and mode of action from that of Von Walcher's. The two former have proved themselves capable of dealing effectively with every class of coal seam, and there is no reason to think that the more recent invention of Messrs. Roberts-Horsfield & Porter is in any respect inferior to its predecessors.

Though the use of these machines as a substitute for explosives occasions a small increase in the cost of getting coal, the difference would not be proved a

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bar to their general adoption if no improvements had been made in the system of blasting. But here, too, inventors have been busy. We have in the first place, the devices introduced by Mr. Francis and Mr. Johnson, of preventing blown out shots by their system of expanding plugs. Then we have the invention of the water shield, a layer of water surrounding the charge, whereby the flame of the explosion is quenched. And last, and most important, there is the discovery of a flameless explosive, a discovery due to the Germans. Carbonite and roburite have been tested under every possible condition in fiery and dusty atmospheres, and found to be perfectly safe. Here, then, we come back to the old system of shot firing, but shorn of its dangers without losing its simplicity. To an unprejudiced mind it must be evident that the contest henceforth lies between this class of explosive and such machines as we have mentioned. What the ultimate result will be it is yet too early to predict. The system of blasting possesses the advantages of simplicity and economy; the method of breaking down with machines affords absolute safety. Moreover, it is to be borne in mind that the difference in favour of the explosive in the matter of simplicity and economy is but small. In a moderately tender coal the difference of cost would often disappear, because the machine will make less small coal than the blast. But here again we must not forget that small coal is becoming more valuable. On the other hand, a properly organised system of working may cheapen the labour of machine "falling." Abundant evidence of this is afforded by recent trials in the collieries of Western Germany. The inventors of "coal getters" will therefore do well to give attention to this matter. The future, and it may be a date not far distant, will bring improvements in electric lighting, and when every form of combustion lamp is excluded from a fiery colliery, it may appear inconsistent to introduce the risks, small though they be, of blasting with the flameless explosives, fired, as they must necessarily be, by fulminate detonators ignited by electric fuses. The prospect, therefore, is not discouraging for those who are spending their energy and their money in efforts to improve the class of machines of which the Roberts-Horsfield & Porter hydraulic "getter" is the latest type.

DOCKYARD v. PRIVATE CONTRACT WORK.

I.

Of all the great departments of State, the British navy has of late attracted most public attention. There have been many inquiries into its administration, resulting in many changes of *personnel* and system. The public purse has found some capable and earnest exponents and apologists, while the navy has had, as usual, its fair share of representation in the House of Commons, where the services are, on the whole, better represented than any other interest in the country. The outcome of the whole matter is a general admission that although we are, as a naval Power, more than equal to any other Power in Europe, our strength is not so greatly superior to that of other naval Powers as, considering our insular position, the great extent and value of our commerce, and our high naval prestige, it ought to be. For these reasons, there is a strong demand on the part of naval authorities for a still higher expenditure, and we are confronted with the prospect of the Goverment having to call upon the British taxpayer for additional supplies, in order that the alarmist demands of the naval experts may be complied with. In these circumstances it is fit that we should inquire how far Admiralty expenditure has hitherto been justified by its results; and how far the recent inquiries into the administration of the navy, and the humiliating exposures of incapacity, wastefulness, and corruption which they brought out, have been so far remedied. This inquiry is necessarily one which, to deal with it exhaustively, would require us to cover a good deal of ground. It may, however, be compressed, as regards its salient features, into the following questions: (1) Is Admiralty work as cheap and as efficient as it should be, relatively to private contract work? (2) Do private shipbuilders obtain a fair share of the work under Admiralty control? (3) Would the public interest suffer by giving out more work to private firms?

It may possibly be among the "things not generally known," that the British Government is at once the largest manufacturer, the largest store keeper, the largest employer of skilled or artisan labour, and the largest consumer of commodities of any firm, corporation, or state in the wide world. A glance at the alphabetically arranged lists of articles produced at Government establishments will show that there is hardly an article necessary for the outfit of vessels which is not produced in one or other of the Government establishments. The Admiralty produces at the royal dockyards ropes, rigging, sails, colours, masts, capstans, boats, blocks, oars, oakum, pitch, wheels, hose, boilers, torpedoes—practically everything required in the construction and equipment of ships, and the ships themselves, from the smallest to the largest craft. It produces at Woolwich, in the royal carriage department, hydraulic buffers, cans, tins, canteens, carriages, cartouches, carts, cases, chests, clips, composition, covers, deflectors, drugs, drums, dubbing, forges, guides, gear, hoops, jacks, lifts, levers, limbers, pads, pans, planks, platforms, pontoons, posts, rammers, ropes, saddles, shafts, shoes, sponges, tables, tools, telegraph equipment, and waggons. In the royal gun factories, it turns out every variety of iron and steel manufactures, including bolts, brackets, bronze carriers, clips, discs, hammers, handles, guides, levers, links, pins, plates, scales, screws, slides, sockets, spiral springs, strips, studs, straps, trays, vents, wrenches, and washers. In the royal laboratory at Woolwich, it produces caps, cartridges, gun cotton bags, cylinders, detonators, fuses, gas checks, gauges, hoops, fuse and shell implements, lithographs, quick matches, mallets, stencil plates, metal plugs, primers, props, rimers, rockets, shells, shot, stands, sticks for rockets, Whitehead torpedoes, tubes, wads, and washers. The victualling yards at Deptford, Gosport, and Plymouth are engaged in the manufacture of flour, biscuits, bread, oatmeal, chocolate, mustard, navy beds, bed covers, frocks, shirts, &c. The manufacture of rifles swords, sabres, bayonets, &c., is carried on at Enfield and Birmingham; that of gun cotton and powder at Waltham Abbey; and that of gas, &c., at Woolwich. Finally, it is the business of the State to superintend at Pimlico one of the largest factories in the world for the manufacture of clothing for our soldiers and sailors.

Lord Brassey, in his "Naval Annual," states quite truly that "there are inherent difficulties in the management of industrial operations by a public department;" but in spite of this well attested fact, the British Government has from time to time extended the range and complexity of its manufacturing business, until it would now be difficult to name any commodity that is in everyday use on a scale of any magnitude which it does not produce. In all this there is one redeeming feature—it does not come into the open market, and compete with private manufacturers. But it does almost, if not quite, as unjustifiable an act. It undertakes the production of very many articles that could be made cheaper, if not better, by private contract. It retains in its own hands a multiplicity of operations over which it is impossible that it can exercise an adequate control. We shall see, by and bye, that there is a consequent serious loss alike of efficiency and economy, which can hardly be excused on the plea that it is necessary that the State should be in a position, in cases of great emergency, to supply all its own needs.

The value of the various manufacturing establishments carried on by the Government is returned in the latest estimates for the army and navy at a grand total of £15,178,000. Of this amount, about £14,000,000 is set down to the various dockyards, £700,000 to Woolwich Arsenal, and the remainder to the small arms factories, &c. The artificers and workmen of all kinds employed number upwards of 40,000, and the amount paid in wages during 1886 was £2,266,000 sterling.

The first thing that occurs to a business man in looking at these figures, is to inquire what provision is made in the estimates for depreciation and interest on invested capital in respect of this vast expenditure. If such an expenditure had been incurred by a private firm in providing works for any business whatsoever, it would be necessary to allow at least 10 per cent. for depreciation and 5 per cent. for interest. This would involve setting aside two sums annually—the first amounting to £1,517,800, and the second to £758,900, or together £2,276,700, which would be equal to 17 per cent. of the total nominal amount of the navy estimates in each of the last two years. But in the case of the Government dockyards no such provision appears to have been made, and thus, to begin with, the dockyards and private shipbuilders do not start fair. Until the two are put on exactly the same footing as regards the financial arrangements entailed by capital expenditure, it is impossible to say that private builders have a fair chance of competing with dockyard work.

After making provision for amortisation of capital, the private shipbuilder requires to consider the two main elements involved in the cost of production, viz., the rates of wages that he would be required to pay for labour, and the prices at which he can purchase his materials. There are no exact data given in the Government returns as to the average rates of wages paid to artisans of different grades at different times, and therefore it is not an easy matter to compare one period with another, nor to institute a comparison of Her Majesty's dockyards with private shipbuilding establishments. The returns do, however, demonstrate two facts beyond all question—the first, that the average rate of wages paid in the dockyards is much higher, taking one department with another, than would be paid in most of the private shipbuilding yards in the country; and the second, that the cost of superintendence is very much in excess of what would be paid in any private shipbuilding works.

The following is a statement of the numbers recently employed and the amount paid in wages in the different dockyards over a period of twelve months:—

Dockyard.	Employés.	Wages paid.	Average wages per employé per annum.
Chatham	4221	£278,000	£65·9
Sheerness	1670	113,000	67·7
Portsmouth	5660	384,000	67·8
Devonport	4594	298,000	64·8
Pembroke	2190	138,700	63·3
Totals	18,335	1,212,200	66·1

In this statement the average amount of wages paid per employé over the year appears to be £66·1, or 25s. 6d. per week. This may be regarded as low rather than high, and if the average applied to skilled artisans no doubt it would be a low average. But the average includes boys and common labourers, and if we could state exactly the proportions of each of those classes it would probably be found that the average of the dockyards was considerably above the average of ordinary private yards. Nor must it be forgotten that men who are on the regular establishment are entitled, in the case of dockyard labour, to a pension after so many years of service, which should affect their wages considerably. As regards supervision, the latest returns show the following remarkable results:—

Number of Officials and Amount of their Salaries at Her Majesty's Dockyards.

Dockyard.	No. of officials.	Amount of salaries.	Average per head.
Portsmouth	306	£52,380	£170
Devonport	241	42,985	179
Chatham	198	34,804	176
Sheerness	120	21,896	182
Pembroke	86	16,771	195
Deptford	15	2,955	196
Portland depôt	2	680	340

The total number of officials in these dockyards as a whole is 968, and their united salaries amount to £172,471, or an average of about £180 each. The total number of artificers of all kinds employed in the same dockyards is 19,554, so that there is one official to every twenty workmen. Let this be compared with the practice of our private shipbuilding yards, and the Admiralty system will be found greatly more expensive. There are several shipbuilding works in this country that employ a larger number of hands than any one of the dockyards, when trade is fairly good. Such firms as the Fairfield Company on the Clyde, and Palmers' Shipbuilding Company on the Tyne, sometimes run up to 6000 or 7000 hands; but they do not expend on supervision more than 5 per cent. of the total amount paid as wages to their emyloyés, whereas in some of the dockyards the cost of superintendence is 20 per cent. of the total sum expended in wages. Economical work is, under these circumstances, all but impossible.

THE NEW INDUSTRIAL ERA IN INDIA.

A few weeks ago we directed attention to the rapid progress which was being made in Japan in industrial enterprise, and pointed out the probable competition we should have with that country for the foreign trade of China. People in this part of the world are too apt to look upon the Japanese as mere producers of curios and of peculiar art wares, and seldom realise the possibility of them developing into active manufacturers. In the same way the India of the imaginations of many is that of a country which produced curiosities, and whose people carried on a retail trade in luxuries. The India of to-day is really a wholesale producer of staples, with an enormous export business.

Sir William Hunter, LL.D., in a recent paper read before the Colonial Institute, pointed out very forcibly that India was now entering the market as a competitor with the British workman—with the farm labourer as with the mill hand—and that before long she would appear in competition with the British capitalist. He believed that the development of India as a manufacturing and food exporting country would involve changes in English production, which must for a time be attended by suffering and loss. The essential competition between India and Europe was now the competition between the productive powers of the tropics and of the temperate zone. This competition in heavy and bulky staples had been rendered possible by the new era in the Indian carrying trade, represented by railways, steam naviga-

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tion, and the Suez Canal. In 1834 the exports from India were valued at 9½ millions sterling. During the next twenty years they amounted to an average of 20 millions for the five years ending 1854. The following twenty years marked the introduction of railways into India, the development of steam shipping *viâ* the Cape, and the opening of the Suez Canal; and the exports expanded to an average of 57 millions for the five years ending 1874. During the next ten years the influences of the Indian railways, of steam navigation, and of the Suez Canal, came into full work. Indian trade advanced by rapid strides, until in 1884 the exports of merchandise had reached the enormous total of 88 millions sterling. Wheat had always been one of the principal crops in India; but until 1873 the export trade in it laboured under duty, and the amount exported in that year was only 1,750,000cwt. Since the abolition of the duty, the export has increased to 21,000,000cwt., and the agricultural returns show not only the large increase that has taken place in the wheat acreage, but that it was still capable of much larger increase. Oil seeds have a similar history from 1875, when they were freed from their export duty. Up to that date their average exportation had been about 4,000,000cwt. a year, while in 1885 it had grown to 18,000,000cwt. But not only had there been an extended production of agricultural staples for sale in Europe, but also a re-organisation of the manufacturing system in India. Thirty years ago the ruin of Indian cotton manufactures seemed final and complete; but that proved only a transition stage. The hand loom of India was almost crushed out; but the industry was about to arise in a new form. A mill for the manufacture of cotton yarn and cloth was set up in Bombay in 1854. By 1884 there were over one hundred cotton and jute mills at work in India, with 22,000 looms, 2,000,000 spindles, and giving employment to over 110,000 people; and even the rapid progress indicated by these figures was merely the commencement of a great industrial development, whose eventual dimensions it was almost impossible to foresee. Coal mining was being developed, and the difficulties in the application of Indian coal had been so far got over that ⅞ths of the coal used in Bengal, with its great railway system and its steam industries, were now raised in the country. Dr. Hunter concluded his paper by enlarging on the generalisation that the world was now entering on a new era of competition—the competition between the productive powers of the tropics and of the temperate zone—and he expressed his conviction that Indian wheat and Indian jute bags and cotton goods were only the forerunners of other commodities in which India was destined to compete keenly with the English producer. Down to the present age, India had been practically disqualified in the competition of the bulkier agricultural staples (common to India and England) by distance and the cost of carriage, by want of steam power, and by the absence of the association of labour and capital on a large scale. During the past thirty years these had been largely removed, and during the next thirty years they would entirely disappear, and in the meantime a whole series of economic questions of the first magnitude were impending—questions which only an English statesman of the first class would have the courage and authority to deal with effectively. If these were properly managed, India's gain would not be England's loss. It would, in the end, be a gain to England in common with the whole world. In the meantime, however, careful attention should be given to the questions involved, both by statesmen and commercial men.

Letters to the Editor.

NICOLA TESLA'S ALTERNATING CURRENT MOTOR.

To the Editor of "Industries."

Sir,—The very interesting researches of Mr. Tesla, which you published in the last number of your valuable paper, will no doubt open a new field of investigation in the direction of applying alternating currents for motive power purposes; but, as you say, the solution does not seem to be perfect in its present form. It is open to several objections, which will readily occur to practical engineers, and the following appear to me to be the most important: (1) The necessity of a three-wire system of distribution (a system which answers very well for direct distribution by means of continuous currents, the e.m.f. of which ought not to exceed a certain value) seems to be a step backward in the case of alternating currents with transformers, where a very high e.m.f. can be used without any inconvenience, being, in fact, the main advantage of the system. (2) Motors on this system would have to be placed in the primary circuit, a circumstance which is not without its dangers in those cases where it is feasible, viz., when there is a transformer to every house; and which becomes an impossibility when, as is the case on the Continent and in America, one large transformer feeds the secondary mains of a whole sub-district. (3) I hardly think that it will be generally agreed with Mr. Tesla that his ring must form the most efficient type of transformer. It is certainly true that the shifting round of the magnetism in the core is more advantageous against hysteresis than rapid reversals of the magnetic field. But, on the other hand, Mr. Tesla's ring does not form a closed magnetic circuit. It has apparent poles diametrically situated; and even if covered over with an iron shell, so as to diminish the magnetic resistance of the combination, there would still be the objection of the air space occupied by the coils, and across which the lines of force would have to leap—a disadvantage which does not exist with ordinary transformers of the ring or shell type. Far from underrating Mr. Tesla's work, I think that the admirable solution he has given of the transmission of energy by means of alternating currents cannot be too much praised. But the question is still in its infancy, and much remains to be done to render it thoroughly practical.

Yours, &c.,
L. H. Despeissis.

25, Rue de Naples, Paris, 11th June, 1888.

THE ELECTROLYSIS OF MERCURY BY THE ACTION OF AN ALTERNATING CURRENT OF ELECTRICITY.

To the Editor of "Industries."

Sir,—Perhaps it will be of interest to some readers of your valuable paper, to know of the peculiar behaviour of two mercury electrodes placed a short distance apart in dilute sulphuric acid, when an alternating current of electricity is passed from one electrode to the other through the dilute sulphuric acid. As soon as a current is caused to flow, the mercury becomes agitated and presents a beautiful wavy appearance on its surface, which increases in its agitation as the current strength increases. The mercury at the same time is attacked by the acid and forms an insoluble sulphate which rises with the hydrogen, which is liberated at the surface of the mercury, in a cloudy form, and slowly falls to the bottom of the cell. This peculiar phenomenon is of great scientific interest, as this sulphate is formed in proportion to the current passing; consequently the mercury loses in weight in the same proportion. We made these discoveries in the course of an extended series of experiments to overcome the difficulty of metering alternating currents. Owing, however, to many mechanical difficulties in the rise of mercury, the idea to use this as a meter was abandoned. Further searches resulted in a successful issue, and we hope to shortly publish an account of the working of our meter.

Yours, &c.,
Eastbourne, 6th June, 1888. Lowrie-Hall.

FUEL TESTING LABORATORY.

To the Editor of "Industries."

Sir,—While fully agreeing with the excellent suggestions, and recognising the value of the information, given by Mr. Bryan Donkin, I wish to draw your attention to the fact that the suggestion of a public fuel testing station is not new, as it was proposed in a paper read by Mr. B. H. Thwaite, C.E., on "Fuel Calorimetry" (see *Industries*, Vol. I., page 276), at the British Association of 1886. The Gaseous Supply Company, Limited, has for its object the establishment of fuel testing stations, so that Mr. Donkin's views are very soon likely to be carried into practical effect.

Yours, &c.,
Silverdale, Carnforth, 9th June, 1888. J. B.

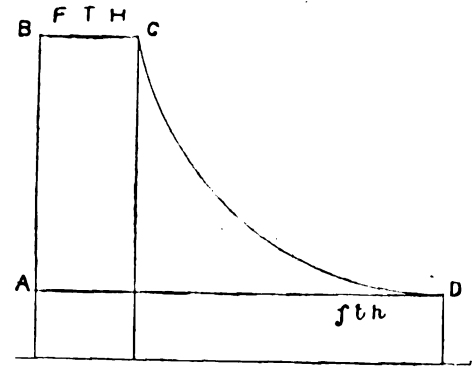
PETROLEUM VAPOUR ENGINES.

By G. R. Bodmer.

The experiments made by Mr. Yarrow with petroleum spirit or similar distillate of mineral oil as a "working substance" in the cylinder of an engine has, owing to the remarkable results obtained, excited so much interest among those concerned with the problems involved in the application of heat to the production of motive power, that a somewhat detailed inquiry into the principles and theory underlying the action of motors of this kind may not be out of place, more especially as it has been suggested that the results obtained by Mr. Yarrow are not in harmony with some of the generally accepted fundamental principles of the theory of heat. The engine in question is simply an ordinary steam engine, to which, however, instead of steam, the vapour of petroleum spirit is supplied as a working substance. The vapour is generated in a copper coil, through which the spirit is forced by a small feed pump, the exhaust being condensed in pipes passing through the water on the outside of the launch, and terminating in a small tank in the bows of the vessel, from which the condensed spirit is again drawn by the feed pump, so that the liquid is continuously circulated and used over and over again. Either a portion of the vapour itself is burned as fuel for heating the copper coil, or ordinary petroleum, gas, or any convenient substance can be employed. In the experiments already described in *Industries*, the fuel used was ordinary coal gas. The engine was first worked with ordinary steam generated in a "Field" boiler, and the consumption of gas for a given power, measured on a Prony brake, observed. Afterwards petroleum spirit was circulated through the copper coils, enclosed in this instance in the steam space of the Field boiler, and the power developed with the same expenditure of coal gas ascertained. It was found that with the spirit vapour about twice as much power was obtained by the same consumption of fuel as when steam was used for working.

Considering the very numerous factors, of a theoretically subordinate but practically very important character, which determine the economy of a steam or vapour engine, it seems rather rash, on the strength of the above recorded results, to jump to the conclusion that the foundations of the mechanical theory of heat are insecure. From the experiments made by Mr. Yarrow, it appears that of the particular oil distillate used by him about nine times as much can be evaporated under atmospheric pressure as of water, with a given quantity of fuel; that is to say, the heat of evaporation of the petroleum spirit vapour is only about one-ninth that of saturated steam. At the temperature corresponding to a steam pressure of 50lb. per square inch, the pressure of the petroleum spirit vapour is 75lb., and its boiling point at atmospheric pressure 180°F. Working between the same temperatures, the spirit vapour would therefore have higher initial and terminal pressures than saturated steam, and with the same volume and a given expansion ratio do more work than the latter; on the other hand, the density being higher, a greater weight of the vapour would be required to do this work. In dealing with the subject from the theoretical point of view, it is more convenient to use the temperatures and quantities of heat required than pressures and volumes, more especially as the fluid heat and heat of evaporation have been determined by direct experiment, and can be introduced without further transformation into the calculations in a very simple manner.

The well known expression for the efficiency of a perfect heat engine, $E=\frac{T-t}{T}$, applies of course to steam and other vapours; but it should not be forgotten that this very simple formula is only applicable to one particular cycle, which never occurs in practical working, and the statement that the efficiency of a heat engine is entirely independent of the nature of the working substance employed, is only, as we shall show, unreservedly true of that cycle, although the deviations from the principle in other cases are very slight. In dealing with engines using vapour, we shall assume that the cycle employed is what may be called the "ideal practical cycle," represented by the annexed diagram A B C D in which the steam or vapour is expanded from the boiler or generator pressure P to the condenser pressure p, the corresponding absolute temperatures being T and t. As usual, all our investigations will, for the sake of convenience, be referred to one pound of the vapour under consideration.



The feed liquid supplied to the boiler is assumed to have the temperature t of the condenser; the heat therefore which has to be supplied to the boiler to produce one pound of the saturated vapour at the temperature T, is $F-f+H$, where F and f are respectively the fluid heats of the liquid at the temperatures T and t, while H is the heat required to convert one pound of liquid at the temperature T into saturated vapour of the same temperature. The heat of evaporation $F-f+H$ is therefore the quantity with which the work done by the substance has to be compared, to arrive at the efficiency as usually estimated.

The work represented by the diagram A B C D is expressed very nearly by

$$W=F-f+H-xh,$$

where h is the heat of evaporation of the vapour at the temperature t, and x the proportion of vapour to liquid present at the end of the expansion. This expression is quite accurate for calculating the indicated work less that required for feeding the boiler, the deduction of which signifies the formula. Previous to the cut-off the vapour is assumed to be dry. The efficiency is

$$E=\frac{F-f+H-xh}{F-f+H} \quad \ldots\ldots\ldots\ldots (1)$$

It must be borne in mind that this expression, in its general form, is quite independent of Carnot's principle and the second law of thermodynamics. All the quantities in it, with the exception of x, have been determined by direct experiment for various substances, and there is not a shadow of doubt as to its validity under the assumed conditions. The value of x, however, has to be determined by another formula, in which the second law of thermodynamics is involved; but as we shall prove, its influence does not in any way weaken our conclusions.

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To avoid a separate calculation, the value for x must be substituted in the above equation for E, and to show its tendency more clearly the various quantities may be expressed in terms of the temperatures T and t; when this is done, we finally obtain

$$E=\frac{H\frac{T-t}{T}+C\left(T-t-t\log hyp\frac{T}{t}\right)}{H+C(T-t)} \quad \ldots\ldots\ldots (2)$$

where C denotes the specific heat of the liquid. This specific heat is in no case quite constant, and in some cases varies considerably with the temperature; but for those substances of which the fluid heat at various temperatures has been determined by Regnault, the average value of C for the particular range of temperature in question may be used in the formula (2).

On inspecting this formula it will be seen that the factor $\frac{T-t}{T}$, with which H is multiplied in the numerator, is nothing else than the efficiency of a perfect engine, and that by omitting in both numerator and denominator the portions multiplied with C, E becomes simply $\frac{T-t}{T}$.

Let us assume that

$$T=460°+302°=762°F.$$
$$t=460°+212°=672°F.$$

whence the range of temperature

$$T-t=90°;$$

then

$$\frac{T-t}{t}=0{\cdot}118,$$

and

$$\left(T-t-t\log hyp\frac{T}{t}\right)=6{\cdot}059.$$

The efficiency is

$$E=\frac{0{\cdot}118H+6{\cdot}059C}{H+90C} \quad \ldots\ldots\ldots (3)$$

We are now in a position to calculate for the assumed conditions the efficiency of an engine working with different substances, when for the latter we know the values H and C. It is obvious that the efficiency E can only be the same for all vapours, if H and C have a constant ratio to each other; this, however, as a glance at Regnault's tables will show, is by no means the case, and consequently, with any other cycle than Carnot's, the efficiency must depend more or less on the nature of the working substance.

The following is a summary of the results obtained with formula (3) for various vapours:—

Steam.

C=1·0224.
H=901·418 B.T.U. E=0·113.

Alcohol.

C=0·978.
H=306·864. E=0·107.

Chloroform.

C=0·245.
H=92·934. E=0·107.

Benzene.

C=0·373.
H=180. E=0·110.

Petroleum Spirit.

In this case we have no accurate data; but taking the heat of evaporation at one-ninth that of steam, as shown by Mr. Yarrow's experiment previously referred to, and the specific heat at 0·4, we have

C=0·4.
H=100. E=0·104.

As regards the value of x, it is, in every case we have considered, less than unity, showing that condensation occurs during adiabatic expansion. If no condensation took place, it is obvious, from formula (1), that the efficiency would be less. The introduction of x into the calculation tends therefore to increase the value of E, and in no way to eliminate the influence of the special character of the vapour used.

The figures we have given show that in spite of the varying proportion between the specific heat and the heat of evaporation, the efficiency of very different vapours under similar conditions is nearly the same for the most favourable cycle as carried out in steam engines, and that therefore we must look for some other than a purely theoretical explanation of the causes for the superior economy of petroleum spirit as compared with steam in the case of Mr. Yarrow's "Zephyr" engine.

In every one of the cases investigated, it will be seen that the efficiency is below that of the perfect engine, and decreases as the ratio of the specific heat to the heat of evaporation increases, so that for the extreme supposition that $\frac{H}{C}=0$

$$E=\frac{6{\cdot}059}{90}=0{\cdot}066.$$

These results all go to confirm—as might be anticipated—the established principles of the theory of heat, more especially of that associated with the name of Carnot.

Having shown that there is nothing in the general principles applying to the action of heat engines worked by vapour to account for the superiority of petroleum spirit over steam in the matter of economy, we come to the question: To what, then, is this superiority due? The two chief sources of loss in the production and utilisation of steam power are, first, the waste of fuel in the generator, and, secondly, the condensation of steam before the cut-off takes place on its admission to the cylinder. Any marked improvement in the performance of a given engine is, in all probability, due to a reduction in one or both of these losses, and if, therefore, a motor when using petroleum spirit is more economical than when using steam under otherwise similar conditions, the natural inference would be that the generator is more efficient for the production of petroleum vapour than for that of steam, and that the initial condensation in the cylinder is less for the former than for the latter. In a small engine, such as that with which Mr. Yarrow's trials were made, there is plenty of room for improvement under both heads when working with steam. It is not at all unlikely that the boiler when used simply as a steam bath for heating the coil through which the petroleum spirit was circulated was more efficient than under ordinary conditions. Owing to the fact that only about one-ninth of the quantity of heat was required to evaporate a given weight of the fluid, the circulation in the tubes would be very rapid, and favour the more effective utilisation of the heat supplied; but it is probably to a reduction in the initial cylinder condensation that we much look as the chief source of improvement.

To perform a given amount of work, a much greater weight of petroleum spirit vapour than of steam at the same temperature has to pass through the engine. Assuming the efficiency to be twice as great with petroleum vapour as with steam, the proportion of the former to the latter required would be $4\frac{1}{2}:1$, the heat of evaporation being taken as one-ninth that of steam. The initial pressure of the spirit vapour is about one and a half times that of the steam at the same temperature, and roughly speaking, therefore, with the same expansion ratio, the work done in the cylinder per stroke will be about one and a half times as great with spirit vapour as with steam, and consequently the weight of the vapour admitted at each stroke $4\frac{1}{2}\times 1\frac{1}{2}=6{\cdot}75$ times that of the steam. The surface of the cylinder walls concerned in producing initial condensation is the same per stroke in both cases, and at a given speed the time of exposure would be equal. The rate at which heat is transferred from the petroleum spirit vapour to the cylinder metal must therefore be much less than for steam, in order to account for the observed greater economy. It is well known that the rate of transmission of heat through a plate of, for instance, cast iron, from one fluid to another, varies considerably according to the nature of the latter; but no data are available on this point with regard to petroleum spirit or similar vapours. That such substances would, however, part far less readily with their heat than wet steam, seems highly probable, and a film of the condensed spirit once formed upon the surface of the cylinder walls must act as an effective non-conductor, whereas a similar film of water would facilitate the transference of heat.

If it be assumed that the quantity of heat abstracted by the walls of the cylinder, in a given time and for a given exposed area, with a certain range of temperature, is the same whatever be the vapour used, then there would still be an advantage in favour of the petroleum vapour, on account of the greater quantity of work done per stroke—that is to say, the condensation would be, approximately, no greater for $1\frac{1}{2}$ h.p. with vapour than for 1 h.p. with steam.

In the absence of detailed particulars of Mr. Yarrow's trials and indicator diagrams, it is, of course, impossible to come to any definite conclusion as to the causes of the reported superior economy of the "Zephyr" engine; and for this purpose it would be necessary to know, not merely the quantity of petroleum spirit circulated in the generator per i.h.p. per hour, but also the specific volumes of the vapour at various pressures, so that the amount of condensation at any point of the stroke could be determined, in the same manner as has been done in the case of steam.

One other point, which very possibly tells in favour of petroleum spirit, may in conclusion be mentioned. It is very generally believed that in steam engines the re-evaporation of a film of water adhering to the walls of the cylinder, on connecting it with the condenser, is largely instrumental in cooling down the metal, and thus causing subsequent initial condensation. If we assume a similar phenomenon to occur with petroleum vapour, it is tolerably certain that the adhering film of liquid cannot be thicker than in the case of steam; and as its specific gravity is less than that of water, the actual weight of the film must also be less. The heat of evaporation, however, is only about one-ninth that of steam, so that less than one-ninth of the cooling effect occurring with steam is produced by the re-evaporation of the film of petroleum spirit on the cylinder metal, and the capacity of the latter for subsequently absorbing heat is proportionately less.

CLYDE SHIPBUILDING FOR MAY.

The total tonnage launched during the month of May was 13,643 tons. The number of vessels, including six yachts, was twenty, so that the average tonnage was very low. The only vessel of note was the "Magicienne," a war cruiser for the British Government, launched by the Fairfield Engineering and Shipbuilding Company, Limited. The "Marathon," sister ship to the "Magicienne," will shortly be launched. Only one sailing vessel of 1200 tons was launched during the month. The new contracts do not involve a large addition to the work on hand. The order, booked in the end of April by Messrs. Scott & Co., Greenock, for two gunboats of 850 tons displacement each, to be named the "Sparrow" and "Thrush," is in course of execution. Messrs. Russell & Co., Port Glasgow, received an order from Messrs. Stewart Brothers, Glasgow, for two iron sailing vessels of about 1300 tons each. Mr. W. T Cumming has begun to build a new steel screw ferry boat, for the Clyde Trust. The other orders consist of a number of yachts, including two centre board boats. The following are the names and brief descriptions of the vessels launched during the month of May:—

War vessel: H.M.S. "Magicienne," twin screw, protected cruiser, 3000 tons displacement, 9000 i.h.p., built by the Fairfield Shipbuilding and Engineering Company, Limited Steamers: "Baltimore City," steel, 2334 tons, built by Messrs. A. Stephen & Sons, Linthouse, for Christopher Furness, West Hartlepool; "Ben Ledi," steel, 2300 tons, built by Messrs. Barclay, Curle, & Co., Whiteinch, for Messrs. Wm. Thomson & Co., Leith, for the tea trade; "Cayor," steel, 1084 tons, built by Messrs A. MacMillan and Son, Dumbarton, for Messrs. Deves & Chaumet, Bordeaux, for the African trade; "Lucy Ashton," paddle steamer, built by Messrs. T. B. Seath & Co., Rutherglen, for the West coast passenger traffic of the North British Railway Company; "Mavis," steel paddle steamer, built by Messrs. Scott & Co., Greenock, to the order of the General Steam Navigation Company, London; "Princess of Wales," saloon paddle steamer, built by Messrs. Barclay, Curle, & Co., Whiteinch, for the Isle of Wight and Southampton traffic of the Isle of Wight and South of England Royal Mail Steam Packet Company, Limited; "Sakkarah" and "Save," twin screw hopper barges, 400 tons each, built by Messrs. Lobnitz & Co., Renfrew, for the Suez Canal Company; "Sung Kiang," steel twin screw, 1650 tons, built by Messrs. Scott & Co., Greenock, for Chinese coasting trade, to the order of the China Navigation Company; screw steamer, 250 tons, built by Messrs. J. Fullarton & Co., Paisley, for Messrs. Richard Hughes & Co., Liverpool; also three steam launches and two steam yachts, including the "Ceto," 180-ton twin screw, built by Messrs. Napier, Shanks, and Bell, for Sir Edward Cecil Sumners, Bart. Sailing vessels: "Banklands," steel, 1239 tons, built by Messrs. John Reid and Co., Port Glasgow, to the order of Messrs. W. Just and Co., Liverpool; also three sailing yachts.

	War Vessels.		Mercantile Marine. Steamships.		Sailing Vessels.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
United Kingdom	1	3000	11	5833*	4	1276†
France	—	—	1	1084	—	—
Egypt	—	—	2	800	—	—
China	—	—	1	1650	—	—
May, 1888	1	3000	15	9367	4	1276
May, 1887	—	—	16	11158	7	4454

* Including three yachts, 248 tons. † Including three yachts, 37 tons.

Messrs. Fleming & Ferguson, shipbuilders, Paisley, have received an order for a steel screw steamer for the China trade, through Messrs. Russel & Spence, engineers, Glasgow. She is to have accommodation for about thirty first class passengers, and is to be fitted by the builders with their improved balanced quadruple engines, to indicate about 1800 h.p.

Steam Boiler Legislation.—On the 6th March last, Mr. Provand, member for one of the Glasgow divisions, brought in a Bill to amend the law relating to and providing for the compulsory examination of steam boilers. On the 5th inst. the order for this Bill was brought before the House of Commons and discharged, and the Bill withdrawn.

Milling Convention. — The annual convention of the National Association of British and Irish Millers is to be held at Plymouth, from the 3rd to the 6th of July. According to the provisional programme, the following will be the order of proceedings: Tuesday, 3rd July: Reception by the Mayor and Corporation. Annual meeting of the Council. Election of president, officers, &c. Paper by Mr. Alph Steiger, on the "Selection of Water Motors for Flour Mills." Visit to Keyham yard. Annual dinner. Wednesday, 4th July: Trip up the river Tamar. Thursday, 5th July: Trip round the Eddystone lighthouse. Paper by Mr. J. H. Carter, on "Pneumatic Sorting." Paper by Mr. H. Simon, on "Haggenmacher's New Patent Scalper." Paper by Mr. J. Salkeld Robinson, subject not yet fixed. Friday, 6th July: Visit in war boats to witness big gun drill and torpedo practice at Devonport. Several mills will be open for the inspection of members.

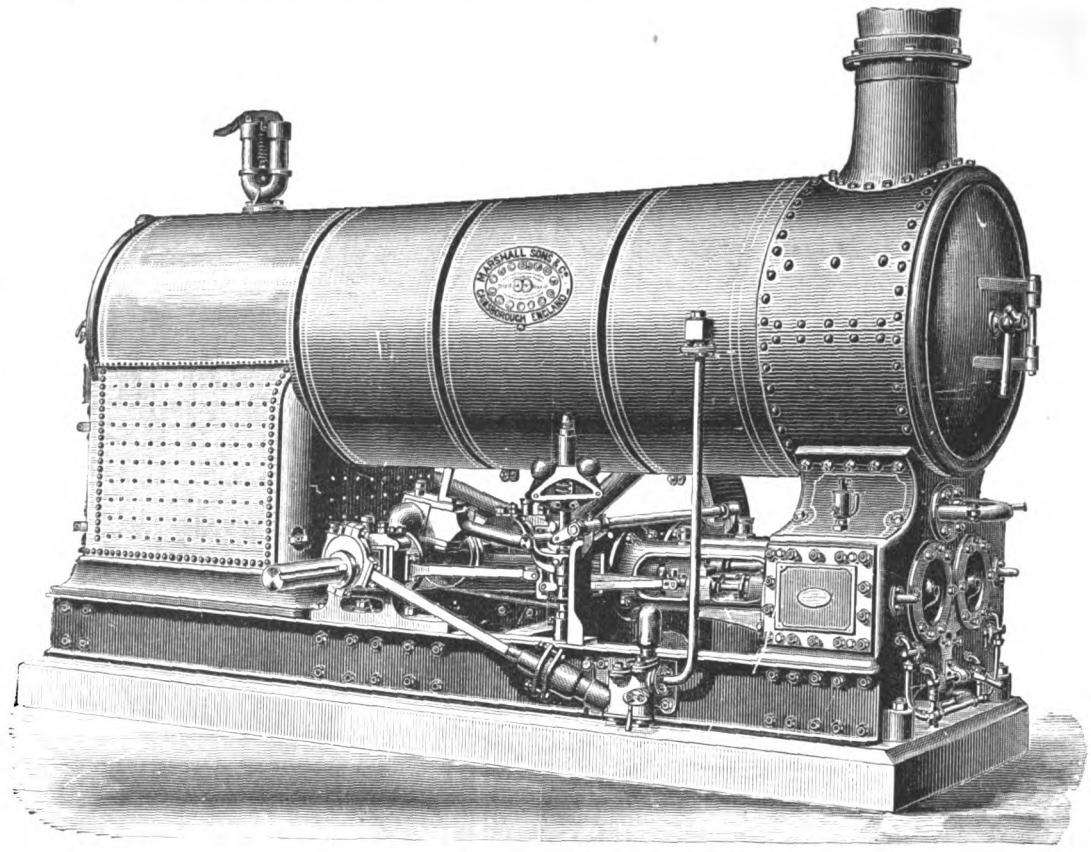
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ELECTRIC LIGHT INSTALLATION AT THE BOTANICAL GARDENS, MANCHESTER.

On Thursday, the 7th inst., we had an opportunity of witnessing a trial of the electric light installation at the Botanical Gardens, Old Trafford, Manchester, which, it may be recollected, formed part of the late Royal Jubilee Exhibition. The installation has been erected by the Manchester Edison-Swan Company, Limited, for supplying the current for fifty-six arc lamps each of 2000 n.c.p. The combined boiler and engine, which we herewith illustrate, has been constructed by Messrs. Marshall, Sons, & Co., Limited, Gainsborough, and was erected by Messrs. J. B. Welch & Co., Market-street, Manchester. As will be seen from our illustration, the engine is fixed on a strong wrought iron frame under a locomotive multitubular boiler, working at a steam pressure of 90lb. per square inch. The shell of the boiler is made of mild steel of special quality. The feed water is supplied by an injector of ample capacity, and a donkey pump is also provided for feeding the boiler in case the injector should get out of order. The smoke box is bolted to the cylinders of the engine, and the end of the fire box rests on a strong ash pan which has a door for regulating the draught. The engine is fitted with two cylinders, each 13in. diam. and 18in. stroke. Both cylinders are steam jacketed, and provided with Hartnell's automatic expansion valve gear, whereby great regularity in speed is obtained, even under considerable and frequent variations of load. The crank shaft is made of steel in one piece and without a weld, and on it are placed side by side two heavy fly wheels of 5ft. 8in. diam., running at a speed of 120 revolutions a minute. We understand that the engine is capable of indicating 130 h.p. From the fly wheels are driven two shunt wound dynamos, specially constructed for this work by Messrs. Elwell-Parker, Limited, Wolverhampton, which are capable of supplying forty 10 ampère arc lamps each. These dynamos were running at about 700 revolutions per minute, and appeared to work very smoothly, and with almost entire freedom from sparking at the brushes. A very complete arrangement of switches and resistances, together with a current indicator, are fixed in the engine room. The arc lamps used in this installation are the invention of Messrs. Phillips, Harrison, and Hart, and are very neatly designed. The inventors claim for this new type of lamp, that the regulating apparatus is very simple and not liable to get out of order, and that the light is steady and almost white. The building which formed the main approach to the late Exhibition has been converted into a dining room, promenade, and concert room, which are lighted by two, twelve, and ten arc lamps respectively. The remaining thirty-two arc lamps are distributed in the grounds, and are fixed to masts. The wires are carried in a very neat manner from pole to pole, and are hardly perceptible. On the whole, the installation worked very well, the only fault being a humming noise caused by the exhaust steam ascending in a wrought iron chimney, and which was distinctly audible in the concert room. It remains to be seen if this noise will materially interfere with the music. We understand that this arc light installation is the largest the Manchester Edison-Swan Company have as yet erected, their specialty being incandescent lighting; but that in future they are going to devote more attention to arc lighting.

COMBINED ENGINE AND BOILER.

Constructed by Messrs. Marshall, Sons, & Co., Limited, Gainsborough.



General View.

THE LIGHTING ARRANGEMENTS AT THE FORTH BRIDGE.

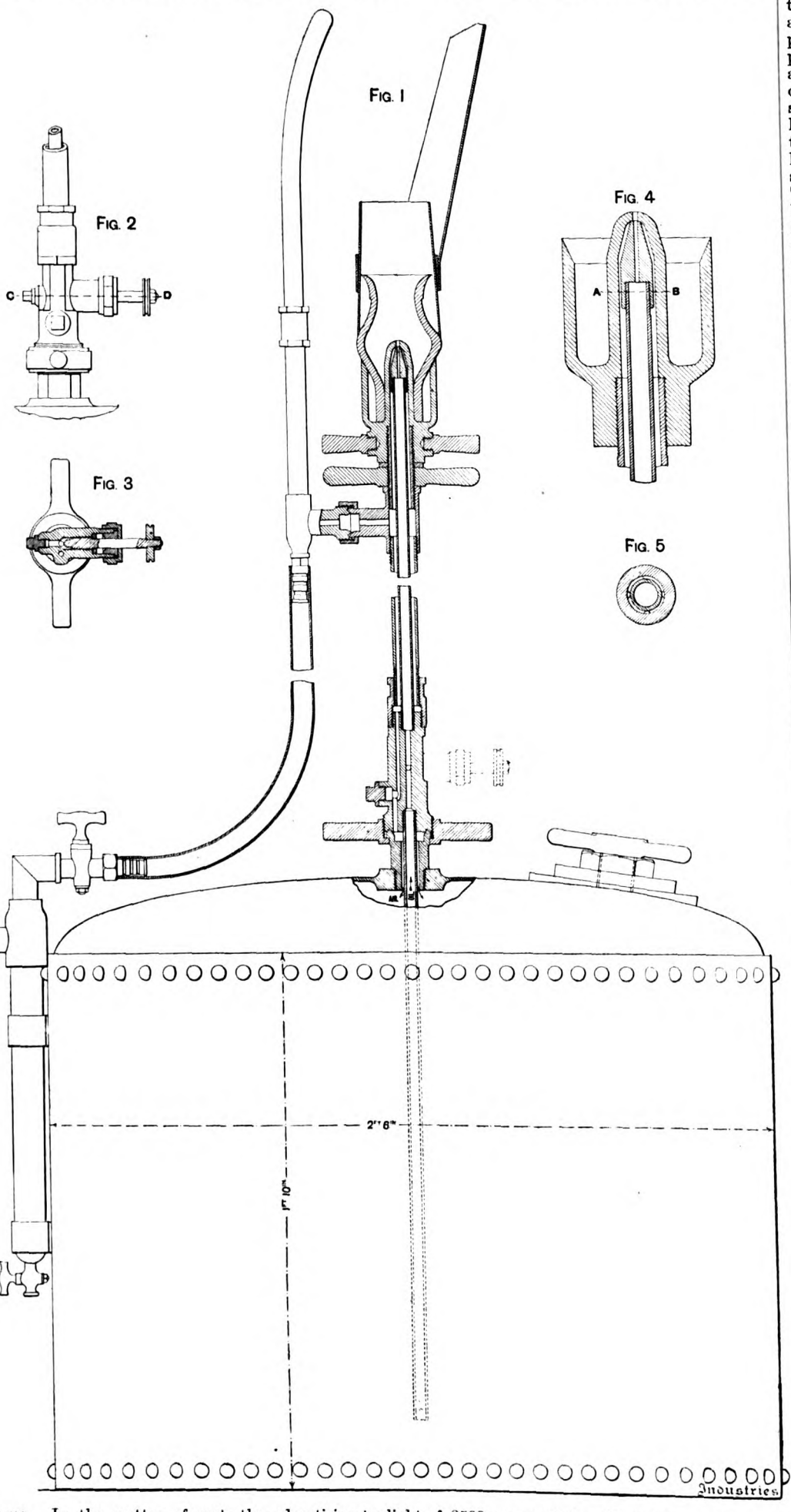
At a very early stage in the operations connected with the erection of the Forth Bridge, it was felt that, as a large part of the work would be carried on continuously day and night, a very complete lighting plant would be essential. Arrangements were entered into with Messrs. Siemens Brothers for an extensive installation on the south side of the river for the lighting of the engineering shops and yards, and of the offices, stores, &c., the former by arc and the latter by incandescent lamps. This installation, which has recently been considerably extended, consists of three Siemens compound dynamos, each wound for an output of 120 ampères at 110 volts, two for 60 ampères at same e.m.f., and five for 15 ampères at 300 volts; there is also a Crompton series machine of a new type for 15 ampères at 1200 volts. The engines are by Messrs. Davey Paxman & Co., of Colchester. They are of the horizontal non-condensing type, and with 60lb. steam pressure indicate 120 h.p.

The two large engineering shops for bending, drilling, and planing the steel plates used in the construction of the bridge are each lighted by twenty-two Siemens differential arc lamps, with triple carbons. They are coupled in parallel circuits of two in series. The e.m.f. between the mains is 110 volts, and a small German silver resistance is placed in circuit with each pair of lamps, to reduce the current to 10 ampères. The moulding loft and the yards are lighted by arc lamps of a similar type. These are coupled in series circuits of six lamps, each circuit being supplied by a separate dynamo. The general offices, drawing offices, and stores are lighted by three hundred 16 c.p. incandescent lamps. Messrs. Crompton and Co. secured the contracts for the smaller installations on the north side of the river, and on the island of Inchgarvie. These consisted at each place of two Crompton-Burgin dynamos, one for six arcs and the other for sixty incandescents. The arc lamps were of the D.D. type, and were hung on poles in the yards, and the incandescent lamps were principally used in the time offices, stores, &c. The dynamos were driven by simple horizontal steam engines. During the sinking of the foundations, the caisson work was greatly facilitated by the electric lamps. Their portability and independence of atmospheric variations rendered them invaluable to those who, with such notable intrepidity and success, carried out the extensive excavations in the bed of the river. On the completion of the foundation and commencement of the superstructure, a complete re-arrangement of the lighting plant on the erection became necessary. On the Queensferry side, extra dynamos for incandescent lighting were laid down, and a high tension machine for arc lighting. Underground conductors had been used extensively for the distribution of the current through the works. These were cables, insulated with gutta-percha and jute, with a sheathing of steel wires, and an external serving of jute and compound. They had been three years underground, and had all become more or less defective. They were therefore replaced by overhead wires, and moved after repair down to the superstructure, where their steel sheathing forms a great protection against accidental contact with plates, &c., and where the demand for insulation is not so high, owing to the possibility of running them almost exclusively along timber stagings. On the north side of the river a complete new generating station has recently been erected, with a 70 i.h.p. horizontal engine, two 14 arc light Crompton-Burgin dynamos, and two Crompton compound machines, each for eighty incandescent lamps. On Inchgarvie an exact duplicate of the existing plant and a Siemens 6 arc lighter has now been added. There are thirty arc lamps on each of the main cantilever erections at South Queensferry, Inchgarvie, and North Queensferry. The lamps are principally by Crompton and Siemens. The remarkable simplicity and strength of the D.D. type of the former maker render it singularly adaptable to work of this class. The circuits are run from one elevated staging to another by means of flexible cables tied to hemp ropes, and the current is led by overhead circuits from the generating stations to terminal houses, from which it is distributed to the various working points. Groups of lamps in series with other groups are provided with automatic cut-outs and equivalent resistances, to isolate the effects of accidents to the conductors. The lamps are suspended from light poles lashed to the girders, or are swung between guide wires on the wind bracing.

While the advantages of portability and economy render the arc lamp very adaptable to temporary engineering operations, the glaring nature of the light and the sharp intensity of its shadows are disadvantages which have been very forcibly demonstrated at the Forth Bridge works. In the engineering shops, although the distribution of the light has been most carefully studied, chipping, planing, drilling, &c., have only been carried on at night by the aid of myriads of hand lamps, and on the erection small and lofty stagings, dependent for light on arcs at some little distance, are thrown into total darkness by the shadow from a passing plate, or some small object interposed between them and the minute source of light. It was while combatting these difficulties with more or less success, that the "Lucigen" light came to the aid of the builders of the bridge. This light was described in *Industries*, Vol. I., page 125, and its earliest and most extensive application has been at these works. Fig. 1 shows a section of the burner, and Figs. 2, 3, 4, and 5 some recent modifications in the form of the combustion chamber and valves. At the works in South Queensferry, where the largest number of Lucigens are employed, an engine, air compressor, and receiver are stationed in the electric engine room, shown in Fig. 6. The air pressure at the engine room is 20lb. per square inch, and is distributed over the works by an extensive system of pipes. Moisture accumulates, owing to the varying temperature of the air, and suitable drain cocks are therefore provided at the low levels. The lamps are usually placed on trestles about 12ft. high, and the oil forced into their tanks from the foot of the trestles by the air pressure. Considerable labour is involved in carrying the oil to the numerous lamps; but in permanent installations this might be saved by having a head of oil at the storage tanks, and a system of supply pipes from there to the lamps. Storage is provided at the works at South Queensferry for 50,000 gallons of creosote oil, which is also used for the rivet furnaces described in *Industries*, Vol. III., page 618. The power required for the air pressure for each lamp of 2500 c.p. is about ·25 h.p. A combined steam engine and air compressor of a compact form is used on Inchgarvie for the air supply for the Lucigens on that part of the works. There can be no question of the great superiority of the Lucigen over arc lamps for many purposes; but intending users of this light should also consider its many serious

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LIGHTING ARRANGEMENTS AT THE FORTH BRIDGE.



disadvantages. In the matter of cost, the advertising circular of the Lucigen Company states it at 2d. to 3d. per hour for 2500 c.p.; this is exceedingly cheap, and very much cheaper than a long series of experiments with numerous Lucigens has shown to be the cost at the Forth Bridge. The cost, of course, varies according to the facilities for obtaining oil; but as the burner, to enable it to maintain a light of 2500 c.p., must be adjusted for a consumption of from 2¼ to 3 gallons per hour, according to the quality of the oil, and as the lowest price of this commodity in the market just now is 2d. per gallon, the facilities for obtaining oil would require to be very much improved to allow the cost even to approach the price above named. Besides the cost of transit, considerable allowance must be made for waste in the transmission of the oil from the manufacturing works to the consumers. A very small quantity of water in the burner will instantly extinguish the lamp, and one of the most fruitful sources of expense and annoyance with the light is the almost unavoidable presence of water in the oil, for although it may be dispatched from the works apparently quite free from water, after standing some time in the storage tanks, large quantities filter through the oil, and must be periodically strained away. This water is the pest of the neighbourhood; it destroys the gardens which lie along its route to the river, and reaching there, and combining with the kelp, it contrives to provide for the stroller along the shores of the Forth a stench well nigh insupportable. The light is not satisfactory in anything like a strong breeze, and invariably spreads an oil shower of more or less density for 15ft. or 20ft. around it, thus greatly increasing the risk of fire on timber stagings. Another very forcible objection to the light is the noisy roar produced by the air blast, and which renders conversation in its proximity inaudible. While readily granting the great value of this light for certain temporary purposes, those who contemplate any permanent artificial illumination will, of course, hesitate before sacrificing a great deal for a large well diffused glare, even if under exceptional circumstances it may prove economical.

As in the shops the Lucigen to some extent superseded the arc lamp, so it in turn has given place to the new type of large incandescent lamp manufactured by the Sunbeam Company, of Newcastle. These are in use up to 1500 c.p., and give great satisfaction; their absolute steadiness and great diffusive power is so far unrivalled.

While each light has some special adaptability, there is an ample field for them all in the varied and extensive operations in rapid progress over the estuary of the Forth, and on dark evenings a remarkable spectacle is presented when the busy scene is illuminated by the brilliant lights, which cast beautiful reflections into the water from their lofty positions on the great structure.

THE REVOLUTION IN COTTON DYEING.

There is, perhaps, no old established industry which has been so completely revolutionised by the results of modern scientific investigation as that of dyeing and calico printing. Although dyers, as a rule, adhere very strictly to what they are pleased to call the "good old processes," they have been gradually led to adopt, in some cases even without being themselves aware of it, the new and much more effective though simpler modes of manipulation suggested by a clearer insight into the chemistry of dyeing. Still we have, until quite recently, considered it as an unchangeable truth that animal and vegetable fibres require perfectly different treatments, owing to their vast difference in chemical composition; and that the former, being composed of albuminoid matter, will generally combine with dye stuffs without the intervention of a mordant, whilst the latter, which consist of cellulose in a greater or lesser state of purity, always require the intervention of a mordant in order to combine with dye stuffs. But even this fundamental fact has been overthrown quite lately by the introduction of a new class of colouring matters, which have very inappropriately received the name of "substantive dyes," and which will dye cotton and other vegetable fibres in exactly the same manner as the old colouring matters dye silk. It is this new and important discovery of which we intend to give a brief account.

It is well known that cotton is the cheapest and by far the most important fibre. Its annual production exceeds several times that of all the other fibres combined. The great purity of raw cotton—which contains from 90 to 95 per cent. of pure fibre, whilst crude silk contains only 70 to 75 per cent. of pure silk, and crude wool only 30 to 35 per cent. of the pure fibre—and the consequent ease with which it may be spun and woven, make cotton goods so cheap that cotton is essentially the fibre for the million. The dyeing of cotton was, however, until now much more expensive than that of wool. As none of the dye stuffs used hitherto would combine with cotton without the preliminary process of mordanting, cotton dyeing required not only more materials, but also a greater amount of manipulation and care, in order to be successfully accomplished. It was only by using a great deal of machinery, and by treating very large quantities of material at the same time, that these drawbacks could to some extent be compensated. But there was still another great drawback which remained. Dyed wool, being a combination of the wool itself with the dye stuff, is, as a rule, a fairly stable compound, resisting the action of atmospheric influences, washing, &c., well enough. Dyed cotton, on the contrary, being a treble compound of fibre, mordant, and dye stuff, is much more subject to deterioration. There are, of course, exceptions, such as turkey red, alizarine blue, or aniline black, which stand any amount of soaping and exposure to light without

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LIGHTING ARRANGEMENTS AT THE FORTH BRIDGE.

(For description see page 599.)

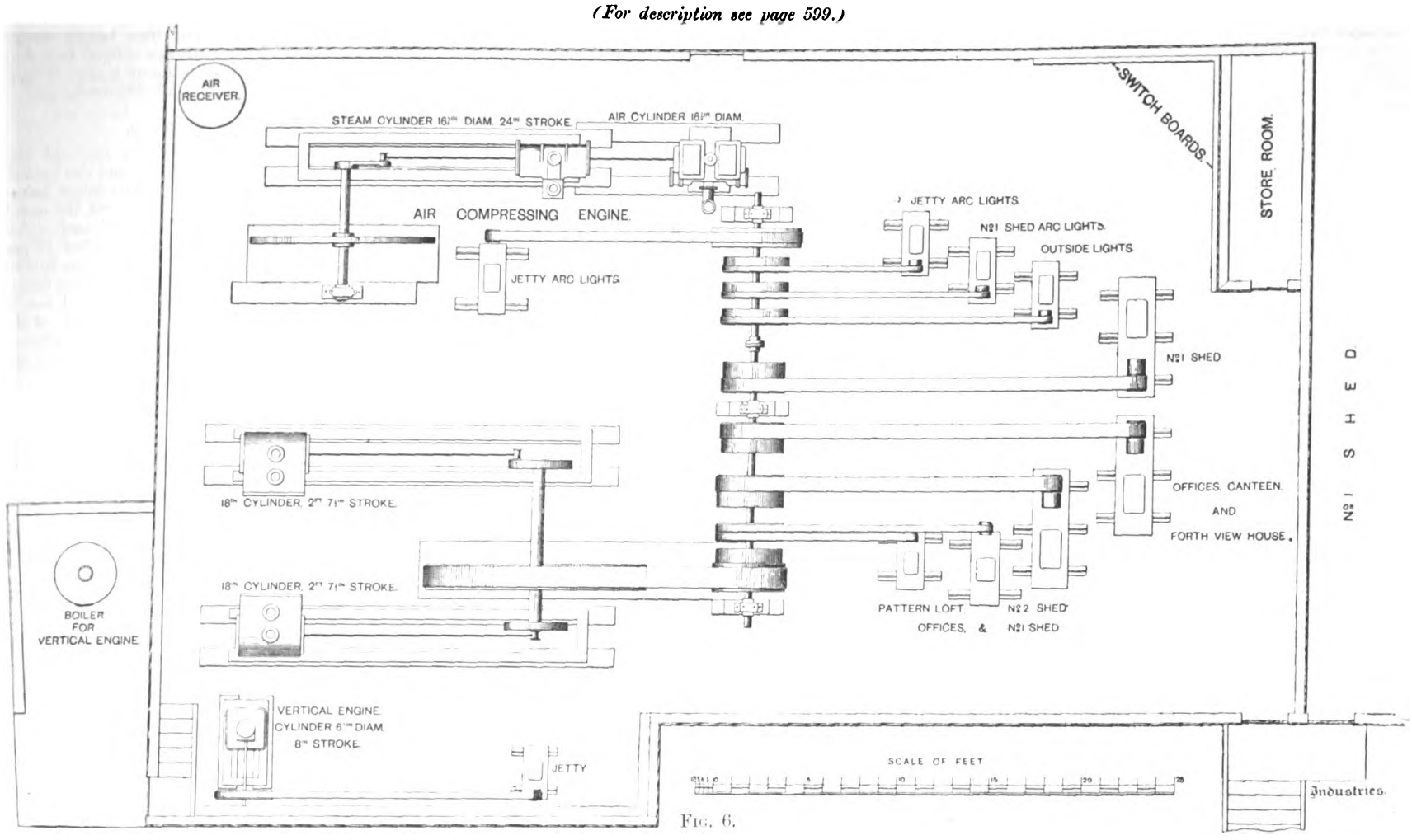


FIG. 6.

deterioration. But these exceptionally fast shades are very expensive to produce, whilst the majority of cheap cotton colours are decidedly fugitive. Most of them stand light fairly well; but they will not stand soaping, which is a very serious drawback, interfering with the cleanliness and health of the lower classes, for whose use cotton goods are chiefly intended.

All these difficulties are removed by the new "substantive" dye stuffs, which, far from being deteriorated by soaping, even require the use of soap or other alkaline mediums in the process of dyeing. These dye stuffs simplify the process of dyeing in an astonishing manner. It is sufficient to prepare a boiling aqueous solution of the dye, to add some soap or soda to it, and to immerse the cotton goods, in order to obtain a perfectly fast shade of any required depth. The soap or soda does not act as a mordant; it only facilitates the combination of the dye with the fibre. It is quite obvious that an agent which has been instrumental in producing the shade on the fibre will not detract from it when afterwards brought into contact with it; and, therefore, goods dyed with "substantive" colours will stand any amount of subsequent washing and scouring without losing their brilliancy of shade.

All "substantive" dye stuffs, of which there exist a very large number, belong to one group of colouring matters, viz., the group known as "azo dyes." This group, the first representatives of which were brought out in 1875, proved the most fertile of all. After having yielded hundreds of colouring matters chiefly adapted for wool dyeing, it has also produced these new substantive dye stuffs, the first of which was discovered, accidentally, in 1884. This substance, which received the name of "congo red," was produced by acting with tetrazo-diphenyl chloride on naphthionic acid. It might have remained unnoticed, as it has no unusual chemical reactions, and, as a wool dye, offers no special advantages. A lucky accident, however, disclosed its power of dyeing unmordanted cotton from an alkaline dye bath, and to this peculiarity congo red owes its unparalleled success as a chemical product. Very soon it was discovered that congo red was only a representative of a very numerous class of substances, and that its peculiar and valuable property was shared by all azo dyes derived from diphenyl and all homologous and analogous substances. It is not our intention to go at any length into a discussion of the composition of substantive azo dyes, as this would necessarily carry us into theoretical chemistry; but we may briefly state that a great variety of substantive azo dyes may be prepared, comprising in shade all the range from yellow through scarlet, red, and violet into deep blue; and also that a certain law has been discovered which regulates the properties of these dyes. This law may be condensed in the following words: All azo dyes are made up of two parts, which, being brought together, combine to form the molecule of the dye stuff. Of these, one enters the reaction in the shape of a diazo (or tetrazo) compound, whilst the other is present in the shape of an amine or phenol. Now, in the case of substantive dyes it has been recognised that the property of dyeing unmordanted cotton merely depends upon the tetrazo compound used, whilst the shade of the dye is dependent upon the amine or phenol combined with this tetrazo compound. Knowing this, we may by judicial selection of the ingredients produce substantive dyes of any required shade, with the only exception of green and clear blue—shades which do not seem to be consistent with azo colours of any description.

The property of combining with unmordanted cotton is inherent in the diphenyl derivatives, which are employed in the preparation of substantive azo dyes. Benzidine (the raw product from which tetrazo diphenyl chloride is prepared), though itself a colourless substance, seems to be able to be attracted from its solution by cellulose and to form a combination with it, which may, by being treated with nitrous acid, be transformed into a tetrazo compound. If cotton, thus treated, be immersed into a solution of sodic naphthionate, congo red is formed on the fibre. This reaction, however imperfect, forms the starting point for a new departure of quite recent date, which may be considered as a very interesting development of the chemistry of substantive azo dyes. Mr. A. R. Green, an English chemist, has succeeded in preparing a compound of distinctly yellow shade, called "primuline," which, although a primary base and not an azo compound, possesses in a much higher degree than benzidine the property of combining with the cellulose of cotton. This fibre, on being treated with primuline, may be dyed any desired shade of yellow; and this yellow cotton, or, chemically speaking, this combination of cotton with primuline, may afterwards be treated exactly like a primary base. It may be diazotised by being brought into contact with nitrous acid. This diazotised primuline cotton may now be dyed any shade by simple immersion into a solution of any amine or phenol, and thus a variety of shades is produced, which, from the fact of their having been formed on the fibre itself, have received the name of "ingrain" colours. Unfortunately, from a scientific point of view, the inventor has not disclosed the composition of his "primuline," and thus it is at present impossible to foretell the doubtlessly interesting consequences of his discovery.

Returning to the practical results of the introduction of substantive dyes, there are still a few points to be discussed. It has already been explained how, by the discovery of these dyes, we have come into the possession of a means of producing cheap and fast shades on cotton goods. Another useful application is furnished by the fact that by their use we are enabled to introduce cotton into woollen goods intended for "milling." The process of milling, so much used in the production of heavy woollen goods, tweeds, &c., consists in saturating the goods with strong solutions of soap, to which soda is added sometimes, and then submitting them to a violent kneading in the milling machine. Of course, goods which are to be milled must be dyed with colouring matters which are not in the least affected by soap and alkaline reagents. Even for wool, very few colouring matters possess the required properties, and it has always been considered impossible to subject mixed goods—produced from wool and cotton—to this process. Now, by using cotton dyed with substantive dyes, this difficulty is overcome, and we may thus produce milled goods which, if the proportion of cotton be kept within reasonable limits, are just as good, but much cheaper, than those made of pure wool. The wool itself, if intended to be milled, is now frequently dyed with substantive dyes, because they are less liable to "bleed" in the operation of milling than the shades produced by the old dye stuffs. It is especially for all uses connected with milling that Green's ingrain colours are particularly valuable, because in them the tendency to "bleed" is reduced to a minimum.

The introduction of substantive dyes into the market has met with unparalleled success, and although of comparatively recent date, the demand for them is enormous and ever increasing. It may be assumed that by and bye, as they cover more and more the range of all the shades required by the dyer, they will supersede, in cotton dyeing, all other dyeing materials. The early aniline dyes, which have triumphantly replaced, only a few years ago, the old fashioned dyeing materials of past centuries, will have to retire into a more modest range of application, and to give up part of the field they have conquered to their new competitors, the "substantive" dyes.

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STANDARDS OF LIGHT

At the meeting of the Society of Chemical Industry, recently held at Burlington House, Mr. W. J. Dibdin read a paper entitled "Standards of Light," in which he gave the results of a number of experiments made by many observers, which results had been compared with each other. He used a Sugg photometer; the room in which it was employed was kept at a constant temperature by means of a modified mercury thermostat set to 60°F. Pentane, as suggested by Mr. V. Harcourt, was considered the most trustworthy light-giving agent, and experiments had been tried with a mixture of air and pentane, burnt at the rate of 2½ft. per hour, and giving the light of one average standard candle. He had also tried the Methven screen, in conjunction with a flame from coal gas charged with pentane; the slot was arranged to transmit a light equal to that of two standard candles, and the arrangement worked well. The 10-candle test devised by Mr. Sugg was also tried. The top of the argand flame was cut off from view by a screen, so that the lengthening or shortening of the flame did not cause sensible variations in the amount of light used. With this arrangement Mr. Dibdin employed air charged with pentane; and found that the flame might be lengthened or shortened 2in. without making any difference in the amount of light passing under the screen.

He then introduced to the notice of the meeting one of the little pear oil lamps, now so popular on the Continent. The burner consists merely of a tube, in which the height of the wick is regulated by a screw, as in some cheap hand lamps in common household use. The wick is not consumed, and does not project above the level of the top of the tube. A little rod on the lamp holds a short horizontal arm of platinum wire at a given distance above the burner, and the length of the flame is so adjusted that its point just touches the platinum wire. The combustible used is acetate of amyl, better known as pear oil, and is selected because of its constant composition. In the photometrical tests, the flame of this lamp came out so well that Mr. Dibdin was for some time inclined to recommend it as the best of all the standards of light; but the colour of the flame is too orange when compared with the whiter light of the other standards. The extra yellowness at first prevented some of the observers taking accurate readings, but this difficulty was overcome after a little practice. No other objection than yellowness of flame could be brought against the pear oil lamp, which, for simplicity and accuracy, was all that could be desired. He had not been able to obtain one of the incandescent platinum standards, but had experimented with a lamp in which the light was given by incandescent platinum. It consisted of a vertical plate of brass with a hole in it; behind this was a steatite screen, also with a hole in it, and behind this again was a movable strip of platinum foil, and behind the foil an oxyhydrogen blow pipe. In use, the instrument was viewed from the front, while the blow pipe flame was brought into play at the back, and at the temperature of melting platinum it pierced the foil. Mr. Dibdin said that this instrument was very simple, and was theoretically correct, but that after numerous trials he had had to abandon it for the present, because of the uncertainty of equally heating the whole surface of the platinum opposite to the aperture, also because of the buckling of the foil from rapid heating and cooling. These causes produced objectionable variations in the light emitted. All the standards of which he had spoken, the methyl acetate flame excepted, gave virtually the same spectrum, so far as practical purposes were concerned.

In testing by standard candles, variations in results were sometimes due to changes in the temperature of the testing room; but even when the temperature remained the same, candles were generally untrustworthy. They were not made of pure sperm, wax being added to "break the grain." He thought the best of the standards of light to be produced by the pentane air gas flame of Mr. Vernon Harcourt, but Sugg's 10-candle test gave wonderfully constant results.

In the discussion, Mr. Harris expressed himself in favour of a 16-candle standard, sixteen candles being the illuminating power of London gas, and in photometric work it was advantageous to have the conditions as much as possible equal on both sides of the central disc. Several other speakers addressed the meeting. One of them said that standard candles are often not made from the sperm oil of the whale of the southern seas, but from the oil of the bottle-nosed whale of the northern seas, and that the latter oil is less luminous. Another speaker said that the variations depended more upon the wicks of the candles, which sometimes contained visible little particles of borax; in fact, an examiner could buy candles which will make the same gas indicate a luminosity of 16 or 18 candles, as he may choose beforehand. He did not see how the purity of various samples of pentane was to be readily ascertained, and thought that examiners should not be allowed to make their own standard gas. A third speaker believed that there were objections on geometrical grounds to the Methven screen, when used at shifting distances from the screen of a Bunsen's photometer; the principle of a cylinder of flame screened at the top was better. Another speaker remarked that a 3in. flame from pentane vapour will give identically the same light, whatever may be the illuminating power of the coal gas passed over the pentane; even if pure hydrogen be used, the light is the same.

Notes.

ITALIAN SHIPBUILDING.

There appears to be great activity in the building of torpedo boats for the Italian Government. In a report by the British Consul at Genoa, he states that in his district Messrs. Ansaldo & Co., of Sampierdarena, have eight sea-going torpedo boats on hand, which will all be completed by the end of the year. Messrs. Odero & Co. have eight boats, and Messrs. Cravero & Co. four boats in construction. The first named firm has also lately launched a tugboat, and has two others on the stocks, besides a large floating crane and several mud hoppers and barges.

THE BOARD OF TRADE RETURNS.

Last month's Board of Trade returns are very favourable, the exports amounting to £19,276,225, as compared with £16,497,836 in the same month of last year, an increase of £2,778,389. Almost all the leading articles of export show an improvement. Machinery and mill work has increased in value by 32 per cent., hardware and cutlery by 21 per cent., cotton yarn by 20 per cent., and cotton piece goods by 21 per cent. Woollens and worsteds also show increases; and iron and steel, though less in quantity, are higher in value. The imports amounted to £30,370,775, as compared with £27,921,321 in the same month last year, being an increase of £2,449,454. A notable feature is the very large increase in the imports of copper ore and regulus, which amounts to 48 per cent. in quantity and 149 per cent. in value.

THE OWENS COLLEGE.

The occasion of the opening of the new buildings at Owens College, Manchester, was celebrated on the 8th inst. by a conversazione, which was attended by a large and distinguished company. Many of our readers will have had the opportunity of inspecting the new buildings when the British Association made use of them as their head quarters last autumn. The ground floor is occupied by the geological and mineralogical museums, and the botanical and zoological lecture theatres; while the first and second floors are taken up with geological museums and an extensive suite of zoological, botanical, and geological laboratories. The rooms have been arranged so as to obtain the greatest possible amount of light, which is so necessary in laboratories and museums. Apart from the main blocks of buildings is the new Whitworth Engineering Laboratory, which has been in full operation for about six months. No expense has been spared in making this important department a success, for there are few establishments of the kind in England which have such a complete collection of machine tools of the most approved patterns. As well as these tools, there is an experimental engine, which can be supplied with steam at an initial pressure of 200lb. per square inch, and a 100-ton testing machine. The whole of the new buildings have cost £80,000, and have been designed by Mr. Alfred Waterhouse, R.A., the architect to the College.

A NEW DREDGER.

The members of the Engineering Society of University College, Bristol, recently spent a day on a new dredger which has been built by Messrs. Simons & Co., of Renfrew, and respecting which the Secretary of the Society sends us the following particulars. The dredger, which is of steel, was constructed to the plans of Mr. Girdlestone, the engineer of the Bristol Docks. It is 225ft. long and 45ft. broad, and draws 14ft. 6in. when fully laden. The dredging is performed in the usual way by buckets having a capacity of 1 ton; these revolve round tumblers, which are worked by the same engines which propel the vessel when she is under way. The buckets combined deliver from 17 tons to 19 tons per minute. The hopper capacity is from 1000 tons to 1200 tons, mainly depending on the nature of the dredgings. When the vessel is fully laden, the bucket ladder is raised by a crane at the stern. The vessel then steams out to sea at a speed of about ten knots an hour. The propulsion is effected by two triple expansion engines of 1600 i.h.p. Each of the engines works a screw fore and aft. Thus there are four screws altogether, each having a diameter of 8ft. 2in. The process of discharging the material is very speedy. The vessel may be going along at nine knots, when on a given signal the engines slow down, and the whole 1000 tons of spoil are discharged in the space of a minute. The doors can be drawn up and the dredger steaming back again at full speed in eight minutes from the first signal. The four screws enable her to travel ahead or astern with equal facility, and to turn in her own length when required. Thus while all large craft are obliged to make use of tugs to navigate the very sinuous course of the Avon, the dredger is independent of all extraneous aid.

MACHINERY IN MEXICO.

Great Britain supplies about 50 per cent. of the total imports of machinery at Vera Cruz, and the United States 30 per cent., a large portion of the latter being light machinery, such as sewing machines. Of the metal goods imported, France and Germany furnish each about 30 per cent., whilst Great Britain only supplies 18 per cent., and the United States 15 per cent. The British Consul at Vera Cruz states that this is due to the efforts of the French and German representatives, and not to the dearness of British goods. A large portion of the American metal goods imported consists of "notions," ingenious trifles which are chiefly machine made, and therefore cheap.

STRIKES IN THE UNITED STATES.

Sir L. S. Sackville West has drawn up a report on the labour strikes which occurred last year in the United States, but does not vouch for the statistics being completely accurate, as the Government have not yet published their report on the subject. According to the information thus far available, there were during the year 1000 strikes, in which 400,000 men were engaged. More than two-thirds of the strikes between January and July, 1887, were fruitless, and only brought loss and suffering to those engaged in them. Of successful strikes in the latter half of 1887 were those of the iron workers at Pittsburgh, Yaingtown, and Hocking Valley. As a whole about 38 per cent., or something more than one-third of the strikers in 1887, succeeded in getting their demands, as against 20 per cent. in 1886. It is calculated that nearly 10,000,000 days' work and wages were lost. About 3 per cent. of all the strikes in 1887 were for peculiar causes difficult to classify. The rest may be grouped under three causes: (1) Demand for fewer hours' work or higher wages, 542 strikes; (2) trades union demands other than wages and hours, 225 strikes; (3) sympathetic strikes, 68. The total loss in wages is estimated at £2,700,000, besides the indirect injury to trade. Sir L. West states that the chief feature of the strikes has been the development of combinations among employers, not only among those in the same line of business and in the same locality, but among those widely separated and engaged in different trades. The employers are now using the same weapons against the workmen as the workmen have used against them.

BRITISH SHIPS AND GUNS.

Admiral Lord Alcester, in speaking at the national defence meeting held recently in the City, gave utterance to some remarks which are of a nature not at all calculated to please British shipbuilders and gun makers. He asserted that we were far behind our opposite neighbours, not only in the quantity but in the quality of our cruisers, and in the quantity of our modern guns; though he fully recognised all that had been done lately to remedy that defect. The Admiral is further reported to have said that "if they could not construct vessels which would, when fitted for sea, have their armoured belts above water, and could stow their crews, let them go to the private yards in France to supply them with the lines of vessels that could. The two latest additions to the French navy, the 'Tage' and the 'Cecille,' were the most dangerous vessels to an enemy's commerce that had ever been launched, and there were three more building; but he did not believe that there was any want of talent in the shipbuilders of this country. With reference to the guns, he believed that if orders were given in time they might yet retrieve their position; but if they could not do so otherwise, let them try whether the gun foundries of Sweden, always a friendly Power, whose steel was proverbial for its excellence, could not provide them with our most urgent wants." It will be noticed that Lord Alcester has qualified his statements with a number of "ifs" and "buts." At the same time it is difficult to discover what good purpose can be served by such a course of argument. At a time when vacant slips are to be found in the principal yards of the leading shipbuilding country in the world, it is preposterous to speak of our Government going abroad for their requirements. Our own shipbuilders are better qualified than any others to supply satisfactory vessels, and any faults which exist in the war ships in the navy constructed by private firms are due not to incapacity on the part of the builders, but to faulty designs on the part of the Admiralty. There is also no reason why we should not be able to turn out all the heavy guns we require ourselves.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

1st June, 1888.

8002. Groth, L. A..... Ships (*Monnot*).
8009. Nelson, A. S..... Hydrocarbon engines.
8010. Mills, E. C. ..... Indicators for steam engines.
8012. Siddell, G. ..... Rotating large forgings while under the steam hammer.
8013. Fontaine, F..... Sewing machines.
8015. Ferguson, J. W..... Indicating the over-heating of bearings.
8018. Combe, A..... Twisting frames.
8019. Sutcliffe & Lindley... Speed regulation.
8022. Reid, D. McI. ..... Lifeboats.
8023. Gilbey & Simpson ..... Automatically compensating for expansion and contraction in railway signal wires.
8024. Gundelach, L..... Sewing machines.
8028. Ansell, R..... Friction lifts.
8031. Ellis, W..... Machinery for cutting wood for matches, splints, and match boxes.
8042. Seale, E. A..... Vehicle wheels.
8050. Hill & Gillmore ..... Small arms.
8052. Redfern, G. F. ..... Centrifugal machines for use in the manufacture of sugar (*Abell*).
8053. Fletcher, G. ..... Evaporating pans (*Brocklehurst*).
8055. Harfield, W. H..... Apparatus for working chain cables.
8061. Watts, J. W. ..... Knitting machines.
8064. Scott, F. W..... Tubular vacuum pans (*Freitag*).
8066. Wells, C. ..... Oil engine.
8069. Seck, H..... Bolting machines.

4th June, 1888.

8074. Roe, J. P. ..... Transporting loads by ropes.
8080. Gullery, J. ..... Washing and mangling machine.
8088. Henshall, W. ..... Rotary motor (*Ward*).
8095. Thwaite, B. H. ..... Solid steel castings.
8096. Bastow, A. ..... Indicator for pumps.
8104. Belton & Lowe ..... Warp lace machines.
8105. Cochrane, W. ..... Weaving fur pile fabrics.
8106. Landye, J..... Railway and tramway vehicles.
8107. Scott, J. R. ..... Feed water heaters.
8113. Morison, D. B..... Pistons for steam indicators.
8114. Bohm, W. D..... Grinding machinery.
8119. Hett, C. L. ..... Centrifugal pumps.
8124. Sautoy, C. S. du ..... Steam traps.
8127. Vyrazil, F. ..... Evaporating, distilling, or condensing apparatus.
8128. Robin, A. H..... Furnace grates.
8136. Backman, P. G. ..... Lift.
8137. Durham & Shaw..... Lubricating bearings.
8138. Park, R. P. ..... Overhead gear.
8143. Myers, F. ..... Type writing machines.
8151. Heeson & Rogers ..... Furnace grates.
8152. Holman & Holman..... Drilling rocks.
8153. Bougouin, L. P. ..... Anti-friction bearings.
8156. Ostolaza, E. A. y ..... An improved motor.
8163. Carpenter, A. H..... Feathering blades of paddle wheels.
8167. Standfield, J..... Lifts.

5th June, 1888.

8174. Fairweather, W. ..... Fringing machines.
8176. Cardwell & Watson... Rail chairs and couplings for permanent ways.
8178. Scott & Carroll ..... Machines for the formation of matrixes for stereotype plates.
8184. Shilton, A. J. ..... Making copper tubes.
8187. Baxter & Macdougald Removal of cotton lint from seed.
8191. Thomson & Thomson... Knife blade for reaping machines.
8194. Hulse, W. W. ..... Drilling, boring, and milling metals.
8204. Peters, G. M. ..... Cartridge loading machines.
8207. Seifert, O. ..... Rotary pumps.
8210. Boult, A. J. ..... Steam engines (*Mesia*).
8211. Thompson, W. P..... Steam engines (*Austin*).
8212. Errock & Kenworthy. Mules.
8213. Derriey, J. ..... Printing machines.
8215. Stokes, P. S..... Improved rasp and rasp punching machine.
8222. Cooper, W. ..... Designing slide valves.
8228. Johnson, J. Y..... Railway signals (*Koyl*).
8231. Newton, H. E..... Embroidery machines (*Ricter and Co.*).
8233. Pitt, S. ..... Cylinder welding apparatus (*Rowland, Hill, & McLachlan*).
8234. Pitt, S. ..... Welding furnaces (*Rowland, Hill, and McLachlan*).
8235. Nordenfelt, T. ..... Machine guns.
8236. Nordenfelt, T. ..... Range finders.

6th June, 1888.

8241. Carmont, W. E. ..... Road vehicles.
8243. Randall, C. A. ..... Indicators for vehicles.
8247. Berry, B., & others..... Self lubricating loose pulleys.
8249. Ashton, F. ..... Valves and ball boxes of hydrants.
8252. Johnston, G. ..... Gas motors.
8253. Wroe, J. ..... Grooving and key seating wheels.
8254. Page, J..... Breech-loading small arms.
8255. Bever, A. ..... Friction clutches.
8257. Leeming, J. A..... Spinning machinery.
8259. Hartley & White ..... Multiple hydraulic motor.
8267. Barth, G. A. ..... Steam engines.
8268. Wakefield & Worth. Mitreing apparatus.
8273. Kosztovits, O..... Gas engines.
8276. Lock, C..... Couplings for railway vehicles.
8278. Freeman, J. K., & others Car coupling.
8280. Miller & Wright ..... Thill couplings.
8286. Reinhold, C. ..... Bending metal rails (*Schrabetz*).
8293. Haddan, H. J. ..... Propellers and rudders (*Hofmann*).
8297. Edwards, E..... Tuyeres for forges (*Giraud and Guillemin*).
8300. Delamare-Debouttéville & Malandin... Starting gear for gas engines.
8304. Fraser, J..... Hydraulic machinery.

7th June, 1888.

8308. Warrington, W..... Dobbies.
8315. Ingham, W. P. ..... Pressure gauges.
8316. Anderson, J..... Planing machines.
8317. Altmann, A..... Petroleum motors.
8318. Baird, R. ..... Steam boilers.
8321. Rapier, R. C. ..... Machinery for the relief of chain cables exposed to sudden strains.
8322. Hustler, J..... Working the fallers of fulling stocks.
8326. Henderson, T..... Slide valve.
8328. Haslam, L. ..... Manufacture of cellular cloths.
8329. Prott & Seelhoff..... Hydraulic accumulators.
8331. Tornell, F..... Revolvers.
8337. Brendel, P. L..... Propelling vehicles.
8340. McDowell, D..... Blast pipes for locomotive engines
8343. Vonhof, P. ..... Hoisting engines.
8345. Vonhof, P. ..... Brakes for regulating the speed of descending loads.
8346. Vonhof, P. ..... Safety catches for cages or corves
8349. Okes, J. C. R. ..... Duplex pumping engines.
8350. Stirling, A..... Steam boilers.
8353. Heathorn, T. B..... Steering and propelling boats.
8356. Mourey, H. ..... Ring spinning machines.
8365. Downing, G..... Manufacturing buttons (*Arnold*).

ELECTRICITY.

1st June, 1888.

8039. Le Clercq & Vansteenkiste ..... Conversion of electric currents.
8062. Kleiner, F. ..... Electrical time switch and electrometer.

4th June, 1888.

8081. Rowbotham & Fox..... Electrical bells.
8099. Crompton, R. E. B., and others..... Electrical hoists or cranes.
8161. Nichols, C. C..... Bleaching paper pulp by electricity.

5th June, 1888.

8170. Allison, H. J. ..... Governing electric motors (*The Baxter Electric Manufacturing and Motor Co.*).
8171. Ghegan, J. J. ..... Magneto-electric liquid level indicators.
8200. Goolden & Ravenshaw Electrical transformers.

CHEMISTRY.

1st June, 1888.

8017. Thomson, W..... Antiseptic substances.
8030. Purvis, F. A..... Separating gold (*Trimble*).

4th June, 1888.

8072. Nicholas, J..... Explosives.
8110-11-12. Abel, C. D..... Manufacture of maltose from potatoes (*Kiderlen, Von Leenhoff, Wernicke, Wilhelmi, and Köhlmann*).
8116. Wilson, E. ..... Curing malt and hops.
8157. Dickson & Clark ..... Ores of copper.
8160. Andreoli, E. M. H..... Chlorine and its oxygenated compounds.

5th June, 1888.

8177. McCulloch, J., & others Obtaining silica and alumina.
8208. Leffmann, H. ..... Carbonic acid and magnesia.
8223. Reed, A. H. ..... Eliminating iron from ores (*Conkling*).

6th June, 1888.

8250. Heys, W. E. ..... Dyeing with aniline black (*Marchal, Falck, et Cie*).
8303. Donkin, W. F. ..... Amalgamation of gold (*Donkin*).

7th June, 1888.

8332. Thompson, W. P..... Extraction of gold and silver from ores (*Julian*).
8351. Page, G. S..... Anhydrous liquid ammonia.
8354. Leclanché, M..... Depolarisers for batteries.
8366. Jeyes, J..... Soap.
8369. Gerson, E. ..... Chemical tanning.

MISCELLANEOUS.

1st June, 1888.

8003. Langstaffe & Peckover ..... Purifying water and preventing incrustation.
8008. Wise & Hopkins ..... Finishing tin plates.
8014. Booth, J. H..... Horseshoes.
8020. Turner, S. ..... Roof tile.
8021. Rawlings & Rawlings Soldering apparatus.
8025. Turner, H. W..... Spanners and pipe wrenches.
8027. Mitchell, C. T. ..... Thermometers.
8034. Harvey, W. ..... Soldering irons.
8035. Jones & Read ..... Extinguishers for lamps.
8036. Lewis, E. J. ..... Velocipedes.
8037. Johnson, J. C..... Socket pipes for conveying liquids and gases.
8038. Higginbottom, J. ..... Separation of dust.
8041. Stahl, J. A. ..... Fire escapes.
8043. Edwards, J. H. ..... Door latches.
8045. Seligsohn, L. ..... Fancy figured wood plates.
8046. Newton, A. V..... Cartridges (*Nobel*).
8049. Paddock, G..... Replacing broken slates.
8054. Casper & Debnam ..... Dyeing.
8058. Chiozza, L. ..... Air pump.
8059. Lake, H. H. ..... Treating vegetable substances for the production of paper stock (*Manning, Peckham, and Chambers*).
8067. Warrick, F. W. ..... Stoppering bottles.

4th June, 1888.

8070. Morrell, J. C. ..... Dust bins.
8078. Watt, J. ..... Increasing circulation in water during ebullition.
8086. Ballardie, D. ..... Lamps.
8087. Hyman, E..... Velocipedes.
8090. Rylands, R. A..... Grindstones.
8094. Stevens, W. F..... Placing fog signals upon the railway metals.
8100. Bowing & Beckingsale Artificial fuel.
8109. Merkelbach, A. ..... Watches.
8120. Davies, J. ..... Indestructible wick for oil lamps.
8121. Walker, F. ..... Process for obtaining two or more parallel back stitch seams (*Koehler.*)
8125. Stone, R. ..... Driving bands.
8126. Werner, R. ..... Velocipedes.
8129. Parry & Welch ..... Utilisation of slate waste.
8130. Liscoe, G..... Mechanically separating solids from fluids of sewage.
8142. Boult, A. J. ..... Seal locks (*Brown*).
8144. Faulkner, H. ..... Shoes for horses.
8149. Haddan, H. J. ..... Decorticating and cleaning grain (*Wimmer*).
8150. Garcin & Jacquemond. Manufacture of gloves.
8158. Coker, W. H. ..... Metallic fences.

5th June, 1888.

8180. Parker, H. ..... Ornamentation of metals.
8181. Norton & Baker ..... Oil lamps.
8183. Blunt, J. C. ..... Cinder sifters.
8196. Rigg, J., & others ..... Valves and taps.
8203. Gilchrist, R. B. ..... Cork extractors.
8206. Scoville, E. U. ..... Valves.
8214. Mewburn, J. C. ..... Lead and rule holders for compositors (*Low*).
8217. Clark, A. M. ..... Adding machines (*Moore*).
8219. Comstock, W. H..... Bottle filling apparatus.
8221. Rapeaud, N. F. E. ..... Artificial leather.
8224. Nunn, E. B. ..... Cutting hay.
8225. Docwra & Docwra..... Raising broken well boring rods.
8226. Downton, R. L. ..... Dust collectors.
8229. Hart & Baynes ..... Spindles.
8237. Seck, H..... Sifting flour.

6th June, 1888.

8238. Haywood, R. ..... Apparatus for ruling lines.
8245. Anslow, G. ..... Locks and latches.
8256. Jüngst, C..... Cutting clay.
8258. Hookham, G. ..... India-rubber tyres.
8261. Garside, E. ..... Purifying the water used for wool scouring.
8263. Hatfield, W. B. ..... Cutlery.
8270. Ellis, C..... Ventilators.
8277. Abbott & Rowe ..... Automatically extinguishing lamps.
8279. Bruce, W..... Fire escape.
8285. Phillips, L. B..... Nails.
8287. Spannagl, J..... Fire extinguishing apparatus.
8288. Griffin, J. T. ..... Alloys for anti-friction purposes (*Singley*).
8290. Johnson, J. Y..... Separating liquids having different boiling points (*La Société Française des Alcools purs*).
8291. Haddock & Harvey..... Treatment of sewage.
8294. Carstens, A..... Horseshoe nails.
8295. Peet, H..... Extinguishing candles.
8296. Edwards, E..... Door locks (*Aubry*).
8298. Edwards, E..... Hoe (*Pirlot-Prévost*).
8299. Thurlow, Lord ..... Fire extinguishing apparatus.
8305. Mauni, R., Baron de ... Direct propelling spring oar.

7th June, 1888.

8306. Thurlow, Lord ..... Fire extinguishing apparatus.
8307. Barraclough, A..... Metal pipes.
8309. Mulligan, J. ..... Ventilating caps.
8310. Roberts, P. ..... Ventilators on boiler fire doors.
8312. Rose & Vollhard..... Valves.
8313. Walker, P. M..... Ventilation of rooms.
8319. Darling, J. ..... Needle holder.
8320. Haddleton, P..... Cleaning and painting dome ceilings without the aid of scaffolding.
8323. Wells, H..... Screw nails.
8325. Love, J..... Carburetting gas.
8333. Jeyes & Short..... Ornamenting glass ware.
8336. Carver, H. C. ..... Extinguishing fires.
8344. Vonhof, P..... Shaft door closures.
8352. Page, G. S..... Bombs.
8355. Cohen, J. B. ..... Flue cap.
8358. Perriman & Alger..... Straining wire.
8364. Weisshuhn, C..... Manufacture of wood pulp.
8367. Ramsden, W. T. ..... Fire escape.
8371. Edwards, W. ..... Prevention of the pollution of rivers.
8373. Lake, W. R..... Gas burners (*Burrows*).
8374. Merryweather and Jakeman ..... Armoured hose pipe.

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COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

9th June, 1888.

8079. Klein, E. ..... Steam regulating contrivances for steam engines.
9133. Hodgson & Tetley..... Weft fork motions of looms.
9513. Fuller, H. E. ..... Nail rolling machines.
9668. Baldry & Pullon ..... Excavators.
9782. Boyle, R. K..... Case hardening of iron or steel.
9809. Reader, R. ..... Sewing machines.
9986. Howell, S. E. ..... Manufacture of tubes for boilers.
10423. Schulhof, J..... Magazine guns.
10621. Dickson, J..... Breech-loading fire arms.
10633. Slater, A..... Buffers for railway vehicles.
10674. Wildman, T., & others... Ring spinning machines.
10737. Wailes, E. F. ..... Stern frames and rudders of ships.
10750. O'Kelly & Collins..... Torpedoes.
10804. Hopps & Bywater ..... Singeing machines for textile fabrics.
10839. Rhodes, G. G., & others Beam engines.
10868. Toussaint, J..... Refining metals.
10873. English, T. ..... Securing rails to metallic sleepers.
10894. Fielden, E..... Weft brake for looms.
10932. Williams, J..... Two-wheeled conveyances.
10976. Hannay, J. B. ..... Furnaces.
11047. Maythorn & Gooday... Four-wheeled vehicles.
11055. Derriman, P. R. ..... Signalling.
11503. Abel, C. D..... Gas engines (*Gas Motoren Fabrik Deutz*).
11687. Gadd, W. ..... Twist lace machinery.
11744. Crook & Ormrod..... Brick making machines.
12041. Thompson, W. P..... Machines for sewing books (*Fifield & Jacobs*).
13177. Appleby, S. ..... Construction of ingot moulds.
13612. Cookson, F. N..... Sewing machine.
17948. Gruhl, A..... Button machinery.
18044. Thomson, J. ..... Combined rotary and reciprocating motion. (Received 5th May, 1888. Ante-dated 12th October, 1887. Under International Convention.)
1028. Carr & Carr ..... Cable grips.
3713. Norton, R. ..... Steam boilers.
4342. Sanderson, R. W. B. ... Feed water purifier (*O'Brien and Weaver*).
4883. Murgatroyd, E..... Wheels.
5469. Brandy, J..... Coupling for railway carriages.
5676. Williams, H. A. ..... Cold rolling metallic rods.
6083. Burdon, L. L. ..... Straightening metallic tools.
6101. Lindheimer, F. O. ..... Crushing mills.
6252. Jefferies, E. A. ..... Locomotive, marine, and other engines.
6549. Holleman, F. A..... Railway brakes.
6574. Daniels, W. H..... Keels for ships' boats.
6599. McConnel & Higginson Grinding the flats of carding engines.
6620. Templeman, G..... Knitting machinery.
6622. Laszgallner&Nöhring Draught regulators in furnaces.
6718. Johnson, J. Y..... Looms (*Moraes*).
6728. Sturm & Schrader..... Machine for wiring bottles.
6788. Walton & Edmeston... Starching machines.

ELECTRICITY.

9th June, 1888.

8240. Hard & Wilson ..... Galvanic batteries.
8701. Ross, J. ..... Electric lighting.
10071. Sayers & Sturge ..... Electric incandescence lamps.
10740. Mathis, S..... Regulators for electric lamps.
14346. Lundberg, A. P..... Bell pull electric light switch.
2703 Hargrave, F. ..... Sounding at sea by electricity.
6076. Gross, A. ..... Electrical appliances for a mariners' compass to give alarm upon deviation from the ship's course.

CHEMISTRY.

9th June, 1888.

10759. Deacon, H. W..... Carbonic acid gas (*Arnois*).

MISCELLANEOUS.

9th June, 1888.

8045. Jaegermayer, E..... Determining the percentage of clean wool contained in a given quantity of raw wool.
8225. Colley, W. W..... Printing, waxing, or oiling tissue papers, and cutting same into sheets.
8500. Waring, R. S. ..... Conduits for electric wires.
8567. Fairfax, J. S. ..... Velocipedes.
8861-2. Mallary, G. H..... Treating esparto grass.
9422. Everitt, P. ..... Filters.
9606. Everitt, P. ..... Filters.
9902. Wilding, S. P..... Distributing oil over the sea (*Boye*).
10078. Shand, H..... Cycles.
10341. Wolstenholme, J. ..... Joints for hose pipes.
10608. Hemming, F. T. ..... Wood veneers.
10620. Pickup, T..... Apparatus for collecting and diffusing heat.
10688. Swainson & Musgrave. Washing bottles.
10755. Stephenson, F. L..... Chamber cartridge.
10764. Stokes, F. W. S. ..... Drying cement slurry.
10820. Mallinson, T..... Tinned wire.
10835. Robinson, C. P. ..... Bobbins for winding yarn.
10837. Winans, W. S..... Bulkhead doors.
10842. Prangey, L. E. A. ..... Sugar.
10856. Phillips, E..... Extinguishing lamps.
10879. Thame, J. R..... Manufacture of paper barrels.
10903. Waters, J. ..... Floating anchors.
10904. Curling & Dunbar ... Disposal of sewage.
11393. Bowen & Cobeldick.... Deodorising & filtering medium.
11725. Thaine, P..... Blank ammunition (*Nordenfelt*).
12158. Ingrund, N..... Manufacture of felt.
13478. Bodden, W. ..... Bearings for spindles (*McMullan*)
15253. Lake, W. R. ..... Driving bands (*Meacom*).
70. Semple, H. ..... Bottle finishing machines.
2750. Adair, J. ..... Manufacture of bread.
3137. Barnley, G..... Extinction of fires.
3752. Imray, O. ..... Roadways, pavements, building blocks, telegraph poles, railway sleepers, and similar articles, and fire proof and preservative paint (*Lee*).
3785. Winterflood, J..... Water heating apparatus.
4245. Moore, D. S..... Gas burners.
4947. Bailey, T..... Fire proof partition.
5374. Gabriel, C. E. P. ..... Ball taps.
5564. Wolf & Friemann ..... Miners' lamps.
5886. Morawetz, C. V..... Lamp chimneys.
6499. Kinnear, W. R. ..... Metallic ceilings.
6509. Bodden, W. ..... Bearings for spindles (*McMullan*)
6678. Kilsby & Payne ..... Extracting corks.
6751. O'Leary, C. M..... Alarm bells.
6781. Michaud, J..... Damping apparatus for lithographic and zincographic presses.
6817. Turner, J. S..... Manufacture of boots.
6837. Braun, H. C. ..... Plastic compound for modelling (*Derry*).
6880. Scrimgeour & Scrimgeour..... Dust bin.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 2nd March, 1888, inclusive).

Year 1884.

3988, 3992, 3998, 4006, 4007, 4012, 4019, 4023, 4026, 4027, 4031, 4032, 4033, 4034, 4035, 4036, 4038, 4039, 4041, 4042, 4045, 4046, 4047, 4048, 4049, 4051, 4056, 4060, 4062, 4063, 4073, 4074, 4075, 4078, 4080, 4085, 4086, 4087, 4088, 4093, 4096, 4097, 4098, 4104, 4105, 4108, 4109, 4112, 4113, 4116, 4120, 4121, 4123, 4125, 4126, 4130, 4131, 4132, 4135, 4138, 4141, 4142, 4143, 4144, 4145, 4147, 4149, 4150, 4152, 4153, 4154, 4155, 4156, 4158, 4160, 4163, 4168, 4169, 4171, 4172, 4174, 4176, 4180, 4181, 4182, 4189, 4190, 4195, 4196, 4197, 4198, 4199, 4202, 4207, 4208, 4211, 4213, 4215, 4217, 4221, 4224, 4225, 4228, 4235, 4236, 4238, 4240.

Year 1883.

1064, 1076, 1078, 1090, 1096, 1106, 1118, 1126.

Year 1882.

951.

Year 1881.

840, 841, 876, 888.

Year 1878.

797.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Iron and Steel.—*J. Toussaint, Brigg, Lincolnshire.*—The inventor proposes the addition of fatty matters, either alone or mixed with some alkaline salt, to the molten iron or steel. The object of this addition is to destroy the oxides present in the metal, and to liberate the pyrites, and to cause them to rise to the surface. One claim is made.—No. 8968. June 23rd, 1887. 6*d*.

Water Motors.—*W. Tee, London.*—These improvements relate more particularly to those hydraulic engines which are employed for working organ bellows. The auxiliary valve for distributing the water to the main valve is dispensed with, and a single valve is provided to control the distribution of water to itself, as well as to the working cylinder. This valve is in the form of a hollow piston, which works in a cylinder connected with the motor cylinder, and is provided with ports on its circumference which work over ports leading to the motor cylinder. The valve receives a reciprocating motion by the pressure of water acting alternately on its opposite ends, and also a reciprocating rotary motion for the purpose of controlling the distribution of water to itself; for generating the latter motion, a tappet is worked by the main piston rod, and acts on the valve spindle either directly or indirectly, according to the relative positions of the valve and the main cylinder. If the motions of the valve and main piston be parallel, the tappets may be made to act on the valve spindle through the agency of an inclined cam or other contrivance for changing the direction of the motion at right angles. Springs are interposed for the purpose of rendering the opening of the valve gradual. Another improvement introduced by this invention relates to the regulating valve for cutting off the supply when the bellows are full of air. Hitherto the valve has been of the screwdown pattern, but by this invention the valve operating lever is geared with the valve spindle by means of a rack and pinion; the valve may thus be kept closed more effectually with a shorter lever. The valve spindle is provided with rack teeth, and the lever is fixed on a shaft at right angles to the spindle, and is geared to the spindle by a pinion. Four claims are made: (1 and 2) For the valve for hydraulic engines, consisting of a hollow piston, receiving both longitudinal and circular reciprocating motion in a cylinder, the valve and cylinder being provided with ports, and being used to control the distribution of water to the motor cylinder and to itself; (3) for the combination of the valve, tappet, and cam gear, with the springs for partially rotating the valve; and (4) for the rack and pinion gear for regulating the supply.—No. 15657. November 15th, 1887. 8*d*.

Rotary Pumps and Blowers.—*O. Imray, London.* (*J. Dow, Philadelphia.*)—Fig. 1 is a longitudinal section of the duplex rotary pump, and Fig. 2 is a transverse section of the piston and abutment valve. The shell A is divided into two parallel chambers B C by a vertical partition D, which is continued

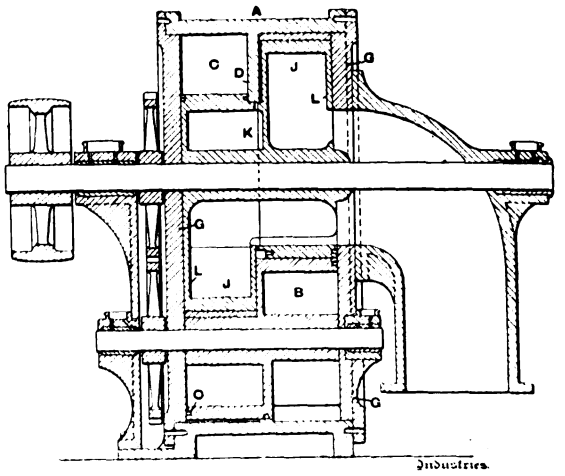


Fig. 1.

through the pipe E to the seat of the valves N. The partition D has an upper circular opening which receives the duplex cylinder, and a lower segmental opening separated from the other opening by a ridge. The piston cylinder K is made in two parts, each carrying a piston J; the ends of the two parts are shouldered down, and the reduced parts enter the upper circular opening, in the middle of which they meet. At each end of the pistons is a thin wing L. The revolving abutments are constructed in one piece in the form of a cylinder, which has two diametrically opposite recesses F, constituting piston openings

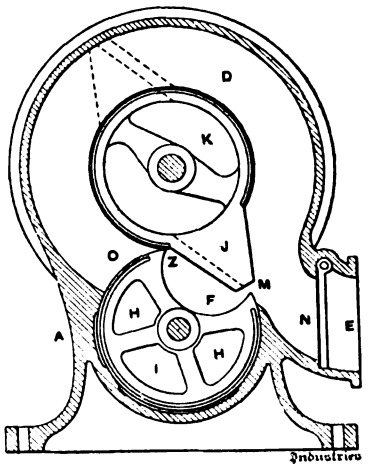


Fig. 2.

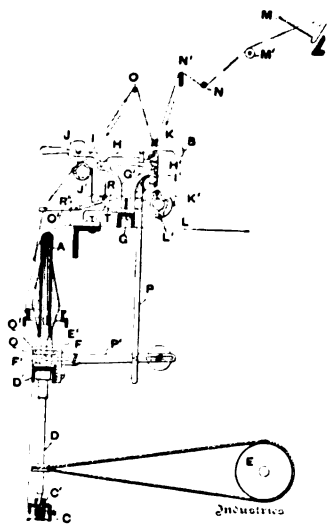
one on each side of the partition D. The ends of the abutments fit closely against the sides G. Two openings H pass from end to end of the abutment cylinder, and other openings I stop at the partition in the middle of the cylinder, which forms the inner wall of the piston openings F. When the piston is entering one of the openings F, as seen in Fig. 2, there is a clearance M for the outflow of the fluid, which would otherwise be imprisoned in F. A valve N is placed in the discharge pipe E so as to prevent any back flow when the piston J is in the position shown in Fig. 2. Three claims are made for making the abutment cylinder in one piece, with opposite openings for the passage of the pistons, with interior chambers open at the ends, and with grooves for fluid packing.—No. 2252. February 14th, 1888. 8*d*.

Steam Pressure Reducing Valve.—*G. Spencer, Hyde, Cheshire.*—A rotary valve works within a tubular chamber and corresponding ports in the valve, and the walls of the chamber are so arranged that the partial rotation of the valve shall regulate the admission of steam. The position of the valve is controlled by a piston, which works in a short vertical cylinder on the low pressure side of the apparatus. A piston rod attached to the piston is weighted by a lever and weight, or by a compressed spring, preferably the latter. When the steam at the desired reduced pressure is acting upon the under side of the piston, the valve will be held in an intermediate position between open and closed. If the pressure increases on the reduced side, the piston will be lifted to a greater or less extent, and the valve will be correspondingly closed; and if the pressure diminishes the valve will be more widely opened. Two claims are made for the combination of the valve, rods, piston rod, piston, cylinder, and spring, for the purpose described.—No. 8331. June 10th, 1887. 8*d*.

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PLANING MACHINES.—*T. H. Martin, Swansea.*—This invention relates to a double acting rest and tool holder, which will enable a horizontal metal planing machine to cut both ways instead of only one way as heretofore. The cutting tool is fixed to the tool stock in the usual way, and is provided with two cutting edges, one on each of the opposite sides of its cutting face, so that it is only necessary to alter its inclination at the end of each stroke in order to prepare it for the return. This reversal of the tool is effected by the self acting feed to the cross slide at the over-run; the belt striking gear of the feed motion moves a cord running over a pulley, which in its turn moves a crank rod, whose backward and forward motion changes the inclination of the tool stock. The reversal of the tool can also be effected by a travelling wheel, which runs on a rod with a shunt, or by means of a cross spindle, pinion, and quadrant. The tool is bolted to a special tool stock which oscillates freely to and fro on the flapping tool box by means of slots in the form of arcs of circles, and pins projecting from the tool box work in the slots; or the tool stock may be pivoted in its centre to the tool box. The amount of oscillation is regulated so as to insure the proper position of the tool for cutting in either direction, and the tool is supported by stops on either side. The flapping tool box differs from the ordinary kind by being arranged to allow this oscillation of the tool stock and tool. Three claims are made for the use in planing machines of a tool with two cutting faces, or of two tools set back to back with cutting edges in opposite directions in combination with the reversing motion as described.—No. 6544. May 4th, 1887. 8*d.*

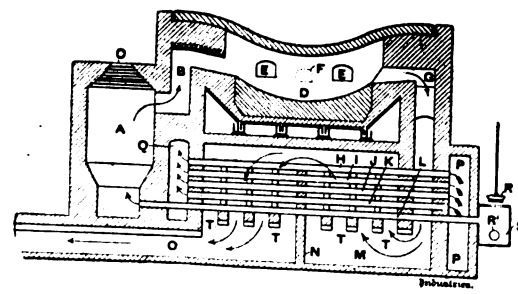
DOUBLING AND TWISTING YARNS.—*E. Sykes & D. Sykes, Huddersfield.*—This invention consists of a self acting mechanism for stopping the delivery of yarn when any of the threads break; the feed rollers and bobbin are caused to cease rotating, while the motion of the spindle, driving band, and tin cylinder is not interfered with. The figure shows a section of the improved machine when the threads are intact. The spindle D is driven from the tin cylinder E, and the bobbin A may be stopped while the spindle rotates by raising the cone F on the bobbin out of contact with the cone F¹ on the spindle. The bracket G¹ supports the rocking frames H H¹, which are pivoted at I and I¹ respectively; the drop wire frame H¹ is provided with notches, which



fit into corresponding notches in H. The roller K¹ is driven from the main shaft, and carries two projecting rods L¹. The two feed rollers are shown at J J¹. When the thread breaks, the eyelet K on the frame H¹ descends, and its lower end comes in contact with the rods L¹; the frame H¹ is thus oscillated, and its upper end with the notches in it moves to the right and allows the right hand end of H to descend. The feed rollers are thus separated, and the delivery of thread is arrested; at the same time the rod P moves downwards and causes the cone F to be raised, with the result that the bobbin ceases rotating. An additional apparatus is added in case the thread breaks between the feed rollers and the bobbin. The eyelet O¹ is placed at one end of a lever R, which is pivoted at R¹; the lever carries a rod at the other end, which passes through an eyelet in a sliding vertical rod in the frame H¹. When the thread breaks, the eyelet O¹ ascends and the other end of the lever descends, and the same train of mechanism is put in action as before. Three claims are made for the frames H H¹ and balanced lever R.—No. 8325. June 10th, 1887. 8*d.*

CARDING ENGINES.—*G. Eastwood, Rochdale.*—The object of this invention is to divide the material into slivers on the doffer before it enters between the rubber leathers. A shaft is mounted between the stripper and the doffer, and it carries a number of circular pieces corresponding to the number of spaces on the doffer. The surfaces of the circular pieces are covered with fillets of card, and are made to approach the surfaces of the doffer and stripper, and to enter the ring spaces which are formed in each. In proximity to the dividing roller is a shaft which is also provided with circular pieces and covered with fillets of card; the office which this shaft performs is to prevent the uniting of the threads at this part of the process, and to insure the separation of the threads before entering the rubber leathers. Another roller is mounted close to and at any convenient part of the under side of the doffer, and is provided with strips of metal which project beyond its surface in the longitudinal direction of the roller. When the engine is in operation a rotary motion is imparted to the latter roller, and by this means the loose fibres, when passing from the cylinder to the doffer, are straightened, and the material is thus caused to pass between the doffer and the roller in a regular form. The revolving shaft situated between the stripper and the doffer insures by means of the circular pieces an effectual division of the slivers; from thence the slivers pass to the dividing roller, and the other rotating shaft carrying the circular pieces obviates the possibility of the re-uniting of the threads on the dividing roller. Four claims are made for the combination of these rollers.—No. 16024. November 22nd, 1887. 8*d.*

OPEN HEARTH FURNACES.—*H. Burrows, Plumstead, Kent.*—According to this invention the gas producing chamber A communicates with the melting chamber D by way of the opening B. The products of combustion pass out through the opening G, and while in their hottest state pass between the series of regenerating tubes H I J K L; the hot gases afterwards



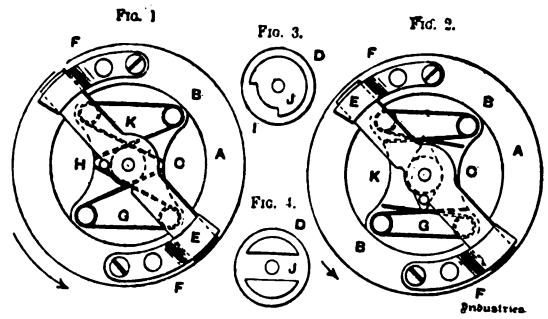
enter the chamber M, which is provided with a partition N for the purpose of thoroughly diffusing the gases among the tubes. The air is admitted through a valve into the chamber P, from whence it passes through the tubes and becomes heated. When it arrives in A it is mixed with gas which is supplied through the valve R and tube L. A tube R¹ is provided in case a forced draught is required. The inventor claims the regenerating air chambers arranged under the melting chamber so as to allow the heated air to pass through, in combination with the means for diffusing the heated gases among the regenerating tubes.—No. 8207. June 7th, 1887. 8*d.*

RAG ENGINES.—*G. Hibbert, Gateshead.*—This invention relates to improvements in protecting the roll bars and plates of rag engines from corrosion, so that their working edge shall last longer. Thin hard plates are placed on one side or on both sides of the roll bars and plates; these thin plates may be made of brass or phosphor bronze, or any other non-corrosive metal, and they may be either straight or corrugated. The side of the plate next to the steel bar is made slightly hollow, so that the plate will be tight in its place when keyed. Three claims are made.—No. 7779. May 28th, 1887. 6*d.*

STEAM PUMPS.—*G. G. Picking & W. Hopkins, London.*—The double cylinders, pistons, and steam ports are so arranged that the steam is distributed to the alternate ends of each cylinder by the movement of the piston without the employment of any slide valve. The cylinders are placed side by side, and a set of ports are made at about the middle of each cylinder leading to the two ends of the other cylinder. The pistons are hollow, and of a somewhat greater length than the stroke. The steam is conveyed to the respective ends of the cylinders by the movement of the piston passing the ports in the cylinder. Three claims are made.—No. 8355. June 10th, 1887. 8*d.*

ELECTRICITY.

ELECTRICAL SWITCH.—*S. Sharp, J. M. V. Money-Kent, and H. J. Payne, London.*—This invention relates to that class of switch in which the contact bar is operated partly by hand and partly by an independent auxiliary force. Fig. 1 represents the switch when "on," and Fig. 2 in an intermediate position, and Figs. 3 and 4 are inverted plans of two arrangements of the handle. The four pins B are cast upon a plate K, and the contact plates F are fixed to the base plate A. A block C is pivoted centrally upon the hollow spindle on the plate K, and



one or two pins H are carried on its upper surface. Two independent springs are secured round the pins B. The operating handle D is secured to a spindle which passes loosely through the contact bar E, and through the hollow spindle of the block C; its lower surface carries a plate J, which may be of either of the forms in Fig. 3 or 4, and is adapted to take against the pins H. When the switch is required to be turned "off," the handle is rotated in the direction of the arrow in Fig. 1; the side of the plate J then comes against the pin H, and the rotary block is turned, and the springs consequently compressed. After a quarter revolution the block arrives at the dead centre position, as in Fig. 2, and the springs are in full compression and ready for action. On the further rotation of the handle, the springs cause an immediate motion of the contact bar, and the contact is thus broken instantaneously. Three claims are made for this arrangement of rotary block and springs for breaking contact instantaneously.—No. 3685. March 9th, 1888. 8*d.*

LIGHTING RAILWAY CARRIAGES BY ELECTRICITY.—*J. L. Yuly and H. W. Andrews, Southsea, Hampshire.*—The object of this invention is to provide a means by which the speed of a dynamo worked by the rotation of the carriage axles can be altered to suit the speed at which the train is running, and to automatically switch the storage batteries on and off when the train is running too slowly or quickly. A wide drum is placed on the axle of one pair of wheels, and open and crossed belts passing around it drive three pulleys on a countershaft, the middle pulley being fixed, and the others loose. Expanding pulleys are keyed to the countershaft, and to the axle of the dynamo. These pulleys have their bosses, by means of which they are keyed to their shafts, formed into conical driving pulleys, which by means of belts drive similar cones on short shafts parallel to the other shafts. These short shafts have ordinary driving pulleys keyed to them, which by means of belts drive similar sized pulleys on the sleeves carrying the expanding cog wheels. The sleeves carrying the cog wheels run loose on the dynamo shaft and on the countershaft, and are kept in gear with their respective pinions by means of collars. By shifting the belts along the cones, the bevel cog wheels are made to run faster or slower than their respective expanding pulleys, and thus set the pinions in motion and increase the diameter of the expanding pulleys. The belt slipping devices are fitted with springs, so that when the hand lever is released the belts immediately move to the middle of the cones. Storage batteries supply the current to the lights while the train is stationary, or is travelling too slow to work the dynamo, and switches are connected to a suitable governor, which is attached to the dynamo or countershaft, so as to disconnect the batteries from and connect the dynamo with the lights when the speed of the dynamo reaches the requisite number of revolutions. The inventors make three claims for the application of expanding pulleys, cones, and belts, for the purpose described.—No. 9256. June 29th, 1887. 8*d.*

CUT-OUT AND SWITCH.—*A. Bernstein, London.*—This invention is an improvement on the instrument described in Patent No. 12315 of 1886, and the object is to provide suitable receptacles for the cut-out plugs, so that they can at the same time serve as switches. The two metal standards F G are supported on the insulating material E, and receive the screwed plug H. The metal end I is attached to the plug by the insulating strips I², and the stud I³ presses against the special compound placed in the recess in I¹. The standard G carries a flat spring J, which makes contact at one end K with the end I¹ of the plug, and at the

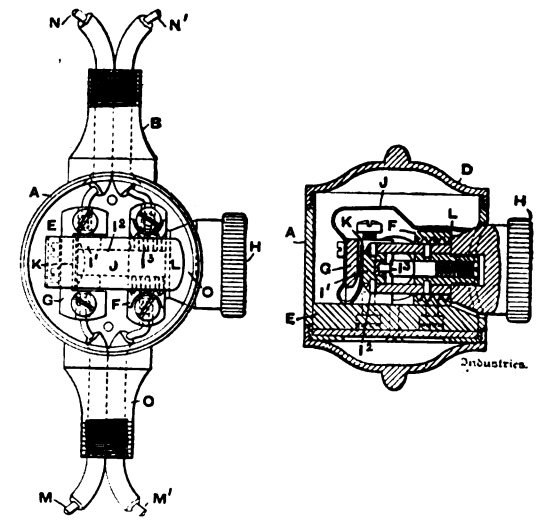


FIG. 1. FIG. 2.

other end L with the standard F when the plug is not screwed up. M M¹ are the main conductors, and N N¹ are the conductors of the lamp circuit which are attached to the standards F G. As soon as the plug is put in place, as in Fig. 2, the metal end I¹ makes contact with the end K of the spring, the metal portion I being in contact with the standard F. The two standards are then only connected through the metallic compound, so that almost the total current passes to the lamp. If the plug is turned slightly out of the case, so that the end L of the spring comes into contact with the standard F, the current will be short circuited through the spring J, and no current can pass through the lamp. The plug will thus work either as a cut-out or as a switch. Two claims are made.—No. 3740. March 10th, 1888. 6*d.*

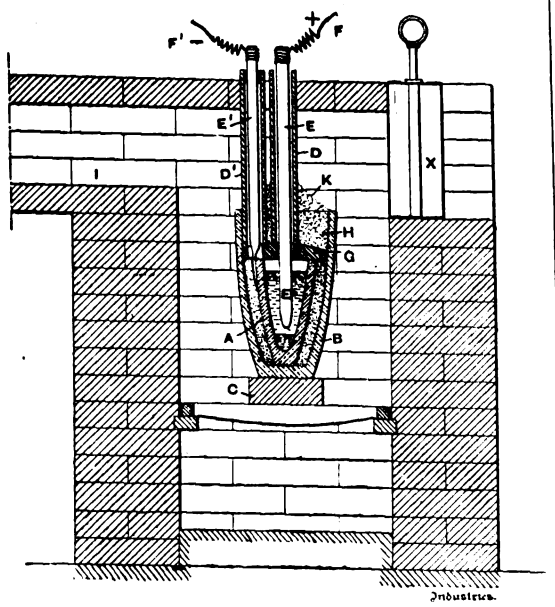
CHEMISTRY.

SULPHATE OF AMMONIA.—*H. C. Bull & Co., and W. E. Sendey, London.*—The inventors first convert purified clay into aluminium sulphate by the action of sulphuric acid, and then introduce gaseous ammonia into the solution, thus converting the salt into sulphate of ammonia and precipitating the alumina. The purification of the clay is effected by mixing it with an excess of water, and by passing it over a series of weirs, which are arranged in chambers; the repeated reversals of the direction of its flow cause the heavier foreign substances to be deposited. After this process is completed the suspended clay is allowed to settle in large tanks. The fine deposit is then delivered into a specially arranged series of leaden chambers where sulphuric acid is being produced. These chambers are round in shape, and are slightly inclined; each of them has a shaft through its centre carrying propeller blades, which convey the clay mixed with sulphuric acid from one end to the other. In passing through the chambers the greater portion of the aluminous material is converted into sulphate of alumina, which is held in solution by the water. The solution is again passed into settling tanks, from which the clarified solution is removed to another vessel, where it is brought into contact with gaseous ammonia. The result of the latter operation is to produce sulphate of ammonia and alumina. The by-product alumina is purified by dissolving it with muriatic acid in order to convert all foreign metallic substances contained in it into chlorides, and is then subjected to a great heat, preferably on a hearth of pure alumina. The chlorides all pass off in vapour, and leave the alumina substantially pure. When this process is carried out at

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a gas works, a large portion of the sulphurous acid necessary to make the sulphuric acid may be conveniently obtained from the oxide of iron used in purifying the gas; and the ammonia can be readily obtained from the gas liquor. The chief novelty of the invention is the production of sulphate of alumina, and so avoiding the expense of concentrating the sulphuric acid, as is necessary in the ordinary processes. Three claims are made for the process, for the plant, and for the utilisation of the by-product alumina.—No. 9543. July 6th, 1887. 8*d*.

Extraction of Aluminium.—*A. C. Henderson, London.* (*P. S. T. Héroult, Paris.*)—According to this invention aluminium is extracted from its oxide by electrolysis, and cryolite is used as a flux in fusing the alumina. The crucible A is formed of very dense and well conducting agglomerated carbon, and acts as the negative electrode. It contains a bath of cryolite, and is placed within another crucible B, which is made of graphite. The pencil-shaped agglomerated carbon rod E¹ serves as a positive electrode, and dips into the bath of cryolite; the carbon rod E¹ is in direct contact with the crucible which forms the negative electrode. The crucible A is closed by a lid G of refractory material, which is covered with fire clay H, and a layer of loam K. When the cryolite, to which the alumina has



been previously added, has been reduced to a molten state by the heat of the furnace, an electric current is sent through it, and the alumina is electrolysed. The oxygen evolved from the alumina unites with the positive electrode E, which, being brought to a high temperature, combines with the oxygen and forms oxide of carbon, and the gas thus given off escapes through the tube D. The tube D¹ is kept closed to prevent the entrance of air. The aluminium passes to the internal walls of the crucible A, where it first settles, and it afterwards falls to the bottom of the crucible. The cryolite remains unchanged. In order to render the production of metal continuous, alumina is added from time to time as required to replace that which is decomposed. For the practical carrying out of this process a current of 3 volts is found to be sufficient, which is a much less tension than has been hitherto employed. The reason for this is that, in the present process, the carbon of the positive electrode E, while it burns, yields an amount of heat which it is not necessary should be supplied by the electric current. When an alloy of aluminum is to be produced, a suitable metal such as copper is employed as the negative electrode, and by the action of the current of electricity both it and the aluminium are fused at the same time. Seven claims are made.—No. 7426. May 21st, 1887. 8*d*.

Manufacture of Sodium.—*J. B. Thompson, London, and W. White, Cheshunt, Hertfordshire.*—For the reduction of sodium the inventors mix the dry carbonate with a fluid hydrocarbon which is decomposable by heat, such as glucose or coal tar. A convenient mixture for this purpose consists of four parts of dry sodium carbonate and three parts of tar; these ingredients are formed into a smooth paste, which is raised to a dull red heat in a crucible. The mixture is afterwards calcined in iron pots, which are preferably introduced into the flue of the furnace; the flue is specially enlarged to receive these pots, so that the waste heat from the furnace may be fully utilised. In reducing the sodium the inventors employ a fire clay tubular retort, into which the calx is introduced after the retort has been raised to a red heat. At the opposite end of the retort is the exit to the condensing chamber, which is placed below the heated parts of the furnace. The receiver for the sodium is placed in the condensing chamber, and contains a little paraffin oil, in order to produce a non-oxidising atmosphere. The chamber is furnished with a pipe for the escape of the carbonic oxide, which, as it issues, is lighted, in order to indicate the continuance of the process. This method of reducing sodium may be also employed for the reduction of potassium. Three claims are made.—No. 8426. June 11th, 1887. 6*d*.

Hydrochlorate of Quinine.—*P. M. Justice, London.* (*L. B. Weld, Falmouth, Massachusetts.*)—In manufacturing the hydrochlorate of quinine a quantity of sulphate of quinine is boiled in alcohol, together with some common salt. The boiling is continued for about ten minutes, and at the end of that time the salts will have been converted into hydrochlorate of quinine and sulphate of soda. The solution is then concentrated and cooled, and the sulphate of soda and any excess of common salt [illegible] precipitated; afterwards the alcohol is evaporated, and the hydrochlorate obtained in a crystalline state. Two claims are made.—No. 3949. March 14th, 1888. 4*d*.

Pyroxyline Compounds.—*F. Crane, Short Hills, New Jersey, U.S.A.*—The object of this invention is to produce thin solutions of pyroxyline for use as lacquers and varnishes without the employment of heat. The acetates of propyl and butyl are used as solvents for the pyroxyline, as they have the special advantages that they evaporate with sufficient rapidity at ordinary temperatures, and that they are not hygroscopic. The following is a suitable mixture to form a pyroxyline varnish: Butyl and propyl acetates 4 gallons, benzine 4 gallons, methyl alcohol 2 gallons, pyroxyline 2½lb. Eight claims are made for the constitution of the solvents made by the mixture of butyl and propyl acetates with benzine, alcohols, or other light hydrocarbons as desired.—No. 8253. June 8th, 1887. 6*d*.

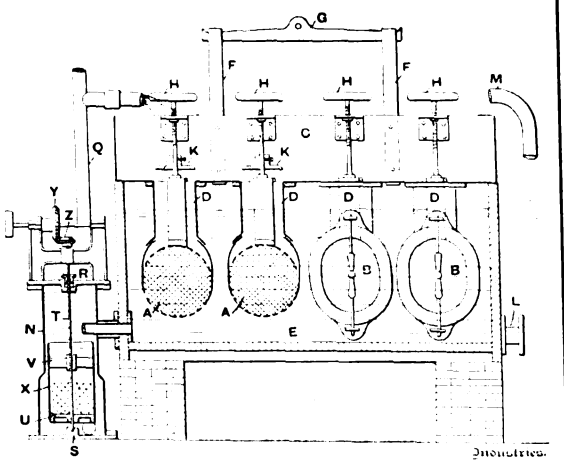
Platinum.—*S. P. Thompson, London.*—This invention relates to the electro-deposition in a bright metallic form of the metals of the platinum group. The chloride is dried and dissolved in distilled water, to which solution is added about thirty times its weight of a solution of phosphate of soda mixed with borate or carbonate of soda. After this mixture has been heated to its boiling point, a brightening substance such as sal ammoniac is added. Any acidity or alkalinity is removed by the addition of either bicarbonate of soda, or chlorine, or hydrochloric acid. This bath is then ready for the electric current. One claim is made.—No. 8284. June 9th, 1887. 6*d*.

Manufacture of Chlorine.—*W. Bramley, Middlesbrough.*—The inventor makes use of waste calcium chloride in order to produce chlorine and hydrochloric acid. The calcium chloride is intimately mixed with a suitable amount of calcined iron ore, and exposed to the heat of a furnace in the presence of a current of hot air. The result of this treatment is that a current of chlorine gas is evolved, which is sometimes mixed with gaseous hydrochloric acid, if there is any moisture present in the air. The residual material is utilised in the manufacture of iron, and consequently the lime contained in it effects a saving of expense in the latter process. One claim is made.—No. 8289. June 9th, 1887. 6*d*.

Aluminium.—*C. A. Burghardt & W. J. Twining, Manchester.*—The inventors take a certain quantity of aluminium sulphate, and precipitate the hydrated oxide by the addition of ammonia. After the oxide has been washed, there is added to it a quantity of caustic soda sufficient to convert it to the aluminate. To this solution potassium cyanide and bicarbonate is added, and after it has been boiled a stream of hydrocyanic acid gas is passed through it. An electric current is then applied, and the aluminium is deposited. Three claims are made.—No. 9389. July 2nd, 1887. 6*d*.

MISCELLANEOUS.

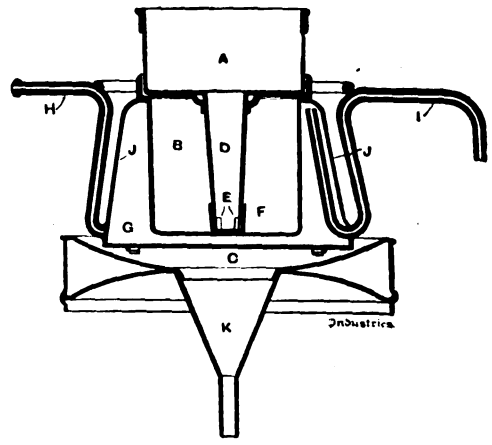
Dyeing Apparatus.—*A. Harmel, M. Harmel, & F. Harmel, Val des Bois, France.*—The apparatus consists mainly of a movable metallic framing, in which are placed horizontal receptacles to contain the material to be dyed. The lower parts of the receptacles are partly perforated, and the upper part constitutes a reservoir for the dye. The dyeing liquor is drawn from time to time from the bottom of the vat, and is passed back into the reservoir, from which it descends through the materials, and issues through the perforations of the receptacles. The accompanying figure illustrates one of the arrangements according to this invention. The metal structure carrying the bobbins of material consists of one or more horizontal receptacles A, which have one end hermetically closed, while at the other they are



provided with a removable cover B. The tubes D attach the receptacles to the bottom of the reservoir C, which rests upon the dye vat E. The bobbins may be compressed between the perforated bottom of A and a curved perforated plate I by means of the screws H, and the loops F and cross bar G assist in the removal of the entire structure from the vat. The apparatus for effecting the circulation of the dye liquor consists of a cylindrical casing N, connected by a tube O to the vat E, and having a branch pipe at the bottom connected to the ascending pipe Q for conveying the dye into the reservoir C. A vertical shaft T is fixed by a disc U and a cross bar V to a perforated cylinder X, and rapid rotary motion is imparted to it. The liquor is delivered from the vat E into the open end of the cylinder X, and the centrifugal action of the latter causes the liquid to be forced into the reservoir. Six claims are made for the construction of this apparatus and for modifications.—No. 3753. March 10th, 1888. 11*d*.

Terra Cotta Fire Proof Articles.—*M. H. Blanchard, Bishop's Waltham, Hampshire.*—Round iron rods or tubes are placed in the moulds, and the plastic clay is afterwards inserted all round them. After having been partially dried, the rods are withdrawn and the article burnt in a kiln. The slabs, which may be of any shape, are then utilised by being placed round iron columns or girders in order to form a protection for them from fire. Iron tubes are passed through the holes in the blocks, and they serve as the means of circulating cold water through the structures. Three claims are made.—No. 326. January 7th, 1888. 8*d*.

Heating Liquids.—*H. H. Leigh, London.* (*J. Bernström, Stockholm.*)—This invention relates to an apparatus which is intended for heating liquids before they are operated upon in a centrifugal separator. The liquid is filled into the receptacle A, from the lower end of which the tube D descends into a socket F in the bottom of the heater B. The lower end of the tube D and the socket are provided with slots which correspond with



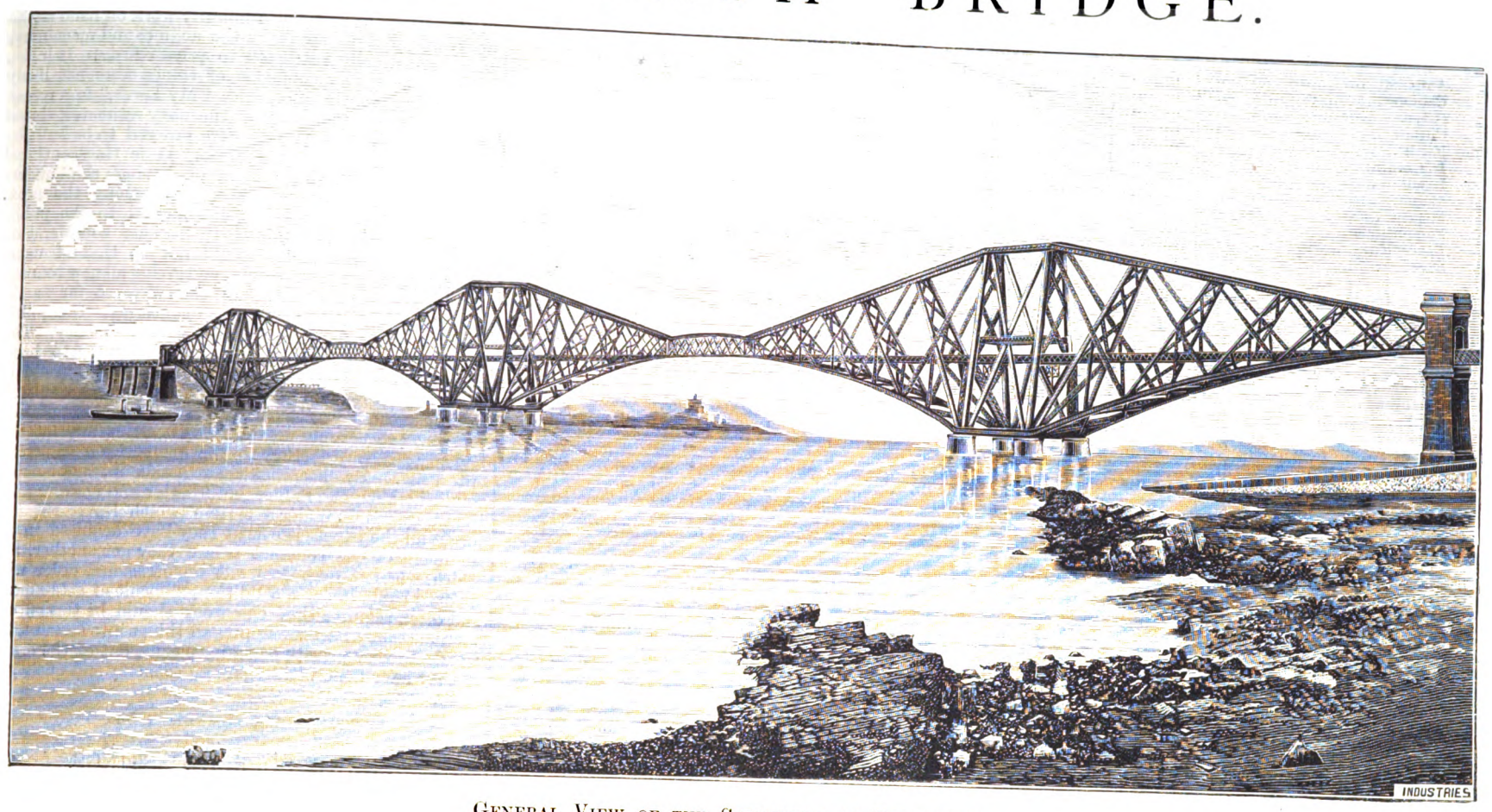
one another, so that the supply of liquid to the heater can be regulated. The space G is filled with water or other liquid, which is heated by steam from the steam pipe H, and the excess of water in G arising from the condensation of the steam flows out through the pipe I. The liquid to be treated is first heated inside B, after filling which it flows over the top and along the inclined shell J in a thin layer. The heated liquid is collected within the bowl C, from whence it may pass through the funnel K to the separator. Two claims are made for the combination of the parts marked A B H I D E F.—No. 3976. March 14th, 1888. 6*d*.

Filter Presses.—*S. H. Johnson & C. C. Hutchinson, London.*—The improvements here introduced into the construction of filter presses are intended to facilitate the opening of them after they have been filled, and to enable them to be worked at high pressure. Usually the loose sliding head of an ordinary filter press has been moved to and fro to open or close the press by means of a central screw, and when the press was worked at a high pressure it was necessary to have a fine pitch on the screw; in consequence, it required many turns of the screw to open or close the press. The present inventors remedy this defect by providing the sliding head with a hollow tubular boss, which projects from the centre of the back of the head, and is open at its rear end. The internal diameter of the tubular boss is made large enough to allow it to slide freely over the screw. A thrust block is also provided, which can be interposed between the end of the screw and the boss, for the end of the screw to work against. This block may either be hinged to the boss, or it may in other ways be made readily removable from the part in front of the end of the screw. When the press is to be opened, the screw is turned back until the thrust block is relieved from pressure; the thrust block is then turned aside, so that the sliding head can be run quickly back; the screw afterwards passes into the interior of the hollow boss. In order to enable one workman at one side of the machine to run the sliding head back easily and rapidly, the inventors mount it on two small wheels running on the side bars of the machine. These wheels are fixed on a common axle, which moves in journals, and is provided at the end with a crank handle or hand wheel, by means of which both wheels can be simultaneously revolved, and the machine thus opened or closed. For the purpose of turning the central screw when required, the inventors make use of a spur wheel, which gears into a pinion attached to a capstan revolving and sliding on a fixed mandrel on the screw standard. Another method of effecting the same object is to fix the spur wheel on the central screw by means of a feather, along which the spur wheel can slide in an axial direction, at the same time revolving with the screw. In order to increase the strength of the screw threads, and to diminish their pitch, a form of thread is employed which has a flat surface at right angles to the axis. This surface sustains the thrust when the press is screwed up; the side opposite to that on which the thrust comes is inclined at such an angle to the axis of the shaft as to make the surface of attachment of the thread to the shaft the greatest which the pitch will admit. The inventors make seven claims—for the sliding head with the hollow, for the boss, for the removable thrust block, for the construction of the screw, and for the method of working it.—No. 9521. July 5th, 1887. 8*d*.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE FORTH BRIDGE.



General View of the Structure as Completed.



Diagram Showing the Work Erected up to the End of June, 1887.

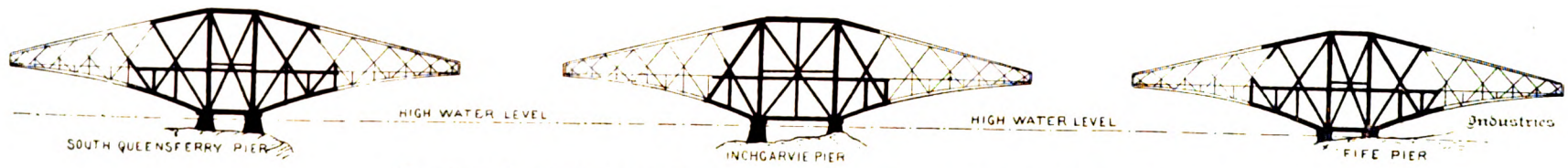


Diagram Showing the Work Erected up to the End of May, 1888.

THE FORTH BRIDGE.

Our illustrations give a perspective view showing the bridge in its completed state, and two diagrams which illustrate the condition of the structure in June last and at the end of last month. By comparing the two diagrams, the progress made since the middle of last year will be easily seen, as the thick black lines represent those parts of the structure which were then and are now erected. It will be seen that considerable progress has been made in the construction of the cantilevers, as at this time last year the main columns only with their bracing had been put in place, and the bottom member of the cantilever had only just been begun. In an early issue we propose to give some further illustrations, and a more detailed description of the work of the bridge.

DOCKYARD v. PRIVATE CONTRACT WORK.

II.

In our last article we referred to the great cost of superintendence in our dockyards, but they are equally at fault in regard to the purchase of materials. The British Admiralty have, without a single exception, established dockyards in localities unsuited for the purchase of materials on reasonable terms. Had one dockyard been constructed on the Clyde and another on the Tyne, the materials of construction could have been purchased minus the heavy item of cost of transport with which they are now weighted, while the Government would have had the very considerable advantage of a much larger command of skilled shipbuilding labour. As it is, they have to pay from 10s. to 20s. per ton more for their iron, steel, and other materials than they would have to pay if the dockyards had been set down in more suitable localities. We do not forget that a hundred years ago, when most of the existing yards had already been established, the iron industry of this country was largely carried on in different districts than the present, and also in those days timber and not iron was the material chiefly employed. Since wood has been superseded by iron the whole of the conditions of naval combination have been radically changed, and if considerations of economy were uppermost with "My Lords of the Admiralty," it would be well worth their while to consider the propriety of setting up a dockyard, say near the great northern coal field, and within a few miles of those great works whence they buy their materials. This, however, by the way. The immediate question before us is whether the Admiralty are able, or if able, whether they make it their care, to buy materials as cheaply as a private shipbuilder would do in their geographical position. We do not hesitate to say that the facts are all and altogether against them. Their own records show that they do not buy in the cheapest markets, although they do produce in the dearest. It is not always easy to bring this to the test of actual figures, but there is a great deal of collateral evidence on behalf of the statement we have just made. One most remarkable fact is that the average cost per ton of the work now turned out of Her Majesty's dockyards is about £110, or just about double what it was fifteen years ago, concurrently with a reduction in prices all round, amounting probably—as regards iron, copper, lead, and other constructive materials—to not less than 40 or 50 per cent. This difference is, no doubt, to some extent enforced by the greater complexity and refinement of mechanism adopted in modern ships of war; but as against that consideration the greater cheapness of materials ought to have counted for much more than it has done.

The Admiralty is accustomed to publish two statements of the cost of the work done by private shipbuilders and in dockyards which are mutually contradictory, and which demand explanations that never appear to have been made. In one statement they show the tonnage built by private contract from year to year, along with what purports to be a record of its cost. In another they show the actual expenditure incurred in turning out completed vessels by both systems. If we take the average cost per ton of unarmoured vessels turned out by private contract under the former series of accounts, it appears that between 1870 and 1885 some 44,513 tons of hull thus produced cost an average of £114 per ton, as against an average of £78 per ton for 79,364 tons of unarmoured vessels turned out of the dockyards in the same period. But when we get to closer quarters, and

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DOCKYARD v. PRIVATE CONTRACT WORK.

Unarmoured Ships built for the British Navy at Her Majesty's Dockyards, 1880 to 1886.

Name of Ship.	Displacement.	Built at	Cost of hull. £	Cost of engines. £	Total. £	Average per ton. £
Amphion	3,750	Pembroke	95,000	65,000	160,000	43
Calliope	2,770	Portsmouth	82,000	38,000	120,000	43
Calypso	2,770	Chatham	82,000	37,500	119,500	43
Curlew	790	Devonport	37,300	12,600	49,900	63
Forth	3,550	Pembroke	151,900	50,000	201,900	57
Iris	3,730	Pembroke	110,800	102,300	213,100	57
Landrail	790	Devonport	37,360	12,600	49,960	63
Mercury	3,730	Pembroke	119,450	93,800	213,250	57
Mersey	3,550	Chatham	100,000	54,000	154,000	43
Polyphemus	2,640	Chatham	114,000	60,450	174,450	66
Raccoon	1,630	Devonport	60,600	31,000	91,600	56
Severn	3,550	Chatham	151,680	60,940	212,620	60
Totals	33,250		1,142,090	618,190	1,760,280	54·3

Unarmoured Steel Vessels built by Private Contract, 1880 to 1886.

Alacrity	1,400	Jarrow	48,289	29,680	77,969	56
Algerine	835	Belfast	25,896	10,556	36,452	44
Archer	1,630	Glasgow	55,916	31,667	87,583	54
Arethusa	3,750	Glasgow	86,763	58,435	145,198	39
Brisk	1,630	Glasgow	55,916	31,667	87,583	54
Cossack	1,630	Glasgow	55,916	31,667	87,583	54
Curaçoa	2,380	Glasgow	85,833	27,098	112,931	47
Fearless	1,430	Barrow	60,881	23,250	84,131	59
Leander	3,750	Glasgow	87,843	60,610	148,453	40
Mohawk	1,630	Glasgow	55,916	31,667	87,583	54
Surprise	1,400	Jarrow	49,084	29,680	78,764	56
Totals	21,465		668,253	365,977	1,034,230	49·1

Details of Armoured Ships built for the British Navy at Her Majesty's Dockyards, 1880 to 1886.

Rodney	9,700	Chatham	563,870	105,400	669,270	69
Inflexible	11,880	Portsmouth	648,811	146,450	795,261	67
Agamemnon	8,510	Chatham	402,295	101,770	504,065	59
Ajax	8,510	Pembroke	411,622	106,735	518,357	61
Aurora	5,000	Pembroke	215,550	64,000	279,550	56
Collingwood	9,150	Pembroke	491,000	95,870	586,870	64
Colossus	9,150	Portsmouth	533,000	80,160	613,160	67
Conqueror	6,200	Chatham	325,000	93,430	418,430	67
Edinburgh	9,150	Pembroke	522,330	77,000	599,330	65
Totals	77,250		4,113,478	870,815	4,984,293	63·9

Armoured Ships built by Private Contract, 1880 to 1886.

Northampton	7,630	Glasgow	296,836	98,968	395,804	52
Orion	4,870	Poplar	239,270	52,959	292,229	60
Orlando	5,000	Jarrow	206,640	60,160	266,800	53
Renown	10,470	Newcastle	612,520	112,330	724,850	69
Sans Pareil	10,470	Blackwall	609,110	110,330	719,440	69
Undaunted	5,000	Jarrow	195,890	60,160	256,050	51
Totals	43,440		2,160,266	494,907	2,655,173	57·3

look into the total cost of the ships built by private contract, the average cost does not usually exceed, and often falls below, £50 per ton of displacement. Now, this system of having two different standards of measurement—the one by weight of hull, and the other by displacement, is exceedingly liable to confuse and mystify. But, putting that on one side, we find that the detailed and complete returns of the total cost of hulls and engines do not bear out the idea of private contract work being more expensive; but, on the contrary, prove just the reverse. We have tested this in three separate ways: First, by comparing the cost of a number of unarmoured vessels, built in Her Majesty's dockyards and in private shipbuilders' yards respectively, previous to 1880; next, by comparing the same class of vessels similarly constructed between 1880 and 1886; and next, by comparing the cost of armoured ships built by each of the two systems also during the latter period. In every case the comparison comes out in favour of private builders' work—not to any very considerable extent, it is true, but still sufficiently so to justify a greater partiality for such work than the Admiralty has hitherto shown. Thus we find that the total cost of 20,780 tons displacement of unarmoured ships, built by private contract between 1875 and 1880, was £951,600, including engines, or an average of £45. 16s. per ton, as compared with £51 per ton for 22,930 tons of unarmoured vessels constructed in dockyards. In this case, therefore, the difference in favour of private contract work was £5. 10s. per ton. Between 1880 and 1886, which brings us as close as we can well get to the existing condition of things, the difference in favour of the private contract work on unarmoured vessels was reduced by 10s. per ton, that is to say, the dockyard work was still some £5 per ton dearer. The uniformity of this difference is peculiar and striking, and as the data with regard to the most recent vessels constructed may be instructive and useful, we give above some tables of comparative results on which the comparison for the period 1880-86 is founded, premising that the vessels in both cases are built of steel, and that they have been selected at haphazard from the list published in Lord Brassey's "Annual." The first table shows the details of a number of unarmoured ships built for the British navy at Her Majesty's dockyards from 1880 to 1886. The next table gives the number of vessels constructed in private yards of much the same description and classes, but we have been compelled to make a more limited choice, simply because the materials for the purpose in hand were less abundant, the work done by private contract being inferior in amount to that done in the dockyards. In carrying this comparison one step farther, and comparing with each other the costs of armoured vessels built by private contract and at Her Majesty's dockyards, it is desirable to remember that the latter have great facilities in being constantly employed with this class of work, whereas the construction of an armour-clad ship comes to a private firm very occasionally indeed. All the resources and equipment necessary for the work are therefore much more fully at the disposal of the dockyards, and yet their tonnage cost, as before, is higher than that of the private yards. In the case of private firms, we are compelled, as hitherto, to rest content with a more limited choice; but the smaller tonnage does not in any way vitiate the comparison or affect the general result, which is considerably in favour of private contract work.

How now is it possible to reconcile with facts like these the remarkable result presented in the annual statement issued by the Admiralty, purporting to show the total tons weight of hull constructed for the British navy in the dockyards and by private contract respectively? These returns, which anyone can easily verify for himself, show that between 1870 and 1885 there were constructed, of unarmoured ships:—

	Tons weight of hull.	Total cost.	Average per ton.
In the royal dockyards	79,364	£6,195,700	£78
In private yards	44,513	5,094,900	114

Being a difference of £36, or 46 per cent. against private shipbuilders. Truly, in this, as in other matters, the ways of the Admiralty are past finding out. On the second part of our subject, viz., the question of whether private shipbuilders receive a fair share of Admiralty work, we think we can afford to be very brief, because, having shown that private contract work is the cheaper of the two, and there being no allegation on the part of the authorities reflecting on its quality, it surely follows that in the interest of the public purse, the more of our new ships of war are put into the hands of private builders the better. Happily, the Admiralty has lately been mending its ways in this respect, and for the first time in the history of the navy, private shipbuilders had in 1886-87 about as much Admiralty work on hand as the dockyards, not to speak of the engines and machinery, which are usually entrusted to private firms. It looks, however, as if this condition of things were not likely to be of long continuance, since "My Lords," in a recent memorandum explanatory of the navy estimates, stated that only two new vessels were ordered to be built by private contract during 1887-88. It is this continual change of policy, this system of having shipbuilders well employed one year and doing nothing the next, that has all along been so detrimental to the public interest; and it is well worth serious consideration whether the true policy would not be that of using the dockyards for repairs only, and giving all new tonnage out to private contract. In this way—so far as the new vessels, at all events, were concerned—the public would be assured of having value for its money. This latter suggestion, of course, would be likely to bring about our ears the cry that the public interest would be endangered by leaving the building of our navy entirely in the hands of private shipbuilders. The only possible reply is that it would be the first time that any interest had suffered by resorting to the competition of private enterprise. By keeping their hands in, shipbuilders would be able to produce both better and cheaper work than they can do under a system which leaves them to forget all the experience that they have acquired in the fulfilment of one contract before they get another, and which, when it does deal out an occasional order with niggard hand, imposes conditions difficult of attainment, and often requires that the work should be turned out with unseemly haste. Taking all things into account, the wonder is that private firms have come out of the ordeal as they have done with regard to economy and quality of work.

SOUND COPPER CASTINGS.

It may seem somewhat strange to refer to "sound copper castings" when castings of all kinds are daily made with alloys whose principal constituent is copper. It is, however, a fact well known to brass founders that it is or has been hitherto impossible to obtain castings of copper in sand similar to those so readily obtained of iron and brass, all attempts to obtain such castings by the addition of small quantities of lead, zinc, tin, or other metal having been futile. The copper smelters and refiners, when casting cakes, ingots, and billets into moulds of iron and copper, and then quickly cooling the cast mass, are not always successful in obtaining castings free from little pin holes. The body of the casting is apparently perfectly sound, and until it is rolled into sheets or drawn into tubes the pin holes do not show their presence. These blow holes or pin holes show themselves when the cake or billet has been rolled or drawn by a line which opens out on the sheet or tube after being bent or tested, thus rendering the labour useless that has been spent on it. Owing to the same cause, a large number of copper rolls for calico printing have been rejected after a good deal of work has been expended upon them.

To obviate this source of loss a process has been recently brought out by Mr. R. Murray, Tylefield-street, Glasgow, whereby it is claimed castings in copper can be obtained with equal facility to those in brass or other copper alloys. The great deterioration in strength and ductility of the copper alloys generally used when exposed to relatively high temperatures was well shown by the experiments carried out in Portsmouth dockyard in the earlier part of last year (see *Industries*, Vol. III., page 2). The results of this investigation show the unreliability of brass or gun metal when exposed to temperatures of 300°F. and upwards, such as are now employed in triple and quadruple expansion marine engines. Copper alone, or when combined with zinc in the proportions used in the alloy known as Muntz' metal, retains its strength and ductility practically unimpaired to 450°F., a temperature far above that of any steam as ordinarily used. The conclusions of this report were emphasised by the bursting of a copper steam pipe on board the s.s. "Elbe" shortly afterwards, whereby ten men lost their lives, owing to the over-heating of the copper pipe while being brazed.

The castings made by the new process are said to be remarkable for their sharpness of detail, and for the beautiful skin and finish which they have when taken direct from the sand. They can, it is claimed, be cast with the greatest ease either in loam, dry or green sand, and in any thickness from an $\frac{1}{8}$in. upwards. The fluidity of the metal may be judged from the fact that a sheet about 6in. square and $\frac{1}{24}$in. thick was cast in green sand, and with such a fine surface that it seemed to have been rolled.

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Ornamental placques are cast by this process, also name plates with letters in relief, from $\frac{1}{16}$in. thick, with all details clear and sharp just as they come from the sand; T and Y pieces of various sizes, bends, ornamental funnel tops, and rivets are also made by the same process; and the inventor guarantees them to be commercially pure copper. The analysis of two samples showed 99¼ per cent. of pure copper. The tensile strength is, on an average, 10 tons per square inch. This process offers the further advantage that when a number of bends or special pieces require to be cast, as in brass or made up from the sheet and brazed, the castings can be made much cheaper, and but slightly heavier than the built-up pipes, with a greater saving in weight than where brass is used; as the copper casting will stand a large amount of hammering at ordinary steam and even higher temperatures, when brass castings or brazed joints would lose their strength and become quite brittle. We understand that these castings have been tested under various steam and water pressures. At the present Glasgow Exhibition (Stand 85, Court 3) a number of these castings are to be seen, some polished and the others with the cast skin left untouched. The letters forming the name of "The Tharsis Sulphur and Copper Company, Limited," are shown. The bases and capitals of the columns at the corners of the glass cases are polished and turned, while the balustrades carrying the hand rail round the stand, as well as a casting of a tea cup, saucer, and spoon in one piece, with castings taken direct from the sand, and having the gates and runners still attached, give a very good idea of the capabilities of this new process.

HYDRAULIC COAL GETTING MACHINE.

In our issue of the 8th inst. we illustrated a hydraulic coal getting machine, invented by Messrs. Roberts-Horsfield & Porter, and we now give, as promised, some further particulars and illustrated details. Fig. 1 shows the machine in part sectional elevation, Fig. 2 is a cross section, Fig. 3 a plan, and Fig. 4 an end elevation. As will be seen from Fig. 2, the apparatus consists of a round steel bar A provided with a hole B running longitudinally through it and closed at each end. From this hole B a short slanting branch leads to the pipe B, which is connected to A in the manner shown. From B short passages C lead into cylindrical recesses in A, into which the rams D fit. The packing of the rams consists of a leather washer E, secured to the ram by means of a metal disc of a slightly smaller diameter than the ram, and a screw. On the top of the rams D is placed a crescent-shaped plate F (Figs. 1 and 2), which is secured to the first and last ram only by means of screws. The first and last ram are also provided with a groove, shown in Figs. 1 and 3, into which a projection of the plate G fits. The groove extends nearly to the cup leather E, and by this arrangement the rams are prevented from falling out or being forced out by the water pressure. When the rams are in their highest position, as shown in Figs. 1 and 2, the small perforations H (Figs. 2 and 3) are opened, and the water escapes without exerting any considerable pressure on the rams. As will be seen from the illustrations, the apparatus is nearly round when the rams are in their lowest position, so that it may easily be inserted into the hole made in the coal. As already described, the water is supplied through a flexible copper tube by means of a force pump, passes into B and through C under the rams D, which are gradually forced up. As soon as the coal gives way the rams reach their highest position, and the water escapes through the holes H.

IMPROVED FLOATING GRAIN ELEVATOR.

The problem of how to effect a rapid transference of goods to and from ships has been very successfully solved during the past few years, especially in the case of grain, for by the aid of elevators and conveyors it is now removed with great rapidity and economy. Fixed elevators, however, necessitate the berthing of a ship alongside the warehouse to which they are attached, and it has therefore during the past few years become the practice to use a portable elevator, by means of which a cargo can be unloaded and placed in any shed alongside of which a ship may be moored. The first type of portable elevator was one which could be lifted from a barge and dropped into the hatch, motive power being derived from an engine placed upon the deck of the ship, and obtaining steam by means of a flexible tube from a boiler carried by the barge. The use of elevators of this description has enormously increased, as is evidenced by the fact that in 1881 81,951 tons of grain were unloaded by their use, while in 1887 745,090 tons were so discharged in the two ports of Glasgow and Liverpool. These elevators are arranged to have two legs, so that they are practically

HYDRAULIC COAL GETTING MACHINE.

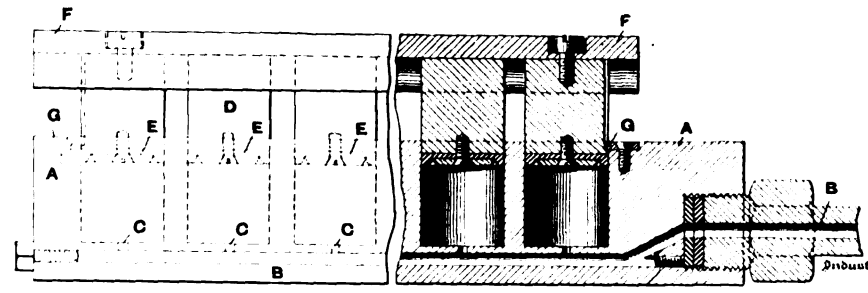


Fig. 1.

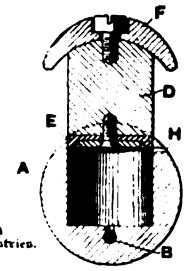


Fig. 2.

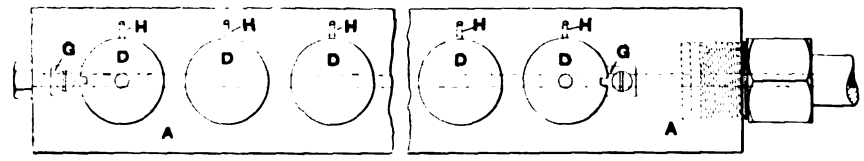


Fig. 3.

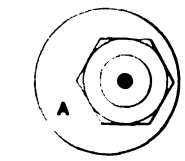


Fig. 4.

duplex, and lift the grain from each side of the ship simultaneously, thus keeping it in even trim. By stopping the operation of one leg, a ship which has a list can be brought upright. It is not, however, with the portable type that we have so much to deal as with a development of that idea which is embodied in a floating elevator. A machine of this class is illustrated in Figs. 1, 2, and 3, Fig. 1 being a side elevation, and Fig. 2 a plan of a single elevator, while Fig. 3 is a perspective view of the application of a duplex elevator to the purposes of unloading grain barges and delivering the material into sea-going vessels. Referring specially now to Figs. 1 and 2, it will be seen that the elevator is carried by a barge or pontoon moored alongside the vessel to be unloaded, and which also contains a steam boiler to supply the necessary power. The upright column is a double one—internal and external—the inner one being fixed to the lower base plate or foundation, and the outer to the upper plate. Between the two plates a set of rollers are placed, so that by means of a hand winch the case and bridge can be revolved, as is sometimes necessary in order to suit the position of a vessel, and to house the elevator. At the upper end of the pillar, two H section girders are attached, which form a bridge or jib for carrying the elevator trunk. In addition to having freedom of circular movement, the bridge can be raised or lowered at the point or nose as desired by means of the wire stays attached to the short end of each girder. This provision is made in order to allow of the elevator trunk being easily placed to suit the delivery, and also to facilitate the housing of the elevator, as will hereafter be described. The requisite power is obtained by means of the winding barrel shown. The elevator trunk is carried in a light wrought iron frame, through which it can slide, the frame being in turn sustained by trunnions, which enable it to be oscillated when necessary. In addition to the oscillatory movement there is also provision for moving the frame and trunk longitudinally on the bridge, by means of a traverse screw worked by a hand chain from the deck of the pontoon or barge. The range of longitudinal movement is of course limited, and is only intended to compensate for the variations existing in the beams of ships. To the head of the elevator leg or trunk is attached a wire rope, which passes over guide pulleys to a barrel, driven by gearing from a pair of engines fixed to the upper plate. By means of this the trunk can be drawn into a horizontal from the vertical position it is in when raising grain. A further lifting rope is taken from a third winding barrel, also driven by clutch gearing, and attached to a ring bolt at the lower end of the elevator case. In this way the latter can be vertically raised or lowered out of or into the hold of a ship, and can thus easily follow the height of the cargo as the latter is unloaded. Two pairs of steam engines are fixed on the revolving base plate, by which the whole of the motions are controlled, one pair driving the three winches described, and the other the elevator and conveyors.

The elevator trunk or leg is fitted internally with two endless chains, running parallel to each other over pulleys at the top and bottom, and to which are attached at short intervals steel buckets. The necessary motion is communicated to these chains by means of pitch chains of special construction, working on sprocket wheels, the chain from the engine driving a second one placed on a shaft running alongside one of the bridge girders, and so communicating motion to sprocket wheels, which drive the elevator and conveyors. This method is clearly shown in the illustrations. Attached to the elevator head is a telescopic delivery pipe, by which the grain is delivered to the conveyor band. If it is necessary to have more than one length of conveyor, a sprocket wheel is placed on the spindle of the roller at the extreme end of the first length, driving a similar wheel on the first roller of the second length. The distance to which the conveyors may be extended is thus very great, the whole of the power being derived from the engines on the pontoon or barge. The sprocket wheel and chain arrangement are of special design, easily detachable, and very convenient.

We had recently an opportunity to inspect a machine of this class which is being supplied to the Limerick Corporation, and we can testify to its easy and efficient working. We have referred to the housing of the elevator. This is requisite when it is out of use or when the machine is being moved from place to place, and is effected in the following manner: A cargo having been discharged, the leg or trunk is, by means of the lifting winch, drawn up clear of the ship's hatch. It is then drawn round until it lies on the bridge, which is swung round until it is fore and aft of the barge, being then allowed to fall at the nose, until the latter rests on a trestle placed on the deck of the barge, the whole being then made fast. The gearing, &c., is then closed up, and the barge is then ready for transportation without any fear of accident. The buckets are stamped out of steel, copper, or brass sheets in one piece; and even in the largest sizes are without a joint. A special plant has been laid down by the makers for this purpose, and they now make a large number of various sized and shaped buckets. The arrangement of these on the elevator chains is such that the maximum duty is obtained, as no space is lost in any way. Each machine is arranged to raise 50 tons per hour, but can, if necessary, raise 60 tons. The whole arrangement is most complete, and the machine we inspected worked well, and was well constructed.

Fig. 3 represents a machine constructed for the transference of grain cargoes from large barges to ocean-going ships—weighing it in the process. This machine was made for use at Odessa, the grain arriving at that port by large sailing barges. As will be seen, one elevator leg is sustained at the end of the jibs or derricks, and raises the grain from the barge, and delivers it to a conveyor. The latter empties it into a weighing machine placed on the pontoon carrying the elevator, which automatically weighs it, and delivers the grain so that it can be raised to the second elevator, which is carried by the upright frames shown. The second elevator delivers the grain to a conveyor, by which it is dropped into the ship. It will be noticed that the whole machine is mounted on a bogie or trolly running upon rails on the deck of the pontoon, so that the elevator legs can be dropped down either hatch of the ship. It should be stated here that, in using these machines, a special conveyor is necessary to bring the grain along the hold of the ship to the foot of the elevator, so as to avoid a good deal of hand labour. This special type of elevator is of course designed for the peculiar circumstances of the traffic; but the makers have to arrange each elevator for its special duty, although the general type is that shown in Figs. 1 and 2. These machines are finding ready acceptance, and are becoming more widely used yearly. The workmanship is exceedingly good, and the design is sufficiently strong without being unduly heavy, which is a point of some importance. The makers of both the portable and floating types are Messrs. S. S. Stott & Co., of Haslingden, near Manchester.

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IMPROVED FLOATING GRAIN ELEVATOR.

Constructed by Messrs. S. S. Stott & Co., Engineers, Haslingden, near Manchester.

(For description see page 609.)

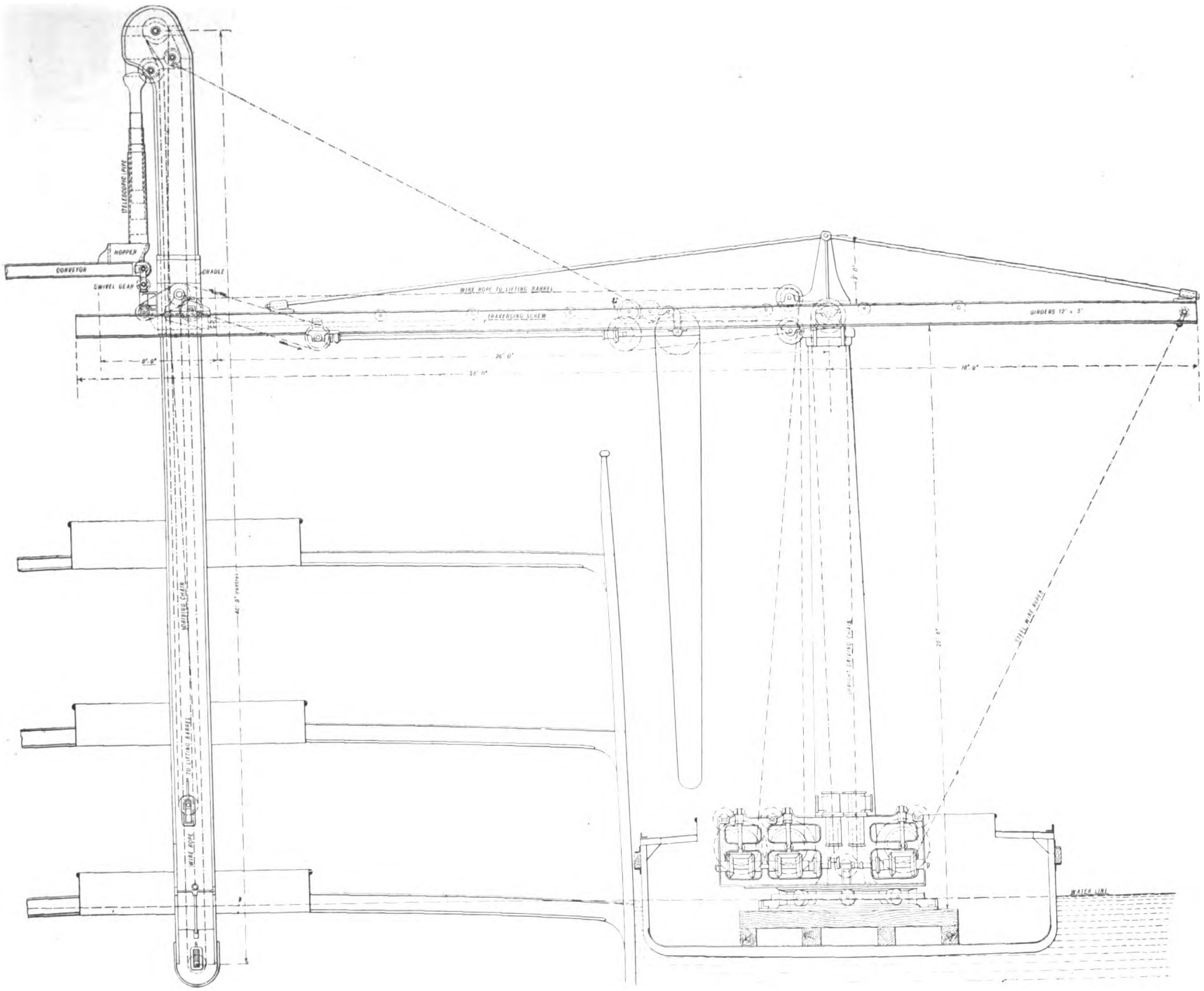


Fig 1.—Side Elevation.

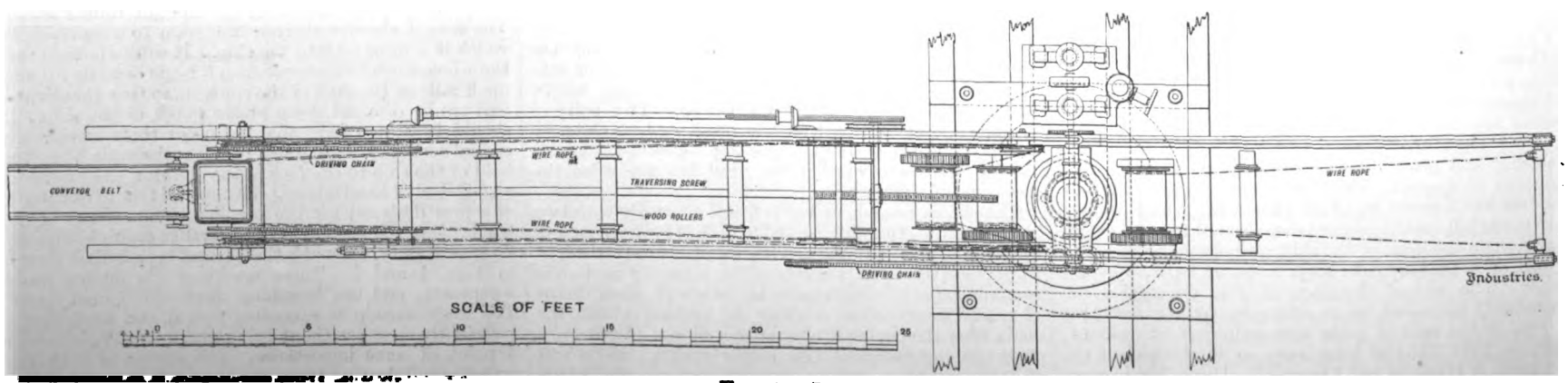


Fig. 2.—Plan.

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IMPROVED FLOATING GRAIN ELEVATOR.

(For description see page 600.)

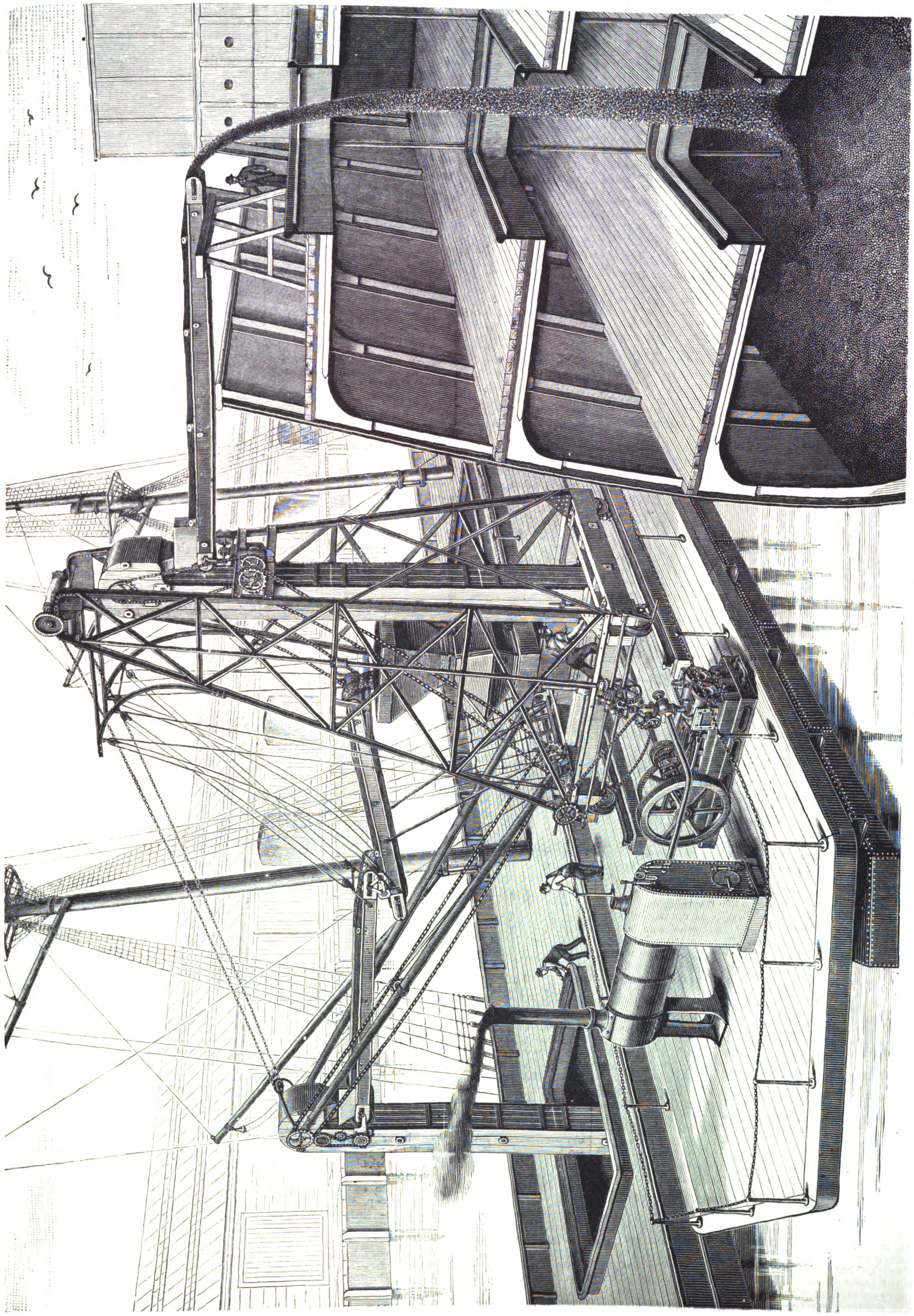


FIG. 3.—GENERAL VIEW.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 19TH JUNE, 1888.

THE IRON MARKET.—The situation of the iron trade has undergone no alteration within the last two or three weeks. The persistence of the same features, however, amounts to a change, as some little time ago the tendency of business was to expand, and hopes were entertained that a period of activity was approaching. The course of events, disturbed by political influences, has proved unfavourable to the development of the commerce of the country, both internal and external; and the iron industry has suffered in common with all the rest. Now the year is too far advanced to leave room for great expectations, and taking this fact into account with the low vitality of the iron trade in England, and the weaker aspect of the Belgian and German markets, hope of further improvement must be abandoned. Still, if the present state of things is maintained, there will be small cause for complaint. The Paris market is inactive, and disturbed by underselling on the part of the merchants; but taking the trade as a whole, there is a fairly strong current of business, and for the principal classes of goods prices are not unremunerative. The near prospect, too, is encouraging in the matter of profits, for manufacturers are strongly combined to resist the influences which tend to bring down prices. The pig iron trade of the Meurthe-et-Moselle is a little less animated, the buying on Belgian account, which gave a stimulus to the business of that district, having practically ceased. But there are no stocks on hand, and there can be no accumulation for at least some months to come, blast furnace owners having sold their output in most cases to the end of the third quarter of the year.

AGRICULTURE IN PRIMARY SCHOOLS.—Theoretical and practical lessons in agriculture are now being given every week in the primary schools of France. These lessons, which are given to boys and girls alike, include the care of cattle, dairy work, and everything which relates directly to farming. In order effectually to combine theory with practice, the pupils are taken once a week during the greater part of the year to the "demonstration plot," a piece of land set apart for the purpose of applying the principles taught in the school, and for affording an opportunity of training the pupils to the work of the farm. In hay time and harvest they are made to assist the farmers of the neighbourhood, and thereby acquire some valuable experience. The system of agriculture taught is essentially local, that is, the practice recommended is that which is most suitable to the locality in which the school is situated. A circular has been issued inviting the municipalities to provide for every district a "demonstration plot" of not less than half an acre.

AGRICULTURISTS AND THE LAND.—The number of persons deriving their living directly from agriculture in France was 6,913,000 in 1886. Since the year 1862 the number has diminished 4 per cent. Among these are about 5,000,000 landowners, of whom about 60 per cent. cultivate the land themselves. That France is eminently the country of small holdings is shown by the following figures: Of holdings under 2½ acres the proportion is 38 per cent.; the holdings between 2½ acres and 15 acres constitute 46 per cent. of the whole number, and those which are above 15 acres and below 62 acres are only 6 per cent.

BERLIN, 18TH JUNE, 1888.

THE IRON MARKET.—The pig iron market in the Siegen district is depressed, owing to the high prices now ruling for coke and ore, to the small amount of export trade which is being done, and to the fact that local rolling mills are withholding their orders for the third quarter of the year. The demand for fine sheets is not sufficiently large to keep the works employed, and wholesale dealers are reluctant to give out orders. The export trade in this class of goods is also weak. The production of the works belonging to the Rhenish Westphalian pig iron syndicate during May showed an increase of 7500 tons of Thomas pig on the previous month, but the output of foundry and forge pig slightly decreased. Representatives of Krupp, of Essen, and of Borsig, of Berlin, have recently visited Ruhla, in Thuringia, with a view to consider the advisability of exploiting certain abandoned iron mines in that district which produce a very good quality of ore. The price of rolled iron in Upper Silesia is firm, and business in steel is brisk. It is proposed to erect some new smelting furnaces for zinc in this district, but the prices fixed by the zinc syndicate will not be changed. Tenders have been received at Magdeburg for a number of locomotives. The Alsace Engineering Company of Grafenstaden quoted £1,670 each for eight locomotives, and £1,540 each for a further lot of twenty; Messrs. Henschel, of Cassel, quoted £1,622. 10s. each for twenty; the Vulcan Works of Stettin quoted £1,625 each for twenty, and £1,515 each for a further lot of twenty-five. The steel works at Witten have received an order from the Belgian State railways for a number of axles at £11. 2s. 5d. per ton; the Cockerill Company made the next lowest offer. The Saxon Engine Works (formerly Rich. Hartmann), of Chemnitz, have received an order for nineteen locomotives for the Saxon State railways.

GERMAN IRON ABROAD.—The official statistics of the foreign trade in iron are now anxiously awaited and eagerly scanned when they appear, in order to learn the latest results of our endeavours to meet, on an artificial basis of prices, the cutting competition of our Belgian and English rivals in neutral markets. Every fresh issue of the Customs returns leaves this question wrapped in greater gloom. The following are the particulars of the export trade down to the end of April, compared with the corresponding period of last year: Pig iron, 45,767 (84,097) tons; scrap, 8606 (23,386) tons; half wrought iron, 8415 (15,820) tons; finished iron, 78,741 (94,353) tons; wire, 62,056 (89,591) tons; rails, 31,833 (52,104) tons; other railway iron, 11,995 (13,353) tons; manufactured goods, other than machines, 66,692 (56,460) tons; total iron of all sorts, 314,105 (429,164) tons, a decrease of 23·36 per cent. The total exports in April amounted to 87,091 tons, against 71,409 tons in March. In the four months' trade there is an increase of about 9000 tons in angles and plates, and a decrease of 25,000 tons in bars. The exports of wire nails amounted to 15,193 tons, against 12,406 tons last year.

TEXTILES.—The present condition of the hosiery trade in Saxony is not very satisfactory. The number of orders recently received is not sufficient to keep the factories employed, and certain classes of goods are being made for stock, whilst prices are as depressed as they were a few months ago. In the little business which is being done, black and striped goods are most in favour, and a few good orders have been received for children's hosiery, both in wool and cotton. Fairly remunerative prices are obtained for fancy articles and all the better classes of goods. Articles in fast colours and light silk gloves are in fairly good request, but the prices obtained are so low that even when manufacturers do a considerable business the profits are exceedingly small. The makers of twist goods are well employed in manufacturing the Lahmann cotton "reform" goods.

STREET LIGHTING BY ARC LAMPS.—Some time ago I reported the experiments which were made in Unter den Linden with arc lighting, to find the best disposition, number, height and power of lamps, &c. The installation of 126 arc lamps is now in progress, the cables being laid underground, and connected to the small central station in the Friedrichstrasse, which was established by the original Edison Company about four years ago, and was at first used for the supply of glow lamps only fixed in some neighbouring hotels and restaurants. Motive power is provided at the station by means of four high speed horizontal steam engines of the Armington & Sims type, but made by Messrs. Löwe, of this town. The present dynamo plant, consisting of four 500-light Edison dynamos, will be transferred to some other central station supplying glow lamps, and special Siemens arc lighting dynamos will be erected instead. The lamps will be grouped twelve or thirteen in series. Architects have been invited to send in competitive designs for the lamp posts. The present subscribers of the station will be in future supplied from the large central station in the Markgrafenstrasse, and the cables for connecting the networks of the two stations are now being laid.

VIENNA, 18TH JUNE, 1888.

THE IRON MARKET.—Business in the iron market has remained quiet since my last report. The most important event of the week has been the establishment of a syndicate of wire nail makers, and in addition to the rise of 16s. per ton advised last week, a further advance is likely to take place both in wire and wire nails. It is expected that a syndicate of cut nail makers will also shortly be formed, as the demand for this class of goods is at present brisk. Heavy sheets are in good demand, and this is greatly due to the fact that engineering works are well supplied with orders, and are making large purchases, thus depleting the existing stocks of heavy sheets. Waggon works are also better employed. The Bohemian Western Railway is on the point of giving out orders for the supply of 14 coal waggons with brakes, 56 coal waggons without brakes, 6 goods waggons with brakes, and 24 goods waggons without brakes. In Hungary the demand for bar iron has been greater than in the previous week, and the works are for the time being fairly well employed. Building iron and heavy sheets are also in better request, but castings are somewhat neglected. Crude iron is languid, but prices have not changed.

METALS.—Considerable activity prevails in the metal market, especially as regards copper, the price of which is again rising. Tin is somewhat neglected. Zinc is active at the previous week's quotation, and lead is advancing. The Nadelburger Metallwaren Fabrik is about to be enlarged by the addition of a special department for the manufacture of pins, and hooks and eyes. Hitherto the specialties of the works were metal articles, such as candlesticks, cutlery and plated goods, mortars, fittings for wells, &c., many of which articles are largely exported to America. The manufacture of special alloys to resist acids and other chemicals is also an important branch of business at these works, which were established 130 years ago, and employ about three hundred hands. The works have water power, and also two steam engines of, together, 340 h.p.

TEXTILES.—The present condition of business is not satisfactory. Cotton yarn is cheap, but spinners are reserved, and many are even selling their stocks of yarn instead of working them up. In linen goods, however, trade is somewhat better. The state of the market in Trautenau is more satisfactory, and the prices for linen yarn are higher than was expected. Woollen goods are firm; but in silk some reserve is shown. This is greatly due to the fact that the silk harvest will very soon be completed, and the results are anxiously awaited. At the Jubilee Exhibition, the cotton spinning mill of Harland, in Austria, is well represented. The owners have, in addition to the spinning mill, also a bleach works and twisting factory, and are, to a certain extent, competitors of English firms in foreign markets. At home, however, English competition is still too strong for them. This is the largest firm of the kind in this country, and the total steam power required in the various branches of their works reaches 800 h.p. Another fine exhibit representative of the Austrian textile industry is that of Messrs. Philip Haas & Sons, of this town, whose specialties are carpets and hangings. This firm have depôts in nearly all European capitals, and even in such remote places as Teheran, Smyrna, Calcutta, Alexandria, Cairo, and Jassy. They employ about 3000 hands in their various factories at home and abroad.

SWITCH BOARD FOR CENTRAL ELECTRIC LIGHT STATIONS.—The Allgemeine Elektricitäts-Gesellschaft of Berlin show at the Jubilee Exhibition a very compact switch board for central station work. The board is designed for seven feeder circuits, but only six of these are used in the electric light station at the Prater, which comprises one thousand glow lamps and one hundred 12 ampère arc lamps. The current is supplied by six dynamo machines to the switch board, from which radiate the mains to the rotunda, various transepts and pavilions, and to the two main avenues in the Prater, which are lighted by arc lamps. The board is supported on a stand which contains the resistances required for the regulation of the exciting current of the dynamos, and also the rheostats for the different feeders. The pressure on each feeder can be read off on a voltmeter provided with a multiple switch, and an earth on any circuit is automatically indicated in the usual way, with a lamp and bell. The switch board is chiefly remarkable for the close arrangement of the various switches, and for the small space occupied by the resistances, the whole apparatus being self contained.

BRUSSELS, 19TH JUNE, 1888.

THE COAL MARKET.—The market continues very firm, coal for industrial purposes being specially in demand. Large coal is quoted at 15s. 2d. to 16s. 10d., unscreened at 9s. 2d. to 10s., dross at 6s. 5d., coke dust at 7s. 2d., and coke at 12s. The number of waggons employed in the carriage of coal and coke on the State railways during the last week shows an increase, as compared with the corresponding week of 1887.

THE METAL MARKET.—There is not much change in the situation, prices being maintained and orders coming in satisfactorily. Complaints are still being made by those rolling mills which have no blast furnaces of their own as to the high price of pig, and they continue to agitate for a reduction of the import duties on the raw material. In the meantime the prices of coal, coke, and pig iron are all high; but as some contracts are being renewed at current rates, and English pig continues to arrive in large quantities, it is not probable that there will be any rise in pig for the second half of the year. Best girders are quoted at 96s., angle iron at 104s., and sheets at 120s. to 176s.

THE GLASS TRADE.—The situation in the glass trade does not improve. The American demand is limited, as there are considerable stocks in the United States. For the English market the following rates have been fixed; 20s. for coarse, 22s. for fourth, and 24s. for third quality.

TEXTILES.—There is little doing in Russian hemp, owing to the rise in the rate of exchange having forced sellers to raise the price. Home grown flax finds a sale at firm prices, but there is not much doing in linen yarn.

THE EXHIBITION.—The engines at the Exhibition are now all at work. Those driving the electrical machinery are distinct from those for the general machinery in motion. The main shaft in the electrical section runs at 110 revolutions, and the power is transmitted to a countershaft running at 250 revolutions a minute. The shafting, pulleys, &c., have been supplied by Messrs. De Naeyer, of Willebroeck. The electric lighting of the gardens and machinery section has proved very successful. There are forty Brush lamps of 10 ampères placed along the lawns, thirty Thomson-Houston lamps of the same power in the horseshoe arcades and the Salle d'Honneur, and eighteen Brush lamps are placed round the hippodrome. There are forty Pieper arc lamps for the lighting of the central promenade in the grounds and for the fountains. Four Brush arc lamps are employed to light the Bodega, and there are eight in the English section, and two at each of the toboggan slides. Twenty-four Pieper arc lamps are placed in and outside the casino, twelve in the Neubecker brewery, and ten in the grotto. In all there are about two hundred lamps in the gardens and outside the buildings. In the machinery section forty-eight lamps of 10 ampères are employed.

ELECTRIC LIGHTING.—The Société Industrielle d'Electricité have received the contract for lighting the Northern Railway Station at Brussels, for the lump sum of £2,400. The plant includes a Walschaert's steam engine of 100 h.p., working at 66 revolutions, and two Lahmeyer dynamos, one of 105 ampères at 115 volts, and one of 130 ampères at 115 volts. This contract gave rise to a lively competition among Belgian electrical engineers, as this installation is considered as an excellent advertisement for its contractor. The same company is undertaking the installation of the new military hospital at Brussels, the lighting being carried out by M. Sandron, who had charge of the electric lighting of the Courtrai railway station. Messrs. Mourlon Frères, in recent private installations, have been employing the Ship-

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man steam engine, in connection with which petroleum is used as fuel. The engine is of the inverted type, mounted on the same bed plate with the boiler, which is a coil. The size of the flame is automatically regulated in accordance with the power required, and the combustion of the petroleum, which is injected in the form of a fine spray, is so perfect that no smoke is produced. The inventor claims that the consumption of petroleum is only 4lb. per h.p. hour.

Gas Lighting.—At Liège, the rates for the supply of gas were altered on the 16th inst., the price charged being now 10c. per cubic metre in the day, and 15c. during the night. The Wenham gas lamp, exhibited in the English section of the Brussels Exhibition, shows various improvements, resulting in greater economy of gas, whiteness of flame, and absence of smoke. The flame is more concentrated, and all the air necessary for combustion passes through channels heated by the escaping gases. This has the double advantage of increasing the temperature of combustion and of decreasing the heat radiated from the metal work of the lamp. At the same Exhibition there are also various samples of the Ezmos lamp on view, and a new burner of M. N. Rey, of the Compagnie Franco-Belge. Both these systems are now finding favour in Brussels.

DÜSSELDORF, 18th June, 1888.

The Iron Market.—On the whole no change has occurred in the market for iron since my last report. Business has become more slack in some classes of goods, but the loss in these directions is partly compensated by greater activity in others. There are no symptoms of serious weakness. The opinion gains ground, however, that the second half of the year will be a period of comparative quiet. The constant shrinkage in the foreign trade is making itself felt, and has a depressing influence. The pig iron market continues dull, buyers being very chary of entering into new engagements. The unanimous refusal of the blast furnace owners to grant any concession in price to the makers of finished iron who work for export has added to the feeling of apprehension with which the future is regarded. The demand for forge pig has further decreased. Spiegel is less inquired after, and basic steel pig is neglected. Bessemer pig continues to be bought, and foundry pig is still in brisk demand. The finished iron and steel trade is wanting in life. In bars, business has further declined. Prices remain firm, but the margin of profit is narrow. Some manufacturers have begun to restrict the make of bars. Stocks are, however, very low, and the common opinion is that as the season advances business will increase. The demand for boiler plates was very brisk at the beginning of the week, probably in anticipation of the rise of 5s. a ton which has just been declared. This advance raises the price of boiler plates to £7. 10s., and that of common plates to £6. 10s. Since the end of last year, forge pig has risen from 42s. to 52s.; bars from £4. 15s. to £6. 10s.; and boiler plates from £6. 15s. to £7. 10s. Sheets are but little inquired after. Wire remains unaltered. The wire nail syndicate is to be carried on for at least another month in the hope of inducing the outstanding Westphalian firm to join it. If this firm persists in its refusal to enter the syndicate, the latter must collapse.

The Linen Yarn Market.—Business in linen yarns is fairly active. The demand on the part of the hand weavers is light, but machine weavers have bought largely. The stocks in the hands of spinners are low and constantly diminishing. Prices are, however, kept down by the competition of foreign dealers, who press their goods for sale, especially in the Bielefeld market. Tow yarns are less inquired after. The net imports of flax in the four months ending with April last amounted to 294,150cwt., against 234,482cwt. last year. The net imports of linen yarn in the same time amounted to 60,156cwt., against 54,250cwt.

Water v. Railway Carriage.—Large quantities of iron ore are now being transported from the North of France to the German iron works on the Ruhr. The ore is conveyed by canal boats to Ghent and transferred into Rhine boats for transport to the ports on the Ruhr. Another instance of the successful competition of water-borne goods with those which have to be carried by railway may be mentioned, especially as it serves to enforce the arguments set forth in your leading article of the 18th ult. The German packing paper makers have a large and steadily growing market in England. The imports from Germany in the first four months of the current year amounted to 147,077cwt., against 129,855cwt. and 111,832cwt. in the corresponding periods of 1887 and 1886 respectively. Lately a large contract was obtained by a German manufacturer because the cost of carriage from Manchester to London is £1. 5s. 10d. per ton, while the freight from Hamburg is only 11s. 6d. per ton.

LILLE, 19th June, 1888.

Textile Manufactures.—The trade in textile goods shows no symptom of returning animation. The market is extremely sensitive to political influences. The death of the German Emperor has occasioned a further depression, buyers limiting their dealings to the wants of the moment, the future being regarded as very uncertain. A stronger tone of affairs is reported from Armentières, where linen goods are in better demand. The summer business seems to have now fairly set in. Fine cloth has advanced in price. The cotton trade of Rouen is still very quiet. There is, however, a steady though feeble current of business, and in the absence of political disturbances there is a fair prospect of activity next month, when the agents of foreign houses usually visit the place. The latest accounts received from Roubaix are less encouraging. The revival which showed itself a few weeks ago has been scarcely maintained. Numerous orders come to hand for fancy goods, but individually they are of little importance. At Calais the spring season has failed to fulfil the hopes of the manufacturers of tulle.

Flax and Yarn Market.—Only a small quantity of home grown flax has been offered for sale this week. There is but little available, and what there is left of last year's crop is firmly held. The higher prices quoted last week are maintained, notwithstanding the improved prospects brought about by the copious rains of the last few days. However favourable the weather may now be, it is certain that the plants can scarcely attain more than half their usual height. Russian flax has been less largely dealt in this week. The rise in the value of the rouble has compelled holders of flax to increase their prices about 1s. 6d. per cwt. Russian tows are in demand at higher rates. The animation which last week formed the distinguishing feature of the yarn market has somewhat abated, but business is by no means slack. The advance of 9d. per cwt. gained for the common sorts of linen yarns has been maintained. Most spinners having sufficient orders in hand for the next three months, no eagerness is manifested to push sales. Jute yarns are in brisk demand, and prices are very firm for all descriptions. The Belgian markets are active, and prices have an upward tendency.

The Iron Trade.—The iron trade of this locality offers no new features. Manufacturers have now abandoned the hope of a steadily growing current of trade, which seemed almost certain a few months ago; and consumers, anticipating a relapse, refrain from all dealings on speculative account. The wants of the moment are, however, considerable, and a large amount of business is transacted in most classes of iron. Bars are somewhat dull, and Paris merchants are buying but little; but joists are in fair demand, and plates are much sought after. Prices remain unaltered.

MADRID, 18th June, 1888.

Pig Iron.—Since the breaking up of the pig iron syndicate at Bilbao, prices have been gradually decreasing, and 46s. is now quoted for the best foundry pig. This rate leaves very little profit at the present high cost of coke. The first Simon-Carvés coke ovens in this country employing English coal will be started next month.

Antimony.—A new antimony mine has been opened in the province of Caceres. The ore appears to be rich, and it is anticipated that large quantities will shortly be produced and shipped from Lisbon. As the workings go deeper, it is expected that the ore will be found to contain a considerable percentage of silver.

Duties on Railway Plant.—All the important railway lines in Spain have had the right to import their plant duty free during the first ten years of their working, but a Bill has now passed the Senate prohibiting any such clause in future railway concessions. The duties charged are, however, very moderate. Locomotives under the general tariff only pay a nominal duty, which will leave the market open to English and German builders. The Bill will, however, probably have the effect of causing railway waggon works to be started in Spain, the duty amounting to £2 per ton weight. The best business would be done by a company with a large capital, which could let the waggons on the hire system to the many new local companies which will be formed to work narrow gauge railways. There is at present one waggon works at Barcelona; but its position is not favourable either for iron, steel, or fuel, and Bilbao would be found a more suitable site for such a business.

Patent Laws.—A Bill has been introduced into the Cortes to amend the patent laws, which are at present very complex and indefinite; but the changes proposed are not satisfactory, and do not appear to be calculated to simplify the existing state of confusion.

NEW YORK, 9th June, 1888.

The Coal Market.—The anthracite coal trade remains in about the same condition as a week ago. It will be a month before any active demand is likely to arise. June prices will remain unchanged, and there is little likelihood of an advance before the autumn. All the leading companies are supposed to be making an effort to restrict production, but notwithstanding this the supply considerably exceeds the demand.

The Iron and Steel Market.—The feeling of doubt and uncertainty in the iron market still continues. Prices are low, and little business is being done. Although there is some scarcity of good irons, yet production has not been brought down to a level with consumption. The average supply is in excess of the demand; the outlook as regards consumption is far from encouraging, and during the next three months is certain to be much less than during any corresponding period for a long time past. Several additional furnaces will soon be at work in the South, so that the present indications point to an increase in the supply rather than to a decrease. Consumers are buying very sparingly, so that the natural shrinkage in consumption is intensified by the determination not only to buy as little as possible, but to carry as little stock as possible. Prices of pig iron are unsettled, and there is no pretence of uniformity except in mill irons, which have not been reduced in proportion to foundry grades. Consumers have no confidence even at the present low quotation, and except for stock immediately required, they are not in the market. The usual quotation for this class of iron is from $16 to $17 per ton, the latter price being for special brands. The Andover furnaces are all out of blast, and as the Glendon have only one in operation, high grade mill irons are becoming scarce. There is an ample supply of lower qualities, but it requires careful selection to secure a fairly good average mixture at $16. There is plenty of iron at $15 to $15·50, but there are no buyers for this quality. The position is somewhat different in foundry grades, the supply of which is fully up to the demand. As there is plenty of iron, it is difficult to arrange prices in proportion to quality, and yet meet buyers' demands. The Thomas Iron Company's quotations are not being met by the trade, those controlling brands of an established reputation claiming to have a demand for all they can spare at higher prices, some getting $18·50 for No. 1, some $19, and some more. The prospect is that good foundry irons will maintain their present position during the summer, and that lower qualities will be weak and irregular, with special low rates to those taking large lots. There is no improvement in manufactured iron, although the demand is fair. With so many mills waiting for work, the market is in a very dull condition. Although prices are no lower than they were some days ago, it is difficult to secure business without yielding somewhat in the buyer's favour. For the next two or three months a very dull season appears to be inevitable. Prices are about 1·8c. to 1·85c. per lb. for bars, 2c. to 2·1c. for plates and angles, and 3·3c. for beams and channels. There is very little doing in steel rails, but the demand for blooms and billets in some measure compensates for the loss in that direction. Prices are nominally $31 to $32 per ton at the mill, but only small lots are taken, so that it is hard to say what would be accepted for a large order.

The Metal Market.—The copper market is quiet, and prices are steady at about 16·6c. per lb. Quite a large stock is accumulating here, which will probably amount to 25,000 tons by the end of the summer, and this is causing some uneasiness as to the future condition of the market. A moderate amount of business has been done in tin, at prices ranging from 19·50c. to 20c. per lb. for spot. The demand for tin plates continues good. The lead market has been a little more active. The spelter market is better, advancing slightly on the news that several Western mines were flooded. Quotations are 4·6c. to 4·75c. per lb. for common domestic.

Electric Railways.—There are now 130 miles of electric railways in operation in the United States—an increase of fifty miles in less than six months. The maximum mileage in any one State is twenty-one in Pennsylvania. There are now sixty-two different roads in operation or nearing completion, and of these seventeen are on the Van de Poele system, fifteen on the Daft, and seven on the Sprague system; the remainder being divided amongst a number of companies.

Glow Lamps.—Lieutenant Hutchins, of the United States Navy, has been making a number of experiments as to the risk of explosions when incandescent lamp globes are broken in explosive mixtures. The first experiment was made with a mixture of hydrogen and oxygen, Swan lamps being used. When the glass was broken the mixture exploded, but the filament was unbroken. The second experiment was made with marsh gas and air, when the filament was broken. Another experiment was made with coal gas, and after the bulb was broken the gas burned for some time. An explosive mixture of coal gas and air was next experimented on, and exploded after the breaking of the bulb. As it is claimed that the breaking of the bulb of an Edison lamp will always break the filament by the first rush of air, the same danger would not attend the use of the Edison lamp as is shown to be the case with lamps of stronger filaments. But even if all were equally dangerous in explosive mixtures, the liability of broken lamps and dangerous mixtures occurring at the same time is very slight.

PHILADELPHIA, 9th June, 1888.

New Steel Works.—Mr. John Birkinbine, of Philadelphia, has completed all the plans for blast furnaces, steel converters, and mills for the Duluth Steel Company, and work has commenced on the foundations for the 140-ton blast furnace, to be followed at once by the casting, stock, and engine houses. The works is not expected to be ready for business before the opening of lake navigation in 1889. The ores to be used are the Bessemer ores of the Vermillion, mixed with the softer ores of the Gogebic range. The plant will cost about £400,000.

A New Galvanometer.—Messrs. Geyer & Bristol, of Stevens' Institute of Technology, have constructed a new galvanometer which indicates the strength of current by its heating effect on a compound bar made of the same metal. The bar is bent into an arc of about 270°, and consists in reality of two bars joined at one end, but otherwise insulated from each other throughout their entire length. They are made of such shapes and sizes that the two parts of the compound bar are unequally heated by the current passing through the bars in series. Gearing is arranged so that the deflection of the pointer is in direct proportion to the current flowing. With the dial removed the apparatus looks not unlike a Bourdon steam gauge.

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RICKINSON'S IMPROVED CASTORS.

The ordinary method of fastening castors to the legs of chairs and tables is admittedly very imperfect. The castor is generally attached by two or three little screws, which are easily wrenched out of the wood, and when this happens it is difficult to find a new place for the screws by the side of the holes from which the threads have been torn. To obviate this difficulty, Mr. H. Rickinson, of Birmingham, attaches the castor by means of a separate sleeve, as shown in our illustrations. The leg of the chair or table is either undercut conically, as in Fig. 1, or a collar is left, as in Fig. 2. Round this collar or cone there is first placed a ferrule A, with a screw thread on the

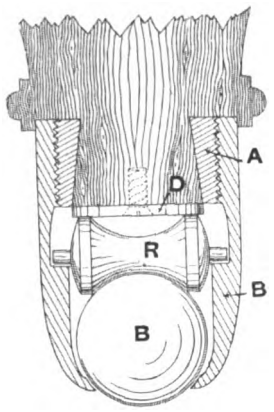


Fig. 1.

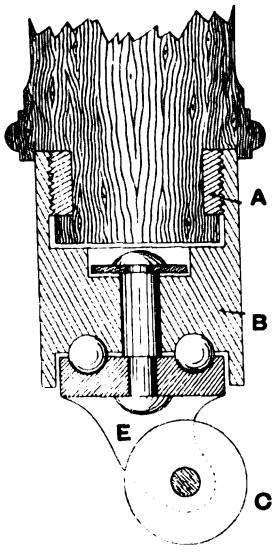


Fig. 2.

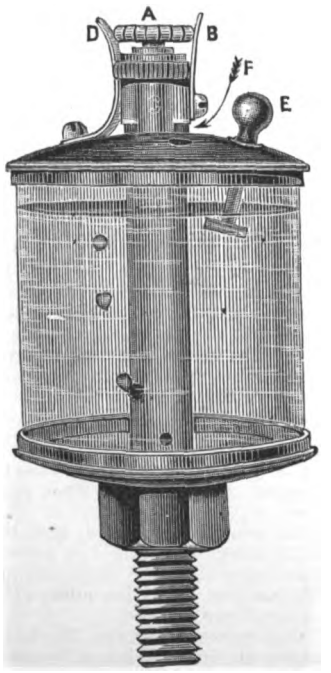
outside. This ferrule is in halves, and over it is screwed the casting B, which is thus secured to the leg in a substantial manner. The castor shown in Fig. 1 consists of a ball B and roller R, upon the latter of which rests the end of the leg, which is provided with a washer D. The roller is turned to the radius of the ball, and is confined by a small ledge within the casting B, upon which the ends of the axis of the roller rest when the leg is lifted. If the leg is pushed along the floor in a direction at right angles to the surface of the paper, the roller R simply revolves, its axis remaining in the position indicated by the sketch. If, however, the leg is pushed slantingly, the rotation of the ball causes the roller itself to turn round so as to place its axis at right angles to the direction of movement, thus always producing a true rolling motion without grinding. In the castor shown in Fig. 2 a ball bearing is used to diminish friction. The roller C is of the ordinary type, but smaller, and held in a bracket E, which is secured to the casting B by a central pin. This is a slack fit in the casting, and only serves to prevent the castor from falling off. The weight is taken by three or four little balls, confined between semi-circular channels, as shown. By this means the castor is made to run very easily, and it is thus possible to bring the centre of the roller C very near to the centre of the leg.

BOILER EXPLOSION NEAR SEAHAM HARBOUR.

About half-past eleven on Wednesday morning, the 13th inst., one of the boilers working at the Murton Colliery, which is situated near Seaham Harbour, exploded. The boiler formed the third in a range of seven used to supply steam to the winding engine of the middle pit. It was of the plain cylindrical externally fired type, with hemispherical ends. The boiler was 30ft. in length, 8ft. diam., and made of plates ⅜in. thick, which were arranged with their longitudinal seams in line for the whole length of the boiler. Each ring was also made of very small plates, each 4ft. 6in. in length and 2ft. in width, there being no less than thirteen plates in each ring. The boiler was provided with the usual mountings, and the safety valve loaded to 30lb. per square inch. The boiler, we understand, was made about the year 1859, and was insured by the Newcastle Boiler Insurance Company. The boiler does not appear to have suffered from corrosion, and although much patched, appeared, considering its great age, to have been in fair condition. Rupture appears to have first taken place at the longitudinal seam of the left side of the boiler near the seating, and the boiler appears then to have torn in three pieces. One portion, about 9ft. from the back end, was blown over the engine house, falling on the top of the winding gear of the Polka Pit, where it remains lodged. Another and larger portion was forced forward through the engine house wall, which was 3ft. thick, and the third piece was thrown over and upon the coal screens. The safety valve weight was thrown 150 yards away, passing through a coal waggon in its descent. Although the pressure at which the boiler was worked was a very low one, it would appear to have been too much for this boiler, which was about thirty years old, and constructed in an extremely weak manner, rendering it liable to disastrous explosion, as in the event of even a small fracture occurring in one of its longitudinal seams, the immediate tendency would be for such a fracture to run the whole length of the boiler, as when a woman rends a piece of calico, by commencing the tear with a short snip. Little reliance can be placed on boilers constructed in this manner, particularly when of the plain cylindrical type, and unsupported either by stays or internal flues; and we think very few boilers of this type are now under the charge of the Boiler Insurance Companies, or even in use, as we believe it has been the custom for many years of the principal companies to avoid where possible the insurance of boilers of a similar type. Nine workmen were injured by the explosion, the fireman severely. As this accident occurred at a colliery, the examination of the boiler will not devolve upon the engineer officers of the Board of Trade. An inquiry may probably be held, however, under the Coal Mines Regulation Act.

QUIGGINS' SIGHT FEED LUBRICATOR.

The accompanying illustration shows an improved sight feeding lubricator recently introduced by Messrs. R. Shone & Co., Liverpool. The lubricator consists of a glass cylinder with a brass cover and bottom, which are pressed against the glass cylinder by means of a nut on the tube passing through the lubricator, an air tight joint being made by means of washers. The brass tube is provided with air holes and oil inlets, and carries a regulating valve A which is locked in position by the spring B. The air enters the lubricator at F, and appears in the form of bubbles at the air holes of the tube. If it be required to



shut the oil supply off, the spring D is forced backwards, and the cap turned until it drops into a recess provided in the cover. A flush of oil may be given by raising the cap bodily off the cover, when the oil will flow as long as the cap is held in the raised position. Neither the cutting off nor the flushing operation interferes with the position of A, so that the lubricator will supply oil at the same rate until the position of A is altered. For filling the lubricator the cap is placed in the recess of the cover, the plug E is partly drawn out, and the oil introduced through the plug hole. The cap is then raised until the spring D drops into the recess provided in A, when the lubricator will begin to act. The advantages claimed for this arrangement are as follow: The lubricator requires no gear or moving parts for working it; the amount of feed may be regulated to any required number of drops per minute, and the supply of oil may be shut off or a flow of oil given without interfering with the adjustment of the regulating valve. The rate of oil supply is indicated by the air bubbles ascending through the oil, which also show if the lubricator is working, and the amount of oil left may be seen at a glance. The makers claim that this lubricator works equally well either on the moving or stationary parts of machines.

PEAT MOSS LITTER.

The manufacture of peat moss litter has, of late years, become an industry of considerable importance, notably in Germany, where in the neighbourhood of large peat fields special factories have been established for cleaning and compressing the peat moss into bales, which are now regular articles of commerce, and a considerable number of which is imported into Great Britain. Large peat fields occur in Holland, Friesland, in the district of Hanover, in the province of Pomerania, in the South of Bavaria, near the lake of Constance and the rivers Lech and Isar; also in Bohemia, and in Scotland. The deposits in peat fields consist generally of three layers: the upper of humus, which supports a scanty vegetation, but is otherwise of no value; the middle layer of peat moss consisting of a more or less open and fibrous agglomeration formed of the roots and other parts of plants; and the lowest layer, which is peat proper, and which forms in many districts the only available fuel. Previous to the present decade the occurrence of peat moss was considered an unmitigated evil by peat cutters, necessitating as it does a great deal of labour before the peat is reached. In some cases, the peat moss was used as a very inferior kind of fuel; but generally it was simply thrown aside as useless. The credit of having discovered a use for this material belongs to a German, viz., Herr W. Hollmann, who in 1880 hit upon the plan of utilising peat moss in lieu of straw or chaff as a litter, and who erected a factory on a peat field in the neighbourhood of Brunswick. The remarkable hygroscopical qualities of peat moss had previoulsy been pointed out by Professor Virchow, and it was this property of absorbing large quantites of moisture, and also gases, which first directed the attention of Herr Hollmann to a possible use of this material in stables, and as a vehicle for natural manure. His first experiment in the utilisation of peat moss was financially and technically so successful as to induce many other persons to erect peat moss factories in various places in Germany; but some of these proved failures, as the success of such undertakings depends very much on local circumstances, and on the best selection of a site.

The importance of the peat moss industry is two-fold. In the first place a valuable material is produced with comparatively small working expenses; and in the second place, the fact that a purchaser can be found for the peat moss overlying the more valuable peat, renders the cutting of peat profitable, even in such localities where otherwise the great expense of removing the upper layers would render the exploitation of a peat field financially impossible. Some of the German peat fields have a depth of from 12ft. to 20ft., and it is evident that unless the greater portion of the material to be dug out can be utilised, the operation would not pay. Peat cutting, as now carried on in the fen districts of Holland, has besides its industrial, also an agricultural value, since large tracts of land, which formerly only supported a most meagre vegetation, are by its means rendered productive. To exploit a peat field, the first step taken by the peat cutter is to dig a main canal, which not only provides a waterway to the nearest town, but also serves as an outlet for the subsidiary canals which are dug for the purpose of draining the field. To properly locate these canals a preliminary survey is required, but the unstable nature of the ground makes it necessary to take special precautions in carrying out this work. The main canal, as already stated, serves as an outlet for the drainage of the field, and at the same time as a waterway for transporting the peat and peat moss to the town, the barges bringing back manure, which is mixed with the humus and incorporated with the sand left after the peat has been removed. By degrees the ground thus prepared becomes fit to produce green or cereal crops. Where, as in Germany, waterways are not abundant, the factory for peat moss litter must be erected on the peat field itself or in its immediate neighbourhood. When on the peat field, it must be placed on its highest point. The bricks of peat moss are first stored in a wooden shed open on the weather side, and provided with a flooring a few feet above the ground. If the bricks were laid on the ground it would be impossible to thoroughly dry them, as they would always absorb moisture from below. A light railway runs through the drying shed into the factory proper, where the peat moss is passed

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through a "devil," which opens out the fibres, and thus effects a preliminary separation of the earthy and vegetable matter. The separation is further carried on by means of a series of sieves, and the resulting woolly material is then passed into bales varying in weight from 1½cwt. to 4cwt., in which form it is brought into commerce.

IMPROVED FEED WATER HEATER.

Our illustrations show a locomotive feed water heater, invented by Messrs. C. A. Haworth and I. Mason, Grey Mare Iron Works, Bradford, Manchester, which is intended to take the place of the brick arch now in use in locomotive fire boxes. The feed water heater A is connected to the injector or feed pump by means of the tubes C and B, and the heated water is conveyed into the boiler

Fig. 1.

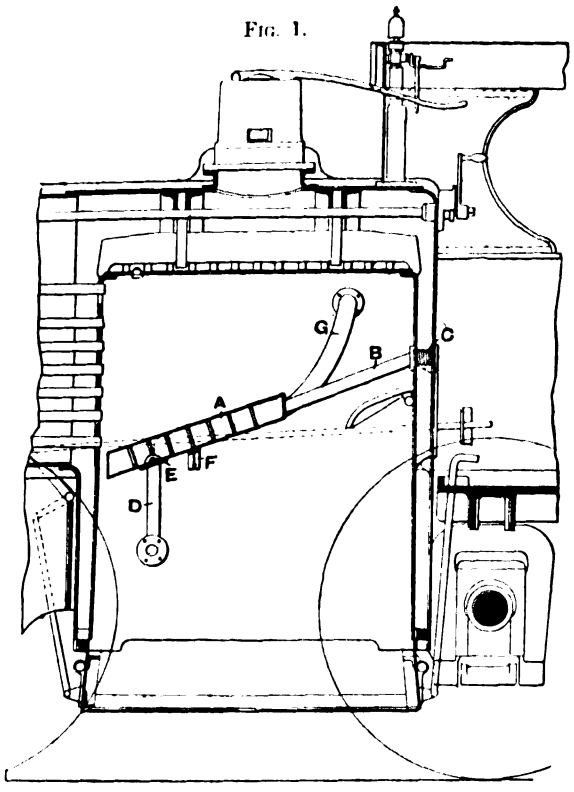
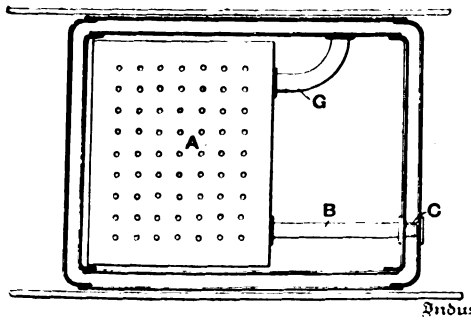


Fig 2.



Industries.

through the tube G. A valve E is provided on the tube D, which prevents the feed water from entering the boiler, but allows free circulation of the water in the boiler through D into A when the engine is standing, thereby keeping the temperature in boiler and feed water heater uniform. The apparatus is supported on a bracket F and the tube D. The advantages claimed for this arrangement are that it may be fitted to locomotives without interfering with existing connections, that it may be easily removed in case of repairs of the tubes or fire box, and that the heat now absorbed by the brick arch may be used for raising the temperature of the feed water to about 300°F., thereby effecting considerable saving in fuel. We understand that this feed water heater has been used with good results on board the steam launch "Fawn."

Electric Lighting.—The contract for the plant and materials required for lighting Gedney's Channel, New York Harbour, with incandescent lamps on buoys has now been given out. There will be required 32,000ft. of three-wire conductors to connect the first two buoys, and 15,000ft. to connect the other four buoys with the three-wire circuit. The return will be on the iron armour of the cables. The Edison Company have been awarded the contract for the dynamos, lamps, &c. The cost of the plant will be £5,200, and the estimated cost of maintenance £600 per year.

SHIPBUILDING NOTES.

The "Kaisong," a screw steamer of 1650 tons, sister ship to the "Sung-Kiang," launched a month ago, left the ways at Messrs. Scott & Co.'s yard at Greenock, on Tuesday, the 12th inst. The "Kaisong" is built to the order of the China Navigation Company. The engines will be of 1000 h.p., and will be of triple expansion type.

The "Leon y Castillo," a screw steamer, for mail service between the Canary Islands, was launched on Friday last, by Messrs. David J. Dunlop & Co., Port Glasgow. The "Leon y Castillo" is 190ft. long, 27ft. broad, and 13ft. deep. The owners of the vessel are the Compania de Vapores Correos Interinsulares Canarios. She is fitted up with the electric light, and is luxuriously appointed for passenger service. The engines are of the triple expansion type.

On the 16th inst., at the yard of Messrs. C. S. Swan and Hunter, shipbuilders, Newcastle, a steel screw steamer, the "Avalon," was launched, of the following dimensions: Length, 380ft.; breadth, 37ft. 6in.; depth, 21ft. 8in. She has been built under special survey, and her construction throughout has been superintended by Captain Henry Towhill, of Liverpool. The "Avalon" is owned by Messrs. C. T. Bowering & Co., of Liverpool, and is built on the cellular bottom principle, with web frames in way of bulkheads, having bridge amidships, raised quarter deck, and topgallant forecastle. The vessel will be classed 100 A1 at Lloyd's, and fitted with four steam winches, steam steering gear, and stockless anchors to draw into the hawse pipe. Her engines, which have been supplied by Messrs. Blair & Co., Limited, of Stockton-on-Tees, are capable of indicating about 1100 h.p.

Notices of Meetings.

THIS WEEK.

Physical Society.—Saturday, 23rd June, 3 p.m. "Note on Continuous Current Transformers," by Professor S. P. Thompson, D.Sc.

NEXT WEEK.

Royal Institute of British Architects.—Monday, 25th June. Ordinary meeting. Ballot for new members. Presentation of medals, &c.

Royal United Service Institution.—Friday, 29th June, 3 p.m. Paper to be read on "The Defence of our Mail Routes in War," by Captain Sir J. C. R. Colomb, M.P.

PRICES CURRENT, 21st June.

Quotations at per ton, unless otherwise specified.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	25	10	0
„ Ceylon	„	22	10	0
Cottonseed	„	20	15	0
Cod	„	18	10	0
Lard	„	43	10	0
Linseed	„	18	5	0
Palm, Lagos	„	20	0	0
Rapeseed: English	„	24	10	0
Seal: Pale	„	22	10	0
„ Brown	„	16	0	0
Sperm	„	40	0	0
Whale	„	14	0	0
Turpentine	per cwt.	1	11	0
Coal	per gal.	0	0	5¼
Petroleum (Refined)	„	0	0	5¼
„ Spirit	„	0	0	7¾

PIG IRON.

Middlesbro' Warrants, No. 3	31/6	Cash	
Scotch Warrants, m/n	38/–	„	
Hematite Warrants, m/n	41/9	„	
Stocks in Stores. Scotch	996,111—Inc. for week,	3407	Tons
Middlesbro'	284,283—Dec. „	2976	„
Hematite	199,969—Dec. „	692	„

Exclusive of stocks in makers' yards.

Market firm, but not much business doing.

Scotch shipments 10,453 tons, against 5459 tons for same week last year.

	No. 1.	No. 3.		
Coltness	47/3	43/3	f.o.b.	Glasgow.
Gartsherrie	43/9	41/3	„	„
Dalmellington	39/6	38/–	„	Ardrossan
Eglinton	37/6	36/6	„	„
Glengarnock	42/9	38/6	„	„
*Derbyshire	—	34/6	f.o.t.	Works.
*Lincolnshire	—	31/6	„	„
*Lancashire	—	36/6	„	„

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £	s.	d.	Best. £	s.	d.	
Middlesbro' Bars	4	15	0	5	5	0	f.o.t. wks
„ Angles	4	12	6	5	0	0	„
„ Plates	4	17	6	5	7	6	„
Staffordshire Bars	4	17	6	5	7	6	Manch'r.
„ Angles	5	7	6	5	17	6	„
Crown Sheets	6	10	0	6	15	0	„
„ Hoops	5	0	0	5	10	0	„
"Siemens-Martin" Steel Boiler Plates				7	15	0	„
„ Ship and Girder				7	10	0	„

METALS.

Spelter: Ordinary	£15	15	0	to	15	17	6
Copper: British Cakes and Ingots	81	0	0	„			
„ Chili Bars	82	12	6	„	82	17	6
„ Manufactured (strong)	88	0	0	„	90	0	0
Lead: Common Pig	13	10	0	„			
„ English Sheet	14	5	0	„			
Tin: Straits	79	10	0	„	79	15	0
„ Australian	81	0	0	„	81	5	0
„ English Ingots	88	10	0	„	89	10	0

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/–	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/–
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/–
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/–

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper.—There is nothing new to report in the position of this metal. Quotations for Chili gobs spot parcels keep steady at about £82. 10s. per ton, with a margin of 5s. per ton either way, and with very little business doing except on syndicate account. Three months is quoted about £4 per ton less. Consumers appear to be still able to draw their limited supplies from outside sources over which the syndicate have no control. The export trade in manufactured appears to have gone "spark out," and it is reported that many of the Eastern markets are importing steel enamelled goods to replace those formerly made of copper. A large quantity of old copper is being shipped from the East for sale in France and England, and this is going forward for re-manufacture. The present unfortunate position of affairs is ruining the copper trade altogether, and it must end in disaster to those who have brought it about.

Tin.—Quotations are lower all round. Straits sharp cash parcels, £79. 15s. to £79. 17s. 6d.; English, £88. 10s. to £89. 10s. per ton.

Lead easier. Spanish quoted £12 to £12. 2s. 6d. per ton.

Spelter is again lower; warrants, £15. 5s. to £15. 10s. per ton

CHEMICALS.

	£	s.	d.		£	s.	d.
Acid: Carbolic Crystals lb.	0	1	2	to	0	1	3
„ „ Liquid gal.	0	1	2	—	0	1	9
„ Citric lb.	0	1	7¼	—	0	1	7½
„ Oxalic „	0	0	3	—	0	0	3¼
„ Sulphuric ton	1	5	0	—	1	10	0
„ Tartaric lb.	0	1	5⅞	—	0	1	6¼
Alum: Lump (powder 10/- ex.) ton	4	7	6	—	5	0	0
Ammonia: Carbonate lb.	0	0	3½	—		.....	
„ Muriate (Grey) ton	23	0	0	—		.....	
„ „ (White) „	26	0	0	—		.....	
„ Sulphate „	11	15	0	—		.....	
„ Liquor lb.	0	0	3¼	—		.....	
Bleaching Powder ton	7	5	0	—	7	10	0
Bisulphide of Carbon „	12	0	0	—	12	10	0
Borax „	30	10	0	—	32	0	0
Benzole (90%) gal.	0	2	6	—	0	2	7
„ (50/90%) „	0	2	2	—	0	2	3
Copper Sulphate ton	20	10	0	—	21	10	0
Copperas „	1	10	0	—	2	0	0
Kieserit „	1	10	0	—		.....	
Lead: Nitrate „	23	0	0	—		.....	
„ White Sugar „	26	10	0	—	27	0	0
„ Brown „ „	21	0	0	—	22	0	0
Potash: Bichromate lb.	0	0	4½	—		.....	
„ Caustic ton	20	10	0	—	21	0	0
„ Carbonate „	17	10	0	—	17	15	0
„ Chlorate lb.	0	0	5½	—	0	0	5¾
„ Prussiate (Yellow) „	0	0	6¾	—		.....	
„ Sulphate (Basis 90%) ton	8	17	6	—	9	5	0
Precipitate: Red lb.	0	3	1	—	0	3	2
„ White „	0	3	2	—	0	3	3
Salts: Epsom Bags ton	2	10	0	—	2	12	6
Epsom Casks „	3	5	0	—	3	10	0
„ Glauber „	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers „	8	10	0	—	9	0	0
„ Recovered „	4	10	0	—	4	12	6
Soda: Ash deg.	0	0	1	—	0	0	1⅛
„ Caustic (White, 70%) ton	6	12	6	—	6	17	6
„ „ „ 60% „	5	12	6	—	5	17	6
„ „ (Cream, 60%) „	5	12	6	—		.....	
„ Crystals „	2	10	0	—		.....	
„ Bicarbonate „	5	10	0	—		.....	
„ Hyposulphite „	6	5	0	—		.....	
Solvent Naphtha gal.	0	1	1	—	0	1	2
Tartar, Cream of cwt.	6	3	6	—	6	5	0
Zinc Sulphate ton	7	10	0	—	8	5	0

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Business in chemicals is quiet. Alum is in moderate demand. Bleaching powder and caustic soda are both easier, but soda ash maintains its position. Sulphate of copper is steady. Muriate of ammonia is asked for, and makers are well sold. Carbolic acid is weakening, also oxalic. Sulphate of ammonia is steady.

Erratum.—Professor S. P. Thompson requests us to make the following corrections in our article headed "The Physical Society," which appeared on page 549 of the present volume. For $P = b K \sqrt{A} \sqrt[4]{\frac{L}{A}} \cdot \frac{L}{l}$ read $P = b K \sqrt{A} \sqrt[4]{\frac{L}{\sqrt{A}}} \cdot \frac{L}{l}$, and for tension in "degrees" per square centimetre, read tension in "dynes" per square centimetre.

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HOME INDUSTRIES.

MANCHESTER, 21st June, 1888.

The Cotton Trade.—It is probable that the usual attempt will be made in Liverpool and New York to raise the prices when the close of the delivery of last year's cotton crop approaches. It rests entirely with the buyers of cotton whether the prices shall be raised or not; for if they buy freely and in excess of actual requirements such a course will be inevitably followed by a period of excessive rates. There is a large increase in cotton deliveries as compared with last year's, and there appears to be no reason to anticipate any scarcity until the end of the season. Spinners find it very difficult to effect sales at any advance on their prices, and they are quite unable to accept many large offers which are coming from the Eastern markets. The extremely low value of the rupee causes Indian and Chinese buyers to telegraph offers that are much below anything which the spinners can accept. The result is that a great amount of business cannot be accepted, and as long as the great majority of spinners remain so well under contract there is no probability of a fall in the prices of yarn. The chances at present are decidedly in favour of the spinners. The various wages disputes which have been disturbing the business of this district for some time past are now practically settled by a general advance of 5 per cent. in the wages of operative spinners. Fine counts of yarn are in active request, and the rates are fully maintained. In the cloth trade the influence of the increasing productive power is now being felt, and the low offers which come from the East are being in some cases met. In several districts round Manchester there are a good many looms standing.

The Employers' Liability Bills.—The United Cotton Spinners' Association has presented a petition to Parliament objecting to several clauses which are proposed for insertion in the new Bills before Parliament. Firstly, against the clause extending the time of giving notice of an action from six weeks to three months, on account of there being no good reason why such an extension should be granted. Secondly, against the proposed extension of the liability of the employer to the acts of all his employés, as it would lead to compensation being paid by employers for the acts of persons to whom they had delegated no authority. Thirdly, against the extension of the limit of compensation of three years' wages if not more than £150, to £150 or three years' wages, whichever may be the greatest.

The Metal Trades.—The iron trade has improved so far as quoted rates are concerned, but there is not much increase in the transactions in pigs. Buyers only purchase small lots, and there are complaints that specifications for contracts are hard to obtain. There is no sort of speculation existing in this market, and a period of steady business with fluctuating prices may be looked for until the autumn "boom" sets in. Wrought iron remains quiet, and common bars continue to fall in price. Although £4. 17s. 6d. per ton less 2½ per cent. is quoted as a minimum rate, plenty of iron can be obtained at lower prices, as there is a tendency in certain quarters to "bear" the market. Steel is in good demand all round; but the requirements in plates outside this district appear for the moment to have been satisfied, and there is consequently a fall in boiler plates of quite 7s. 6d. per ton. For this step there does not appear to be much justification, although it is fully appreciated by purchasers. There is a stagnation in the other branches of the metal trade, notably in copper. It is now practically impossible to find customers for any large quantities of copper or tin, and there is a prevailing expectation among consumers that a period of lower prices is not far distant. Business is seriously checked at present, and the conduct of the smelters with regard to manufactured copper is helping to add to the confusion. With a nominal price of £88 per ton for sheets, as low as £84 has been accepted, and it is stated that even lower rates for good lots would not be refused.

LONDON, 21st June, 1888.

The Money Market.—The tone of the money market has become still duller, and it is hardly possible that rates can recede much further, or the demand shrink to any greater extent. The supply of floating capital seeking for employment is excessive, and there is no outlet for it of any importance. The stock markets have had a better tendency since the death of the Emperor Frederick, and the greater vigour which has been infused into the political situation has favourably influenced the business in stocks. Foreign securities are in general much firmer, those styled "international" showing the most marked improvement. This is a practical proof that the capitalists do not anticipate any disturbance of European peace as the result of the accession of the Emperor William II. At home the improvement in the stock market is more of feeling than of actual prices. British Government securities are more freely bought, and there is substantial though not extensive buying of the stocks of the heavy or investment home railways. The unsettled weather has depressed the passenger lines, whose traffic returns show at once the effect of such adverse influences. The American railway market is fickle, though more disposed to rise than otherwise. The expectation is that within the next month these securities will improve in price, and will then fall away again in the autumn. The commencement of the Presidential campaign will injure business in the United States. There is little doing in mine shares, and diamonds are uncertain. The outlook in the copper market is doubtful; but it is considered good policy to buy cheap gold shares at present—not at random, of course, but with respect to the character of the mines. The alluvial mines of Colombia are in growing favour, as the results have been extremely good.

Companies.—The following new companies have been registered since our last report: Easton & Anderson, Ld., with a capital of £250,000, to carry on business as engineers, &c., in London and at Erith; The Manchester Engineering Company, Ld., with a capital of £10,000; Edward Young and Co., Ld., with a capital of £150,000, to carry on business in Liverpool as distillers; The D'Humy Cabinet Battery Syndicate, Ld., with a capital of £15,000; The Spontaneous Steam Generator Company, Ld., with a capital of £10,000, to acquire certain patents; The Tirydail Tin Plate Company, Ld. (Duffryn, Carmarthenshire), with a capital of £20,000; Perkin & Co., Ld., with a capital of £8,000, to carry on business as engineers in Leeds; The Dee Oil Company, Ld., with a capital of £100,000; Beverley Brothers, Ld., with a capital of £100,000, to carry on business as brewers at Wakefield; The Burton Brewery Company, Ld., with a capital of £250,000; Luther Hanson and Co., Ld., with a capital of £7,500, to carry on business as electrical engineers at Halifax; Automatic Electrical Corporation, Ld., with a capital of £75,000, to undertake the supply of electricity for lighting and other purposes in the United Kingdom; The Manchester Chamber of Commerce, Ld.; The Sydney Godolphin Tin Mine, Ld. (Cornwall), with a capital of £20,000; The United Anthracite Collieries, Ld. (Glamorganshire), with a capital of £25,000; and Phosphate Mining Company, Ld., with a capital of £100,000.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 10th June amounted to £1,223,657 on 15,862½ miles, as compared with £1,189,122 in the corresponding period of 1887, when the mileage was 15,742½ miles. An increase is thus shown in the mileage of 120 miles, or 0·7 per cent., and in the receipts of £34,535, or 2·9 per cent.

The Navy.—The steam trials of the turret ship "Victoria" were made at the Nore on Tuesday and Thursday of last week. The vessel has been fitted with twin screw triple expansion engines, by Messrs. Humphrys, Tennant, & Co. The cylinders are 43in., 62in., and 96in. diam., and 4ft. 3in. stroke. The first day's trial was with natural draught, a four hours' run being made with the following average results: Steam pressure in boilers, 131·16lb.; vacuum in condensers, 27·8in. and 26·8 in.; revolutions, 87·3 by the starboard and 88·5 by the port engines; i.h.p., 3855·9 starboard and 4182·1 port, giving a total of 8038 h.p., or 538 h.p. in excess of the contract power, which was 7500 h.p. The mean speed was sixteen knots. The average result of four hours' steaming on Thursday with forced draught gave the following results: Steam pressure in boilers, 133·41b.; mean air pressure in stoke holes, 1·97in. of water; vacuum in condensers, 27·4in. and 27in.; revolutions, 101·26 by the starboard and 100·37 by the port engines; i.h.p., 7107·67 starboard, and 7136·86 port, giving a total of 14,244·53 h.p., or more than 2244 h.p. in excess of the contract power, which was 12,000 h.p. The average speed was over 17¼ knots, and 2lb. of coal per i.h.p. were consumed per hour.—The torpedo cruiser the "Racoon" was taken out of Plymouth last week for a four hours' trial of her engines. Everything proceeded very satisfactorily until the seventh trial, when the port engine broke down. The belted cruiser "Aurora" has made a successful trial of her machinery at Plymouth. The total i.h.p. was 5670, the speed attained being 17·25 knots.—A battery of forty of Drake & Gorham's latest type of ship lighting cells is to be supplied for lighting the Queen's yacht the "Victoria and Albert," which is now in the hands of the Admiralty.

Institute of Chemistry.—A soirée was given last week at Marlborough Rooms, by Dr. James Bell, the President of the Institute of Chemistry. There were numerous exhibits, which included many of those shown at the conversazione of the Royal Society, and of which an account was given in *Industries* of the 18th May last. Mr. T. Fletcher, of Warrington, sent his oxy-hydrogen blow pipe: the Badische Anilin-Fabrik, Messrs. Boulton and Co., and Messrs. Brooke, Simpson, & Spiller, exhibited samples of coal tar colours, and Brin's oxygen apparatus was shown at work.

The Royal Society.—The list of the gentlemen who were elected Fellows of the Royal Society, on June 7th, included the names of Mr. Charles Vernon Boys, Professor John H. Poynting, and Mr. William Henry White, M.Inst.C.E.

The Paris Exhibition.—The General Committee of the British Section of the Paris Universal Exhibition, 1889, has been registered under license of the Board of Trade and limited by guarantee. The object is to promote commerce and art by securing the due representation of British industries, commerce and art, at the Paris Universal Exhibition, 1889; to aid, represent, and assist British, Irish, Indian, Canadian, and Colonial exhibitors at the said Exhibition, and to secure combined action amongst such exhibitors; to negotiate and correspond and arrange with the French Government and its representative commissioner and agents of and in relation to all questions concerning Great Britain, Ireland, the Empire of India, the Dominion of Canada, and the English Colonies in connection with the Exhibition, notably those relating to the distribution of space, the manner of installation of and payments to be made in respect of the British section; to prepare and publish a catalogue in English of the British section, and to do all such other lawful things as are incidental or conducive to the attainment of the above objects or any of them.

Arts and Crafts Exhibition.—An exhibition is to be held under this title at the New Gallery during October and November this year, at which will be shown work done by designers and craftsmen. Exhibits are divided into the following twelve sections: Textiles; gold and silversmiths' work, including enamelling; metal and iron work; decorative paintings; wall papers; bookbinding; printing; glass; stained glass; wood and stone carving; and cabinet making. A guarantee fund is being subscribed in connection with this undertaking, and further information respecting the Exhibition may be obtained from Mr. Ernest Radford, 121, Regent-street, W. Forms of applications to exhibit must be filled up and sent in by the 30th instant.

GLASGOW, 21st June, 1888.

Shipbuilding.—A number of new orders have been placed during the past few days. Among these there is one for a tank steamer of 4000 tons, for the petroleum trade, to be built by Messrs. A. and J. Inglis, Pointhouse; and one for a small steamer, to be built by Messrs. R. Napier & Sons. It is reported that Messrs. Alex. Stephen and Sons have contracted for a large screw steamer. A schooner yacht, with auxiliary screw, named the "Garland," built by Messrs. Ramage & Ferguson, Leith, for the Hon. Mrs. Elliott Yorke, has just been finished. The "Garland" is handsome in outline, and is luxuriously fitted up. She is 124ft. long, 21ft. 6in. broad, and 13ft. 6in. deep. The triple expansion engines are of 280 i.h.p., and are fitted with Messrs. Ramage & Ferguson's new valve gear. The cylinders measure respectively 11½in., 18½in., and 30in. The boilers are intended to work up to 150lb. pressure, and they are fitted with Brown's patent annular ribbed furnaces. The windlass is Messrs. Napier Brothers' steam capstan.

Coal Shipments.—This year's coal shipments from the Clyde are still keeping far ahead of the corresponding exports for 1887. In spite of a slight falling off last week the relative figures for the five months and a half are 1,932,786 tons, against 1,178,761 tons, or an increase of 750,000 tons.

The Central Railway Bill.—The House of Lords' Committee, presided over by Lord Auckland, has found the preamble of the Central Railway Bill proved subject to slight modifications of clauses. The new Central Railway line will start from the extreme east of Glasgow, and passing under the principal street of the city, Argyll-street, throughout its whole length, will extend beyond it and will pass to Stobcross Docks, whose traffic has hitherto been practically monopolised by the North British Railway Company, as the access to the docks to the Caledonian is only available on payment of wayleave to the North British Company. This railway will also give the Caledonian Railway a hold upon the traffic in the west end of Glasgow generally. The promotion of the Bill has, of course, been suggested by the success of the City and District Railway, whose underground trains are among the best paying in the system, in spite of many drawbacks, such as deficient ventilation of the tunnels, &c.

New Gold Process.—The commercial column of the *Glasgow Herald* has been the means of announcing the patenting of a new process for the recovery of gold from refractory ores. The process is said to be the discovery of Mr. J. H. Pollok, assistant to Professor Ferguson, professor of chemistry in Glasgow University. The cost of materials for extraction is stated to be 4s. 6d. to 6s. per ton. In addition to this process there has also been recently developed in Glasgow at least one other process whose features are apparently similar to those of the process above mentioned, and which, though it has been hitherto kept in reserve, has actually been worked upon a scale sufficiently large to demonstrate its practicability.

Glasgow International Exhibition.—The beautiful weather has had a good effect upon the attendance at the Exhibition. The numbers on Saturday last were larger than on any previous occasion, 64,880 admissions being registered. The average daily attendance, exclusive of Saturdays, remains about 26,000, the Saturday admissions bringing the average up to about 34,000 per day.

(From our own Correspondents.)

LIVERPOOL, 20th June, 1888.

The Water Famine in Liverpool.—Although the usual constant supply of water to the city was reduced some months ago to an intermittent supply of twelve hours daily, and although the streets are now watered entirely with salt water obtained either from the docks or from the drainage of the Mersey Tunnel, the Water Committee have resolved, on account of the very low level of the water at Rivington, to further restrict the supply to six hours per day.

Serious Subsidence in Dale-street.—An extraordinary cavity, about 14ft. square and 7ft. deep, was found last week under the tram lines in Dale-street, the only thing which sustained the traffic being the concrete foundation of the roadway. Wooden tracks were laid to bridge over the opening for the tram traffic; excavations are now proceeding to ascertain the cause of the subsidence, and although the workmen have descended almost 30ft., no solid bottom has yet been reached.

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SHEFFIELD, 20th June, 1888.

Iron and Steel.—The prices of iron continue to be very easy. Foundry pig can be bought at from 34s. to 41s., and hematite pig at 42s. to 44s. There is a steady business being done in bars at £4. 17s. 6d. per ton; the best quality, however, is being sold at £5. 10s. Hoops are going at about £5, and plates at £7 and upwards. Both crucible and Bessemer steel continue to be in good demand, and several large orders for the former kind have been placed recently. Most of the Sheffield converters are busy, and there is some talk, at least in one firm, of putting down new plant. Not only has the export trade been more satisfactory during the past few weeks, but the home markets have also been better customers. Manufacturers and merchants are doing a large business with Germany, France, Russia, and Austria; and some are developing a connection with Spain with specialties in competition with America. There is comparatively little being done in armour plates and gun forgings; projectiles are in good demand, however, and Firth's and Hadfield's are busy in this department. Shipbuilding and railway materials find steadily extending markets. Marine engines and propellers, and rails, tyres, axles, and springs are on large order. Hydraulic and other machinery is yielding fairly abundant work in the engineering shops; and at the rolling mills operations are more constant. For colliery plant there is an encouraging inquiry. The commercial event of the week has been the issue of Messrs. John Brown & Co.'s report. The profit on the year's trading is £45,539, which, with the balance of £20,950 from last year, makes a total balance of £66,489. Still the dividend is only 5 per cent., as against over 6 per cent. for the past four years. Edge tools are selling well in the home markets, on the Continent, and especially in the Colonies. The best descriptions of cutlery are being exported in large quantities; and table cutlery, chiefly in cases or cabinets, is just now being very freely ordered.

NORTH STAFFORDSHIRE, 20th June, 1888.

The Iron Trade.—Towards the close of the quarter there is a somewhat better feeling in the iron trade, and in some instances makers are holding out for a small advance on the lowest prices which have recently prevailed. All idea of any real improvement before the autumn, however, has vanished, and producers are not very hopeful with regard to the early prospects of 1888 being realised at all. In spite of its speculative character the dulness of the Scotch pig iron market has some influence here. The price of No. 1 foundry iron is about 40s., and of forge iron from 34s. to 35s. into truck.

North Staffordshire Mining Institute.—At the meeting of the Institute held last week, Mr. A. R. Sawyer, Assistant Inspector of Mines, read a paper, illustrated by diagrams, on some "Experiments with regard to the holding power of glands on wire conductors under varied conditions." After describing different methods of securing wire conductors in the shaft and maintaining them there in a constantly rigid state, Mr. Sawyer urged the importance of great care being taken in screwing up the glands, and pointed out that the safety of underground workers in pits where conductors were used was at least twice a day dependent upon their efficiency. Attention has frequently been called in these columns to the efficient and beneficial work which is being done by the Institute in connection with the mining interests of this district; this success of the Institute is due in no small measure to the willingness of Mr. Sawyer to give the members the benefit of his wide experience, and the above lecture will form an important addition to the literature of mining which the author has already published.

LEICESTER, 20th June, 1888.

Wool Spinning and Yarn Trades.—The wool market is extremely quiet at present, and all operations, except small sales for pressing wants, are suspended. There are two reasons which clearly account for this quiescence: the London wool sales commence to-day, and their tendency will largely affect the rates in the market here; also, the local wool fair will be held at the close of the current month, and will settle the price of the raw material for some little time to come. The complete absence of speculative dealing is good for the market, as the true state of affairs is more clearly indicated and quotations are more reliable. The present condition of the wool trade may be said to be a waiting one. Spinners are not very well employed, and many of the workpeople are on short time, more especially those employed on worsted yarns. Orders are offered in these yarns, but the prices quoted make spinners chary of accepting them. In lambswools there is rather more being done, as the prices have not fallen so low in this department. In fine yarns the best trade is being done, and prices are firm, with an upward tendency. Yarn merchants are doing an unequal trade, and the volume of it is not very great.

Hosiery Trade.—In the lighter goods an improved demand is apparent. Some fairly good orders have been placed for the autumn delivery of heavy goods, but the trade as a whole is not so satisfactory as could be wished.

Boot and Shoe Trade.—The trade at present is in its usual state, but the turnover of the year so far is much below the average. Most of the factories are now fully employed. Home orders are for encouraging amounts, and the shipping trade to the Colonies is brisk. Several of the leading houses are sending excellent selections of goods to the Melbourne Exhibition. The financial state of this industry is now sounder than for some time past; failures lately have been very infrequent and only for small amounts, and there is an absence of rumours of monetary weakness. Leather merchants are doing a quiet but steady business; the rates rule extremely low, and the market does not indicate any immediate prospect of recovering a firm tone.

BARROW-IN-FURNESS, 20th June, 1888.

The Labour Market.—The circulation of reports that a revival was being brought about in many of the industries of Barrow is having the effect of drawing to Barrow a large number of skilled and unskilled workmen, as well as several tradesmen for whom at the moment there is nothing to do. There is no reason to doubt that in the course of a short time there will be room for many workmen in the shipbuilding, engineering, and other trades; but at the moment there is not more work in the town than will employ those who are living there, while the complaint is frequently urged that there are too many shopkeepers in the place.

Iron and Steel.—A better tone is reported in the hematite pig iron trade. The demand is stronger from all sources, and more iron is required as well for prompt as for forward delivery. The output has not been increased, as there is no need for this with the large stocks in hand; but stocks have been very sensibly reduced, and it is noteworthy that the tendency is in the direction of a still further reduction, as not only are home buyers taking large parcels, but considerable shipments are being made to the Continent and elsewhere. Prices are quoted this week at 43s. per ton net f.o.b. for mixed parcels of Bessemer iron, and 42s. for No. 3 forge and foundry iron net f.o.b. In the steel trade a great improvement is noticeable. There has been no diminution in the activity at local steel works, but the market lately has been much weaker in tone, and makers who some time ago were well sold forward, had cleared out a large number of orders. There is now, however, a very good inquiry for steel rails, and for shipbuilding material, both of which departments are very briskly employed. There is not much change to note in the value of steel rails, which remain steady at £3. 17s. per ton for heavy sections net f.o.b., and £4 to £4. 5s. for light sections. In ship plates the demand has been considerably improved on both local and general account, and prices are £6. 7s. 6d. for plates and £5. 12s. 6d. for angles net f.o.b. The trade in blooms is limited, but there is a fair inquiry on American account at £3. 13s. 6d. per ton net f.o.b. The business doing in billets is steady, and prices are firm at £3. 16s. per ton. Spiegeleisen is in large consumption, and is not only imported in large parcels, but one or two furnaces in the district are producing this metal, which is quoted to-day at £3. 18s. 9d. per ton net f.o.b. In the shipbuilding trade there is a gradual industrial revival, and as the recently accepted orders for large ocean steamers are to be supplemented by others of equal importance, there is reason to look forward to a very brisk business in these departments. Iron ore is in good demand, and prices have advanced. Ordinary qualities are now quoted at 9s. 6d. to 12s. per ton net at the mines.

MIDDLESBROUGH, 20th June, 1888.

Pig Iron.—The tone of the market still continues to be firm, although business is very quiet. There is an increasing confidence in a steady, though perhaps slow, advance. There are buyers at 31s. 6d. per ton for prompt delivery, and 31s. 9d. for the third quarter. Makers have advanced their price to 32s. Warrants are 31s. 4d. per ton cash for Connal's No. 3 G.M.B., and 42s. 6d. for Connal's Nos. 1, 2, and 3 hematite, nominally. The stock in Connal's store is still decreasing. The amount on Saturday was 284,480 tons.

Shipments of Pig Iron.—The shipments of pig iron are not much more than half of what they were during May, but they are ahead of what they were during June, 1887. During the first eighteen days of June this year they amounted to 44,197 tons, as against 42,221 tons in the corresponding period of last year. There is about a third less going to Scotland, but nearly double the quantity to Germany and Holland and other foreign countries.

Manufactured Iron and Steel.—There is no change in these departments of trade. The mills are working steadily on regular time. Finished iron is of course more precarious, but as yet new orders have succeeded the old in sufficient quantity to keep the works going. The strike in the ship yards at no time affected the deliveries, and the satisfactory settlement has taken away even the possibility of such a circumstance.

Shipbuilding.—The men having gone in at last upon the masters' terms, the yards are once more in full work. The terms are 5 per cent. advance on piece work, and 1s. 6d. per week advance in time wages, to date from the first week in July. The North Shore ship yard in Stockton, which has been shut up for some time now, is to be opened shortly. Altogether the shipbuilding industry is in a favourable condition.

Salt.—The demand for this article still continues, and all that can be manufactured is at once disposed of. A considerable quantity is used by the fish curers, who have begun operations for the season.

NEWCASTLE, 20th June, 1888.

Chemicals.—This being "race week" industrial operations are temporarily suspended throughout the district, the only exceptions to this rule being certain departments of the chemical factories, in which a stoppage would involve exceptional loss and inconvenience. Soda crystals, bleaching powder, and high strength caustic are the products principally in demand, and the works engaged in the manufacture of these commodities are generally well employed.

Copper.—The establishments of the Tharsis Copper Company at Hebburn and Howdon are kept in steady work, though some inconvenience has been caused by a wages dispute with the operatives in one of the departments. The shipments of "purple ore," and briquettes manufactured therefrom, to local steel works, and also to America, have been very satisfactory of late, and this now forms a most important branch of the company's operations.

Lead.—The manufacture of sheet lead is just now pretty brisk, the requirements for building purposes being somewhat large. The production of white and red leads is quite up to the average, and on the whole the industry may be said to be in a fairly healthy state.

Cement.—The whole of the cement works in the district are now very busy. The local demand has increased, and shipments to America have been unusually heavy lately; a diminution of stocks has therefore taken place.

Paints, &c.—The manufacturers of paints, compositions for ship bottoms, patent lubricants, &c., are generally doing a brisk business, and the production in each of the branches named is much above the average at this time of the year. The Mica Lubricant Company, South Shields, besides having a very large home demand for their specialty, are fulfilling some very heavy foreign orders just now.

The Timber Trade.—Up to the present time the arrivals of timber cargoes at the port have been few as compared with former years, and there is consequently little animation in the trade. With the advent of July, however, it is expected that the imports will increase very largely.

The Coal Trade.—For steam and manufacturing coals the demand keeps good; but as is usual at this time of the year, there is very little inquiry for gas and household qualities. The shipments of coal and coke from Tyne Dock for the week ending June 16th were 100,641 tons, a decrease of 8275 tons as compared with the corresponding week of 1887.

The Shipbuilding Trade Wages Disputes.—At a conference of employers and workmen's representatives, held at Newcastle on Monday, an arrangement was arrived at which will prevent an interruption of work. Under this arrangement the members of the Boiler Makers' and Iron Shipbuilders' Society, who demanded an immediate advance of 10 per cent. all round, will receive an advance of 5 per cent. on the 1st August, and the members of the Amalgamated Joiners' Society, who asked an advance of 3s. per week, will get an immediate advance of 1s., to be increased to 1s. 6d. on 1st August.

DUNDEE, 20th June, 1888.

Linen and Jute Trades.—In both branches of the local trade business during the past fortnight has been fairly active, and the demand fully maintained. Holders are anticipating a higher range of prices and consequently are not eager to sell, and spinners being in the meantime well supplied are not disposed to operate at an advance. The contract market continues strong. The Russian exchange remains high, and shippers are firm in their demands. There is a good demand for both flax and tow yarns, and the tendency is against buyers. Manufacturers hold out against the advance on the ground that the prices obtained for cloth are still unremunerative. There is, however, a better demand for linens both on home and on American account. In Fife, manufacturers are reported to be busy with orders on their books sufficient to keep all their looms going. Heavy goods, including sailcloth, are selling more freely. A good business is passing in raw jute at full rates. The new crop sells freely, and prices are rising. Calcutta telegrams report the market there as steady, with an upward tendency. Advices from the growing districts represent the prospects of the new crop to be good. Jute yarns are in active demand, and rather higher rates are obtainable, more especially for immediate delivery. In jute fabrics good orders for Hessians have recently been placed, and some of the larger makers, being well sold forward, are holding for higher prices. Sacking and bagging sell freely at firm prices. The narrower widths of tarpaulin are in less request.

Improvement in Weaving Machinery.—A new checking motion for weaving, for which several important advantages are claimed, has been patented by Mr. John Allan, engineers, Lyon-street. It is stated that by means of the new machine a greater number of shots can be inserted in a pattern than by any machine previously in use, and that the change of shots can be accomplished with greater facility, while the weight of the machinery which effects this is much less than in the present machines for two and three shots. In Mr. Allan's patent, six shuttles are at work from each end of the loom, and by an ingenious arrangement the number of shots can be regulated to suit the pattern.

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THE EASTERN ARSENAL OF TIENTSIN.

By Allan C. Wylie.

I.

After crossing in a flat bottomed boat to the east side of the river Peiho, and passing large numbers of Chinese coolies busily employed on the earth works of the new railway, and after a ride of three miles across a plain interspersed with mounds indicating the last resting places of generations of Chinese, the former inhabitants of this district, I arrived at a castellated brick archway leading into the Eastern Arsenal of Tientsin, which is encompassed by a massive wall of earth work about 15ft. high, and this again is surrounded by a moat, almost like a lake, 60ft. to 70ft. wide. The smoke from about twenty large chimneys indicated the existence of a series of factories, and reminded me of a visit to one of the busy manufacturing villages in Lancashire. On passing the archway, I found myself in a large enclosure of fifty or sixty acres, and in this space has been erected from time to time during the last twenty years the various departments which I shall now endeavour to describe. In this area a tramway has been laid down of 30in. gauge, with the necessary turntables and trucks, by which materials can be easily transported to and from the various departments as required. A creek branches off from the Peiho, passing through the southern wall of the Arsenal into a small dock facing the machine shops, by which means all raw and finished materials are at present conveyed to and from the Arsenal. The northern end of this creek also runs into a canal connecting the Peiho with the Pei-t'ang River, which empties itself into the Gulf of Pechili, about eight miles to the north of Taku, at the mouth of the Peiho. By this means the manufactured war materials are conveyed to the various magazines and depôts for distribution to the camps and forts in the provinces served by this Arsenal; but a branch of the new railway will be constructed which will dispense with much of this slow water carriage. In the small dock or basin already mentioned, I saw a light draught stern wheel paddle steamer, 75ft. long by 14ft. beam, fitted with a pair of compound horizontal engines of 20 n.h.p., which is used for conveying officials to and from Taku, Pao-ting-fu, Tunchow, and other places, where a light draught steamer can only be used. I will now give a brief description of the various shops:—

Pattern Shop.—This consists of three rooms, in which are made the wooden models of machine castings for the foundry, and is fitted with a general joiner, and several wood turning lathes. The finished models I examined were of very excellent workmanship, and contrasted favourably with what I have been accustomed to see turned out at home.

Moulding Shop.—This building is about 120ft. long by 50ft. wide, with a roof of more than the average height. It is fitted with two 5-ton hand cranes, arranged to meet at a centre over a large tank, so as unitedly to lift a 10-ton casting. Two 3-ton, one 4-ton, and one 5-ton cupolas of the ordinary description furnish the metal required. In this shop all kinds of castings in loam, and dry and green sand, are made; also chilled rolls for rolling copper, and shells for various sizes of guns. These shells are formed in moulding machines designed and made in the Arsenal. The castings produced are very good, and will bear comparison with the average castings from European foundries.

Turning and Fitting Shops.—This department is about 270ft. long by 45ft. wide, and well supplied with a plant of lathes, planing, shaping, boring, drilling, slotting, emery grinding, and other machines by our best English makers. The whole are driven by a 30 n.h.p. horizontal condensing engine.

Boiler Shop.—The boilers, tanks, torpedo mines, and other work are made in this building, which is very roomy, and well arranged with an excellent plant of powerful punching, shearing, plate bending, drilling, and other machines, including a very good design of boiler shell drilling machine; also a superior plant of Tweddell's hydraulic portable and stationary riveting and flanging machines, with the necessary pumps and accumulator. The work done here will also bear the closest inspection.

Smiths' Shop.—This contains eleven fires, driven by fan blast, and fitted with a 20cwt. steam hammer, the only one in the Arsenal.

Rolling Mills.—This department comprises a melting shop for casting brass and copper ingots, from whence they are taken to the annealing ovens, and then passed through a series of rolls until reduced to the required thickness. In this shop there is also a well arranged roll lathe, with traversing emery wheel for re-grinding the chilled rolls. The whole is driven by a horizontal condensing engine of 30 n.h.p. This plant has been made by the old established firm of James Watt & Co., Soho, Birmingham.

Cartridge Factory.—This large building contains a plant of machinery for the manufacture of cartridges and percussion caps, consisting of a complete set of punching, drawing, and finishing machines, producing 10,000 cartridges per day. Also machines for making percussion caps for the old fashioned rifles still in use; a hydraulic press and plant for making lead rods for bullets, and several bullet forming machines. The cartridge filling and finishing shops are detached from the factory, but near to it; a series of buildings at a safe distance being used for the manufacture of the various kinds of detonating compositions required. The whole of this machinery was made by Messrs. Greenwood & Batley, Leeds, and is driven by a high pressure horizontal engine of 15 n.h.p.

"Cash" Foundry.—In this department, which is not generally to be seen connected with arsenals, a large number of men are busily engaged in moulding, casting, and finishing the "cash" used as coin all over China—Mexican dollars and Sycee silver being used in large transactions. I may state here that I saw these dollars made by screw presses worked by hand in the mint at San Luis, Potosi, Mexico, in 1884, and also in the mint at Zacatecas, by a plant of new machinery sent out by Messrs. James Watt and Co. The cash are made from an alloy of copper and zinc, nearly the same as the well known Muntz metal; and it takes about 5000 of them to answer as change for a sovereign, so minute and low do prices run to in this country, of which I will only give one instance. The fare for crossing the ferry on the Peiho was only two cash, or less than half a farthing. This cash foundry will shortly be superseded by a new mint, nearly completed; the machinery of which is now being erected. It will comprise two blank cutting machines, ten coining presses, and all the die sinking and other machines complete; and will be driven by a horizontal tandem compound condensing engine, with cylinders 10in. and 17½in. diam., and 20in stroke. This engine is one of the best of the type I have seen, both as regards design and workmanship, and reflects great credit on the makers, Messrs. Greenwood & Batley, Leeds, who have supplied the whole of the plant for this mint.

Fuse Department.—This building is well laid out with lathes, copying machines, &c., for the manufacture of the various kinds of fuses required for the guns of the army and navy.

Torpedo Department.—In this building are manufactured the electrical fuses, torpedo cables, and batteries. The wires for the cables is drawn on the native system, the draw plates being of Chinese manufacture of a very hard description of cast iron, which seems to answer the purpose admirably. There are also several braiding machines, and machines for covering the wire with guttapercha.

Gun Cotton Factory.—The manufacture of this article is carried on in a large block of buildings, consisting of: (1) A cotton cleaning room, in which the material, which is all grown in the neighbourhood, and of very short staple, is cleaned by one scutching and one carding machine. (2) A room containing the dipping troughs and cooling tanks, also the acid measuring and mixing tanks. (3) A room containing one hydro-extractor for extracting the surplus acid before the first washing. (4) A room containing two large washing tanks made of wood, in which the material is immersed after leaving the hydro-extractor, and stirred for some time in cold water by manual labour. (5) A room containing another hydro-extractor, through which the gun cotton is again passed, and then boiled by steam in wooden tanks lined with lead. (6) A room containing a pulping machine, similar to the beating machines in our paper mills; from this machine the pulp is conveyed to a service tank, and drawn off as required. (7) A room containing two hydraulic presses and pumps, communicating with the service tanks in room No. 6. The smallest press converts the pulp into various shaped discs as required, and the large press reduces these discs to about a third of their previous thickness; in the same room is also a neat little double spindled vertical drilling machine for boring the holes in the discs for detonators. (8) A room for steam drying the detonating discs, which completes the process, from which they are conveyed to magazines several miles distant until wanted.

Sulphuric Acid Works.—This acid is made in a building containing a large lead lined chamber, capable of producing about 15cwt. of acid daily, with the necessary platinum stills for concentrating the same.

Nitric Acid Works.—Adjoining the above works is a building in which is erected the necessary retorts and condensing apparatus for producing the nitric acid required for the manufacture of gun cotton.

Powder Mills.—These mills were begun about eighteen years ago, and have been increased from time to time. They now comprise: (1) A charcoal burning house with six retorts. (2) A charcoal grinding mill, nearly similar to a large coffee mill, fitted with a horizontal reel, covered with wire cloth of very fine mesh, for sifting the ground charcoal. (3) A sulphur refining house, the plant in which consists of two refining pots in the form of stills, fired in the ordinary way, the lighter portions, containing sulphurous acid and a small portion of sulphur, passing into a dome, where it is condensed—the heavier fumes afterwards passing through a water jacketed pipe, at the end of which a receiver collects the liquid sulphur, from which it is ladled out into wooden tubs, and conveyed to the grinding mill when cool. (4) A sulphur mill, in which the refined sulphur is ground to a fine powder under a pair of heavy rolls, constructed on the mortar mill principle. (5) A nitre refinery, consisting of one large copper boiler, in which the crude nitre is boiled, and then passed through straining cloths into four coolers, where it is agitated with wooden rakes while cooling; it is then passed into troughs and washed with distilled water until free of salt; the nitre seemed of excellent quality, and an abundant supply of the raw material is obtained from the neighbouring province of Shansi. (6) A mixing house, where the various ingredients are weighed and passed through a small mixing machine in charges of 50lb. (7) The incorporating mills, and in the above charges are first conveyed to a small magazine, and from thence brought as required to the incorporating mills, four in number, comprising twenty pairs of edge runners, driven by four compound condensing beam engines, each of 20 n.h.p. (8) A press house, in which the material from the incorporating mills is pressed into cakes by hydraulic presses, containing alternate layers of powder between copper plates. (9) A corning house, where the powder is passed through corning rolls, and separated into the different sized grains required. (10) A glazing and dusting house, the plant in which consists of four glazing barrels, and the necessary dusting and separating machines. (11) A drying house, where the powder is put on wooden trays with canvas bottoms, and placed on racks over steam heated pipes, giving off just sufficient heat to slowly remove all remaining moisture; the finished powder is then conveyed to the packing house, and from thence removed to the magazines daily. The whole of the machinery, engines, boilers, and other apparatus in these mills have been made by Messrs. J. and E. Hall, Dartford, Kent, and the design, workmanship, and general arrangement are very satisfactory.

SERIOUS COLLISION DURING A TRIAL TRIP ON THE CLYDE.

On Saturday last, a collision, involving the death of three persons and more or less serious injury to some twenty others, took place on the "measured mile" off Skelmorlie, near Wemyss Bay, on the Firth of Clyde. The "measured mile," as is well known, is the distance marked at either extremity by posts on the shore, by which steamers effect their speed trials. On the forenoon of Saturday, two vessels proceeded to the point off Skelmorlie for the purpose of being tried. These were the "Balmoral Castle" and the "Princess of Wales." The "Princess of Wales" was a new paddle steamer recently built by Messrs. Barclay, Curle, & Co., Whiteinch, for the Southampton and Isle of Wight Steam Packet Company. The "Balmoral Castle" is a vessel whose name was at one time familiar enough. A screw steamer of about 4000 tons, she was formerly in the Castle fleet of Messrs. Donald Currie & Co., and was subsequently bought by a Spanish company, and while in their hands was the scene of a great fire, in which some two hundred persons lost their lives. Recently, the "Balmoral Castle" has been thoroughly overhauled and re-fitted by Messrs. McMillan & Son, Dumbarton. Until the evidence comes out in an authoritative fashion at the inquiry, it is difficult to state precisely how the accident occurred; but the following appear to be the facts: The "Princess of Wales" had completed one run on the "measured mile," and was about to run back, when the "Balmoral Castle" was sighted 150 yards distant. Through some misunderstanding, which will doubtless be brought out in the evidence, the "Princess of Wales" either crossed the bows of the "Balmoral Castle," or the "Balmoral Castle" attempted to cross the bows of the "Princess of Wales." The collision occurred almost immediately the possibility of danger was apprehended. The extremely short interval which elapsed, however, sufficed for Mr. James Gilchrist, jun., of Messrs. Barclay, Curle, & Co., who had charge of the engines, and who was on deck at the time, to run into the engine room and turn the engines to full speed. Had this not been done, the vessel would have been struck and cleft through at the engine space, thus probably involving explosion of the boilers and immediate submergence. As it was, the "Princess of Wales" was struck abaft the engine room bulkhead, and was cut completely in two. The after part of the vessel sank almost immediately. An attempt was made to tow the forward half of the "Princess of Wales" to the beach, but before this could be effected the bulkhead appeared to give way, and the vessel settled down in deep water almost at once. The "Balmoral Castle" was considerably damaged on the port bow, and is now under repair. It is expected that an attempt will be made at once to raise both parts of the sunken vessel. Messrs. Ross & Marshall, Greenock, have been instructed to conduct the operations.

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Offices for Publication:
22, *Wellington-street, Strand, London, W.C.*
70, *Market-street, Manchester.*
62, *St. Vincent-street, Glasgow.*

Advertisements:
London: 22, *Wellington-street, Strand, W.C.*
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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," *either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.*

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Industries, Vols. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 22ND JUNE, 1888.

STEAM BOILER LEGISLATION.

BY the withdrawal of Mr. Provand's Boiler Inspection Bill, on the 5th inst., the last has probably been heard for this session of any attempt to legislate either in the direction of the examination and certification of boiler and engine attendants, or of the compulsory inspection of steam boilers. Lord Stanley's Bill for the Registry and Inspection of Steam Boilers, read a second time in the House of Lords on the 15th August, 1887, was allowed to drop when he severed his connection with the Board of Trade; and the Bill entitled the Steam Engines and Boilers Bill for the examination and certification of attendants was rejected on the 17th April, in the House of Commons, on a division for the second reading, by a considerable majority, the general opinion being that nothing had been brought forward by the supporters to justify the members in thinking that such a measure would be likely to produce the results the promoters anticipated. Although no parliamentary action has been taken with regard to the Boiler Registry and Inspection Bill, yet much information has been given, and considerable discussion of its conditions has taken place, not only in our own columns, but in the general Press, during the interval. In our issue of the 17th February last, we drew attention to this Bill, and gave a summary of its leading provisions; at the same time we put the following questions: What do we really require? and is further legislation the best means of obtaining it? Since that time one of the Assistant Secretaries of the Board of Trade has presented some data for the consideration of the Right Hon. The President of the Board of Trade, which has been presented to both Houses of Parliament, and issued to the public, for the apparent purpose of proving how great the need is for legislation; or, to use the writer's own words, "to meet what is believed to be a great and growing evil." The information and data supplied do not appear, however, to establish the conclusion he would seem to desire. A large portion of this "Memoranda" is devoted to a consideration of the working of the Boiler Explosions Act, 1882, and in pointing out what appears to the Assistant Secretary to be its imperfections. A consideration of some of the statements made will enable the reader to understand in some degree the singular inaction of the Board of Trade during the time this Act has been in operation, and will explain the grounds upon which it has practically been allowed, so far as its punitive character is concerned, to be a dead letter. The Assistant Secretary says: "It has been suggested that formal investigations should be frequently held, if for no other reason than to find the owner of the boiler liable in the costs and expenses; but this view is untenable, as being inconsistent with the objects of the existing Act. That object is inquiry, and not punishment." If the Executive of the Board of Trade have all along held these views their inaction is conceivable, but it does not explain either the grounds for arriving at such a conclusion in the face of the apparently quite clear and definite instructions of the Act, nor why the Board of Trade should first seek powers to severely fine peccant boiler owners, and then quietly stultify them and be content with a mere "inquiry."

The words of the Act show that "the Court may order the cost and expenses of a preliminary inquiry or formal investigation, or any part thereof, including therein the remuneration of persons holding such inquiry or investigation, to be paid by any person summoned before it, or by the Board of Trade; and such order shall, on the application of any party entitled to the benefit of the same, be enforced by any court of summary jurisdiction, as if such costs and expenses were a penalty imposed by such Court." Apparently nothing could be clearer or more definite, and it is important that the reasons should be given, why—to quote from the same authority—"there is no power to make an owner or user, however careless or culpable he may have been, pay the expenses." The Board of Trade have power to make formal investigations "either upon or without preliminary inquiry," and where culpability is found and proved, so far as the ordinary construction of language goes, it would appear they have power to charge expenses. It is beyond doubt that so far as the public are concerned, that has been the impression, and there can be little doubt that the fear of publicity and of such costs being laid upon boiler owners has been the cause of a great number of boilers being placed under insurance, and of the large and satisfactory reduction in the number of explosions. It is stated in the "Memoranda" that 446 explosions, 489 deaths, and 707 cases of personal injury have occurred during the last ten years. But during four or five years of this time the particulars could only be gained from newspaper reports and unofficial sources; and very many explosions, or at least mishaps such as are now entered as "explosions," escaped record. In the fifth annual report upon the working of the Boiler Explosions Act, 1882, the same authority states that 37 explosions took place, with 24 deaths, and 44 injured; and these figures show a considerable reduction in the rate of explosion, the death rate, and number injured. A consideration of these and similar facts would tend to show that what we want as an immediate requirement is that the Boiler Explosions Act, 1882, should be amended—if it be correct, as stated, that no power at present exists to enforce costs even in cases of formal investigations—and that unmistakable powers be given, so that in every case where culpability can be clearly proved, the punitive section of the Act may be put in force. An examination of the number of explosions occurring in France, Germany, and other countries where governmental inspection is enforced, goes to show that the rate of explosions in this country is already less than that prevailing abroad under the closest governmental supervision; and it may be hoped that the increased attention to boiler engineering, examination, and attendance which has characterised the last six years, will soon reduce the number of explosions to those which are purely accidental, or against which inspection would have been ineffectual. It seems remarkable, if no power exists to assess costs, that the public have been so long left in ignorance of such an important defect in the Act, and that no allusion was made to the matter prior to the attempted passing of the Boiler Registry and Inspection Bill. It is very desirable that the matter should now receive the earliest possible attention, and it would form an interesting and valuable subject for interpellation by any member of the House interested in the steam using community.

In the fifth report of the Assistant Secretary upon the working of the Act, to which we have already referred, it is stated that of the thirty-seven cases

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of explosion which occurred during the year 1886-87, "five cases only were under the inspection of boiler insurance companies. In only three of the cases insured, however, were the explosions attributed to defects which a more thorough inspection on the part of the insuring companies' officers would have revealed. The work of these companies is no doubt often performed under considerable difficulties, arising not only from the unwillingness of some steam users to incur the loss of time and outlay necessary for repairs, but also from the lack of sufficient opportunities for making thorough inspections; but the figures referred to would seem to show that, notwithstanding these drawbacks, the examinations made under the direction of the companies during the year have, in the main, been conducted upon a satisfactory system." Bearing this statement in mind, and having regard to the increased care and responsibility felt by the steam user, under a wholesome fear of the expense of a formal investigation in the event of an explosion being decided as resulting from the want of necessary precautions upon his part, it would appear that what is immediately required is a wise and judicious use of our present legislative machinery, amended if necessary to make its working more clear and decisive.

Before concluding, we may remark that the value of the evidence provided by the "Memoranda" to which we have referred depends altogether upon its accuracy, and it is of the utmost importance that the Assistant Secretary should carefully sift the statements that are made to him; otherwise he may be led into errors which will render his conclusions valueless. Thus in quoting the evidence given by the late Sir William Fairbairn before the Mr. Hick's Committee on Boiler Explosions held in 1871, the Assistant Secretary would only appear to have taken those parts which are apparently detrimental to the boiler insurance system, and which tend to throw discredit on the operations of what the Assistant Secretary calls "the then existing *quasi* inspection societies," but forgetting it would seem that Sir W. Fairbairn was at the time the chairman of one of such societies. From all the sources of information that are available, it seems clear that public interest in the question of boiler legislation is extremely weak, and that whatever vitality it may have, and all such steps as have up to the present been made, are due to long sustained efforts on the part of a few persons, whose advocacy is marked by perhaps a very natural bias towards their own schemes. While regard for the public safety should always be a paramount consideration in dealing with this matter, still the steam using community should certainly see that their industrial activity is not hampered by any ill-advised legislation or red-taped officialism.

TEXTILE STATISTICS.

I.

THE "German Archive of Commerce," published by the Home Office of the German Empire, recently gave a very able and exhaustive essay on the "Wool Industries of Great Britain." This treatise is divided into two parts, one of which reviews the statistical, and the other the economical aspect of the case. The following summary taken from the latter part may be of special interest to the Bradford trade.

At first the period of depression is dealt with which was experienced by our textile industries in 1875, manifesting itself in a continued preponderance of supply over demand. The Royal Commission on the Depression of Trade, in its report, stated that the principal cause of this depression was that the Franco-German War suddenly opened enormous fields of trade, which, after the conclusion of the war, gradually closed up again, whilst the increased production in the United Kingdom continued. However, although at present this over-production seems to have found its level, there are complaints from all sides that the profits have materially decreased, and are often turned into actual loss. To speak of the decay of British wool industries would be a fallacy, from the simple reason that, according to unmistakable evidence, the extent as well as the volume of production has, generally speaking, increased. On the other hand, however, the average value of the goods produced by the British wool industries, as well as the profits which the capital employed therein yielded, has decreased. The present condition therefore is aptly designated with the description of depression of prices and diminution of profits. Most of the countries competing with England in the world's markets, and especially the greater part of the British Colonies, gradually adopted the policy of protective duties, and this could not remain without effect on the industries of the United Kingdom; whilst in other countries the industries gained strength, and the consumption of raw material sensibly increased. A rise in the importations of foreign manufactured goods into the United Kingdom may be noticed. Thus the import of woollen yarn amounted to 10,803,000lb., representing a value of £1,362,700, in 1881; and 15,924,000lb., representing a value of £1,999,100, in 1885. The import in woollen stuffs was computed to be, in 1881, £5,985,863 value; in 1885, £7,374,808 value. We find therefore, on comparing 1885 with 1881, that there has been an increase of import of woollen yarns into the United Kingdom of 47·4 per cent. in quantity, and of 46·7 per cent. in value, and an increase of wool stuffs of 23·2 per cent. in value. For the last fifteen years this increase is computed to be about 25 per cent. The export of British woollen yarns amounted, in 1881, to 29,731,400lb., representing a value of £4,382,898; and the export of wool stuffs amounted, in 1881, to about 272,874,900 yards, representing a value of £18,128,756; in 1885, to about 272,983,400 yards, representing a value of £18,847,053. Thus, on comparing 1885 with 1881, there is an increase of the export of British woollen yarn of 46·2 per cent. in quantity, and of 35·8 per cent. in value; whereas the increase in the export of British wool stuffs has only been about 0·05 per cent. in quantity, and 3·9 per cent. in value. For the last fifteen years there has been a decrease in value in the export of British wool stuffs of about 43 per cent. Taking, however, the fall in prices into account, the decrease of export is estimated at only about 11 per cent. Hitherto it was generally assumed in England that the chief cause of the growing imports of foreign manufactures was to be explained by the lower cost of production of other countries. It appears, however, from the report of the Royal Commission, that the main cause of this increase is the influence exerted on the English market by the change of fashions emanating from foreign countries. On the other hand, those British experts who placed the above causes in the foreground, laid stress upon the fact that the industries of foreign countries are in a position, by lower wages and longer hours of labour, to compete successfully with English industries in the British as well as in the so-called neutral markets. They pointed especially to France and Germany, who compete with England in the Colonies; their goods, they maintained, were often better and much more adapted to the taste ruling in the Colonies. The present extension of the British wool industry, and the development which the same experienced in the last thirty years, are demonstrated by the accompanying tables taken from the last report of the Factory Inspection Department of the Home Office.

According to these tables, the number of power looms has increased 23·5 per cent. during the period from 1868 to 1874, and by only 1·57 per cent. from 1874 to 1885. On the other hand, the number of spindles, which in 1868 amounted to 4,190,670, decreased in 1874 to 3,165,569 and in 1885 to 3,054,144. The total number of hands employed in the British wool industries was, in 1874, 134,605; in 1885, 139, 316; consequently, there has been an increase of 3½ per cent. in eleven years. The number of children employed in these industries was lower in 1885 than at any other time since 1856, and the number of hands under eighteen years of age is lower now than between 1868-1874. On the other hand, the number of male hands over eighteen years, and of females over thirteen years, has steadily increased. Of the 1918 factories of the woollen industry at present in existence, there are in in England 1503; Scotland, 274; Ireland, 141.

In the worsted industry accordingly a decrease of 2270 is shown in the number of power looms, and an increase of 2 per cent. in the number of spindles has taken place since 1874. The total number of hands employed in the British worsted industry, according to the above statistics, amounted, in 1874, to 142,097; in 1885, to 138,230; consequently, there is a decrease of 2870 in the last eleven years. The explanation of this decrease lies in the greater efficiency of machinery, and in the fact that in 1885 there was a decrease of 11,516 in the number of children, while 7649 more grown up persons were employed than in 1874 Of the 725 factories of the worsted industry in existence at present, there are in England 697; Scotland, 24; Ireland, 4. In the British wool industries (woollen and worsted) there were employed in 1885 a total of 277,546 hands, against 276,702 hands in 1874. These were distributed in 1885 as follows: England and Wales, 241,183; Scotland, 33,025; Ireland, 3338.

TEXTILE STATISTICS.

WOOLLEN INDUSTRIES.

	1885.	1874.	1868.	1862.	1856.
Number of factories	1,918	1,800	1,658	1,679	1,505
" " spindles	3,054,144	3,165,569	4,190,670	2,182,609	1,786,972
" " twisting spindles	230,941	158,312	167,248	—	—
" " power looms	57,990	57,090	46,204	21,770	14,453

Number of Persons employed in the British Woollen Industries.

	1885.	1874.	1868.	1862.	1856.
Children { Boys	2,916	4,977	3,658	3,362	3,774
Children { Girls	2,316	3,289	2,867	2,607	2,929
Male persons under eighteen years	12,462	13,690	12,921	11,213	11,134
Females over thirteen years	69,622	64,599	55,366	34,622	30,579
Males over eighteen years	52,000	48,050	43,192	35,179	30,675
Total numbers employed	139,316	134,605	118,004	86,983	79,091

WORSTED INDUSTRIES.

	1885.	1874.	1868.	1862.	1856.
Number of factories	725	692	703	532	525
" " spindles	2,227,192	2,182,792	2,193,210	1,289,172	1,324,549
" " twisting spindles	536,329	399,638	348,363	—	—
" " power looms	79,931	81,747	71,666	43,048	38,956

Number of Persons employed in the British Worsted Industries.

	1885.	1874.	1868.	1862.	1856.
Children { Boys	8,684	14,169	11,534	6,238	4,828
Children { Girls	9,628	15,659	14,535	6,910	6,400
Males under eighteen years	11,777	11,259	9,641	6,614	7,116
Females over thirteen years	73,277	69,388	7,451	47,652	51,371
Males over eighteen years	34,864	31,622	24,712	18,619	18,079
Total numbers employed	138,320	142,097	131,896	86,063	87,794

THE EDISON GLOW LAMP PATENTS.

WE brought the report of the case of Edison *v.* Holland down to the end of the eighteenth day in our number of the 25th of May. On the 30th of May, when the Court again sat after the Whitsuntide recess, Mr. Swan's evidence was completed, and the next witness was Mr. Charles Henry Stearn, the managing director of the Swan United Electric Light Company, whose persevering efforts in obtaining a sufficiently perfect vacuum in incandescent lamps, both before and after the date of Edison's patent, contributed in a very large measure to the eventual success of incandescent lighting. Mr. Stearn was called on behalf of the plaintiffs and examined by the Attorney-General. He corroborated Mr. Swan in his statements that the early lamps made by Mr. Swan were all of the paper and stick carbon character, and that the first thread lamps which were exhausted by Mr. Stearn were exhibited by him in his house at Rock Ferry, somewhere about June or July in 1880, and not in 1879, as suggested by the defendant's evidence. Mr. Stearn said he had had no cotton thread lamps given to him by Mr Swan before March, 1880. Mr. Stearn was cross-examined by Mr. Finlay at some length as to an article by Mr. Stearn, published in Germany in 1885, in which he had reviewed the early steps in incandescent lighting made by different inventors. In that article Mr. Stearn had stated that prior to the date of Edison's patent all the essential principles of electric lighting were

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known, and he now adhered to that statement, and further, that all that remained to be done at that date was to perfect the details for putting those principles into practice. Mr. Stearn explained that Edison's English patent contained four claims, but the German Patent Office had rejected the second one—which is the one to which almost the whole of the evidence given in this case has been directed—and Mr. Stearn added that it was the most important part of the patent, and that no practical success attended Mr. Edison's early lamp. He had never known of a lamp made strictly according to Edison's specification being sold. The conclusion of Mr. Stearn's paper was to the effect that, although much credit was due to Edison, his scientific results did not precede, either in invention or merit, those of Swan and other inventors whom he enumerated. One or two unimportant witnesses were called, and then Mr. Imray was re-called, and stated that he had succeeded in carbonising in sand in a coke furnace, and that he had carbonised various fibres in an iron vessel without either sand or plumbago packing. In this case he had used a gas furnace. In cross examination, he admitted that if he had continued the carbonising process for as many hours as the plaintiffs carbonised the filaments in the lamps they sell, they would probably have been burnt; and it appeared that the iron box had been repeatedly used in some carbonising process before Mr. Imray used it, and that it had a certain amount of graphite on the inside walls when he used it.

Mr. Charles Henry Gimingham, the resident superintendent at the works of the plaintiffs, was the next witness. He produced a large number of lamps, most of which had been recently made at the plaintiffs' works by his brother, for the purpose of showing that the directions in Edison's specification were sufficient. He had the lamps tested for duration at the rate of 10 watts per candle. On cross-examination, Mr. Gimingham stated that he had on one occasion, immediately after hearing Sir Frederick Bramwell's evidence, tried whether he could carbonise in one of the ordinary crucibles used by the plaintiffs in their ordinary carbonising furnaces, and had found that the filaments were burnt. He had not repeated the experiment. Mr. Glazebrook, of the Cavendish Laboratory, Cambridge, was next called to speak to Despretz's experiments, and that brought the evidence in the case to a close.

Mr. Justice Kay intimated in the course of the proceedings that there was in this case a very direct conflict of evidence on more than one point in Edison's specification between the eminent scientific gentlemen on both sides, and suggested that each side should perform any experiment of which evidence had been given by that side, in the presence of two of the scientific witnesses on the other side, and in the presence of some eminent man of science to be subsequently agreed upon. This course was adopted. Professor Stokes has been requested to attend and report the results to Mr. Justice Kay.

WEEKLY WAGES BILL.

A Bill has been introduced into the House of Commons, backed by several labour representatives, to provide for weekly payment of wages in Great Britain and Ireland, and enacts that the wages of every workman engaged by time shall be paid in full by the employer to him at least once in each week. In case of a workman being engaged otherwise than by time, the wages earned by him shall be paid to him in full at least fortnightly, or by giving one day's notice to his employer he may require payment of 75 per cent. of his wages weekly. The Bill also requires the provision by an employer of pay notes showing the amount of wages earned to be furnished to any workman requiring the same on the day previous to that on which his wages are payable. The Act applies to labourers, servants in husbandry, journeymen, artificers, handicraftsmen, miners, railway servants, or others engaged in manual labour. Any employer contravening this Act is liable to the penalty imposed by Section 9 of the Truck Act, 1831. We are not aware of any grave objection to the passing of such a measure. Fortnightly payments prevail in some colliery districts—Shropshire for instance—both for day wages and piece work, and if the Bill becomes law an alteration in this system would have to be made. The provision for pay notes would probably be found in practice to be a dead letter as regards miners at all events, as we have been unable to trace any desire on their part for such an innovation. It is somewhat difficult to see what grievance is to be met by the Bill, or what beneficial results would follow its passing into law; and it strikes us as being rather intended to keep the labour party of the House of Commons to the front than to serve the interests of any material section of the community. We would just direct attention to the additional penalty it might involve upon those who are on the threshold of the Bankruptcy Court. On the whole, it would seem to be an attempted addition to that style of "grandmotherly" legislation which is unfortunately now too prevalent.

ANTI-FOULING COMPOSITIONS.

The question of anti-fouling compositions for ships, to prevent the growth of weed, slime, and shells on their bottoms, has occupied the attention of both the Admiralty authorities and those immediately interested in our large shipping companies more or less since the introduction of iron ships. Some six years ago the preservation of the underwater plating of the "Edinburgh" and "Colossus" was specially considered by the Admiralty Board of Construction. A number of compositions were submitted to experiment, two of which were placed on the bottom of the "Mercury," sister ship to the "Iris," and these proved to be, in a measure, somewhat successful. Since then the anti-fouling composition manufactured by Messrs. Kirkaldy & Son, of London, from Captain Renney's patent, has met with considerable support from a large number of shipping companies, it having been found, as the result of its application, that after long voyages ships returned with little or no growth of either grass or shell on their bottoms. Recently attention has been drawn to quite a new composition, manufactured by Messrs. Stevenson and Davies, of Queen Victoria-street, London. This composition was tested by the Admiralty a short time ago, with highly satisfactory results, on the bottom of the "Cossack," and a more severe test of its merits has just been brought to a successful issue. The bottom of the "Sultan" was cleaned and painted in June of last year, and large patches on the port bow and starboard quarter of the ship were covered with Stevenson and Davies' composition. The vessel remained afloat for ten months. On being docked at Portsmouth, it was found that the surface coated by this firm's composition was almost perfectly clean, while the other portions of the vessel were liberally covered with long grass and shells. It would be interesting if the Admiralty were to extend these experiments, and apply this composition to vessels proceeding on distant voyages and cruising in tropical waters. A good anti-fouling composition is invaluable in preventing loss of speed, which results from the increased surface friction of a foul bottom. The speed of a vessel is frequently reduced by a half knot or a knot per hour, and the coal consumption largely increased, by a foul skin. On the score of economy, it is therefore essential that strict attention should be paid to this question, and the best compositions only should be used for the protection and preservation of the bottoms of our costly ships, both in the navy and mercantile marine.

Letters to the Editor.

COAL GETTING MACHINES.

To the Editor of "Industries."

Sir,—With reference to Roberts-Horsfield and Porter's new patent hydraulic coal getter, permit us to correct any wrong impression which might be conveyed by the article in your issue of the 15th inst., under the heading of "Coal Getting Machines," to the effect that the use of this machine as a substitute for explosives "occasions a small increase in the cost of getting coal." On the contrary, the use of our machine will in any case be considerably cheaper than explosives, and as it gets the coal without slack the cost is even further covered by the more marketable condition of the out-put.

Yours, &c.,
Mallett, Porter, & Dowd.

London, N., 20th June, 1888.

FUEL TESTING LABORATORY.

To the Editor of "Industries."

Sir,—I am of opinion that the suggestion put forward by Mr. Bryan Donkin, in the issue of your valuable journal of the 8th inst., is worthy of the attention of steam users and coal consumers throughout the kingdom, and also to no less an extent of the attention of colliery proprietors and coal merchants. Taking the case of a steam user who deals with hundreds of tons of coal per annum, the heat value of the said fuel is a considerable item in his yearly expenses, and as it actually represents the quality of the fuel supplied, a testing station, such as suggested by your correspondent, would not only enable a large consumer to practically value the fuel before purchase, but also enable the vendor to guarantee a qualitative value which would in itself constitute the best advertisement of his business.

A suitable site for such a station would be upon the banks of the Thames, between Plaistow and Purfleet on the Essex bank, or Charlton and Erith on the Kentish shore, where the requisite space may be obtained at a comparatively low rental. The coal may be delivered at a cheap rate of transport upon a suitable jetty, and any nuisance arising from the operation of testing would not, in such a locality, prove to be an objection, while the proximity to London renders it easy of access.

Respecting the first outlay, and assuming that the 20 h.p. boiler and accessories mentioned by Mr. Donkin would suffice for preliminary testing, I think that the certainty of ultimate success would warrant sufficient ground space being acquired in the first instance to allow of considerable addition to the plant at a future time. Allowing, therefore, that £700 would cover the first cost, it does not seem to be a difficult task to raise this sum—say seven persons or firms advancing £100, and guaranteeing £100 per annum each. When we consider the thousand-and-one companies that have been successfully floated during the past two or three years, involving the outlay of an enormous capital, and when the practical and scientific aspect of the objects of such companies is duly estimated, showing but a poor hope of return, it certainly does not seem impracticable to raise a small sum for establishing a concern which is of vital importance to the commercial community, such as that suggested by Mr. Donkin. With regard to the cost of maintenance, we may assume that the services of a competent expert may be retained to attend tests when required at about £350 per annum, and that an assistant and a stoker may be kept regularly; the approximate annual cost may then be placed thus:—

	£
Technical expert	350
Assistant	180
Stoker	65
Rent	35
Stores	16
Depreciation	35
Total	£681

Now, in the City of London and environs there are a vast number of steam users, whose annual expenditure for fuel would render such a testing station an important acquisition, and they, with the merchants who supply them with fuel, would eagerly support the enterprise if it were brought before their notice, and the conditions were reasonable. I would suggest, therefore, that a system of monthly reports of tests should be organised, and that such reports should be sent to subscribers who pay in advance an annual subscription of say 7s. per annum. In this case 3000 subscribers would cover the annual expenses, including postage, salaries, &c., and also pay a dividend of 7 per cent. upon the first outlay and guarantee fund; and such a number may be found to appreciate the value of the system.

The majority of steam users do not care for technicalities; but in this case the appeal to their pockets would command their interest. It is comparatively easy for the quantity of feed water evaporated per diem to be accurately estimated in every factory, and if the monthly reports furnished by the station were detailed in simple language, so that the heat value of the fuel tested could be reckoned in gallons of water evaporated per ton of fuel, every steam user could apply the test for the better regulation of his annual expenses, without going deeply into the technical part of the question of the relative thermal values of different fuels.

Yours, &c.,
Fredk. Walker.

4, Moorfields, London, E.C.,
14th June, 1888.

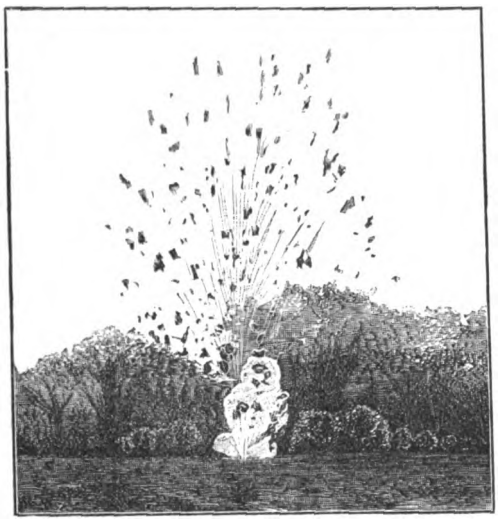
THE ROBURITE EXPLOSIVE COMPANY, LIMITED.

On Saturday, the 16th inst., we had an opportunity of inspecting the works of the above company at Gathurst, near Wigan, and of witnessing some interesting experiments made with roburite. Roburite is a light yellow powder resembling powdered resin, and has a peculiar smell arising from the benzol used in the manufacture of it. It was invented and perfected by Dr. Carl Roth, of Berlin, whose chief aim was to produce an explosive which might be handled with the utmost safety, and exploded without producing any injurious fumes or explosion of the gaseous mixtures commonly found in mines. The inventor claims that roburite can only be exploded by specially powerful detonators. Should this explosive prove as safe and effective as it is claimed to be, there is no doubt that it will soon be employed in mines and other underground operations, and that its use will tend to greatly reduce the fatal accidents which now so frequently occur. The works of the Roburite Company have been designed and erected by Mr. Hammersly Heenan, M.Inst.C.E., Manchester, and Mr. C. N. Hake, Westminster, London, part of the buildings originally constructed for the Tar Dyes Company being utilised. The works are divided by the river and the canal flowing in the Douglas valley into two portions; the chemical factory being on the south side of the valley, close to the railway connecting Manchester and Southport, while the north side is occupied by the mixing house, the cartridge making, and packing houses, and the several magazines for storing the roburite cartridges and detonators. Both canal and railway afford ample means for transporting the explosive. The chemical factory consists of a laboratory, the benzol shed, and the chlorine shed; while the buildings for the manufacture of nitrate of ammonia are still in course of construction. The valley is spanned by a wrought iron bridge, whereby the two portions are converted into one establishment, thus avoiding many restrictions imposed by the Explosives Act. The north part has been constructed with strict regard to the regulations of the Home Office, though these precautions are hardly necessary with an explosive of the character described. The cartridge making houses are some distance apart from each other, and separated by strong wooden walls, while mounds of earth surround them. The magazines are substantial brick buildings, with double doors, and to each magazine is attached a small ∩-shaped detonator magazine, also built of bricks. One of these magazines is situated close to the canal, to facilitate the carriage by water. All rails passing the mixing house, the cartridge houses, and stores are made of brass, and steel and iron are studiously omitted from all moving parts of the machinery, gun metal being invariably used. The roburite is filled into cylindrical

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paper bags by hand, with the help of a neat little apparatus. After closing the cartridges, they are provided with a waterproof cover, and are then sent to the packing room, where they are packed in square tin boxes, a number of which are put into wooden cases. A 4oz. cartridge measures about 4½in. in length and 1⅛in. in diam.

The experiments were carried out in an open plot of grass land adjoining the works at the north side, and close to the river. The first experiment was intended to show how unlikely roburite is to explode by rough treatment or heat. A small quantity was placed on an anvil and repeatedly struck with a hammer without exploding it. The explosive was next placed on the fire, then stirred with a red hot iron, and finally a cartridge was blown up with gunpowder without producing any effect. The next four experiments showed the destructive power of the explosive. One, two, three, and four ounces of roburite were simultaneously exploded on a double headed steel rail weighing 90lb. per yard. The 2oz. charge missed fire, but the other three made varying indentations in the rail. Then 2oz. of roburite and 2oz. of dynamite were tried on a similar object, the roburite proving the more effective of the two. Next a 4oz. cartridge was exploded on a similar rail, considerably bending the rail. Finally, 2lb. of roburite were exploded in an earth mine, and made a hole 9ft. square, the peculiar feature being the sharp corners and edges of the hole. We give an illustration of this explosion, which is



Explosion of Earth Mine.

reproduced from an instantaneous photograph taken by us at the time. The trees shown in the illustration, and which were of average height and close to the mine, form a fairly good gauge of the height to which the earth was thrown. The next experiment, which was the first on the river side, was the explosion of a 4oz. cartridge under water, which was thrown to a considerable height. The last demonstration was intended to consist of the explosion of roburite, gunpowder, and dynamite in an explosive mixture of gas and air, an old boiler being provided for that purpose. Unfortunately time was too far advanced to admit of this experiment being carried to the end, the roburite only being exploded. This is the more to be regretted, as this experiment might have shown the advantage of roburite over gunpowder and dynamite in not igniting gases, this being the chief feature claimed. The roburite certainly did explode without igniting the mixture contained in the boiler, but it would have been interesting and instructive to have seen the behaviour of the other two explosives mentioned under exactly similar conditions. It may here be mentioned that in none of the experiments was a flame visible, a light brownish smoke only being produced. Practical experience alone can now show in how far the roburite fulfils the last mentioned property claimed for it.

Books Received.

Reports from the United States Consuls. No. 88. January, 1888.

Granites and Our Granite Industries. By George F. Harris, F.G.S. London: Crosby Lockwood & Son.

Rules and Regulations Recommended for the Prevention of Fire Risks from Electric Lighting. By a Committee appointed by the Council of the Society of Telegraph Engineers and Electricians. London and New York: E. & F. N. Spon.

A Higher Arithmetic and Elementary Mensuration. By P. Goyen. London and New York: Macmillan and Co.

Watts' Dictionary of Chemistry. Revised and entirely re-written by H. Forster Morley, M.A., D.Sc., and M. M. Pattison Muir, M.A. London: Longmans, Green, & Co.

Ninth Annual Report of the Winnipeg Board of Trade. Issued by authority of the Board.

Principles of Dynamo-Electric Machines. By Carl Hering. New York: W. J. Johnston.

Cleveland Institution of Engineers. Proceedings, 23rd February, 1888.

Asbestos: Its Production and Use, with some Account of the Asbestos Mines of Canada. By Robert H. Jones. London: Crosby Lockwood & Son.

A Manual of Practical Assaying. By John Mitchell, F.C.S. Edited by William Crookes, F.R.S., Pres.C.S. Sixth Edition. London: Longmans, Green, & Co.

A Chapter in the Integral Calculus. By A. G. Greenhill, M.A. London: Francis Hodgson.

Die Erzeugung und Verteilung der Elektrizität in Zentral-Stationen. Von Dr. Martin Krepg. Magdeburg: A. and R. Faber.

Recent Advances in Electricity. Edited by Henry Green. New York: N. Y. Agent College of Electrical Engineering.

Applications of Dynamics to Physics and Chemistry. By J. J. Thomson, M.A., F.R.S. London and New York: Macmillan & Co.

Proceedings of the Cleveland Institution of Engineers, 16th April, 1888.

The Academy: A Journal of Secondary Education. Issued monthly. Vol. III., No. 4. Syracuse, New York: George A. Bacon.

Local Option. By J. Gunsberg. London: Liberty and Property Defence League.

Naval Supremacy: Where is it? By War Truths. London: E. S. Boot.

Mining and Quarrying. By J. H. Collins, F.G.S. London: Crosby Lockwood & Co.

The Standard of Value. By William Leighton Jordan, F.R.G.S., Assoc.Inst.C.E., M.L.C.C. Fifth Edition. London and New York: Longmans, Green, & Co.

Electrical Instrument Making for Amateurs. By S. R. Bottone. Second Edition, enlarged. London: Whittaker & Co.

Reviews.

Practical Arithmetic. By Samuel Young. Manchester: John Heywood.

The author of this work is right in claiming that there is more information concerning transactions in cotton spinning, engineering, and manufacturing generally contained in this book than in any hitherto published treatise on arithmetic. The materials used in the examples are taken from modern trade, and there is hardly a trace of antiquated and obsolete methods of business. We are also glad to see that the author does not propose in his examples any of those impossible or ridiculous transactions which mar the usefulness of so many books on arithmetic. The numerous varied examples form the real value of this book, and we can heartily recommend its use to anyone who wishes to attain an expertness in calculation. The weak point of the book is its lack of breadth and thought, which shows itself in the bareness and incompleteness of the explanations of rules and principles. We hope that this fault may be remedied in a future edition.

Elements of Metallurgy. By J. Arthur Phillips, F.R.S., F.G.S., &c. New edition, Revised and Enlarged by the Author, and H. Bauerman, F.G.S. London: Charles Griffin & Co. 1887.

The first edition of Mr. Phillips' "Manual of Metallurgy" appeared in 1852, the second in 1854, and the third in 1858, up to which latter date no other work on the subject had been published in England. Thereafter a considerable number of treatises appeared, some of them very large, and consequently expensive, while others confined themselves to the metallurgy of one of the metals only. The first edition of the present work was issued in 1874, and was intended to give in a single volume with considerable detail the metallurgical operations relating to all the principal metals, and at the same time to serve as an introduction to the general literature of metallurgy. The work was essentially a new work, and not merely a revised edition of Mr. Phillips' "Manual." Its object was to supply, within moderate limits, such practical information on general principles and typical processes, as might not only afford a comprehensive view of the subject, but also enable the reader to study with advantage more elaborate treatises and original memoirs; and the information was brought up to date as far as possible. The author was engaged on a new edition at the time of his death, and this has been completed and superintended in its passage through the press by Mr. Bauerman, who is well known for his writings on metallurgical subjects. The chief advances in metallurgy during the past ten years have been recorded, and large additions and alterations have been made, especially in the section relating to iron, although many notable additions are also to be found under the heads of copper, lead, silver, and gold, dealing with the newer developments in processes for the smelting and extraction of those metals from their ores; while in revising the text, notices have been removed of several processes which have either failed in practice or become obsolete. The work contains sections on the physical properties of metals, fuel, refractory materials, iron, copper, tin, zinc, mercury, lead, silver, gold, and platinum, as well as on the rarer metals; and the space which is given to each is well proportioned to their importance from an industrial point of view; and altogether we can recommend the book as the most generally useful treatise on metallurgy, for its size, which has yet been written.

Counsel's Retainers. By E. B. G. London: William Clowes & Sons, Limited.

In this modest little pamphlet a mass of unwritten law is reduced into twenty-five rules. The general public will learn with interest the distinction between, and the peculiar virtues of general and special retainers, the fees payable in each case, the circumstances under which retainers are revoked, and the extent to which they entitle a client to the counsel's services. A favourite character of the author is the cautious solicitor. He, of course, knows all about retainers; but the articled clerk, who hopes in time to develop into one of these ornaments of the human race, might do much worse than study these pages. Struggling barristers will wonder why, if a retainer costs so little, they so rarely see one; and smile sardonically at the writer's warning that a special retainer, if accompanied by the requisite fee, cannot be refused unless another party to the action has already given a retainer, whether general or special. There is room in certain passages for improvement of style, but it is hypercritical to expect literary elegance in books dealing with legal subjects.

Screw Threads. By Paul N. Hasluck. London: Crosby Lockwood & Co.

This is a small illustrated pocket treatise, containing seventy-nine pages of closely printed matter, on screw threads and methods of producing them. The author deals, in successive chapters, with screw threads in general, dies and die stocks, screw cutting in the self acting lathe, cutting complex thread rates on self acting lathes, and tap making. The book will, no doubt, be found to contain much that is useful to the intelligent workman, who is desirous of thoroughly mastering that part of his craft with which the book deals. Since the work under consideration is not merely a book of reference, but constitutes essentially a treatise, it might, we think, with advantage have been brought out in a more readable form, the size, both of the book and type, being too small and inconvenient for practical use.

Tables and Memoranda for Mechanics and Engineers. By Francis Smith. Fourth edition. London: Crosby Lockwood.

This little volume contains a surprising amount of information useful and interesting to both master and workman. In addition to the usual rules and tables for mechanical engineers, we find therein some leading facts connected with wood work, plumbing, slating, plastering, hydraulics, &c., together with a detailed account of the various special weights and measures used in England. The articles on "Trigonometry" and "Surveying," however, are somewhat deficient as regards treatment; and the same may be said of the treatment of the foreign money and exchanges.

Some National and Board School Reforms. Edited by Lord Brabazon. London: Longmans, Green, and Co. 1887.

The editor of this book has long taken an interest in public questions; and believing that many of our several evils would in a great measure be removed if an improvement were to be effected in our national system of education, by the inclusion in the Government code of physical, technical, and industrial training, and wishing to hasten this reform, he has re-published in a cheap and popular shape some of the most recent expressions of opinion on the subject. These consist of papers which have appeared in various reviews and newspapers, and their publication in a collected form will be welcomed by all educationists. The first is by Lord Brabazon himself, and is on "The Health and Physique of our City Populations," a subject which is now beginning to demand special attention. The second paper is by the same author, on "Open Spaces and Physical Education," and may be looked upon as supplementary to the first. There are various other papers on elementary education, but

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those to which we wish to direct special attention are contained in the second part of the book, and relate to technical and industrial training; and among the authors there are Samuel Smith, M.P., Sir Philip Magnus, W. Fowler, M.P., H. Cunynghame, Professor Huxley, and the Marquis of Hartington. The speeches and letters of the two latter on the occasion of the inauguration of the National Association for the Promotion of Technical Education attracted considerable attention, and they are here reproduced, with the articles which appeared in the *Times* on them. Miss Evelyn Chapman gives an account of the Slöyd system of education as practised in Sweden, and, from observation of it, she is convinced of its excellence, of its claim to be regarded as an important factor in education, and the need there is for something of the kind in our own schools; and, among others, Lady Leigh puts in a powerful appeal for the better training of girls. We agree with the editor when he says that if such reforms as are advocated in these pages were effected, the future generation, furnished with the means of leading industrious, prosperous, and happy lives, would find itself in a much superior position to the present, which, being nourished mainly on intellectual food, finds its body starved and its hands paralysed.

SELL'S DICTIONARY OF THE WORLD'S PRESS AND ADVERTISER'S HAND BOOK. London: SELL'S ADVERTISING AGENCY, Fleet-street. 1888.

We certainly think that this work is one of the cheapest of our publications, for the book contains thirteen hundred pages, and only costs two shillings. There is a complete list of all the newspapers, periodicals, and magazines published throughout the world, and to each one is appended some definite and accurate information about the circulation, the views expounded, the scale of charges for advertisements, and the nature of the trade reports which appear in its pages. The press of the British Isles is noticed and described more fully, and greater details are entered into as to the industries which form the staple trades of the districts in which the papers circulate. The present volume also contains several valuable articles, which have been specially written for this work, including "Hints on the Law of Libels in Newspapers," by Dr. Blake Odgers; "The Rise of Provincial Journalism," by Mr. H. R. Fox Bourne; "Some Newspaper Men," by Mr. J. W. Robertson Scott; and "The Centenary of the *Times*," by Mr. John Astle. Among the other features of the book, may be mentioned a series of portraits of sixty-four "heads of the press," in England, France, and America, the history of each of the London daily newspapers, and a collection of old advertisements. The book is both valuable for reference and interesting to read; but it is evident that the chief purpose which it is intended for, is to serve as a hand book for advertisers. There are many practical hints on the art of attracting attention by the aid of blocks and type, and the information about the various newspapers is exactly what is desired by an intending advertiser. If there is one article in the book to which we may take exception, it is the account of the modern mechanical type composers. There is no mention at all of the latest improvement in this direction, viz., The Thorne Company's machine, which was exhibited at the American Exhibition at London last year, and described in *Industries*, Vol. III., page 69. The Thorne machine has lately been adopted by some provincial newspapers. Nevertheless, Mr. Sell's book should circulate among all classes, for it is the handiest and most complete compilation in connection with the art and business of advertising which has yet been published.

PRACTICAL EDUCATION. By Charles G. Leland, late Director of the Public Industrial Art School, Philadelphia. London: WHITTAKER & Co. 1888.

The name "practical education" is now generally understood to mean a training in some departments of practical work, and therefore synonymous with what is usually understood by technical education. Mr. Leland's book, though it is based on the teaching of art, is neither a scientific nor technical manual. It begins with an elucidation of the principles involved in art education, and from those as a foundation it evolves the rational method of teaching. The author remarks that education, as it at present exists, consists in storing the memory, developing the intellect, and training the constructive faculty. He goes a step beyond this, and shows how the memory may be created, quickness of perception awakened, and the constructive power formed, so that the mind, when it begins to acquire knowledge, may do so with confidence and strength. In short, he keeps in view throughout a popular analysis of mind, and insists that children, before learning, should acquire the art of learning —that is, that we should *intellectualise* them before attempting to improve their intellects. Mr. Leland's method is, in fact, a development of the kindergarten. He argues that if a child can learn in the kindergarten to sew, sing, braid, draw, and model, it can in a more advanced school study more advanced subjects, and all the more so, because the whole system does not depend on learning different branches, but because the necessity of design and modelling is the same for every art study, be it in wood, clay, sheet brass, paper, or even embroidery. That is to say, these different branches are not taught directly as bearing on particular trades, but simply as means of educating the mind, the eye, and the hand, and thus lay the foundation for proficiency in all trades. This is practically all that can be done in the way of technical education in elementary, and, to a large extent, in secondary schools. Mr. Leland dwells on the importance of freehand drawing, but not in the manner in which it is usually taught, by mere mechanical copying, but in such a way that from the first lesson in which the children are taught to throw lines freely and accurately, they are made to exercise their inventive faculties, or to design. As by the ordinary system the child too frequently wearies of drawing, by this it is step by step made familiar with variations upon given motives or patterns, so that it can in a few weeks or months develop entirely original patterns. By a union of drawing and the minor arts, the eyes and the hands are trained, and through them the intellect developed, and at the same time the pupils are prepared for every practical occupation. Mr. Leland's school was from the beginning an experiment to fully ascertain what children could do, and not simply an institution to teach art. A want of appreciation of this fact on the part of the public has been the source of the only troubles which the school has experienced. A common outcry has been—at least in America—"Teach boys while at school a practical trade by which they can get a living." Whereas the Leland experiment was made solely to find out what boys and girls are capable of learning. The result has been to prove beyond doubt that all children taking one or two lessons, of two hours each in a week, in an *atélier*, can in two years' time learn, not one but several arts, so well that they can obtain paid situations on leaving school. The book abounds with examples of methods, and with clear statements of principles which are worthy of the careful study of all engaged in the work of education, and to such we cordially commend it. An appendix containing a list of the principal works on technical education will be found useful to the same class of readers.

THE CORNELL UNIVERSITY REGISTER, 1887-88. Published by the University, Ithaca, N.Y.

In our first volume (page 566) we gave an account of the Engineering Department of Cornell University, so that we need not now enter into details regarding it. We are, however, much pleased to see that progress continues to be made, and that at a rate which in this country would be considered astonishing, thanks both to State and private liberality. In addition to the subjects which are usually included in the branches of University education, Cornell University has taken up those which are generally called technical, and it is rapidly becoming an important engineering school. Out of a total of 1022 students, 33 have chosen Agriculture, 55 Architecture, 111 Civil Engineering, 83 Electrical Engineering, and 136 Mechanical Engineering. Of the latter department Professor Thurston is the director, and a special college, founded by the Hon. Hiram Sibley, is devoted to it, and every facility is given both for theoretical and practical investigations. The former consists of the study by text book and lecture of the materials used in mechanical engineering, the valuable qualities of these materials being exhibited in the mechanical laboratory by the use of the various kinds of testing machines, as well as by examination of specimens of all the most familiar grades, of which samples are seen in the cases of the museums and lecture rooms. The theory of strength of materials is here applied, and the effects of modifying conditions—such as variations of temperature, frequency and period of strain, method of application of stress, are illustrated. This course of study is followed or accompanied by instruction in the science of pure mechanism, succeeded by that of machine design and the theory of the steam engine and other motors, all being applied to designs in the drawing rooms. The last term of the regular course is devoted largely to the preparation of a graduating thesis, in which the student is expected to exhibit something of the working power and knowledge gained during the course. A *graduating piece* is demanded, also, of each student, both in the drawing room and the workshop, which shall show proficiency in this department. In the mechanical laboratory the work is conducted by an instructor familiar with its apparatus, and with the best methods of work, who plans a systematic course of instruction that is intended to give the student not only skill in the use of apparatus of exact measurement, but to teach him also the best methods of research, and to give him a good idea of the most effective methods of planning and of prosecuting investigations, with a view to securing fruitfulness of result with minimum expenditure of time and money. An institution conducted on such principles is sure to be successful. The same thoroughness pervades all the other sections of the University, and it now draws students from all parts of the world, a few even from England.

THE LEAMINGTON CENTRAL ELECTRIC LIGHT STATION.

THE credit for having given the first impulse to the introduction of the electric light into Leamington, is due to two members of the Town Council, Messrs. Fell and Bright, who, after seeing the lighting of the Birmingham Art Gallery, which was carried out by Messrs. Chamberlain & Hookham, Limited, were desirous of introducing the electric light into their own houses, and suggested that this firm should establish a central station in Leamington. Eventually the Midland Electric Light and Power Company, Limited, was formed, and a station was built on a site in Wise-street. The company had secured from the Town Council the right of way for laying their cables under the streets, and by October last year the work had so far progressed that a portion of the streets and some private and public buildings could be lighted. The lighting was carried on experimentally until Christmas, 1887, and from that date the regular service was commenced and has continued to the present time. Thus far the history of the Leamington installation presents nothing very remarkable. In all similar undertakings there must be a certain amount of experimenting until the service can be finally organised; but the remarkable thing about Leamington is that now, when the installation is in full working order, complaints against it are louder than during its experimental stage. These complaints emanate from the party who are opposed to the electric light, not on its own merit or want of merit, but because their political opponents are in favour of it. In Leamington every local question is taken up as a matter of politics and fought over in a political spirit, which, we need scarcely say, is not calculated to bring out much fairness or do justice to technical points where the question is one of scientific or industrial importance. In the case of the electric light installation, the opposing party have done their best to disparage the work, both in the Council Chamber and in the local Press; and as these unfavourable statements have from time to time been reproduced in some technical journals, the electrical engineering profession at large finds itself somewhat puzzled what to think of the Leamington Central Station. It was with a view to judge for ourselves that we, last week, paid a visit to Leamington, and inspected the electric lighting arrangements, Messrs. Chamberlain & Hookham having courteously given us permission and every facility to see all their work.

The station is a building 90ft. square, and stands close to the Warwick Canal on a piece of land large enough to permit a future increase of the building to two or three times its present size. There are at present fixed two steel boilers, locomotive type, each 5ft. barrel by 19ft. long, having a total of 770 sq. ft. of heating surface; and two horizontal compound condensing engines, each of 200 effective h.p., with cylinders 15in. and 26in. diam. by 2ft. 4in. stroke. These engines, as well as the boilers, have been supplied by Messrs. Robey, and are provided with the Proell cut-off gear, controlled by Richardson's electric governor. The boilers are designed to work at a steam pressure of 140lb. per square inch; but only 120lb. is now carried, this being sufficient for present requirements. There is a partition across the engine room, so placed that the barrels of the boilers are in the engine room proper, whilst the fire boxes are on the other side of the partition in what may be described as the boiler room, this arrangement having been adopted to keep the dust and dirt of the stoke room from the machinery. Each boiler has its own injector, and in addition there is a feed pump common to both. Room is provided for a third engine and boiler, and the steam pipe is common to all the boilers, so that any engine can be worked by any boiler. The engines have 9ft. fly wheels, provided with nine grooves, each taking a cotton rope $1\frac{1}{2}$in. diam., known as the Lambeth cotton rope, made by Mr. Thomas Hart, of Blackburn, for which it is claimed that it will not stretch, the fibres being laid together without twist. These ropes drive on to 4ft. followers on a 6in. main shaft, on which are four 6ft. pulleys with four grooves for ropes of the same size, by which the power is transmitted to four Chamberlain & Hookham shunt-wound dynamos. These machines are each of 800 lights' capacity, and two of them are at present sufficient to supply the whole demand of current for about 1100 lamps out of a total of 1500 lamps wired. During the day time current is supplied by two storage batteries, each consisting of sixty-three E.P.S. cells of the 31 L 1888 type, giving a maximum discharge of 70 ampères. These batteries are charged by two 10 kilo-watt dynamos driven by a 30 h.p. Robey high speed engine. In this case also the transmission is by cotton ropes, the dynamos being set

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in line with the driving pulley between them. The driving pulley is carried on a short spindle, and connection with the dynamo spindles is made by flexible couplings of Mr. Hookham's design. The charging current is stopped when the lighting is done from the batteries, and the pressure is regulated by including a larger or smaller number of cells between the terminals of the two feeders; but arrangements are now being made to keep the number of cells constant, and to regulate the pressure by sending the current through a rheostat in the manner adopted in some of the Edison stations. By this means the contractors hope to obtain a more delicate adjustment of pressure, and to avoid injury to the end cells, which at present get charged and discharged unequally.

The current from the large dynamos is led to a main switch board consisting of enamelled slate set in an iron frame, and carrying a number of Drake & Gorham's ring contact switches, by means of which any of the four dynamos can be coupled to any of the two pairs of feeders, two dynamos and one engine only being at work simultaneously, the other set of two dynamos and engine being in reserve. There is also another switch board of similar construction, by means of which the coupling between the charging dynamos and the batteries, and between the batteries and the feeding mains, is effected. On this switch board are two electromagnets which cause a bell to ring when the discharging current from either of the batteries exceeds 70 ampères, thus giving the attendant warning that the large engine must be started to supply the growing demand for current as the evening advances. The routine of the station is as follows: From dawn until dusk the batteries are coupled to the feeders and the engines are stopped. The consumption of current during the day time is very small, but the pressure is always on the wires, so that private consumers can have the light at all times except once a month, for an hour or so, when the cables are being tested for insulation, conductivity, &c. Towards the evening, as soon as the electric bell has given warning to the attendant that the current in the feeders has increased beyond the capacity of the battery, he starts one of the main engines and two dynamos, and switches the dynamos into circuit. This can be done without any interruption in the lighting, the dynamos and batteries being coupled in parallel for a short time, after which the batteries are switched off. The feeders are then supplied from the large dynamos direct, and the charging dynamos may now be started and the batteries again charged up, so as to be ready for a day's supply on the morrow.

The distributing plant was originally laid down on the three-wire system; but owing to the great complications entailed by this system, both in the station and on the consumers' premises, it has been changed to the ordinary two-wire system. The change was effected in the feeders by coupling the balance wire to the negative or return wire, and in the distributors by coupling the positive and negative wires together to form the out circuit, and using the balancing wire as the return. The current is supplied to the town by two lines of feeders, one 900 yards and the other 460 yards long. The sectional area of the cables is respectively 375 and 300 sq. mm. The feeders are laid in brick trenches 2ft. square placed 5ft. under the level of the road. The trenches are covered by 3in. Yorkshire flags, and above them there is therefore about 3ft. of earth and paving. The cables are of Callendar's make, and are supported in cleats of paraffined wood which rest upon slate shelves clear of the bottom of the trench, so as to keep the cables above any water which might accumulate at the bottom. Provision is, of course, made for draining away any water which might find its way into the trench. The feeders which start from the main switch board in the station, terminate at two iron distributing boxes placed above ground in the streets, and all the connections with the distributing mains are made in these boxes. The distributing mains themselves are also carried in brick trenches 15in. square, and the longest service reaches the house of Mr. Fell, the Mayor, which is about 1860 yards from the station. The section of the distributing mains varies between 120 and 60 sq. mm., according to the distance and the number and size of houses lighted on the way. The service wires to the houses are all permanently connected with the distributing mains underground; but no junction boxes are used, the connection being simply made to the mains within the trench and well insulated. The distributing mains for the lighting of the street lamps are controlled from the two distributing boxes, the connections being arranged so that out of a total of 183 electric street lamps, eighty-three can be turned out separately. This at present is done at 11 p.m., and the 100 remaining lamps are turned out at 1 a.m. The Town Council pay £2. 2s. per annum for each street lamp, the total lighting time being 2860 hours. This sum covers renewal of lamps. The street lamps are nominally of 16 c.p. This is decidedly too small a candle power to produce a good effect, and the arrangement of the lamps is also open to objection. The lamps are fixed to brackets projecting at right angles from the lamp posts; but these brackets are alternately turned parallel to the direction of the street and at right angles to it, so as to bring the lamps over the footpath. When looking down the street, this gives a most untidy appearance to the lighting. Some of the lamp posts carry three brackets, set at 120° from each other, and this arrangement has a rather pleasing effect. The great mistake, in our opinion, was to employ lamps of 16 c.p., and perhaps less, for street lighting. An ordinary gas jet has quite that power, and thus in point of light there is no advantage whatever in replacing it by a small glow lamp. Considering the great expectations usually entertained about electric lighting, the inhabitants may well be excused if they feel disappointed at the electric light as now supplied to their streets, and in so far the anti-electric light party of Leamington has some reason for complaining. On the other hand, it should be stated that the arrangement of the lamps and their candle power were not left to the discretion of the contractors, but were prescribed by the town authorities.

Having criticised adversely the street lighting, we are glad to be able to give unqualified praise to the indoor lighting as carried out by Messrs. Chamberlain & Hookham. By the courtesy of the Mayor of Leamington, we were enabled to inspect his own private installation, and also that of the Town Hall, and in both instances the lighting is excellent. The assembly room in the Town Hall is, as far as our experience goes, the best lighted hall in this country. It is 80ft. long, by 40ft. wide, and 28ft. high, and the whole of the lighting is done from above by 186 lamps set in five circular clusters on the centre line of the ceiling. Each lamp is surrounded by a reflector of silvered glass somewhat resembling a large egg cup turned with the opening downwards, the rim being slightly above the bottom of the filament. The curve of this reflector is so chosen that no rays are reflected vertically downwards, whilst the number of rays reflected in a slanting direction increases as the angle of the ray to the horizontal decreases. This represents the curious effect that to an observer standing immediately under the first cluster this appears less bright than the next and the following clusters. In fact, the furthest cluster of lights appear the most brilliant, and the practical effect of this arrangement is that every corner of the hall is as brilliantly lighted as any part of the floor immediately below the lamps. By this peculiar arrangement of reflectors, which has been devised by Mr. Hookham, the light is perfectly diffused. The staircase, council chamber, and other rooms are also very tastefully lighted, the total number of lamps fixed in the Town Hall being 360. The current consumed is measured by two of Mr. Hookham's new meters, which we shall presently describe. In the pump room there is an installation of 170 lights, also supplied with two meters. As regards smaller installations, the testimony of the shopkeepers in Leamington is unanimously in favour of the electric light. Tobacconists find that since they have abandoned gas their stocks of cigars exposed in the shop windows keep saleable, and are not deteriorated through the moisture and heat emanating from gas jets. In a jeweller's shop, we saw some very pretty effects produced by incandescent lamps placed within the shop windows close to the exhibited articles, but screened from the observer outside by semi-opaque shades. As regards the application of electricity for motive power purposes, up to the present there is only one example in Leamington, viz., a small motor used by a dentist; but Messrs. Chamberlain & Hookham are confident that before long there will be a good demand for motors, to be used by drapers for working sewing machines, and by printers. A small motor is also to be erected at the Central Station for driving a lathe and other tools which are required for small repair jobs to be done on the spot. Whilst noticing the use of the electric light in the shops of the town, we must not forget to mention the town office of the contractors, which is situated near the Town Hall. This office, besides serving as a show room for lamps and fittings, and for the commercial business of the company, is also used as a point of control for the work done at the Central Station. The office boy there has the duty to record every hour, between 6 p.m. and 10 p.m., the pressure kept on the mains, and the nightly record thus obtained gives the engineer in charge a means to find out whether the attendant at the station has properly done his work. We were allowed to examine the log book, and append here a copy of two of the entries taken at random. On the 10th June, the entry is as follows:—

Time, p.m.....	6	7	8	9	10
Pressure, volts....	112	112	112	111	111

On the 14th June the record is:—

Time, p.m.....	6	7	8	8-45.....	10
Pressure, volts....	113	110	111	111	113

It will be seen from these figures that the pressure kept in the mains is remarkably uniform, and this explains, to a certain extent, the satisfaction felt with the service by private consumers.

The means employed to obtain this result are exceedingly simple. As we have already stated, there are two feeders going out from the station to two distributing boxes. Each feeder is supplied by one battery in the day time, and by one dynamo at night. The dynamos are not coupled together at the station, but each delivers current independently to its feeder. To each feeder is attached a compound Schuckert voltmeter, made with a specially wide scale in the range of 100 to 130 volts, so that the pressure can be accurately read off. The main current passes round the voltmeter in one loop, formed of a stout copper rod, and the loop is so connected that the main current tends to turn the needle in opposition to the current in the shunt coil of the voltmeter. The adjustment of these compound voltmeters is exceedingly simple, and consists in raising or lowering the whole instrument within the fixed loop until the exact balance is obtained. The voltmeter is then fixed in this position, and indicates not the pressure at the station, but that at the distant distributing box. The e.m.f. of each dynamo is adjusted by means of a rheostat in the exciting current. This rheostat is from time to time adjusted by the attendant according to the indication of the compound voltmeter, the duty of the man being simply to keep the voltmeter at 110 volts. This forms the final adjustment; but within certain limits the adjustment is automatic, and is performed by the Richards governor which controls the speed of the main engine. According to the load the speed varies from a minimum of 84 revolutions when the demand for current is small, to a maximum of 90 revolutions when the demand is largest. Since the load is fairly distributed between the two feeders, and since the ratio of load between them can only vary within narrow limits, the final adjustment to be made by the attendant is required within equally narrow limits, and his task is rendered still more easy on account of there being added a pair of connectors between the two distributing boxes, so that any sudden and excessive demand upon one box is in part supplied from the other. By means of these regulating devices, the work at the station is simplified to such an extent that no special skill or extraordinary attention is required on the part of the man in charge, and this also explains the remarkably small variations from the standard pressure which will be apparent from the figures we have given above.

The most interesting part of the installation is, perhaps, the new Hookham meter, which is used both as a station and as a house meter. Briefly described, the meter consists of a dynamo with a disc armature containing no iron, and revolving between the poles of a permanent magnet of tungsten steel. The strength of field is about 1200 C.G.S. units, and the armature is set in rotation by passing either the whole or a definite portion of the main current through it. To one side of the armature is attached a solid copper disc, which is thus carried through the field as the armature revolves, and the eddy currents produced in this copper disc tend to retard its motion. Without going into the theory of this very ingenious meter, we may say that, apart from certain small disturbing causes, the number of revolutions performed by the disc in a given time is exactly proportional to the quantity of electricity which has passed in the same time. The revolutions of the disc have, therefore, only to be registered upon a counter in order to obtain a record of the current supplied during each quarter. For convenience, the counter is arranged to register Board of Trade units. The calibration of the meter to Board of Trade units is exceedingly simple. In most cases only a small portion of the main current is passed through the meter, and the latter is calibrated by increasing or diminishing the resistance of the shunt which carries the greater portion of the current until the counter shows correctly Board of Trade units. All the larger consumers have meters of this description, and they pay for the current at the following rates: When from 1 to 40 units have been consumed per quarter, the charge is 8d. per unit; between 41 and 150 units, the charge is 6d.; and from 151 upwards, the charge is 4d. At these rates the cost per lamp hour varies from ·54d. to ·27d., according to the amount of electricity used. We may notice that the electric light installation at Leamington has had a very salutary effect in a direction not contemplated by the contractors. We have it on the authority of a leading citizen, that since the introduction of the electric light the candle power of the gas supplied has improved from 15 c.p. to 16¾ c.p.; whilst at the same time the previous price of 2s. 9d. per 1000ft. has been reduced to 2s. 7d., representing an annual saving to the consumers of gas in Leamington of £1,200. After our visit and inspection, we are glad to be able to state that the electric light installation at Leamington is by no means the dismal failure which the local Press and some technical journals have made it out to be. On the contrary, it is a modest yet fairly successful attempt to supply a public want; and the enterprising townspeople of Leamington are quite ready to take advantage of the facilities thus offered them.

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BELT GEAR FOR TESTING DYNAMOS.

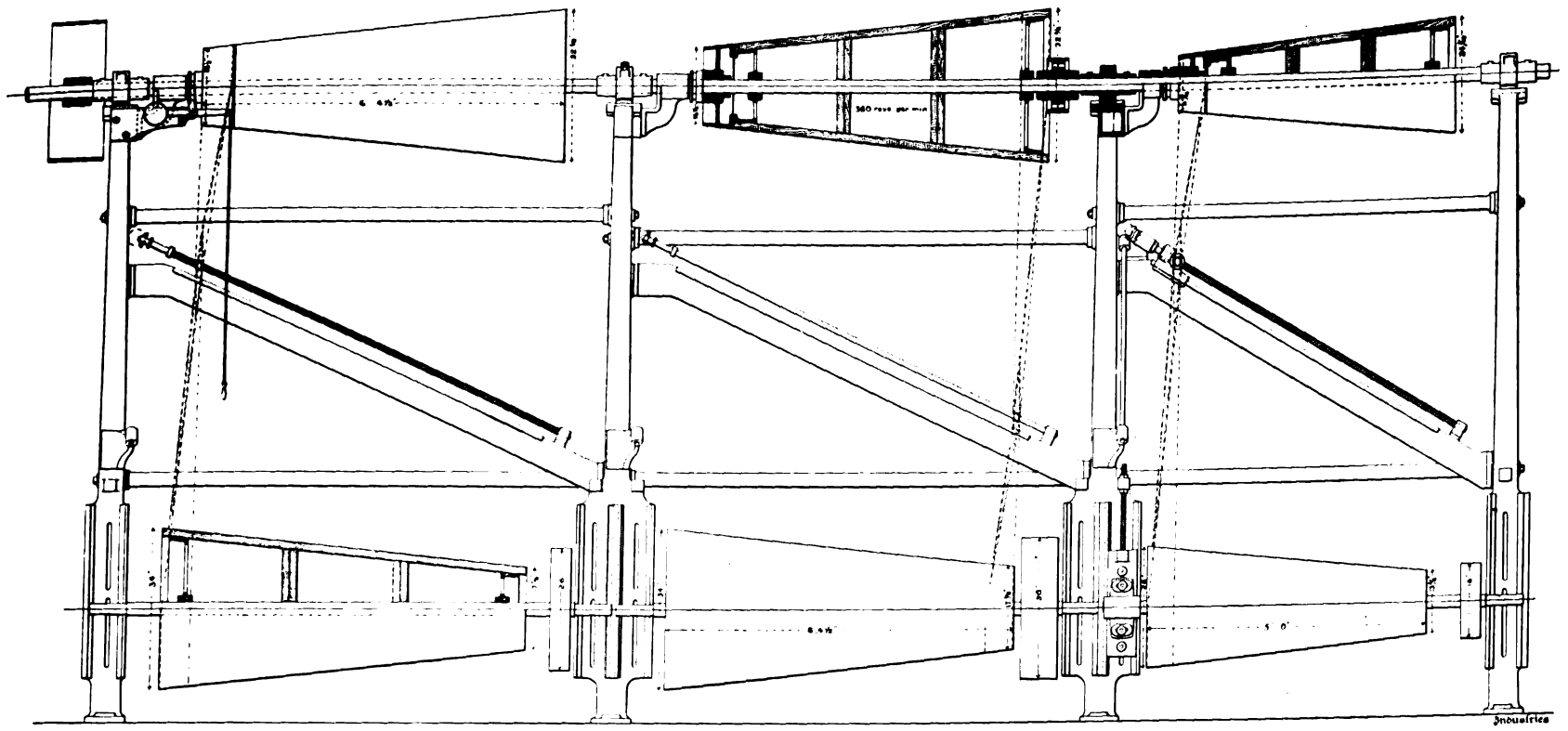


FIG. 1.

BELT GEAR FOR TESTING DYNAMOS.

THE employment of heavy currents in laboratory experiments and the testing of dynamo machines have of late years become so necessary portions in the curriculum of electrical engineering students, that most schools have now more or less complete plants of dynamo machines and driving gear at their disposal. One of the most complete installations of this kind is that at the Central Institution of the London and City Guilds in South Kensington, and as the driving gear there employed may with advantage be adopted elsewhere, we publish herewith a sketch of it. Fig. 1 shows the gear partly in front elevation and partly in section, and Fig. 2 shows an end elevation. The gear has been made by Messrs. A. Ransome & Co., of Chelsea, to the designs of Professor Ayrton, who was assisted by Mr. Mather, and has, since its erection some eighteen months ago, proved perfectly suited for the work carried on at the laboratory in the Central Institution. Power is supplied by an 8 n.h.p. Marshall semi-fixed engine, running at 180 revolutions per minute. A belt from the fly wheel drives on to the pulley on the left hand end of the top shaft, giving the latter a speed of 360 revolutions a minute. On this shaft are keyed three cones, each consisting of an iron frame with a wood lining outside. Similar cones are mounted on separate shafts below, which are adjustable vertically, so that the belts may be tightened. The ratio of diameters is such that the speed of each lower cone may be varied between the limits of one to three. Three dynamos can be simultaneously tested, and the speed of each can be varied through this range. Thus if the minimum speed required for one dynamo be 500 revolutions, the maximum speed obtainable without interfering with the other dynamos will be 1500 revolutions. If the minimum speed required for dynamo No. 2 be 600 revolutions, this same machine can be run at any speed between 600 and 1800 revolutions, and similarly the third machine can be worked between the limits of 670 to 2000 revolutions. Two pairs of cones are of equal size, and the third pair is somewhat smaller. The larger cones have been used to transmit up to 14 h.p. each, and the smaller pair has been used up to 6 h.p.; but they are capable of transmitting 10 h.p. An important and valuable feature of this design consists in the support of the belt on a separate loose pulley when the gear is not used. This loose pulley forms a prolongation of the narrow end of the cone, and is supported upon a separate sleeve surrounding the shaft, but not running with it. This sleeve is held by a bracket at the side of the bearing as shown. If the belt be shifted to the left, so as to lie wholly on the pulley, the shaft with the upper cone keyed to it runs idle, and the lower cone remains at rest. There is consequently no waste of power through friction. If it be desired to start the lower cone, the handle shown in our illustration is pulled downwards, and by this means the conical pulley is pressed against the face of the cone, and by virtue of the friction between the surfaces commences to revolve. At the same time the belt shifting gear is set in motion, and thus the belt is shifted on to the cone itself. As soon as the cone takes hold of the belt the handle may be released, and the belt may be set on to that portion of the cone which will produce the

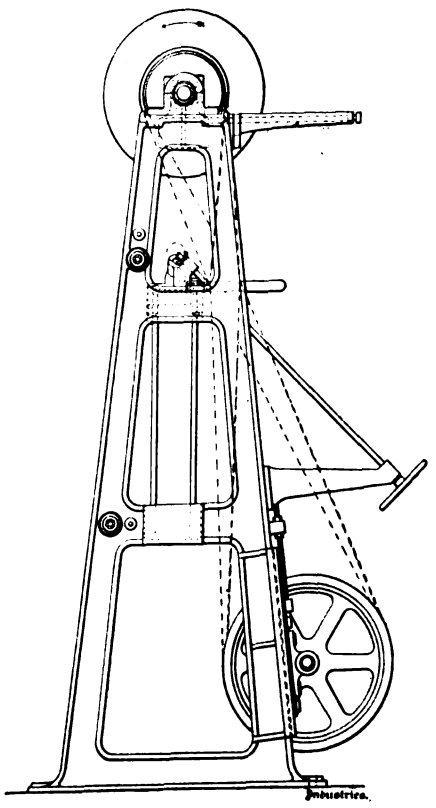


FIG. 2.

required speed. Thus the friction clutch is only brought into action at the moment of starting, and there is, therefore, no permanent waste of power through friction, nor the danger of a heated collar bearing, as is the case in ordinary friction clutches. The shifting of the belt is performed by a roller inserted into the crossing place of the belt. The roller is held on a stud which can be shifted to the right or left, by means of a screw and nut controlled by a hand wheel, as shown in Fig. 2. The screw is inclined diagonally across the frame supporting each pair of cones, as the height of the crossing point of the belt naturally varies with the horizontal position of the belt. By means of the hand wheel it is possible to maintain the speed of each dynamo practically constant, notwithstanding great variations in the power required by the machines under test, and the consequent irregularity in the speed of the engine. It is therefore possible to adjust the speed of each dynamo so as to obtain either a constant current or a constant pressure: conditions which are essential for certain experiments, and which are not fulfilled by ordinary compound wound dynamos worked from an engine which is governed by a centrifugal regulator.

COMBUSTION OF COAL.*

THE presence of combustible gases in the products of combustion is certainly a proof of the deficient utilisation of coal. The defective methods used to collect the products of combustion have often led experimentalists to neglect the presence of combustible gases. M. Scheurer-Kestner thinks this a serious matter, and has taken care, when collecting these gases, to guard against sources of error. He finds the quantity of air most favourable to combustion, by beginning with a volume smaller than the theoretical quantity required, and increasing it until it exceeded the maximum which could be well used. He determined that if from 8 to 9 cubic metres of air are employed for the combustion of 1 kilo. of Rouchamp coal, carbon monoxide and perhaps pure hydrogen and carburetted hydrogen would be found among the gaseous products of combustion, and that from 6 to 18 per cent. of the carbon contained in the coal was lost; if from 10 to 12 cubic metres of air are allowed, the loss was only from 4 to 6 per cent.; with 12 cubic metres it is only 4 per cent.; while with 15 cubic metres it is reduced to 1 or 1½ per cent.

Practice, he stated, had already given useful data on this head; but the important fact to establish was the precise limit when the loss was the least, and the gain the greatest. He found that the furnace should be fed with a volume of air about 5 per cent. more than the theoretical quantity required for the combustion of the coal.

In regard to the question of smoke, the following experiment, he thought, could not be too much recommended to persons disposed to complain of factory chimneys. He remarked: "In the course of a boiler experiment, I placed beside the apparatus containing the gases of combustion a glass tube open at each end, into which I had introduced a layer of asbestos from 25 to 30 centimetres thick, in such a manner that without exercising the least pressure, the gases were allowed to pass freely, and only the soot was retained. This tube was placed in communication with an aspirator, and the gases which entered were measured. The soot adhered to the asbestos, but only along a length of from 5 to 6 centimetres, the rest of it remaining perfectly clean. I was thus enabled to establish the proportion between the quantity of soot produced, and the quality of the coal consumed. But to anyone

* Abstract of a paper read by M. Scheurer-Kestner, before the Chemical Society of Paris.

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who has not observed the fact, it is curious to note that however black and thick the smoke may be, even when purposely produced by feeding the furnace with insufficient air, it represents a loss of not more than 1½ per cent. of carbon in the coal; and if air be suffered to enter more freely, the loss resulting from the smoke falls to ½ per cent." M. Scheurer-Kestner, therefore, does not attach much importance to the generation of smoke so far as economy is concerned, and he only recognises two really efficacious systems: one based upon the continuous mechanical feeding of the furnace, and the other upon the combustion of smoke by mixing it thoroughly with very hot gases. In both cases the expense exceeds the economy effected by consuming the smoke. Of course there are frequent cases in which the necessity arises to have no smoke, and to employ apparatus to prevent its formation.

It may be useful to add the results obtained with a steam boiler of the French elephant type, with three tubes and a feed water heater. With the Rouchamp coal, taking the heat of combustion in the coal at 100 thermal units, the results were as follow:—

	Per cent.
Thermal units in the steam were	63·5
" " carried up the chimney...	5·1
" " in the combustible gases	4·9
" " in the soot.....	3·7
" " unaccounted for	22·8
	100·0

In more recent experiments 78·9 per cent. thermal units were obtained in the steam with coal "de la Ruche," and as much as 83 per cent. with a special Welsh coal sent by Mr. Donkin, of London. This loss, which ranges from 17 to 21·1 per cent. in the examples just given, is often more in practice, and must be attributed partly to the external radiation from the boiler, and partly to radiation from the brick work.

Notes.

RAILWAYS IN THE PHILIPPINE ISLANDS.

Consul Gollan, of Manila, reports that very little progress has been made with a railway between Manila and Dagupan, the concession for which was granted to an English company under a Government guarantee of 8 per cent. The prospectus of another line, the Centre of Luzon Railway, has been issued. The length of the proposed railway is 23¾ miles, and its course, in the immediate vicinity of Manila, would be through so populous and fertile a district, that no guarantee on capital is asked for from the Government, as it is thought that the traffic will prove sufficient to give a handsome return on the outlay. The required capital is estimated at £225,000.

COTTON IN CHINA.

A report has been prepared on the trade of Ssŭ-ch'uan, a province of China about which very little information is available, by Mr. Bourne, who was until lately the British consular agent at Ch'ungking. He states that home spun cotton is the leading clothing material, very few using any other textile. The foreign import trade was stationary for some years owing to bad harvests; but an improvement is now visible, both grey and white shirtings showing a large increase. Mr. Bourne suggests that much might be done to make British imports more suited to the wants of the province, and mentions as an example that the bales of cotton piece goods imported have to be re-made in smaller packages to cross the rapids.

A STEAM LIFEBOAT.

For several years the Committee of the Royal National Lifeboat Institution have been endeavouring to find a means of propelling lifeboats mechanically. In 1886 a special sub-committee conducted investigations to this end, but were eventually compelled to bring in an unfavourable report. In the following year the Committee offered gold and silver medals for designs for such a lifeboat; but, although there was a satisfactory response to the offer, the judges did not consider that any of the designs were of sufficient value to deserve an award. In the beginning of the present year, however, a model of a steam lifeboat was submitted to the Institution by Messrs. R. & H. Green, the well known shipbuilders at Blackwall, London, and after some modifications had been made in the designs at the suggestion of the Committee, this firm received instructions to build an experimental lifeboat on the proposed principle. The new boat will be 50ft. long, with 12ft. beam, and is to be propelled by a turbine wheel driven by an engine of 170 i.h.p. The Committee are to be congratulated on the energy and determination with which they have persevered in their endeavours, and we sincerely hope that their efforts may meet with success.

THE SKILLED LABOUR MARKET.

The Labour Correspondent of the Board of Trade reports that there is again a sensible improvement in the condition of the labour market, as indicated by the trade returns of certain societies of skilled workmen. Of such organisations twelve have supplied full details. These unions show an aggregate membership of 139,772, of which total 6678 were out of work—a proportion of 4·8 per cent. In the previous month the figures were 7352 unemployed for the same societies, a proportion of 5·3 per cent. There is thus on the month a decrease of 674 on the unemployed list, and a fall in the proportion of ·5 per cent. This improvement is chiefly due to the continued progress of the building and engineering trades, the former branches of industry especially being much better. The revival in iron shipbuilding seems to have reached almost a stationary point, as the figures are practically the same as those for last month. The labour market has, however, been disturbed in this trade by wages disputes, which may account somewhat for the lack of improvement. The cotton spinning trade is rather better, and some points of difference as to wages, which threatened to lead to serious disputes, have been amicably settled by advances to the workpeople. The steam coal trade has much improved; the number of unemployed is very low, and most of the pits are working full time. The reports may be generally summarised as five slightly better, two stationary, two good, and three moderate.

SOCIETY OF CHEMICAL INDUSTRY.

The annual meeting of this Society will be held in Glasgow on the 4th, 5th, and 6th July. On Wednesday, 4th July, at 11 a.m., a meeting will be held in the Bute Hall, Glasgow University, with the President, Professor James Dewar, M.A., F.R.S., in the chair. The business will consist in dealing with the report of the Council and treasurer, the election of office-bearers, the President's address, and other miscellaneous business, including the fixing of the place for holding the next meeting. The afternoon is left free for a visit to the Glasgow International Exhibition. At 6-30 p.m., the annual dinner will take place at the Grand Hotel, Charing Cross, Glasgow. For Thursday, 5th July, several excursions are planned. The first of them will proceed to the Forth Bridge Works and Broxburn Oil Works, where luncheon will be provided by the Broxburn Oil Company. The second excursion is divided into two branches, one proceeding to the Thornliebank Print Works, the other to the Langloan Iron Works (Messrs. R. Addie & Sons) and to the Summerlee Iron Works (Messrs. Neilson), where two different processes for recovering ammonia from blast furnace gases are in use. The third excursion will visit Nobel's Explosives Company's Works, where luncheon will be provided. On Friday morning, 6th July, a visit will be paid to Greenock to inspect Messrs. J. Walker & Co.'s sugar refinery. At 12-15 the steamer "Victoria" will leave the Prince's Pier, Greenock, for an excursion on the Firth of Clyde, returning to Glasgow at 6 p.m. Ladies are invited to join this excursion. Luncheon will be provided on board the "Victoria."

INSTITUTION OF MECHANICAL ENGINEERS.

The summer meeting of this Institution will be held in Dublin, on Tuesday, the 31st of next month, and following days. For organising the arrangements of the meeting an influential Local Committee has been formed in Dublin, of which the Right Hon. the Earl of Rosse is chairman, and Mr. Henry A. Ivatt and Mr. Samuel Geoghegan are the honorary secretaries. A similar committee is being formed in Belfast with the Mayor, Sir James H. Haslett, as chairman, and Mr. A. Basil Wilson and Mr. Bowman Malcolm as the honorary secretaries. The following is an outline of the provisional programme proposed by the Local Committees. On Tuesday morning, the 31st July, the President, Mr. Edward H. Carbutt, and the Council, together with the members of the Institution, will be received in Trinity College by the Right Hon. the Earl of Rosse and the members of the Local Committee. Papers will then be read and discussed. In the afternoon luncheon will be provided by the Local Committee in Trinity College. A steamer trip in Dublin Bay, or a visit to works in Dublin open to inspection, will fill up the afternoon. In the evening the Institution dinner will take place. On Wednesday morning the reading and discussion of papers will be continued in Trinity College, and in the afternoon luncheon will be provided by the Local Committee in Trinity College. Subsequently visits will be paid to the Great Southern and Western Railway Locomotive Carriage and Waggon Works, Inchicore, and to the Rathmines Water Works. In the evening there will be a conversazione. On Thursday Guinness' Brewery and places of interest in and around Dublin will be inspected, and in the evening members will proceed to Belfast. On Friday morning there will be a reception in the Belfast Town Hall by the Mayor, Sir James H. Haslett, and the members of the Local Committee, after which a visit will be paid to Messrs. Harland & Wolff's Shipbuilding and Marine Engine Works. Luncheon will be provided by the Local Committee in the Town Hall, followed by a trip on a steamer round Belfast Lough by invitation of the Belfast Steamship Company. In the evening a conversazione will take place in Queen's College, Belfast.

BREAKING UP OLD SHIPS.

The Norwegians have, according to our contemporary *Fairplay*, hit upon a new way of breaking up old wooden ships unfit for further use, the old method having long been felt to be a laborious and costly one. The new Norwegian plan is to loosely anchor the useless ship in a dangerous position near the coast, and to have her broken up to bits by the sea in the first heavy gale. The sea not only breaks up the ship but carries the results ashore, when they are collected and sold at good rates for firewood, &c.

ITALIAN IRON WORKS.

The iron works of the Genoa district are, according to a Foreign Office report, doing a very large business, and owing to the protection afforded by the additional duties are likely to increase their production. Messrs. Ansaldo and Co., of Sampierdarena, have in hand the engines and boilers for the "Sicilia," representing 20,000 i.h.p. In addition they have in hand an important order for castings and forgings for the Government, and a number of locomotives. Messrs. Raggio & Co., of Sestri, are now turning out rolled sheets, the work being done by men brought over from Birmingham. Messrs. Tardy, Benecke, and Co., of Savona, are extending their business in the direction of making steel rails and armour plates for ironclads.

CLIFTON SUSPENSION BRIDGE.

The *Bristol Observer* in an article on the above subject comments upon the great number of suicides committed by leaping from the bridge, and illustrates several suggestions for preventing any further occurrences. It states that since the opening of the bridge in 1864 as many as twenty-six cases have been recorded, all but one of which proved fatal. The fact that two suicides occurred within five days caused Mr. Pickersgill, M.P., to ask a question on this subject in the House of Commons. What effect this course may have on checking, or better still, on entirely preventing this fatal tendency, it is impossible to say; but public attention will at least be drawn to the necessity of providing some safeguard which would prevent people from throwing themselves from the bridge. We gather from the article in question that not only people bent on committing suicide, but also persons who are in no way anxious to prematurely terminate their existence, are seized with a strong inclination to try the fatal leap, and it is quite possible that a man on whose mind care heavily weighs may yield to the impulse of the moment, though he never thought of suicide before. The construction of an efficient guard is by no means an easy task. The weight of the material and the surface exposed to the pressure of the wind must be kept as small as possible, or they would seriously interfere with the safety of the bridge. On the other hand, the graceful outline of the structure, so seldom found in modern iron bridges, ought to be kept intact without incurring heavy expense. In the four devices illustrated in the article under consideration, wire netting is used by two designers and spikes by the other two. The first arrangement consists of wire netting projecting 4ft. or 5ft. beyond the bridge, and acts not exactly as a preventive, but more like a check, to suicide. The designer of this arrangement assumes that most people climb over the railing and drop from the bottom rails, and in that case they are caught in the net, which slopes towards the footway. From this net they may be rescued, but they may also persevere in their former resolution, and there is nothing to check them any further. In the second suggestion, a wire netting is connected to the hand rail and the suspension rods, forming a sort of awning over the footway. This arrangement appears to be satisfactory, as it makes it impossible for anybody to climb over the railing. Besides, it would not add materially to the weight of the bridge or to the surface exposed to wind pressure, and would not interfere with the general appearance of the structure. The third design shows spikes fixed to the hand rail. The spikes are about 1ft. long and curved inwards, and are likely to prove effective, besides being cheap and simple. The fourth suggestion is to have a loose wire running on the top of the hand rail supported on iron standards 1ft. high. The wire is fitted with barbed spikes at short intervals. This plan has, together with the third design, the advantage of being easily erected and cheap, and of not straining the bridge in any manner. Many more difficult problems have been satisfactorily solved, and we hope that a solution will be soon found to satisfy all persons except perhaps those tenaciously bent on suicide.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

8th June, 1888.

8375. Ladd, J. H. ..... Manufacture of screws.
8377. Roe, J. T. ..... Railway vehicles.
8378. Hutchinson, H. ..... Stockless anchors.
8379. George, J. J. ..... Warehouse trucks.
8382. Briggs & Eastwood ... Carding engines.
8385. McConachy, J. ..... Ventilating apparatus.
8392. Perkins, J. ..... Lock-stitch fair-stitching machine.
8393. Anthony, J. H. ..... Breech-loading guns.
8395. Stott, J. H. ..... Warping and beaming machines (*Whitehead*).
8398. Farini, G. A. ..... Machine guns.
8400. Roberts-Horsfield and Porter..... Hydraulic presses for mining purposes.
8407. Marlor, S. ..... Self acting mules.
8417. Martignoni, J. ..... Turning and planing machine tool.
8423. Siddell, G. ..... Moving large forgings of iron or steel.
8428. Maxim, H. S. ..... Quick-firing guns.
8429. Green & Curtin..... Artificial draught in steam boiler furnaces.
8437. Molloy, P. ..... Suspended railway.
8440. Lawrence, J ..... Elevators.

9th June, 1888.

8445. Garside & Stockton... Twisting machine used in the manufacturing of felt hats.
8450. Low, R. ..... Steam boilers.
8455. Hargreaves & Inglis... Boiler furnaces.
8456. Friedrich, M. ..... Apparatus for grinding and pulverising.
8459. Corrigan, J. ..... Winding yarns on bobbins.
8460. Broadbent, H., & others Preparing and spinning cotton.
8466. Barnett, C. ..... Hydro-compressed air power.
8467. Rothwell & Rothwell Picking motion of looms.
8469. Eyre, W. ..... Forged hollow weldless shells.
8483. Mannesmann, M. ..... Toothed gearing wheels.
8484. Mannesmann, M. ..... Universal joint for coupling revolving shafts.
8485. Mannesmann, R. ..... Fire proof columns.
8487. Mannesmann, M. ..... Tubular shafts.
8494. Davies, E. J. V. ..... Manufacture of paper.

11th June, 1888.

8511. Burdon & Clark..... Steel castings.
8520. Hunt & Crockford ... Marine governor.
8521. Coulter, J. ..... Stone dressing machinery.
8523. Crosland, W. ..... Automatic machine to press books.
8524. Lynde, F. C. ..... Water gauges.
8526. Stockwell & Widdowson..... Securing rails in railway chairs.
8531. Boult, A. J. ..... Steam pumps (*Northey*).
8534. Boult, A. J. ..... Rotary engines (*Avis*).
8537. Hodder & Swain..... Manufacture of mats.
8538. Biggerstaff, J. ..... Nosing motion for mules.
8541. Kiddier, H. ..... Knitting machines.
8542. Anderson, G. ..... Raising girders.
8547. Wheatley, W. H. ..... Wheels for waggons (*Hall*).
8549. Nagel & Linnenbrügge Stone crushers.
8550. Lechner, E. ..... Purifying feed water.
8553. Boluss, A. R. ..... Air brakes.
8565. Yates, J. ..... Starter for vehicles.
8568. Stark, D. ..... Heating & purifying feed water.
8571. Pitt, S. ..... Supplying water to boilers (*Kieley*).

12th June, 1888.

8577. Clegg, T. ..... Bed for cloth cutting or finishing machines.
8583. Landye, J. ..... Steam chests and slide valves.
8589. Withy & Sivewright... Drainage wells in connection with water ballast tanks in vessels.
8593. Bosley & Dickson ..... Safety valve.
8601. Newington, A. S. L. ... Apparatus for raising water.
8602. Hattersley & Hall ... Friction clutch and brake mechanisms.
8614. Day, C. A. ..... Machinery for making wire nails (*Morgan*).
8615. Cochrane, R. ..... Weaving chenille.
8619. Dempsey, C. W. ..... Traction and brake apparatus.
8620. Butler, E. ..... Hydrocarbon motors.
8628. Oliphant, W. ..... Apparatus for feed water heating and filtering.
8629. Bartlett, J. E. T. ..... Blades of propeller wheels.
8633. Imray, O. ..... Feed water regulator (*Cook and Thoens*).
8635. Vojáček, L. ..... Cutting rails and girders.
8638. Lake, H. H. ..... Sewing machines (*Peerless Button Hole Attachment Co.*)
8642. Moraes, A. C. da C. ... Weaving ribands. (Date applied for under Section 103 of the Patents Act, 1883, February 24, 1888).

13th June, 1888.

8653. Banks, L. F. ..... Breech-loading fire arms.
8656. Friedrich, M. ..... Friction clutches.
8665. Hyde, G. T. ..... Swaging metallic shapes (*Price*).
8667. Stark, J. ..... Hydraulic apparatus for starting tramway cars.
8682. Picking & Hopkins..... Wind engines or motors.
8686. Cannon, F. W. ..... Steam engines.
8688. Ainley & Oakes ..... Drilling machines.
8692. Taylor & Taylor ..... Driving sewing machines.
8696. Pinkney, C. W. ..... Gas engines.

14th June, 1888.

8703. Shaw, J. F. ..... Motive power engines.
8712. McAdam, J. ..... Tools for slotting machines.
8713. Schmidt, W. ..... Steam generators.
8714. Offermann & Ziegler. Combing machines.
8719. Whiteley, J. B. ..... Sectional warping machines.
8725. Parker & Turner ..... Boiler furnaces.
8729. Ferriday, J. ..... Hydraulic wedges employed in the falling of coal.
8730. Willcocks, R. T. ..... Paper making machines.
8734. Hardwicke, J. B. ..... Application of anti-friction rollers to thrust bearings.
8744. Alloo, L. J., & others... Railway signalling.

ELECTRICITY.

12437A. Crompton & Swinburne ..... Electrical measuring instruments. (This Application having been originally included in No. 12437, dated 14th September, 1887, takes, under Patents Rule 23, that date.)

8th June, 1888.

8401. Clifton & Robinson ... Electric batteries.

9th June, 1888.

8457. Mellett, L. ..... Telephones.
8503. Ducretet, E. ..... Magneto-electric exploders.

11th June, 1888.

8525. Rawson & Jolin ..... Electric bells.

12th June, 1888.

8596. Johnson, J. Y. ..... Automatic telegraphy (*Mallett*).
8637. Parcelle, A. L. ..... Electric clocks.

13th June, 1888.

8657. Barcroft, H. ..... Dynamo-electric machines.
8700. Renard, L. M. J. C. C... Electric batteries.

14th June, 1888.

8724. Snelgrove, W. ..... Electrical switch machines.

CHEMISTRY.

8th June, 1888.

8410. Groth, L. A. ..... Purifying metals (*Pellegrin*).
8427. Guild, J. E. ..... Extraction of the precious metals (*Galbraith*).

9th June, 1888.

8496. Lea & Hammond..... Electro coating metals with zinc.

12th June, 1888.

8597. Hanson, J. ..... Generating sulphurous acid gas.
8604. Stitt, C. A. ..... Soap.

14th June, 1888.

8738. Lisle, E. A. de..... Vegetable black for decolourising.
8740. Nevill, W. H. ..... Soap.
8746. Brin, L. Q. ..... Plating with aluminium.
8747. Brin, L. Q. ..... Aluminium bronze and other alloys of aluminium.

MISCELLANEOUS.

8th June, 1888.

8380. Sarjeant, E. ..... Oil lamps.
8381. Lynam, P. J. ..... Range finders.
8383. James & James ..... Horseshoes.
8384. Wooldridge, H. ..... Horseshoes.
8388. Carmichael, D. C. ..... Steering cycles.
8396. Boothroyd, I. W., & ors. Velocipedes.
8404. Emsley, J. W. ..... Cycles.
8406. Herbert, C. ..... Velocipedes.
8422. Baker & Fowler ..... Valves and taps.
8424. Betjemann, S. ..... Copying presses.
8425. Leechman, G. D. ..... Velocipedes.
8426. Plom, L. ..... Blasting cartridges.
8430. Earle, E. J. V. ..... Manufacture of boots.
8431. Hartley & Rose..... Valves.
8434. Boult, A. J. ..... Manufacture of water proof linen (*Warschauer*).
8436. Winsor, G. F. ..... Manufacture of rugs.
8441. Bellis & Dadd..... Lubricator.

9th June, 1888.

8453. Brining, T. ..... Manufacture of boots.
8454. Coleberd, G. E. ..... Cultivator and pulveriser.
8462. Chippindall, J. ..... Velocipedes.
8468. Hutchinson, W. N..... Little friction with the "Jones—circuitously—travelling piston."
8470. Young, C. ..... Mortise latches.
8472. Whibley, E. ..... Guide fence to machines.
8473. Watkins, J. L. ..... Velocipedes.
8479. Gagné, R. ..... Flexible tubes for fluids under pressure.
8480. Galley, J. G. ..... Destroying refuse.
8486. Stringer, W. ..... Reciprocating sieves.
8491. Price, J. ..... Expelling liquid from sewage.
8498. Clegg, W. W. ..... Bicycles.
8501. Keen & Alleyne..... Caulking the seams of steam boilers.
8504. Smith, C. ..... Projectiles (*Margary*).

11th June, 1888.

8505. Grätz, M. ..... Extinguishers for lamps.
8507. Bell, G. ..... Malleable cast iron nails.
8512. Southon, S. J., & others Valve.
8515. Malvern, T. ..... Gulley trap.
8522. Fericka & Eggimann... Clarifying fermented liquids.
8528. Swingler & Airey..... Tube expanding plyer.
8530. Holliday, T. ..... Fabrics dyed black, composed partly of animal and partly of vegetable fibres.
8532. Thompson, W. P. ..... Gas lamps (*Herzfeld*).
8539. Baxendale, L., & ors.... Lead wire and piping.
8540. Smith, J. ..... Adjusting the length of muzzle and check straps for looms.
8543. Leechman, G. D. ..... Velocipedes.
8546. Wheatley, W. H. ..... Joints for metal vessels (*Barrath and Knecht*).
8551. Westwood & Wright... Lids or covers of gas retorts and ovens.
8558. Haggenmacher, C..... Sifting granular material.
8559. The Gas Patents Syndicate ..... Manufacture of gas (*Archer*).
8560. The Gas Patents Syndicate ..... Fuel gas burners (*Archer*).
8561. The Gas Patents Syndicate ..... Kilns for firing bricks (*Archer*).
8562. Osgerby & Lea ..... Chimney tops.
8572. Hayes, W. R. ..... Ventilation of ships.
8574. Wise, W. L. ..... Centrifugal cream separators (*Jonsson*).

12th June, 1888.

8576. Bradshaw, J. ..... Fibrous substances.
8580. Lucas & Bennett ..... Lamp burners.
8582. Doleman, T. ..... Easing the setting on of straps for mules.
8584. Farini, G. A. ..... Cartridges.
8591. Packer, W. N., & others Belt fastener.
8592. Triffitt, W. ..... Gas cocks.
8603. Burkin, B. ..... Laying fog signals on railways.
8605. Zimmerman Refrigerator Company ..... Refrigerators.
8624. Petersen, H. ..... Centrifugal separators.
8625. Michaelis, M. ..... Horseshoes.
8627. Oliphant, W. ..... Liquid purification.
8639. Gigon, A. ..... Watches and clocks.
8640. Sugg, W. T. ..... Gas regulators.
8641. The Lezant Syndicate Manufacture of manures from basic slags.
8643. Mumford & Moodie ... Separating dust.
8649. Walker, J. ..... Valve taps.
8650. Walker, J. ..... Stop cocks.

13th June, 1888.

8651. Schönheer-Schöner, T. Locks.
8658. Harris & Williams ... Coating tin plates.
8660. Lynam, P. J. ..... Range finders.
8661. Manwood & Manwood Cans for containing slivers.
8662. Jackson, J. W. ..... Vessels for measuring fluids.
8663. Johnston, J. ..... Apparatus for heating & drying.
8664. Beck & Bleckley ..... Grate bars.
8666. Lewis, A. E. ..... Cycles.
8668. Settle, M. ..... Cartridges for blasting in mines.
8689. Lyddon, C. ..... Horseshoes.
8693. Baker, C. ..... Cement.
8695. Defries & Feeny ..... Lamps.
8697. Sandeman, J. ..... Mariners' compasses.
8701. Gascoigne, A. ..... Lubricating the axles of vehicles.

14th June, 1888.

8704. Harrison, H. C. ..... Fire escape.
8708. Baxter, L. ..... Connecting links for chains.
8710. Thompson, W. P. ..... Ventilating apparatus (*Gourdan-Fromentel*).
8715. Fawcett, T. C. ..... Manufacture of briquettes.
8716. Manger & Blyton ..... Fog signalling apparatus.
8717. Snell, S. ..... Hurricane lamps.
8723. Ashwin, M. C. ..... Manufacture of bricks.
8727. Plested, W. E. ..... Sharpening chisels and plane irons.
8728. Barry, J. H. ..... Purification of sewage.
8742. Cannot, G. A. ..... Utilising peat fibre (*Béraud*).
8745. Teideman, G. ..... Liquid meters.
8748. Dambois, L. ..... Locks.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

16th June, 1888.

8099. Ingham & Simpson ..... Shedding motions of looms.
8560. Weber, C. ..... Carding cotton.
8597. Kochs, E. ..... Screening and loading coal.
8772. Fawcett, H. ..... Manufacture of carpets.
9197. Boult, A. J. ..... Cannon (*Blood*).
9591. Gwynne, J. E. A. ..... Fans for steam boilers.
9768. Hewitson, J. ..... Preventing boiler explosions.
9914. Melhuish, A. G. ..... Force pump.
10176. Hahn, E. J. ..... Gas motors.
10375. Ashworth, W. J. ..... Paper pulping engines.
10487. Brain, T. ..... Breech-loading small arms.
10595. Hicks, J. J. ..... Pressure gauges.
10754. Simpson & Porter ..... Excavators.
10888. Brighton, W. H. ..... Breech-loading small arms.
10889. Holden, G. H. ..... Mechanism for stopping spindles on the breakage of a thread.
10936. Dixon, S. ..... Drilling boiler rings.
10938. Oakes, W. J. ..... Rack pulley.
10961. Stott & Grimshaw..... Knitting machines.
10977. Urbain, G. ..... Finishing woven fabric.
11003. Crossley, F. W. ..... Regulating the supply of air or other fluid to reservoirs containing fluid under pressure, and for relieving the compressing or pumping machines of work.

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11005. Bruun, J. ..... Automatic lubricators.
11008. Smith, H. H. M. ..... Manufacture of wire rope (*Hallidie*).
11048. Kincaid & Waller..... Tramway crossings.
11062. Haddan, R. ..... Automatic feed lubricators (*Lindner*).
11066. Knap, C. C. S. ..... Steam boilers.
11073. Alexander, W..... Steering steamers.
11081. Swailes, J. B., & others. Mechanism for placing cop tubes upon spindles.
11122. Royle, G. ..... Type writers.
11210. Lake, H. H. ..... Drilling rock (*Heilbronn*).
11225. Gilmour, T..... Feed heating apparatus.
11226. Howden, J. ..... Triple expansion steam engines.
11461. Sellers, J. M..... Knitting machines.
11574. Fenby, H. P..... Rotary engine.
12442. Ormerod & Haworth.. Driving carding engines.
12556. MacLaine, A. ..... Heating feed water.
14275. Pitt, W. A..... Air compressors.
14291. Monk, J..... Picking motion for looms.
14607. Lamparter, G. H. ..... Dividing of slivers from carding machines.
16969. Bland & Cashmore..... Small arms.
17836. Johnson, J. Y..... Permanent way for railways (*Moncharmont*).
141. Brown, J. H..... Magazine fire arms.
1122. Campbell & Pomphrey Manufacture of woven gloves.
1627. Richmond, G. S. ..... Corn grinding mills.
1938. Wotherspoon, J., and others..... Testing boiler tubes from the outside by hydraulic pressure.
2930. Olsson, P. P..... Knitting machines.
3152. Haimes & Newbold..... Fabric for gloves.
3908. Essers, E..... Manufacture of double pile fabrics.
4176. Kudlicz & Ahlemeyer. Moulding and casting metal pipes
5714. Hunter & Hunter..... Cartridge loading machines.
6084. Whitney, A..... Milling twist drills.
6342. Moraweitz, G. V..... Fastening railway rails on the sleepers.
6647. Knowles, J..... Picking motions for looms.
6952. Bookwalter, J. W..... Iron and steel.
6989. Wade, J..... Looms for weaving pile fabrics.
7075. Kelly, P. ..... Drawing off rollers for combing machines.
7076. Kelly, P. ..... Actuating dabbing brushes for combing machines.
7094. Smith & Oldham..... Axle boxes for railway vehicles.
7170. Abel, C. D. ..... Furnace grates (*Langen*).
7201. Hart, F. B. ..... Operating railway signals.
7215. Burnham, W..... Moulding and welding metals.
7222. Skinner, A. L..... Power looms.

ELECTRICITY.

16th June, 1888.

8641. Edmunds, H..... Distribution of electricity.
8795. Ayrton & Perry..... Galvanometers.
11004. Smith, M. H. ..... Electrical propulsion of tram cars.
16473. Bromhead, S. S..... Electric signalling device for railways (*Street*).
1932. Royce, F. H..... Electrical contacts for switches.
4673. Justice, P. M. ..... Dynamo-electric machines (*Heisler*).
4964. Boult, A. J. ..... Transferring electric currents (*Doubrava*).

CHEMISTRY.

16th June, 1888.

9760. Walker, A. ..... Sulphates of soda and potash.
10093. Bayer, C. J..... Alumina compounds.
10127. Hood & Salamon ..... Desulphurisation of gaseous products.
10144. Hallsworth & Bailes.. Copperas and ferric sulphate.
10222. Hallsworth & Bailes.. Ferric sulphate.
10818. Hanson, J. ..... Manufacture of sulphuric acid.
10821. Brock & Mayer ..... Manufacture of gunpowder.
7177. Thompson, W. P..... Antiseptic compounds (*Belcher*).

MISCELLANEOUS.

16th June, 1888.

8540. Wright, F. ..... Soldering.
9336. Brough, R. ..... Valves.
9565. Beck, W. H. ..... Ascertaining the internal condition of pipes and conduits (*Kaiser*).
9703. Cave, J., & others ..... Manufacture of boots.
9759. Preston, W..... Water tap.
10318. Humphris, J. E. ..... Driving bands.
10552. Johnson, H..... Jumpers for making bore holes.
10803. Blakeney, W. H..... Pneumatic carrying apparatus.
10858. Gill, J..... Manufacture of pottery.
10954. Boult, A. J..... Producing currents of air (*Bisson*).
10957. Mond, L. ..... Apparatus for treating solids by gases.
11065. Jackson, I. ..... Fastener for driving belts.
11082. Entwistle&Farnworth Strap fastener.
11195. Imray, O. ..... Incandescent bodies for illuminating purposes (*Von Welsbach*).
11298. Pintsch, J..... Gas burners.
11323. Sutcliffe, W..... Manufacture of boots.
11509. Warrington and Howlett..... Bricks.
1556. McCann, J..... Blocks and tuyeres for blast furnaces.
12098. Shepherd, J..... Axles and naves for wheels.
12270. Fielden, S. ..... Picker for looms.
12967. Simpson, W. M..... Lubricant for machinery (*Simpson, Roberts, & Co.*).

15884. Ashworth, J. ..... Miners' safety lamps.
841. Lind, J..... Lanterns.
1302. Campbell, S. ..... Fire escape.
2366. Snelus, G. J., & others. Cement.
6746. Lighbody, W. ..... Oil lamps.
6872. Thompson, W. P..... Preservative coating on iron and steel surfaces (*Wells*).
6875. Favier, A..... Cartridges and detonators.
7020. Alber, W..... Oil cement.
7028. Bingham & Bingham.... Horseshoes.
7072. Nobiling, M. ..... Tricycles.
7156. Bruzon, R. ..... Wire fencing.
7167. Sargent, T. R..... Apparatus for tilting casks.
7207. Brown, G. W. ..... Lubricators.
7213. Oliver, P. A. ..... Gunpowder mills.
7232. Earnest, J. T., & others Heating and ventilating railway carriages.
7234. Las, R. le..... Washing and sorting coal.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 9th March, 1888, inclusive).

Year 1884.

4243, 4244, 4249, 4251, 4261, 4266, 4268, 4269, 4270, 4276, 4279, 4280, 4283, 4285, 4286, 4291, 4293, 4294, 4295, 4296, 4300, 4301, 4303, 4304, 4305, 4311, 4315, 4317, 4321, 4322, 4323, 4326, 4328, 4332, 4333, 4334, 4335, 4339, 4342, 4346, 4350, 4351, 4352, 4358, 4360, 4362, 4364, 4372, 4381, 4382, 4387, 4389, 4391, 4394, 4395, 4396, 4397, 4401, 4407, 4412, 4414, 4417, 4419, 4420, 4421, 4422, 4423, 4426, 4427, 4429, 4430, 4431, 4434, 4436, 4440, 4444, 4447, 4449, 4452, 4454, 4457, 4459, 4462, 4463, 4465, 4466, 4467, 4469, 4470, 4471, 4472, 4473, 4476, 4477, 4479, 4483, 4486, 4487, 4493, 4502, 4508, 4509, 4511, 4513, 4518, 4521, 4522, 4523, 4525, 4526, 4527, 4528, 4529, 4531, 4533, 4536, 4537, 4538, 4542, 4544, 4546, 4547, 4548, 4550, 4552, 4553, 4554, 4559, 4561, 4562, 4568, 4570, 4572, 4575, 4577, 4578, 4579, 4581, 4582, 4583, 4586, 4591, 4592, 4594, 4600, 4609, 4611, 6597, 7186.

Year 1883.

1152, 1155, 1169, 1172, 1223, 1257, 1271.

Year 1882.

1026, 1062.

Year 1881.

915, 968, 977, 1001, 1014.

Year 1880.

1001, 1017.

Year 1879.

842, 906, 918.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Rotary Engine.—*J. Selwig, Braunschweig, Germany.*—The two accompanying figures represent two sections taken at right angles to each other. The engine consists of three main parts—the crown wheel A, the pinion wheel B, and the casing C. The teeth D of the wheel A are cast in one piece with the cylindrical disc S, which is attached to the driving shaft O. The wheel B turns on the axis P, which forms part of the outer

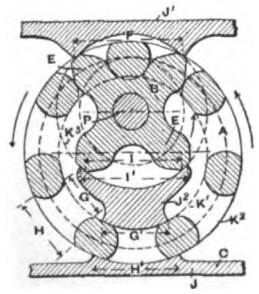


Fig 1.

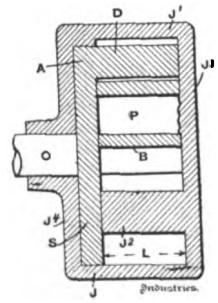


Fig. 2.

casing. The part J^2 of the casing forms a prismatic projection penetrating from the front side part J^3 to the inside of the wheel A. When a liquid under pressure is present at the left hand side of Fig. 1, the wheel B is caused to turn in the direction of the arrow, carrying with it the wheel A; motion is thus transmitted to the shaft O. The engine can be used for either liquids or gases, and as a pump or blower. Six claims are made for this engine, and for an adaptation.—No. 3801. March 12th, 1888. 8*d.*

Combing Machines.—*I. Holden, Keighley, Yorkshire.*—The drawing-off rollers which are employed for drawing the fibres from the travelling combs have hitherto been pressed together at their ends by means of springs. It has been found that this end pressure tends to arch the rollers, so that their grip is impaired at the centre. The present inventor supplements the use of the two ordinary drawing-off rollers by the employment of additional rollers for the purpose of supporting the rigidity of the other rollers. In applying this method to a square motion comb circle, the two additional fluted rollers have each an endless leather apron working round it; one of them works below and against the lower drawing-off roller, and the other over and against the upper drawing-off roller. The under additional roller may run in either fixed or adjustable spring bearings, and the upper one is adjustably borne by spring pressure to its drawing-off roller. One claim is made for the employment of these additional rollers for the purpose described.—No. 9989. July 16th, 1887. 11*d.*

Gas Engines.—*C. G. Beechy, Liverpool.*—This invention relates to certain improvements in the gas engine which was described in Patent No. 3199 of 1885, granted to the same patentee. One of the improvements consists in arranging the compression and working cylinders in such a manner that the piston of the compression cylinder shall complete its stroke before the piston of the working cylinder has completed its instroke. Plenty of time is thus allowed for the discharge of the gases before the communication between the two cylinders is closed. This is effected, as shown in Fig. 1, by inclining the compression

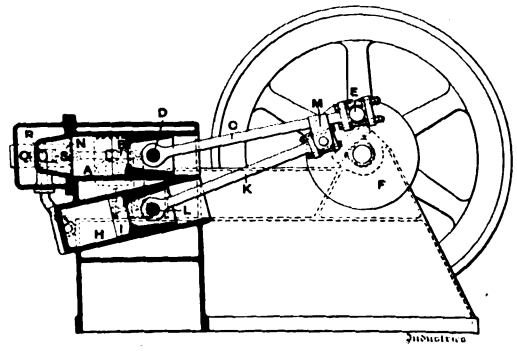


Fig. 1.

cylinder H at an angle with the working cylinder A. The connecting rod is coupled by the piece M to the rod C. Another part of the improvement consists in the employment of a single slide valve N, which serves the triple purpose of a valve for the admission of the air and gas to the compression cylinder, of a valve for the passage of the air and gas from the compression cylinder to the power cylinder, and as a communication for firing the charge. The port P effects the communication alternately between the air and gas supply pipe Q and the port R leading to the compression cylinder H, and between the port R and the port S of the power cylinder A. The firing hole is shown at T, and the igniting tube at U. The exhaust port V is situated at the side of the cylinder A, and near the middle of its length, and the exhaust valve W is operated through the intermediate lever X by the same eccentric that works the slide valve N. In the outward stroke of the two pistons, the compression piston I draws a charge of air and gas into the cylinder H through the port P, the slide valve being then in the position

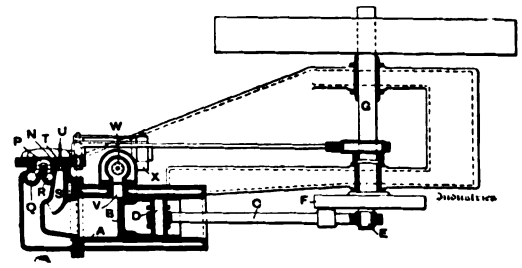


Fig. 2.

shown in the figures. In the return stroke this charge is forced through the port P into the charge chamber of A, the port P being then in communication with the ports R and S. During this time the exhaust port V is open until the piston B passes over it; after which the compression of the charge takes place in the charge chamber, and the charge is fired. Owing to the angle between the two cylinders, the piston I has a slight lead, and completes its instroke before B; the combustible charge is therefore forced into the power cylinder before the piston completes its instroke. As it is not required to fire the charge before the power piston has completed its instroke, there is time for the slide valve to close the communication between the two cylinders before the firing hole T comes into communication between the port S and the igniting tube U; a lap of $\frac{3}{32}$in. is obtained, and any liability of the fire passing into the port P is prevented. Three claims are made for the inclination of the two cylinders to each other, and for the slide valve arrangement as described.—No. 8818. June 18th, 1887. 8*d.*

Steam Boilers.—*W. Ambler & W. O. Blackburn, Bradford.*—The object of this invention is to promote a greater circulation of the water in the boiler and to increase its heating surface. The main flue is constructed in sections of a corrugated form, which are united by sections of a plain cylindrical form. An auxiliary boiler tube is placed within this flue rather nearer to the top than the bottom; it is made up of sections in a similar manner to the flue, and is connected by short tubes to the boiler above and below the main flue. By this arrangement the flames which pass along the top of the flue are forced downwards and encircle the auxiliary tube, and their heat is therefore more fully utilised. One claim is made for the formation of the tube and flue, and for the disposition of the one inside the other.—No. 8172. June 7th, 1887. 8*d.*

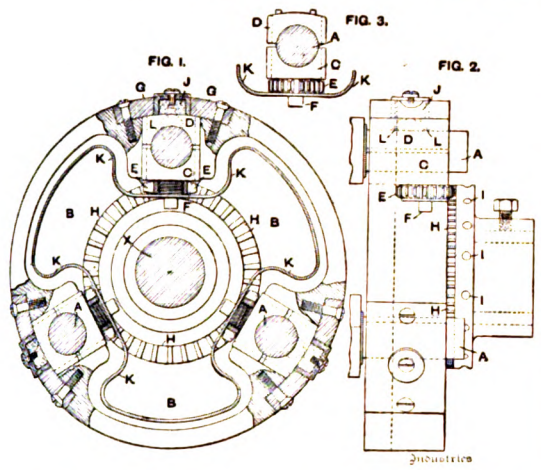
Spherical Engines.—*R. H. Heenan, Manchester.*—Improvements are here introduced into the construction of the spherical engines described in T. Bower's Patent No. 3953 of 1879, and Heenan & Froude's Patent No. 13102 of 1884. In these engines there is a librating and revolving piston, which forms the middle member of a universal joint connecting two inclined shafts, which have semi-circular blades jointed to the piston at right angles to each other. According to the present invention, the jointings of the blades to the piston are arranged at points nearer to the centre of the piston than formerly; the piston is thus permitted to have an uninterrupted periphery, which is fitted with a spring packing ring. The joints of the blades and the piston are provided with bushes and packings, and oil holes are drilled obliquely through the blades and their bosses to a central oil passage in the shafts. Three claims are made.—No. 16420. November 29th, 1887. 8*d.*

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FRICTION CLUTCH.—*O. Reynolds, Manchester.*—In the improved form of clutch, one friction disc is mounted on a feather key on the shaft to which power is to be transmitted, and a second friction disc is loose on the shaft. The first disc is controlled by a clutch lever, and one end of a spiral spring or flexible band of metal is secured to the boss of the second disc. The flexible band of metal is coiled round a sleeve fixed on the shaft, and its other end is secured to the boss of a bevel wheel which is mounted loosely on the shaft, and which receives motion from a bevel wheel on another shaft. When the first disc is moved into contact with the second disc driven by the spiral spring from the bevel wheel, the resistance caused by the frictional contact between the two discs binds the spiral spring to the surface of the sleeve, and so rotates the shaft. When the first disc is moved out of contact with the second disc, the coil unbinds itself from the sleeve and so releases the shaft. Three claims are made.—No. 9603. July 7th, 1887. 8*d.*

MACHINE FOR MAKING DIES.—*H. H. Lake, London.* (*G. McKay, Boston, U.S.A.*)—This machine is designed for the purpose of automatically grinding and grooving the bevelled faces of the dies which are used in the manufacture of cut nails. The machine consists of a grinding wheel and a scoring wheel, which are composed of emery and attached to the same rotating spindle. The cup wheel, which is used in grinding the bevelled ends of the dies, acts on the dies while they are held in a groove in a suitable carriage; the bottom of the groove is inclined in the right way so as to give the end of the die the desired bevel, and the carriage is automatically reciprocated by special mechanism. The scoring wheel at the opposite end of the shaft is more or less rounded at its acting edge, according to the groove which is to be cut in the die. In order to keep the edge of the scoring wheel in its established curve, the machine is provided with a wheel-shaping tool, composed of a diamond confined in a holder, which is mounted upon an adjustable pivoted arm. This arm is made adjustable in a direction perpendicular to the axis of the wheel to be ground, and also in the arc of a circle at right angle to the axis of the scoring wheel. The holder for the diamond is longitudinally adjustable in the arm. Ten claims are made for the various details of this machine.—No. 5325. April 10th, 1888. 8*d.*

NAP RAISING MACHINES.—*J. Y. Johnson, London.* (*G. M. Bauche and H. A. Bauche, Paris.*)—Figs. 1 and 2 show a front and side view of a set of three workers or nap raisers, and Fig. 3 is a detached view of the bearings of a worker. The axis A of each of the workers is mounted in bearings C D; C is capable of sliding in guides in the carrier B. According to the degree of pressure of the spring K on the movable portion C, the freedom of the shaft A to rotate will be regulated; and as the rotation of the shaft is effected by the contact of the workers with the



material, the action of the workers on the material will be varied by the degree of elasticity of the spring. To regulate its elasticity the movable part D is provided with a stem F, upon which is screwed the pinion E gearing with the wheel H. By rotating the wheel H the pinion E will be screwed up or down, and the spring will press the movable part D against the axles A with greater or less power. Each of the parts C of the bearing is held in position by a covering plate G, which is screwed upon the rim of the carrier B, and in this plate there is a chamber J for the reception of lubricating matter. Five claims are made for mounting the workers in flexible or yielding bearings, so arranged as to be capable of being adjusted to vary the pressure of the workers on the material operated on.—No. 4102. March 16th, 1888. 8*d.*

STEAM ENGINES.—*C. H. Benton, London.*—This improvement is intended to obviate the wear and tear of the reciprocating parts and their connections, consequent upon the strains in these parts when the crank passes the dead points. Two systems of reciprocating parts are attached to the same crank, one system communicating the impulse of the steam in one direction, and the other in the contrary direction. The systems work together as a single double-acting piston as far as the distribution of the steam is concerned; but they have a slight relative movement, and consequently, as far as the strains are concerned, they form a double system. The piston head is made in two parts; to one of these parts is attached a hollow piston rod, which is connected to two crank pins by two connecting rods on each side of the hollow rod; to the other part of the piston is attached a piston rod which is capable of a slight longitudinal movement through the hollow rod. A connecting rod communicates motion from the inner piston rod to a crank placed between the two other cranks on the driving shaft. Each part of the double piston is exposed to the pressure of steam in one direction only, and the strains caused by this pressure are always in the same direction, and not alternately reversed, as is usual in ordinary engines. In order to keep the strains in the same direction at the end of the stroke the inventor employs auxiliary cylinders, whose pistons are attached to the two sets of reciprocating parts. These pistons compress some of the steam upon their return stroke, and thus counterbalance the energy of motion of the moving parts. To facilitate the starting of the engine, a stop cock is placed in the auxiliary cylinders, so as to allow the compressed fluid to escape during the first few strokes, or, if permanent pressure is used, a valve is arranged for the purpose of removing the pressure during the first few strokes. Five claims are made for these double systems of reciprocating parts as described.—No. 7729. May 27th, 1887. 8*d.*

LATHES.—*J. Barrow, Johnstone, Renfrew.*—By this invention an improvement is introduced into the construction of lathes which are used for turning long shafts. Hitherto a sliding stay has been employed which is separate from the ordinary slide rests carrying the cutting tools, or the slide rests have had to be removed from the saddle of the lathe and a special construction of apparatus substituted, in which the slide rests and stay are more or less self contained. The present invention enables the ordinary rests of a duplex lathe to be retained and utilised for the purpose of sliding with a self contained stay; a holding piece formed to contain the stay is attached to the front or back rest, and to the other rest a similar holding piece is attached, which carries another slide rest and turning tool within itself. Whatever may be the diameter of the stay it can be firmly fixed between the back and front rests by using the screws which actuate the bottom rests upon the saddle, until the stay is rigid and concentric with the shaft to be turned; the ordinary back and front rests as well as the finishing rest are close to the work, and the tools are capable of adjustment without disturbing the rigidity of any of the parts. One claim is made.—No. 9344. July 1st, 1887. 11*d.*

GAS ENGINES.—*H. Lea, Birmingham.*—Two improvements are here introduced for facilitating the starting of the engine. The first improvement is intended to do away with the necessity of the fly wheel being rotated by hand. For this purpose a hollow circular casing is fitted loosely upon the projecting end of the crank shaft, and within it is a ratchet wheel, which is keyed securely on the shaft; the hollow casing also contains one or more spring pawls engaging with the teeth of the ratchet, and a series of holes, preferably four, are formed in the rim of the casing, into any one of which a handspike can be inserted. When it is required to start the engine, the gas is first turned on and the slide light ignited in the usual way, and the lever, having been placed in one of the holes in the rim of the casing, is worked up and down like a pump handle, and the crank thus turned. When the engine has attained some speed, the crank shaft cannot turn the lever, as the connection between them is only the ratchet and pawl mechanism. Two other modifications are described in the specification for effecting the same object. The second part of this invention relates to the movement of the exhaust cam from the non-compression position at starting to the compression position after the engine has attained a certain speed. To obviate the necessity of completing this operation by hand, the inventor attaches a bent arm to the upper end of the exhaust valve lever. To the inner face of the bent arm is pivoted a short lever pointing upwards, which can be moved to and fro through a small arc by means of a knob upon its upper end. From the inner face of the movable lever project two pins, at such a distance apart as to embrace the exhaust roller, and the motion of the lever is limited by two stops fixed to the bent arm. When the lever is moved to and fro by hand, which can be safely done while the engine is working at full speed, the roller is moved to and fro upon its stud in a direction parallel to the axis of the stud, and can thus be immediately placed in either of the required positions. The knob is sufficiently heavy to maintain the lever in either position, so that the usual pin can be dispensed with. Two claims are made.—No. 13436. October 4th, 1887. 8*d.*

ELECTRICITY.

VOLTMETERS.—*W. E. Ayrton & J. Perry, London.*—One or more short straight fine parallel wires of conducting or semi-conducting material are fastened at both ends to supports which are fixed inside a short horizontal tube. The wires are attached at their middles by means of a stirrup and fine wire to one end of a magnifying spring, as described in Patent No. 2156 of 1883. The other end of the spring is fixed so that its axis is at right angles to that of the wires. On passing a current through the wires they stretch slightly on account of the heat generated, and a pointer attached to the end of the magnifying spring is rotated. The instrument may be also adapted for use as an ammeter by attaching a shunt to the wires; the shunt consists of a metallic rod or strip which is longer than the wires, and so does not heat. Three claims are made.—No. 7802. May 28th, 1887. 8*d.*

REGISTERING WATT-METER.—*H. H. Leigh, London.* (*J. L. Clerc, Paris.*)—The indications of an ammeter or watt-meter are transmitted intermittently to a quadrant or cam through the agency of a coil which is excited by a special circuit by means of a clock. When an ammeter is used, a current is passed through a coil whose iron core depends from a cord passing round a pulley; on the axis of the pulley is mounted a triangular plate or equivalent cam, the outer edge of which is provided with a scale. The core of a second coil is suspended over the rim of another pulley, and is balanced by a counterpoise; a ratchet wheel slides over a prolongation of the axis of this pulley, and a pawl on the pulley engages with the teeth of the ratchet. When the current flows through the second coil its core is lifted; when the counterpoise drops, and comes in contact with the outer edge of the triangular plate above mentioned; the pulley over which the cord passes is rotated, and the pawl slips over the teeth of the ratchet wheel. The second coil is wound with fine wire, and is excited by a special circuit controlled by a rheostat which is actuated by a clock. This clock at periodic intervals will move the arm of the rheostat, and will transmit through the coil a current at first gradually increasing, and afterwards decreasing by means of the resistance of the rheostat. When the current decreases, the iron core of the second magnet slowly drops, and by means of the pawl and ratchet its motion is communicated to a train of wheels. Instead of employing an ammeter, the inventor sometimes makes use of a watt-meter. The instrument is arranged vertically, and the fine wire coil is placed within the other coil, which is wound with thick wire. A spiral spring counterbalances the reciprocal action of these two coils, and a pair of leads conduct the current into and out of the coils. The fine wound coil is suspended, and carries a vertical rod which supports a horizontal rod, and one end of the horizontal rod is furnished with a balanced pawl. The vertical rod also carries at its lower extremity a horizontal rod, to which are fixed two arc-shaped cores each at the same distance from the rod. These cores are actuated by fine wound coils whose cavities are shaped to correspond to the cores. The coils are excited in the same manner as the second coils were before. As the current gradually increases and decreases in proportion to the motion of the arm of the rheostat, the pair of arc-shaped cores slowly move the fine wound coil of the watt-meter, which is first let down to zero and afterwards slowly regains its equilibrium. The balanced pawl engages with a gear wheel, over which it slides when the watt-meter leaves zero, and by means of the arc-shaped cores rotates the wheel when the watt-meter returns to zero. Two claims are made for these two arrangements.—No. 3303. March 3rd, 1888. 8*d.*

MAGNETO-ELECTRIC MACHINES.—*W. Gillett & G. Haseltine, New York.*—The magneto-electric machine here described is intended for generating currents for ringing bells and other similar purposes. Fig. 1 shows a plan and Fig. 2 a vertical central section of the machine. A is a frame which forms an

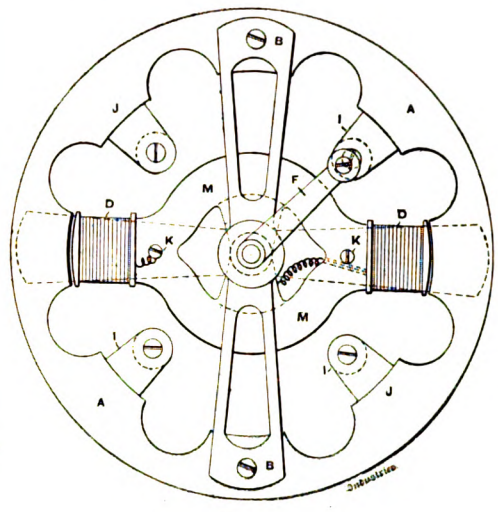


FIG. 1.

armature, and B are cross bars which are attached by means of screws to the frame; the lugs I secure the generator to its base. The magnet C carries coils D of insulated wire, which are fastened together by the screws K. The trunnions E from the centre to the outside magnet pass through the cross bars B, and the handle F attached to the outer trunnion serves to revolve the magnet C and coils D. One end of the wire G passes from

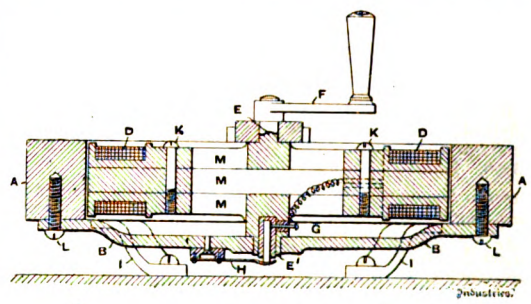


FIG. 2.

the coils D through the main trunnion, and makes connection with the spring H, which is insulated from and attached to the cross bar B. The handle F is turned to operate the generator; the permanent magnets C and the coils D are revolved, passing the segmental portions J of the frame A. As the coils approach these projecting portions the magnetism is diminished, and as they recede the magnetism is augmented, and a current is thus produced in the coils. Three claims are made for the projections J of the armature and for the combination of the parts B C D G and H.—No. 4929. April 3rd, 1888. 6*d.*

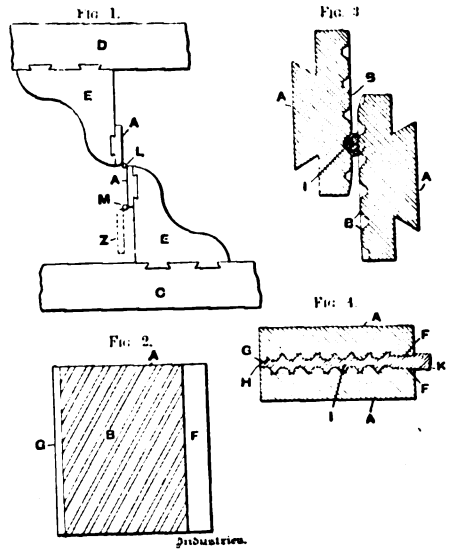
DYNAMOS.—*E. Jones, Leeds.*—The present invention relates to a method of forming the brushes and holders, with the object of insuring a steady pressure between the brushes and commutator, and of preventing the wear of the commutator incident on the friction of the brushes. The brush is formed of a bundle of fine copper wires; this bundle is first dipped in a suitable lubricant, and is then inserted in a metal tube of thin brass, and soldered to one end of it. The tube and its contents are submitted to pressure in a mould, by which means the tube is flattened out, and a number of serrations are formed on its under side in order to receive the edge of a clip. The brush holder consists of a two-armed bracket, which has a slot in each arm for the purpose of receiving the brush. A spring which is secured to the bracket carries the clip before mentioned. By means of this spring connection the brush is kept in contact with the commutator at a regular pressure. The bearing end of the brush is bevelled off to accommodate itself to the commutator, and as the brush end becomes warm the lubricant is gradually drawn down to the point of contact. The inventor makes two claims for the brushes and holders respectively.—No. 9011. June 24th, 1887. 8*d.*

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MISCELLANEOUS.

ARTIFICIAL FUEL.—*J. Swallow & N. Proctor, Leeds.*—In order to manufacture one ton of the fuel, the inventors take 5lb. of sugar, 5lb. of flour, 5lb. of resin, 40lb. of pitch, and 1lb. of common salt, and mix these ingredients with the requisite weight of coal dust or the like to make up the ton. The whole is mixed together and moistened with water. The mass, being then in a plastic state, is passed through an ordinary brick machine, from whence it issues in compact blocks. Instead of mixing water with the combination of materials, the mass may be heated, and the resin and the pitch then form the cohesive medium. One claim is made for the constitution of this artificial fuel.—No. 5689. April 17th, 1888. 4*d.*

DIES FOR MANUFACTURING TWIST DRILLS.—*A. Laundry, Coté St. Paul, Montreal, and H. H. Warren, Massena, New York.*—This invention relates to the construction and arrangement of dies which are employed in the manufacture of twist drills. The dies are made with diagonal ribs, and are set face to face, so that when one is moved parallel to the other, a round bar rolled between has the required helical twisted form imparted to it. Fig. 1 represents the dies arranged in connection with an ordinary power press; Fig. 2 is a front elevation on an enlarged scale of one of the dies; and Figs. 3 and 4 are sections of the pair of dies. A A are the two dies, each made with diagonal parallel ridges B of an approximately semi-cylindrical shape. One die



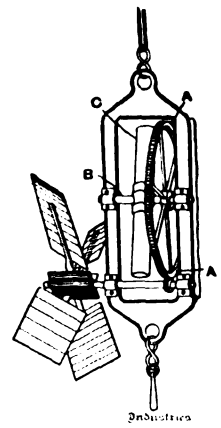
moves over the other in the vertical direction in Fig. 2. F and G are marginal surfaces without ridges, and they are made slightly inclined, in order to give the neck and the point of the twist drill a conical form. As shown in the figures, the faces of the dies are for the greater part of the depth parallel to one another; but the lower part of the one and the upper part of the other slope gently back, so that the bar to be acted on can be freely entered as at L in Fig. 1, and taken out from between the dies at M. The brackets E are attached to the bed C and follower D of the press. The inventors claim, in the manufacture of twist drills, the use of a pair of dies, each having diagonal parallel ridges arranged face to face, so as to roll between them a round bar and to impress it with a helical twist, as described.—No. 3096. February 29th, 1888. 6*d.*

DRIVING SPINDLES.—*L. Binns, Philadelphia.*—A single band is here employed for driving a pair of spindles on the opposite side of a spinning and twisting frame. The drum is placed between the two rows of spindles at right angles to them. The band passes from the whirl of one of the spindles across and over the drum to the whirl of the opposite spindle; having passed round this whirl, the band goes round the drum and back to the whirl of the last named spindle, round it, and across and under the drum to the whirl of the first named spindle; it then goes round this whirl, and round the drum, and back to the point from which it started. By this arrangement a firmer hold is obtained on the spindles with an increased length of band; the total length of band, however, is much less than is ordinarily used when the two spindles are driven by separate bands. Two claims are made.—No. 5335. April 10th, 1888. 6*d.*

LIME AND CEMENT KILNS.—*N. R. Foster, Uxbridge, Middlesex.*—The burning and drying chambers are so constructed that the heated gases in passing from the kiln to the chimney shall be made to pass alternately over the surface and underneath the slurry in the drying chamber, and thereby to utilise to the greatest extent possible the heat of the gases from the burning chamber. The kiln pans are oblong in form, with rounded angles; their internal sides diverge upwards, and are completed by an arched crown. The usual low arched wickets and high fire bars are dispensed with, much higher wickets are employed, and the fire bars are placed at a short distance from the floor. By this arrangement the kilns can be loaded and discharged more readily, and the draught is increased. The drying chambers are attached to the kilns in pairs, each pair being divided by means of an inner wall, in which are a number of arched openings. The drying chambers are closed by arches, whose upper sides form the drying floor for a chamber above. The floor of the lowest chamber is flat, and is composed of tiles which are built so as to allow the current of heated gases to enter underneath them. By this arrangement the furnace gases can approach the slurry alternately over and under it; and as the drying chambers are arranged in pairs, their floors are less arched, and the layer of slurry is consequently of more uniform depth. Four claims are made for this construction of kilns and drying chambers.—No. 7708. May 27th, 1887. 11*d.*

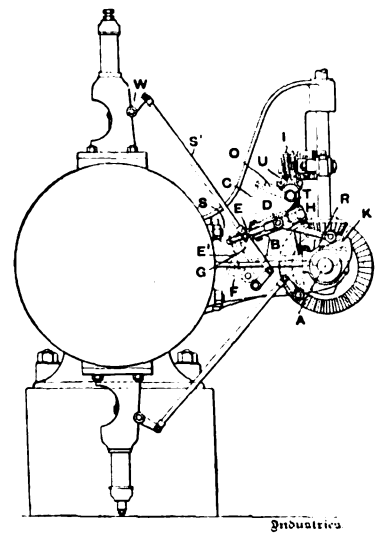
GERMAN PATENT ABSTRACTS.

WATER METER.—*K. T. Boeckler, Munich.*—Vanes are attached to a spindle provided with a cog wheel which gears with the wheel A, to the spindle B of which is secured a tube C. C contains a ball which comes in contact with the ends of C when



A is revolved, thereby imparting a jerking motion to the cord on which the apparatus is suspended. The water flowing through a vessel actuates the vanes which revolve A. The jerking motion in the cord actuates a counting apparatus, which thus records the revolutions of A.—No. 42800. August 21st, 1887.

VALVE GEAR.—*K. Seiffert, Leipsic.*—In this valve gear the admission valve is actuated by a cam K keyed to the shaft A, which rotates in the direction of the arrow. The cam K actuates the bent lever H, which is fitted with a roller R, and H oscillates round the pivot D. This oscillating motion is transmitted by means of the connection G to the rod S, which actuates the valve by means of the bent lever W. In order to obtain a



variable admission the pivot D of the lever H is secured to a slide T, which slides in the guide B. The slide T is influenced by the governor, which actuates a rack into which the pinion gears. To the shaft of this pinion is keyed the worm I which gears with the worm wheel segment U. The motion of U is communicated by the levers C O F E' to the slide T. The alteration in the position of T also causes the points D and E to change their position. If D moves towards E the roller R gets nearer to the shaft A, and engages for a longer time with the cam K, thereby increasing the period of admission. A movement of D in the opposite direction has the opposite result.—No. 43016. August 20th, 1887.

UNITED STATES PATENT ABSTRACTS.

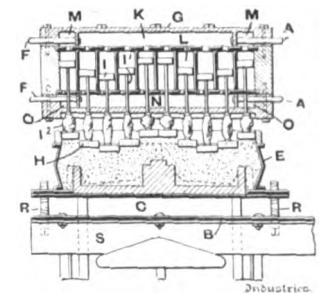
A NEW WARP FOR PATTERN MAKING.—*C. H. Landenberger, Philadelphia.*—Short warps for pattern weaving are formed in a broad loom by interweaving the weft threads carried by the shuttles with warps placed in groups on opposite sides of the loom; these warps are adapted to serve as head bands, and other warps are woven at intermediate intervals to serve as lease threads. The weft threads thus interwoven with the head bands constitute short warp. When one such warp or section has thus been produced, it is wound upon a warp beam, and the ends of its threads are joined to those of the threads of other sections formed in a similar manner of either the same or different designs. Three claims are made.—No. 383182, dated 22nd May, 1888.

COTTON GIN.—*D. B. Haselton, Charleston, North Carolina.*—The gin has two hoppers, between which revolves a cylinder, and inside the cylinder is a series of frames provided with teeth. The teeth are protruded while they are in the interior of the cylinder, then are gradually withdrawn while passing the seed bars, and finally withdrawn fully in order to drop the cotton. The pivoted frames are connected by rods, which at each end extend into cam grooves in plates at the ends of the gin; the cams effect the change of position of the teeth in the manner desired. Five claims are made.—No. 383223, dated 22nd May, 1888.

NUT LOCK.—*L. J. Benton, Alpine, New York.*—This arrangement for locking nuts is intended to be used in combination with two similar bolts and nuts. A spring bar has its ends coiled round on different sides of itself, and these coils are placed round the threads of the screws, the bar extending diagonally between the two bolts. The upper sides of the loops are serrated, and they gear with similarly serrated washers placed underneath the nuts. There is also a projection from the washers which lock with the nuts. After the nuts have been screwed round and fixed, the serrations in the loops and washers effectually prevent any slipping. Two claims are made.—No. 382789, dated 15th May, 1888.

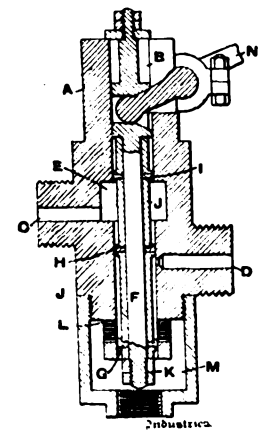
PAVING BLOCKS.—*W. Bignall, Nebraska City, Nebraska.*—The bricks used by the inventor for paving roads are provided with a vertical rib on two adjacent sides. The ribs are near the middle of their respective sides. By this arrangement the bricks may be placed in position on the roadway without any trouble at the right distance from each other, and a continuous space will be left round their corners, so providing a suitable space for filling up with concrete. Two claims are made.—No. 382683, dated 15th May, 1888.

SAND MOULDING MACHINE.—*J. R. Davies, Pullman, Illinois.*—The accompanying figure shows a section of the improved part of the machine. The box G is capable of a horizontal sliding motion, and is also made vertically adjustable for the purpose of removing it from the flask E. The interior of the box G is



divided into a series of non-intercommunicating chambers M K N O. Intermediate between these chambers are the cylinders L, and the pistons I which work in them carry the tamping rammers I^1. The water which supplies the hydraulic pressure to the pistons enters the chambers through the pipes A, and leaves through the pipes F. When the sand has been placed over the object to be moulded the tamping heads are pressed down by the water in the cylinders L. By this arrangement of separate tamping heads and cylinders the pressure is distributed more uniformly through the sand, and the mould is thus made firmer. Ten claims are made.—No. 382217, dated 1st May, 1888.

HYDRAULIC VALVE.—*M. B. Kirker, McKee's Rocks, Pennsylvania.*—The accompanying figure shows a section of the valve which is intended for regulating the pressure and supply of water to a hydraulic engine. The valve casing contains a cylindrical chamber E, into which the water enters by the port C. The

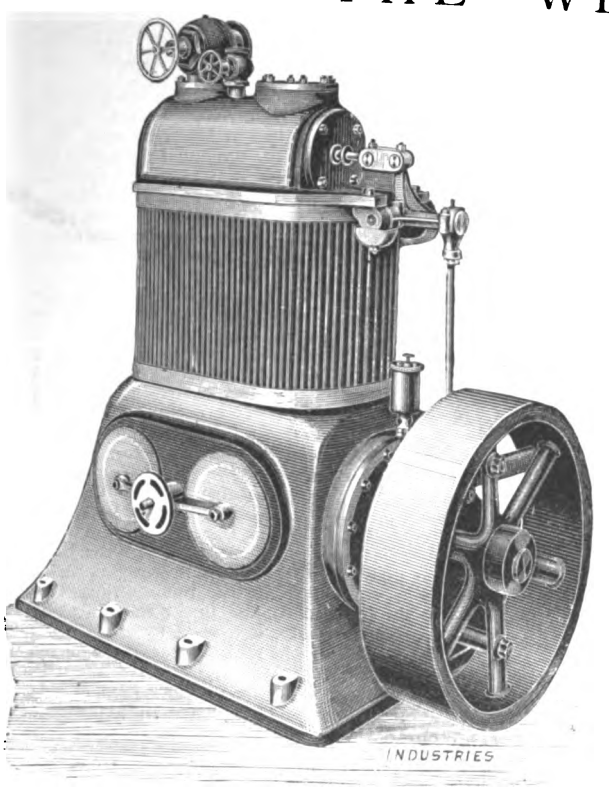


water proceeds to the machine through the port D. A valve stem F passes through the chamber and through the cylindrical bore between the chamber E and port D, and is actuated in a vertical direction by a suitable mechanism at its head; two packing discs H I are fitted to the stem, the concavity being on that side of the disc which is foremost during the motion of the valve over the port when the disc is under pressure. Three claims are made for this arrangement of valve stem, ports, and packing discs.—No. 382003, dated 1st May, 1888.

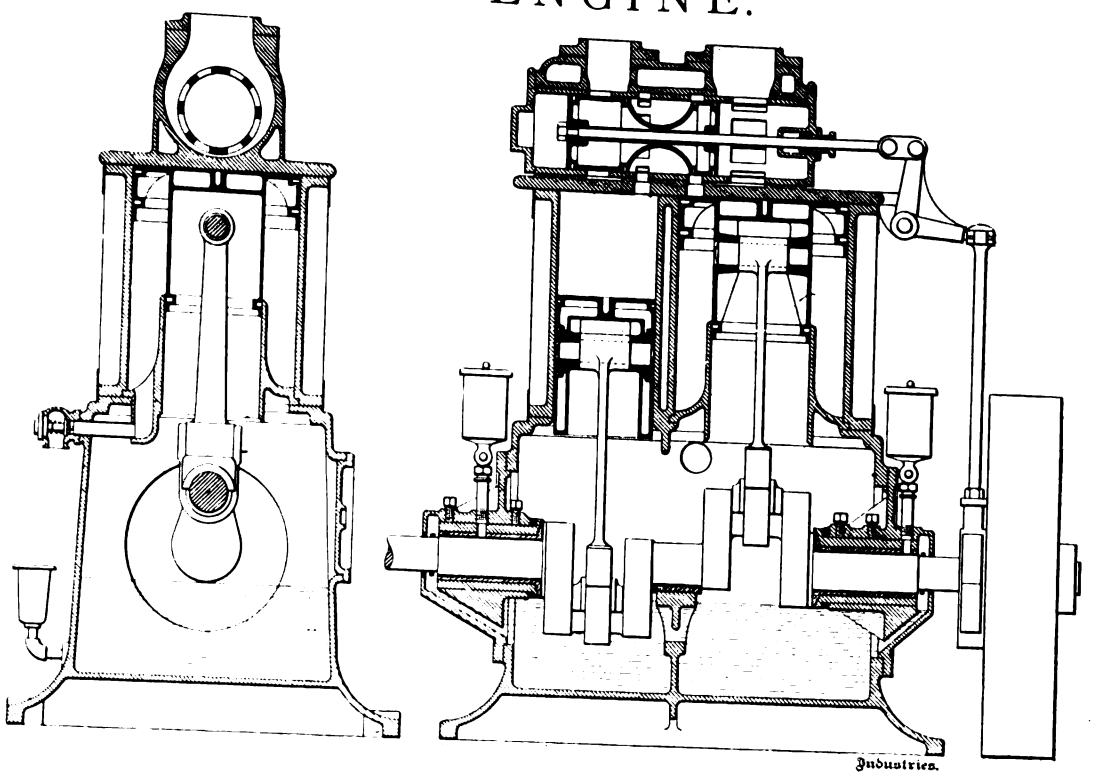
The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of INDUSTRIES, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE WESTINGHOUSE ENGINE.



General View.



Sectional Elevations.

THE WESTINGHOUSE ENGINE.

The requirements of electric lighting have stimulated engine builders to produce high speed steam engines which should not only be free from the mechanical defects which appertained to the so-called rotary high speed engines of ten years ago, but should equal, and if possible excel, the ordinary steam engine in point of economy. Thus new types of high speed engines have been developed, amongst which the best known are the engines of Tower, Rigg, Parsons, Willans, and Chandler. In the matter of economy, the Willans engine is probably ahead of its competitors in England; but it is run very hard by the new Westinghouse engine, which is now largely used in central electric light stations in America. As will be seen from the above illustrations, the engine is exceedingly simple in construction. Steam is admitted to both cylinders by a single piston slide valve worked from an eccentric by means of a bell crank lever. The valve is placed on the top of the cylinders, in order to reduce the length of steam passages to a minimum. The admission is controlled by a centrifugal governor within the fly wheel, acting upon the eccentric sheave. To prevent the low pressure piston from overtaking the crank on the upward stroke, and thus causing knocking, an ingenious contrivance has been adopted. As will be seen from our illustrations, the low pressure piston is provided with a central trunk, the annular space between piston and trunk being in communication with the external atmosphere by means of a valve which opens outwards. On the low pressure piston descending, the air in the annular space is compressed until its pressure has risen sufficiently to force open the valve. When the piston ascends, the valve closes and the air in the annular space expands, producing a partial vacuum, and thus keeping a downward pressure on the connecting rod.

Water Rates per Brake Horse Power at Varying Pressures and Loads.

Condensing.

Brake horse power.	Boiler pressure in lbs. per square inch.							
	120		100		80		60	
200	19·62	.....	22·53	.....	—	.....	—	
160	18·86	.....	20·02	.....	23·17	.....	—	
130	18·38	.....	19·56	.....	21·32	.....	24·3	
100	19·14	.....	19·44	.....	20·34	.....	23·1	
70	19·8	.....	20·05	.....	21·43	.....	22·57	
40	22·9	.....	23·12	.....	24·75	.....	25·25	

Non-Condensing.

200	23·94	.....	—	.....	—	.....	—	
160	23·5	.....	25·2	.....	—	.....	—	
130	24·32	.....	26·24	.....	27·7	.....	—	
100	25·57	.....	27·75	.....	29·8	.....	—	
90	26·51	.....	28·3	.....	29·8	.....	31·7	
70	29·4	.....	30·77	.....	32·48	.....	36·0	
40	40·05	.....	39·3	.....	42·75	.....	45·82	

It will be seen that Mr. Westinghouse produces by means of a partial vacuum the same result as is produced in the Willans engine by means of the air buffer. The high pressure piston being lighter is not provided with the annular air chamber; but the latter may, of course, be applied to the high pressure as well as to the low pressure cylinder in larger engines. An exhaustive series of steam trials was carried out during February last at the works of the Westinghouse Company, in Pittsburg, with a compound engine having 14in. and 24in. cylinders by 14in. stroke. The speed throughout the trial was kept at 250 revolutions. The accompanying tables of results have been sent to us from an American correspondent.

EMERY TESTING MACHINE.*

(Concluded from page 590.)

Fulcrum Plates.—Figs. 1 and 2 (shown on page 632) are two general views of the machine, Fig. 1 being a front elevation, and Fig. 2 a side elevation of the testing machine proper. In Fig. 3 is shown a plan of the straining mechanism. In Figs. 4 and 5 is illustrated the scale case, containing the mechanism for measuring and indicating the strains on the specimen, and the valves for controlling the action of the machine. Fig. 4 is a front elevation, and Fig 5 a plan of the scale case. In Figs. 10 to 15 and Figs. 6, 7, 9, 19, and 20 are illustrated various details. Figs. 21 to 28 and Figs. 16, 17, and 18 show the construction of the holders for tension and compression, and the apparatus for transverse tests.

Hydraulic Chambers.—The testing machine proper, shown in Figs. 1, 2, and 3, comprises the apparatus for holding and straining the specimen to be tested. The bed or base of the machine, as shown more clearly in Fig. 12, consists of a hollow rectangular frame F of cast iron, having two rigid bearing surfaces, one near the bottom and the other at the top, suitably united at their four corners, and thus leaving an interior open space. Rising from the bed, as seen in Figs. 1 and 2, are the two main adjusting screws M, carrying the hydraulic straining press P, the vertical adjustment of which is effected by means of the long nuts (Fig. 12). The nuts are geared together, and are rotated equally by means of a vertical shaft and bevel gearing worked by a handle or belt pulley at X (Figs. 1 and 2). The fluid pressure is conveyed to the ram through the jointed tubes T. The hydraulic press acts in one direction for tension, and in the reverse direction for compression and transverse strain; in either case its pressure is directly transmitted to the specimen A. The upper holder U for holding the specimen is attached direct to the ram of the straining press; the lower holder L is secured to the head block H, which in turn is connected by four steel bolts to the bottom block B, as shown in Fig. 11; these two blocks thus constitute a yoke or stirrup, which envelopes the hydraulic chamber or support S. This yoke is secured in proper position within the frame F by horizontal fixing plates of thin tempered steel, which hold it steady laterally, while leaving it free to move vertically through the minute range desired. The transverse beams G G pass between the yoke blocks H and B, and bear at their outer ends against the cross beams of the frame F. These transverse beams are similarly free to move vertically within slight limits, but are stayed against all lateral motion by flexible fixing rods. Between the transverse beams G G is the hydraulic chamber or support S, which is 25in. in diameter, and 3in. in axial length. The space between the blocks H and B is 0·007in. more than the thickness of the parts contained between them; and this clearance is transferred from the upper to the lower block, according to the direction in which the specimen is strained. The change is conveniently effected by a single turn of a pair of nuts above the caps of the load springs R (Figs. 22 and 23). The function of these initial load springs is also to take up and absorb all clearance or back lash; in changing the apparatus from tension to compression, the clearance or back lash is taken up in the right direction by the load springs, and the scale is then balanced with the parts in this position before commencing a test. The strain received by the specimen from the straining press P is directly transmitted through the yoke and beams G G to the hydraulic support S. No frictional resistance is developed under the action of the load; but a slight elastic resistance is developed in the fixing and stay plates, by the minute yielding of the parts under pressure. This resistance, however, is not lost or absorbed, but is all of it taken account of in the rating of the scale. The strains resulting from tests of compression or tension act identically except in direction, the former acting downward on the support, and the latter upward. The hydraulic support, shown in section and plan in Figs. 14 and 15, consists essentially of a base block K, 24in. in diameter, to which is bolted a ring N, and within the latter is a movable disc or piston D. The lining diaphragm of the base block and the working diaphragm of the piston are each made of soft sheet brass 0·005in. thick; and each as originally made is flat and smooth. These parts are put together as shown in Figs. 13 and 14; and as soon as the fluid pressure is introduced between the two diaphragms, it forces the thin brass into the annular grooves turned in the base and piston (Fig. 15), thus interlocking each diaphragm with its rigid backing, and relieving it from all looseness or tendency to buckle under changes of temperature. The diaphragms thus act simply as linings to prevent the escape of the contained fluid. An interval of 0·1in. is allowed between the piston D and the ring N (Fig. 14), and through this interval all round the piston the diaphragm is unsupported. The piston is thus permitted to move vertically, the exposed portion of the diaphragm acting as a flexible joint or hinge. The motion of the piston, however, being due chiefly to the compression of the liquid and its contained air, is limited to a maximum of less than 0·001in. While thus left free to move vertically within these minute limits, the piston is secured against all lateral motion by the annular fixing diaphragm at its upper face, and the working diaphragm at its lower face (Fig. 14). The smaller hydraulic chamber or "reducer" R, contained in the scale case, is shown in enlarged size in Fig. 6. It consists of a steel base block and ring, with a movable disc or piston resting on the pressure diaphragm. In this case the brass lining diaphragm is dispensed with, and a single diaphragm of tempered steel is employed, which is best shown in Fig. 13, and consists of a flat disc of spring steel tempered, 0·006 in. in thickness. It is sealed by bedding against a lead ring contained between two bronze rings, the fluid being retained between the under side of the diaphragm and the upper surface of the steel bed. The annular space between the piston D and the ring N is 0·06in., which is the amount of free span of the diaphragm to permit of the free vertical movement of the piston under pressure. An annular fixing diaphragm is used to centre and guide the piston, in the same manner as in the case of the larger support. In Fig. 8 is shown in enlarged size the form of hydraulic support used in railway weighing machines, which clearly illustrates the construction and action of this important element of the Emery system. The cap C is placed over the support to exclude dirt, and the platform of the scale rests on this cap, the pressure being transmitted by it through a block of rubber R to the head of the pressure column P. The pressure thus received is supported on the thin film of fluid contained between the bottom of

* Paper read by Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A., before the Institution of Mechanical Engineers, on the 3rd ult.

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EMERY TESTING MACHINE.

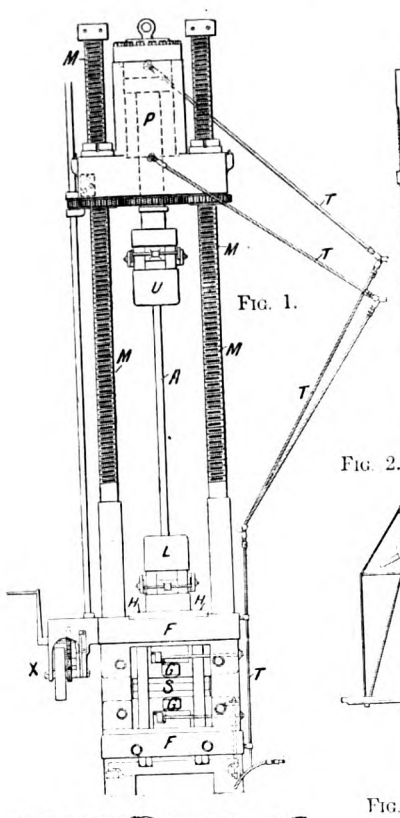


Fig. 1.

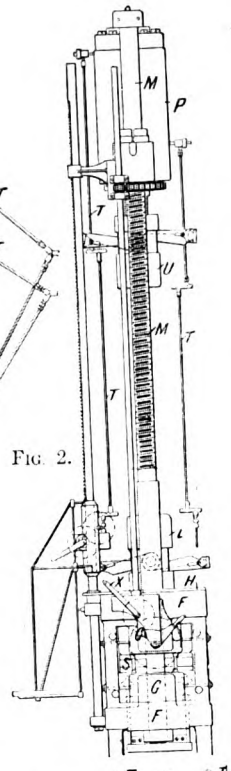


Fig. 2.

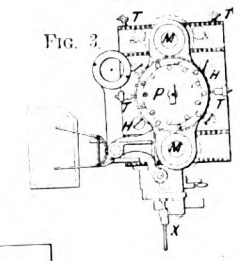


Fig. 3.

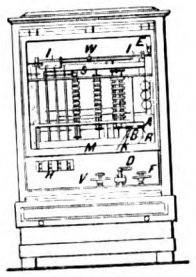


Fig. 4.

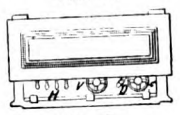


Fig. 5.



Fig. 6.

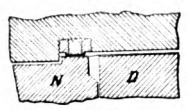


Fig. 7.

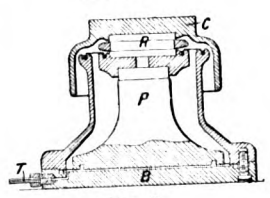
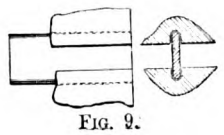


Fig. 8.


Fig. 9.

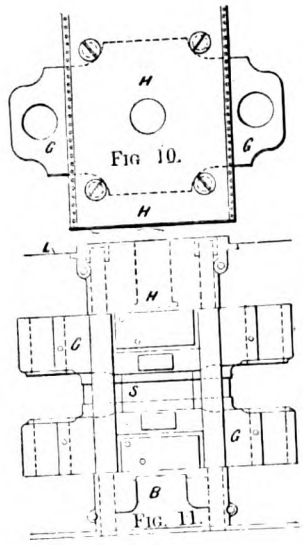


Fig. 10. Fig. 11.

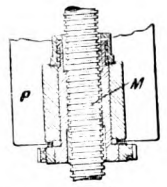


Fig. 12.

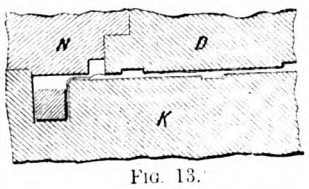


Fig. 13.

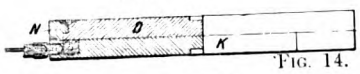


Fig. 14.

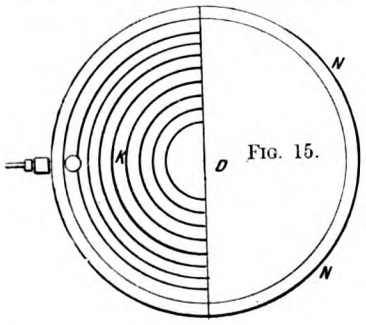


Fig. 15.

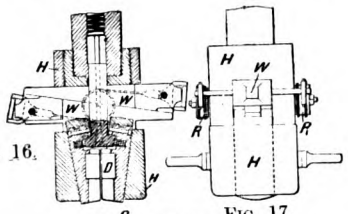


Fig. 16. Fig. 17.

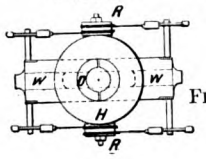


Fig. 18.

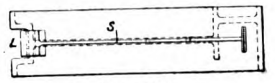


Fig. 19.

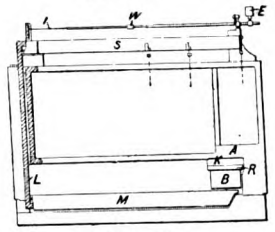


Fig. 20.

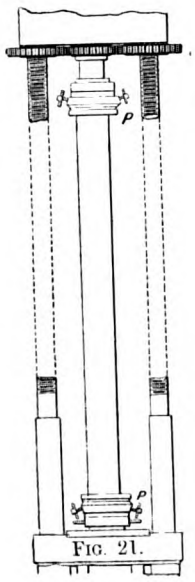


Fig. 21.

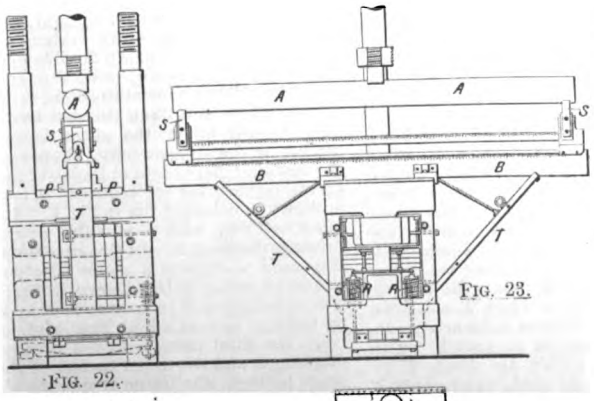


Fig. 22. Fig. 23.

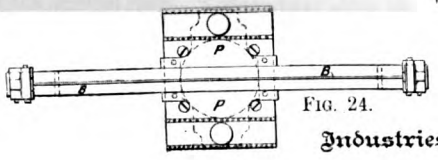


Fig. 24.

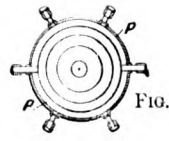


Fig. 25.

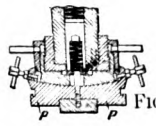
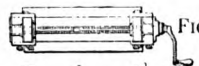


Fig. 26.


Fig. 27.

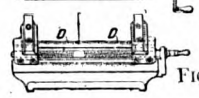


Fig. 28.

Industries.

the column P and the base piece B, this pressure being communicated through the small copper tube T to the scale mechanism by which it is weighed. The fluid employed for filling the hydraulic supports and chambers is either refined kerosene oil or alcohol and glycerine. No waste of this fluid occurs in use, either from leakage or evaporation, all of the joints in the hydraulic support and reducer, and the connecting tube between them, being made absolutely tight without packings.

Scale Case and Levers.—The hydraulic portion of the weighing mechanism terminates at the reducing chamber. Referring to Fig. 4, the reducer R is seen in position in the scale case. The pressure of the liquid in the reducer, tending to separate the piston and the fixed block K, acts against the frame A above as an abutment, and is received upon the transverse block B below, which in turn transmits it through the first steel fulcrum plate to the first or main lever M. This fulcrum plate carries about 10,000lb., being $\frac{1}{30}$th of the load put upon the hydraulic support in the testing machine. As shown in Fig. 9, it consists of a thin piece of tempered steel, 0·06in. thick by 0·3in. long and 10in. wide, forced under the heavy pressure of 40,000lb. or 50,000lb. into seats in the two pieces which it connects; the interval between the two pieces is 0·15in., which is the width of the free or exposed portion of the fulcrum plate. The relation and arrangement of the several beams composing the lever system of the scale are shown also in the outline (Figs. 19 and 20). The right hand end of the first lever M is connected with the fixed frame of the scale case by a similar fulcrum plate, so that the downward pressure from the reducer received through the block B tends to depress the left hand end of the first lever M. At the left hand end this lever is connected by another smaller fulcrum plate to a vertical link L, contained in a recess of the scale frame, and extending upwards through the latter, its head being seen again close to the indicator scale in the upper part of the case. The action of the reducer thus causes downward pressure on the link L, the upper end of which is connected by a thin fulcrum plate, 4in. wide by 0·02in. thick, to the overhanging short arm of the second lever S; the fulcrum supporting the latter is slightly to the right of the connection with the link L, and consists, as in the previous case, of a flat steel fulcrum plate, one edge of which is fixed in the under side of the lever S, and the other edge in an abutment of the scale frame. The pressure transmitted from the reducer thus tends to depress the left hand end of the second lever S, and to elevate proportionately its right hand end. The third and last lever consists of the indicator bar I, which is suspended at its right hand end from the scale frame by two thin fulcrum plates, set 4in. apart, each of them being 0·005in. thick by 0·3in. long, and here used in tension; whereas all the fulcrums previously described are used under compression only. In like manner, the right hand end of the indicator bar I is connected with the second lever S by a thin fulcrum plate which is also always in tension, owing to the fact that the indicator bar, aided by the small sliding weight W which it carries, overbalances by reason of its great leverage the combined unbalanced weight of the levers M and S, of the vertical link L, and of their connected parts. The balancing of all of these movable parts, and the adjustment of the scale so that the indicator stands exactly at the zero point when the machine is unloaded, are effected by sliding the balance weight W along the indicator bar to the proper position, and there fixing it by a thumb screw in the weight. The sensitising weight E, on the right hand overhanging end of the indicator bar, is capable of vertical adjustment, the effect of which is to alter the centre of gravity of the indicator bar relatively to its point of suspension, and thus to change the sensitiveness of the scale. Usually this weight is so adjusted that the point of the indicator bar shall move one division on its scale for each 10lb. of load applied to the specimen. The amount of vibration of the indicator over its scale thus affords a most convenient means of reading small variations in the load. As already explained, the total multiplication of the lever system is 1 to 20,000. This enormous velocity ratio is made possible, without the great loss inherent in the knife edge system from friction and from change in fulcrum distances, by the use of the system of plate fulcrums, whereby the two fulcrums which determine the length of the short arm of each lever can properly be brought into close proximity, and the leverage in each case made proportionately large. As each succeeding leverage is multiplied by that preceding it, the total becomes rapidly very great. Hence a very small weight on the indicator bar counterbalances a very large force acting through the reducer on the first lever. Conversely, it follows that the amount of motion of the indicator bar sufficient to be distinctly visible, say 0·1in., is reduced, through the action of the lever system, to $\frac{1}{20000}$th part, that is $\frac{1}{2000000}$th part of an inch, at the transverse block B (Fig. 4), which bears against the reducing chamber R; this is therefore the motion of the piston of the reducing chamber, while $\frac{1}{20000000}$th of an inch is the corresponding motion of the piston of the hydraulic support in the testing machine. The motion of the latter piston, and of the flexible diaphragm on which it rests, thus becomes exceedingly minute, and insensible to sight or touch. This fact should be borne in mind in considering the motion in both the hydraulic chambers, in each of which it is so extremely minute that their functions can be more appropriately described as consisting simply in the reception and transmission of pressures of varying intensity, rather than in motion of one part relatively to the other. Referring again to Fig. 4, it will be seen that each increase of pressure applied to the specimen tends to depress the left hand end of the first lever M, and therefore to depress similarly the point of the indicator bar I. Downward motion of the indicator therefore denotes increase of load and the need of additional weights to balance it, while upward motion of the indicator denotes a reduction of the load or an excess of counterpoise. The operator thus quickly learns that if the point of the indicator falls below the zero mark he must apply more counterpoise, and when it rises above the zero mark he must decrease the counterpoise. There are four series of counterpoise weights, each series controlled respectively by one of the four handles H, through a set of levers connecting these handles with the frames which carry the weights when they are not required in the poise rods of the beam. Briefly described, each of the successive series of weights is in the ratio of 10 to 1; each series except the last comprises nine individual weights, of which any desired number can be instantly applied to or taken off from the

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poise rods of the scale beam by a simple motion of the handles. The operator uses only two of these handles at a time, watching the indicator bar and keeping the scale beam balanced within limits less than its full vibration; and by noting the pointers carried by the four vertical rods connected with the handles H, he has always before him a clear indication of the position of the whole series of poise weights. This record remains undisturbed by the breaking of a specimen, and can be accurately noted afterwards. In accurate work the position of the indicator bar at the moment of rupture should also be noted, and the load it indicates should be added or subtracted before the load indicated by the poise weights is recorded. The strains upon the specimens are controlled by valves contained in the lower part of the scale case (Fig. 4), and worked by hand wheels which are conveniently grouped together to the right of the handles H that control the poise weights. The hand wheel V controls the main inlet valve between the pump or accumulator and the testing machine; and the smaller hand wheel on the top of it controls a smaller and finely graduated valve contained within the main valve, thus affording convenience for all possible adjustments of flow; the rate of motion of the ram can be adjusted to a maximum of 1ft. per minute, or to a minimum as small as 0·001in. in half an hour. The handle D controls a set of reversing valves, which determine the direction of flow from the pump or accumulator into the hydraulic cylinder or straining press of the testing machine. When standing in the position shown in Figs. 4 and 5, these valves cause the liquid from the pump or accumulator to flow to the under side of the piston, thus moving it upward, as required in tests of tension; turning the handle D to its other position, that is through an angle of 180°, reverses the direction of flow, and causes the piston to descend, as required in tests of compression. A single motion therefore of the handle D enables the operator to reverse and entirely control the direction of motion of the piston or ram of the straining press, whether for the purpose of adjusting it for making a test, or for the actual making of the test itself. The two handles F control a by-pass or circulating valve, the opening of which lets off the pressure in the straining cylinder to any desired extent, by permitting the escape of liquid therefrom into the reservoir or cistern. All the weighing mechanism contained in the scale case is protected from dust, and from currents of air, by a plate glass sash in front, as seen in Fig. 4. In addition to this, a shutter of wood can be let down over the sash, which, meeting a similar folding shutter in the lower part of the case, entirely closes and protects the weighing mechanism and valve gear. This shutter being secured by a lock and key, the machine is safe from interference or injury. The only connections between the scale case and the testing machine proper consist of the small copper tube connecting the hydraulic support with the reducer, and of the pipe connections between the valves in the scale case and the jointed pipes T on the testing machine (Fig. 1). The scale case can therefore be placed in any desired position relatively to the testing machine, and is disconnected from the latter so far as relates to transmission of shock or jar resulting from the rupture of specimens. The eliminations of all back lash, and the careful provision for the absorption of all shock and recoil, combine to reduce the effect of the rupture of specimens to a minimum which is so surprisingly small as to be hardly credible until actually seen. An observer may safely keep his hand on the platen of the testing machine while a specimen of the largest size is tested to rupture, no sensible jar being experienced even at the instant of rupture. Indeed, except for the pistol-like report caused by the sudden rupture of a large specimen, particularly of metal having a high modulus of elasticity, such as steel with a high percentage of carbon, the senses would hardly take cognisance of the fact that rupture had occurred.

Holding of Specimens.—In Figs. 16 to 18 is shown in detail the apparatus for holding specimens in tests for tension. Each of the tension holders consists of a cylindrical steel shell H, properly secured to the platen of the machine and to the ram of the straining cylinder. The outer end of this shell, as seen in Fig. 16, has conical seats bored within it, in which are two cylindrical wedges D (Figs. 16 and 18). Suitable jaws or clamps are fitted to the internal facings of these cylindrical wedges, for adapting them to receive round, square, or flat specimens of the various commercial sizes. The jaws having been opened sufficiently to admit the specimen are again closed upon it, thus giving a slight initial grip, after which the motion of the straining press in applying strains to the specimen causes the cylindrical wedges to be drawn outward in the shell of the holder, thus forcing them still more tightly upon the specimen by reason of the incline or wedge form of the cavity within which they slide. Two transverse following wedges W are provided, which, under the pressure of spiral springs coiled in the two spring boxes R on each side of the holder and acting through cords, tend to close together, and thus follow up the gripping wedges, as the latter move outward under the action of the increasing strain upon the specimen. The result is that when rupture takes place, little or no back lash is possible in the holders, each of which acts substantially as a solid block in transmitting the shock to the parts which, as already stated, are so constructed as to receive and absorb it without injury. Figs. 21, 25, and 26 show the arrangement of platforms used in making tests under compression. Fig. 26 is a sectional view of the compression platform as applied to the bottom of the ram of the straining press. Upon the end of the ram is screwed a nut or sleeve, which in turn carries and supports the bed B. This bed has a convex spherical surface, against which is fitted the head or platen P, having a corresponding concave spherical surface. The latter piece is provided with six adjusting screws, by means of which it can be revolved or shifted relatively to the convex bed, so as to cause the outer face of the platen P to take any desired angle relatively to the axis of the machine or specimen. The adjustable platforms make it unnecessary to observe any special care in securing parallelism between the ends of a specimen to be tested under compression. All that is needed is that each end should be a true plane; and if these two planes are not exactly parallel, either or both of the adjustable platforms is so adjusted that the plane of its bearing face coincides with that of the end of the specimen (Fig. 21), while the axis of the specimen remains parallel with that of the machine. This being done, the test can be proceeded with under assurance that the results obtained will be exactly the same as though the ends of the specimen were not only true planes, but were also exactly parallel. The facility thus afforded tends not only to more correct results in testing, but to great economy and convenience in the preparation of specimens. When it is desired, the face of the platen P can be set normal to the axis of the machine, in which position it is shown in Fig. 26. The apparatus for transverse tests is shown in Figs. 22 to 24. A heavy rectangular bar B of steel is placed upon the platen P of the machine, and suitably secured there. Its outer ends are supported by inclined struts T, the lower ends of which are stepped into the foot block of the stirrup or yoke shown in Fig. 11. Downward pressure on the bar B acts therefore upon the testing machine precisely as similar pressure transmitted through a specimen when tested in compression. Sliding on the top of the bar B are two supports or bearings S on which rests the specimen A. These bearings may be set at any desired distance apart, according to the length of the span desired for making the test. Their positions are accurately indicated by the scale engraved on the side of the bar B. A smaller but similar apparatus is shown in Figs. 27 and 28, designed for transverse tests of short specimens only. This is identical with the larger apparatus, except that the bearing blocks are moved and set by a right and left hand screw worked by a crank handle. An ordinate bar D is suspended within these bearing blocks, in such a manner as to be entirely free from distortion during the progress of a test, thus affording a true base line from which, by means of the sliding gauge shown in Fig. 28, the deflections of the specimen can be accurately measured.

Rating.—The mode of rating the action of the Emery testing machine with standard dead weights is as follows: The internal diameter of the larger hydraulic support when completed can be accurately measured with the greatest precision. The exact diameter of the reducer, and the ratio between the two hydraulic chambers, are not material, and practically are never considered, except approximately when designing the machine. In like manner, the fulcrum distances of the levers are originally fixed approximately, but in actual construction are never gauged or in any way closely determined in the adjustment and rating of the scale. The aggregate velocity ratio between the platform movement and the movement of each poise weight is determined by actual loads simultaneously placed on each and balanced. The loads applied to the platform are obtained from a special rating machine, the action of which has been carefully determined at each point with actual dead loads, so that its indications are known to be correct. By means of this rating machine known loads are applied to the hydraulic support of each testing machine up to its maximum capacity. The exact weight required on each poise rod to balance a known load on the machine is thus ascertained by actual test, and the poise weights are then carefully adjusted thereto. Each of these weights is electro-plated with gold to protect it from oxidation, and are all contained in a dust tight case behind plate glass; in use they are applied without friction, and without being touched by the hand. The ratio between the two hydraulic chambers remains absolutely without change; and in like manner the fulcrum distances of the lever system are unchangeable. Inasmuch therefore as the aggregate ratio between the larger hydraulic chamber which receives the load, and the weights by which the intensity of the load is measured, is thus readily determined by actual test throughout the entire range of the machine, and as this ratio remains constant, it follows that the machine when once adjusted and rated will continue unchanged indefinitely; and this conclusion is confirmed by actual experience. In machines based upon the principle of the common knife edge scale, on the contrary, the test with known dead loads usually covers only a small portion of the range of the machine; and it is assumed that the action of the machine throughout the remainder or higher part of its range will be the same proportionately as within the lower range tested by actual loads. This assumption is undoubtedly erroneous, for experience has shown that absolute or even approximate rigidity in such machines is impossible, and that the yielding and bending of the parts of a knife edge scale inevitably cause serious disturbances in the fulcrum distances and also in the frictional resistances, while for neither of these disturbances does the knife edge system provide any compensation. Extensive experience has established the fact that the principles involved in the construction of the Emery machines, and the methods adopted in adjusting them, are such that a degree of precision has been attained beyond anything previously accomplished, and that this precision is maintained unimpaired even under the exceptionally severe conditions obtaining in the use of testing machines of large capacities. As indicative of unsuspected sources of error in the earlier and cruder testing machines, particularly those in which the applied strains are measured by simply gauging the hydraulic pressure in the straining cylinder, it may be mentioned that a test was recently made of one of the largest machines of that kind in the United States, by having a large and long bar of steel tested for extension in the Watertown machine, the test being carefully kept within the elastic limits of the metal, and the stretch accurately noted by micrometer gauges at each successive increment of the load. The specimen being released from strain was found to return to its original form, thus showing conclusively that it had not been strained up to its elastic point. The same specimen was then subjected to test in the hydraulic machine above mentioned, and its extensions were again noted by micrometer gauges, the specimen thus serving as a delicate dynamometer by which to determine the differences in the readings of the two machines. With loadings up to a maximum of 400,000lb. these differences, under precisely equal extensions of the specimen, varied from 4 per cent. to 16 per cent. of the applied loads, the larger proportional discrepancies occurring with the smallest loads. These results are corroborated by other experiments which have been made with the Watertown machine, and justify the assertion that in ordinary testing machines the rate of error or variation, due to loss from friction and to incorrect methods of weighing, covers a wide range, amounting in some cases to probably more than 20 per cent., and rarely, if ever, to less than 5 per cent. in the case of hydraulic machines. For certain commercial purposes this approximation to facts may suffice; but for the more accurate purposes of scientific work, as well as for ultimate economy and safety even in ordinary commercial work, testing machines of greater accuracy will inevitably be required. The appliances now described meet these requirements in the fullest degree; they have been extended in practice to machines ranging in capacity from 70,000lb. to 800,000lb., and are capable of advantageous application to machines of any desired capacity, the designs for a machine of 1,200,000lb. capacity having already been prepared.

From the foregoing description the writer hopes it will be seen that the inventions of Mr. Emery have led to the production of a machine capable of developing and controlling forces amounting to hundreds of tons, and of so utilising and weighing these forces as to entitle the machine to take rank as a true instrument of precision. This machine, it is believed, is the first in which all of the factors of the case have been successfully provided for, so that all sources of error and doubt are eliminated, and results are made possible which in the fullest sense are precise and accurate. These important results are obtained by a degree of precision and perfection heretofore rarely if ever attained, or even attempted, in mechanism of such large dimensions. At the same time, unusual facility has been obtained for the convenient manipulation of specimens, and for the adaptation of the machine to the different kinds of tests.

BRITISH WATCH INDUSTRY.

At a recent meeting of the Balloon Society of Great Britain, an address was given by Mr. James Kendal on "The British Watch Industry." The lecturer stated that the sun dial of Ahaz is the first record of a timekeeper, that the obelisks of the Egyptians were intended as gnomons, and that the next record of a sun dial was the hemicycle of the Chaldean astronomer, Berosus, 450 B.C. The clepsydra, or water clock, was the next contrivance for measuring time, used by the Chaldeans; but to whomsoever the early discovery of timekeepers may be due, he said that clocks were set up in churches as early as 1174, and in the reign of Henry VI. a pension was granted to the Dean of St. Stephen's for taking charge of a clock in Palace Yard, Westminster. In 1326, Richard Wallingford, abbot of St. Alban's, placed a clock in his monastery which showed the hours, the motion of the sun, the changes of the moon, the ebb and flow of the tide, &c., and the account of this clock is still preserved in the Bodleian Library at Oxford. In 1340 Peter Rightfoot, a monk of Glastonbury Abbey, made a clock which, at the Reformation, was removed to Wells Cathedral, and the original is now to be seen at the South Kensington Museum. The clock for the Strasburg Cathedral was begun in 1352, and finally completed in 1574 by Conradus Daspodius. The use of the pendulum for securing accuracy of time was first adopted by Vincent Galileo, in 1648, and the anchor escapement, for regulating it, by Dr. Hook, 1666; and he stated that little progress was made since that time until Mr. Dennison, now Lord Grimthorpe, designed the clock for the Victoria Tower of the Houses of Parliament, in 1854. The most remarkable episode in the construction of timekeepers is the lever escapement, invented by Thomas Mudge, in 1770, the last epoch in the history of the watch. The progress of the last fifty years in watch making has consisted rather in the perfection of proportions than in the introduction of new principles, for even the invention of winding from the pendant, instead of a watch key, is tardy appreciation of an invention patented more than half a century ago. At the International Inventions Exhibition of 1885, Kendal and Dent exhibited a horological novelty of a watch with two dials placed back to back, with the movement between them. On one dial was marked the old divisions of twelve hours, and on the other the suggested hour circle with twenty-four divisions, and this invention attracted considerable attention from horologists and mechanicians. Mr. Kendal then referred to the important uses to which timekeepers are devoted by the use of marine chronometers to enable the navigator to ascertain his longitude as he travels over the sea. In 1714 the English Government offered a reward of £10,000 for determining the longitude to within sixty miles; £15,000 within forty miles; and £20,000 within thirty miles; and this reward was secured, after thirty years of unremitting labour, by John Harrison, a carpenter, of Faulby, in Yorkshire, who succeeded, in 1764, in producing the present marine chronometer.

TRAVELLING CAISSONS.

The illustrations shown on pages 634 and 635 represent a new travelling caisson, designed by Mr. W. R. Kinipple, of 2, Westminster Chambers, S.W., for the Russian Minister of Marine. The caisson is being built in Russia, and in general principle is similar to some caissons which were constructed to Mr. Kinipple's design in this country and abroad. Fig. 2 shows the dock entrance with the caisson in place, and the dotted lines indicate the position of the caisson when it is drawn back into its chamber, so as to leave a free passage between the sea and the dock. It will be noticed that the sides

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TRAVELLING CAISSON.

DESIGNED BY MR. W. R. KINIPPLE, M.INST.C.E., FOR THE USE OF THE RUSSIAN MINISTER OF MARINE.

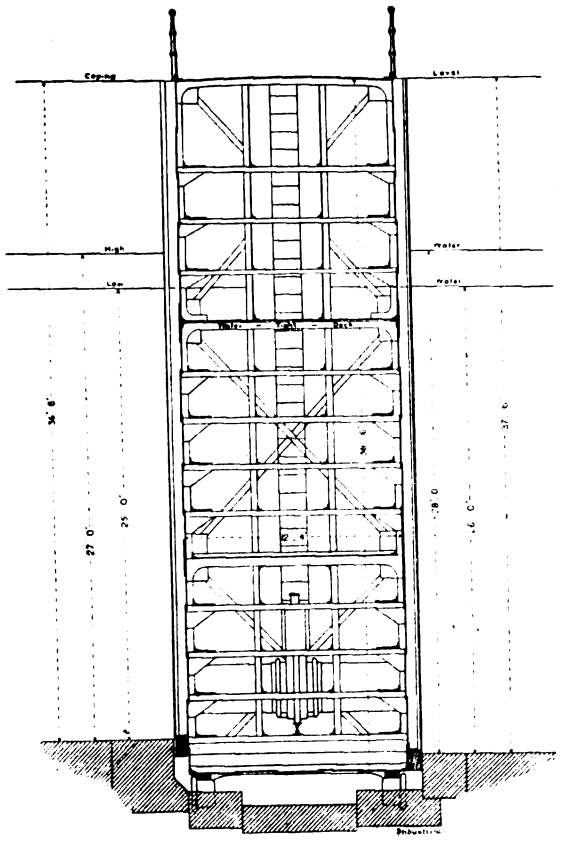


FIG. 1.

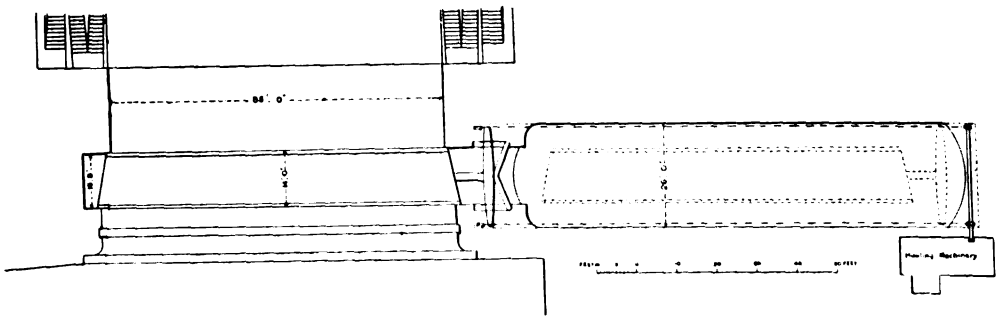


FIG. 2.

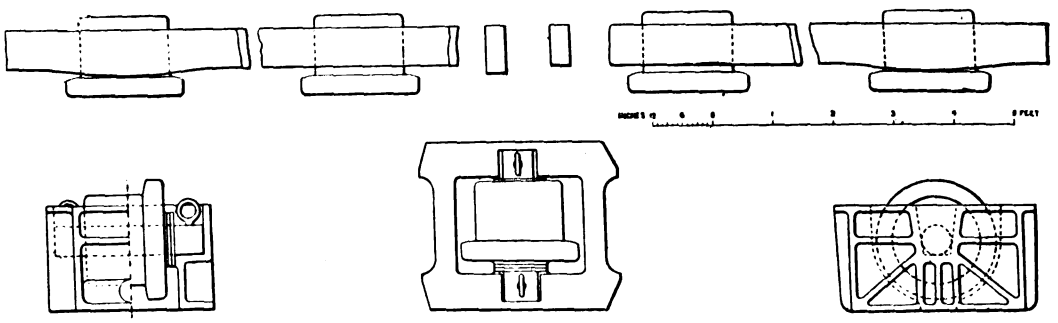


FIG. 3.

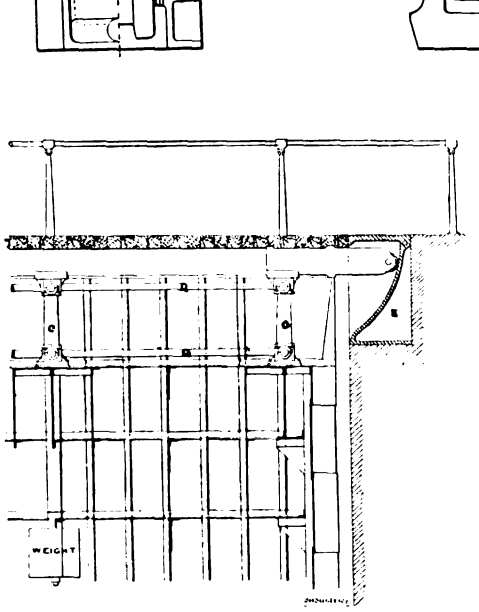


FIG. 4.

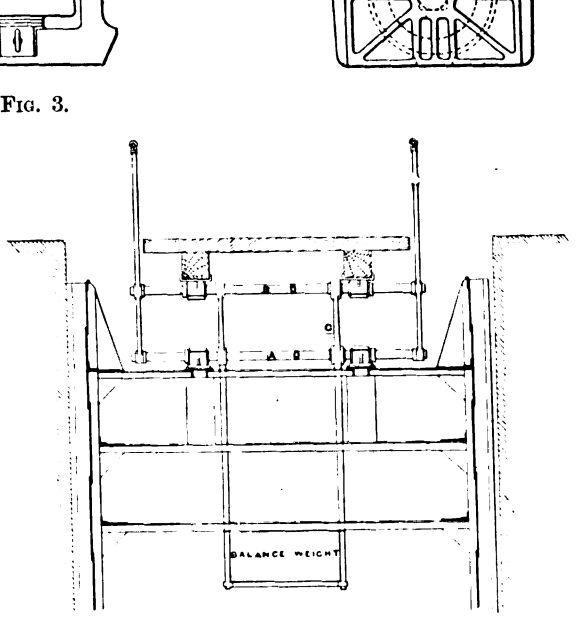


FIG. 5.

of the caisson are vertical, but bevelled horizontally, the larger surface being presented to the sea. The object of bevelling the sides is to provide an easy means for turning the caisson round within the dock entrance, and floating it out for repairs. The caisson is provided with two steel keels, which are of varying width, and run on cast iron rollers, as shown in Fig. 3, and in the front elevation shown on the opposite page. The rollers are fixed on the masonry at the bottom of the dock entrance, but are below the sill proper, so as not to be exposed to damage from passing vessels. The rollers are provided with flanges, which constrain the keel at its wider portions. When the caisson is in position for closing the entrance, only the narrow parts of the keels lie immediately above the rollers, thus giving the water on either side free play to force the caisson against the granite walls of the recess on either side. The joint is made by greenheart facing pieces, 16in. in width, which run along the bottom edges and up the sides. When the caisson is drawn back, the wider portions of one or the other of the keels come against the flanges of the rollers, and force the edge of the caisson away from the facing in the masonry recess, so that no loss of power from friction and no undue wear take place. If the caisson is to be removed, it is first run a short distance into its chamber, and then floated out on the tide. The difference in width between the inside and outside face being 5ft., and the caisson being a few inches narrower than the recesses, this operation is easily performed. The operation of hauling the caisson in and out is performed by means of a hauling bar and yoke, to which are attached endless chains, set in motion by a hauling shaft shown in Fig. 2. Power is supplied by a special 30 h.p. steam engine, fixed in a house at the end of the caisson chamber. The caisson is a steel structure built up of angle and T sections, and the sides are formed of plates varying in thickness from $\frac{5}{8}$in. to $\frac{7}{16}$in. The plates are stiffened by vertical angle iron frames, 18in. apart. In addition to the top deck there are two internal decks, formed of $\frac{3}{8}$in. plating, with butt joints and straps. The first of these, which is about one-third of the way down, is water tight; and the other, about two-thirds down, is braced like a horizontal lattice girder, in order to withstand the horizontal pressure of the water. As will be seen from the front elevation, communication between the sea and the dock can be established by means of three iron tubes, each with a sluice valve in the centre worked from the upper deck. There are also four smaller sluice valves just above the water tight deck, which serve to run water in and out of the space above this deck, and thus control the buoyancy of the structure. Three vertical air shafts, extending from the top deck to the lower water tight deck, give access to the interior of the caisson, and these shafts are also used for adding or withdrawing ballast. The caisson is 38ft. 6in. deep, and has a displacement of 854 tons. Its weight without ballast is 356 tons. At the bottom it is ballasted with 453 tons of concrete, and with an additional 60 tons of loose ballast, which can be removed when it is necessary to float the caisson away for repairs.

The use of sliding caissons instead of the ordinary dock gates is gaining favour, as may be gathered from the following list of caissons already constructed to Mr. Kinipple's design:—

	Span. ft.	in.
Garvel graving dock, Greenock	60	0
Quebec graving dock, Port Lewis	69	0
Aberdeen graving dock	50	0
Travelling bridge, West Harbour entrance, Greenock	103	6
James Watt dock, western entrance, Greenock	75	0

These were all constructed under the immediate supervision of Mr. Kinipple; but in the following cases his caissons have been employed by other engineers:—

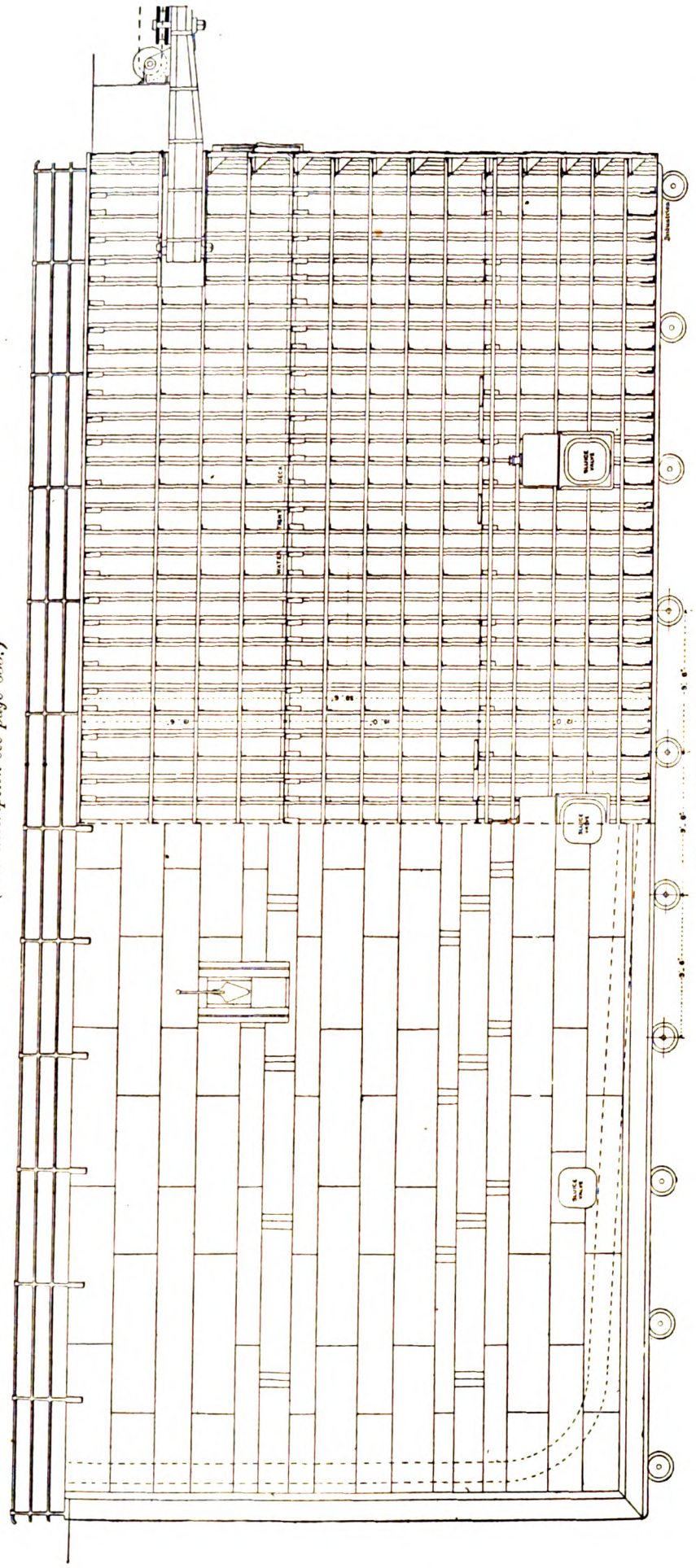
	Span. ft.	in.
Monte Video	55	0
Govan graving dock, Glasgow	60	0
Cockatoo Island, New South Wales	88	0
Graving dock, Newport, Monmouthshire	50	0

In certain cases it is inconvenient to have the caisson chamber open at the top, and to provide for such cases Mr. Kinipple has designed an arrangement by which the upper deck is automatically lowered when the caisson is drawn into its chamber, thus enabling the latter to be covered over. This arrangement is illustrated in Figs. 4 and 5, being the design adopted in a caisson constructed for the Esquimault Harbour at the joint expense of the British Imperial Government, the Dominion of Canada, and the Government of British Columbia, and which was opened in June last year. The illustration shows the upper deck, or rather the gangway and rails, raised into the position they occupy when the caisson is across the dock entrance. The gangway is supported on a set of bars B joining the upper ends of the levers C, which are pivoted on the bars A. Some of the levers are prolonged downwards, and carry balance weights. The levers are joined by tie bars D, which constrain them to move simultaneously, and thus raise or lower the gangway on a kind of parallel motion. The balance weights are not quite sufficient to keep the gangway raised, and the operation of raising is performed by a casting E, with an inclined curve fixed to the masonry, and nose pieces fixed to the under side of the gangway. When the caisson is drawn across the dock entrance, the rollers on these nose pieces come in contact with the inclined curve, and as the caisson further advances they are forced upwards, thus bringing the deck into the position shown in our illustration. Upon drawing the caisson back, the rollers slide down the inclined surface, and the gangway is thereby lowered sufficiently for the caisson to pass into its covered chamber. It is interesting to note that M. Eiffel proposes to use similar caissons instead of the usual gates for the docks on the high level canal across the isthmus of Panama. In this case the caissons will run on rollers in the sill when across the entrance, and will hang from rollers attached to the under side of the covered chamber when withdrawn.

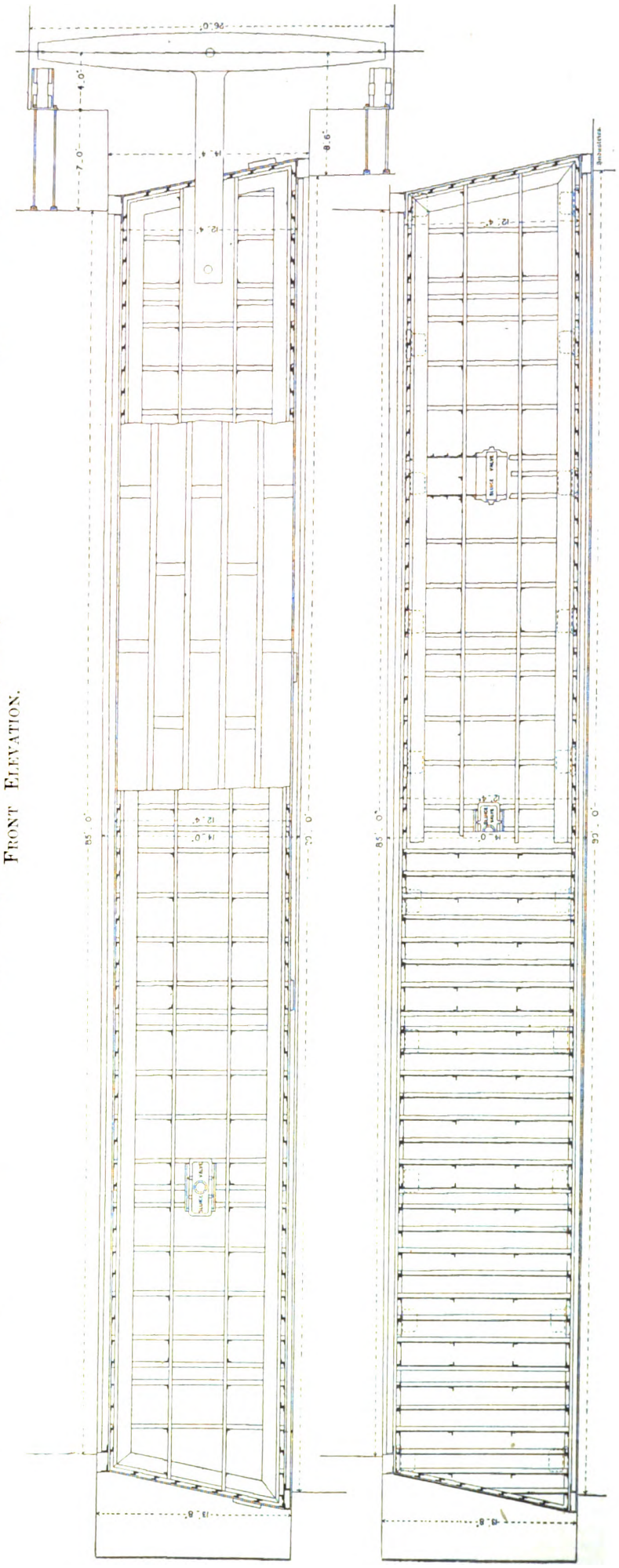
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TRAVELLING CAISSON.

(For description see page 633.)



FRONT ELEVATION.



SECTIONAL PLANS.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 26TH JUNE, 1888.

THE COAL MARKET.—Tenders have been received for 10,000 tons of unscreened coal, and 17,000 tons of round coal, for the Assistance Publique de Paris. The lowest offer for the former was 7s. 2·9d. per ton; for the latter 10s. 2·9d. per ton was tendered for 6000 tons, the remaining 11,000 tons being offered at 10s. 7·2d. The imports of foreign coal in the first five months of the year amounted to 3,272,204 tons, against 3,469,675 tons in the corresponding period of 1887. Of this year's quantity, English produce formed 45·4 per cent.; Belgian, 45·1 per cent.; and German, 8·1 per cent. The average value per ton was 9s. 1·34d., exactly the same as last year. The imports of coke in the same time show an increase from 413,296 tons in 1887 to 437,156 tons in 1888.

ENGLISH COAL IN FRANCE.—Though English coal has hitherto held its ground in the markets of France, there is reason to expect a considerable loss of trade in the near future. The coal mining industry of the Nord is being steadily developed. By means of reduced railway charges, the market has been extended eastward at the expense of Belgian produce. Now an effort is to be made to push on in a westerly direction at the expense of the English import trade. The Government has this week officially sanctioned a new tariff, proposed by the Northern and Western Railways, for the transport of coal in trains of 250 tons at a reduced rate from the collieries of the Nord to Havre. The special object in view is to enable French producers to compete successfully with the importers of English coal, not only at Havre for bunker use, but for consumption in several of the western departments.

THE IRON MARKET.—There is a little more life in the iron market this week. Consumers are buying more freely, and as the stocks in the hands of the merchants are now small, there is a prospect of better prices. Business here is transacted on the basis of £5. 16s. for bars and £5. 8s. for joists. Some concession is allowed on these prices for large orders, but generally the rates are firmly maintained. Old rails are stationary at about £3. 6s. In the Haute Marne galvanised wire is in brisk demand, and manufacturers are fully occupied with orders in hand. Wire nails are less sought after. Within the last few days a better demand has sprung up for sheets. Founders are fairly busy, but prices remain low. The Forges de Saint Nazaire, an important works giving employment to some seven hundred men, has gone into voluntary liquidation, and will shortly be closed. This circumstance serves to strengthen the Paris market for the moment, but the prospect is discouraging for the future.

THE METAL MARKET.—The copper trade offers no new feature. Consumption has been greatly restricted, manufacturers buy only sufficient to cover present needs, stocks increase, and prices are firmly upheld by the syndicate. This is a state of things which no combination of capitalists can long maintain. Tin continues to droop in price. It is expected that the syndicate will come in again, and command the situation. Lead is firm. Spelter continues to decline.

STATE OF TRADE.—The trade of France seems to be wanting in recuperative force. The year is fast passing away without bringing the hoped-for improvement, and there is reason to fear that on the whole the home trade tends to shrink. Certainly the foreign trade is decreasing. The Customs returns for the first five months of the year show a decrease relatively to 1887, both in the imports and in the exports. The declared value of the former amounted to 1678·62 million francs, against 1715·85 millions, while the value of the latter is only 126·95 million francs, against 1281·08 millions last year. The diminution in the imports is wholly in raw materials and manufactured goods. Among the exports these classes show a slight increase, the decrease being in articles of food.

THE SUGAR BOUNTIES.—At a meeting of the Agricultural Committee of the Seine-et-Oise, held a few days ago, M. Léon Say denounced in strong terms the aim of the London Conference for the abolition of the sugar bounties. Feeling runs high on this question, and the agitation against the measure gains strength.

BERLIN, 25TH JUNE, 1888.

THE COAL MARKET.—At the present time Russian coal is imported into this country in considerable quantities, especially at the railway stations of Thorn, Bromberg, and Mocker, and is sold at cheaper rates than coal raised in Silesia. This is partly due to the low tariffs ruling on the Warsaw-Vienna Railway, and partly to the depreciation of the rouble. In order to reduce, if not to entirely exclude, Russian competition in the eastern districts of the empire, our colliery owners in Silesia are making great efforts to obtain a reduction in the rates for the carriage of their coal, and have already addressed a request for that purpose to the railway administration in Bromberg. On the lines bringing coals from the Westphalian districts, a reduction has already been granted, which will come into force on the 1st of next month. Herr F. Krupp, of Essen, is negotiating for the purchase of the Prinz Wilhelm and Prinz Heinrich pits.

THE IRON MARKET.—A few weeks ago, I referred to the proposal to establish a syndicate of fine sheet makers in Western Germany. A meeting has now been held, and it has been decided to form a syndicate with sales bureaux in Siegen and Dortmund, provided the co-operation of the Gutehoffnungshütte in Oberhausen, and the von Viebahn-Carlshütte, can be obtained, which works were not represented at the meeting, and provided that a satisfactory understanding is arrived at within a fortnight with the South German sheet rolling mills, viz., the Dillinger Hüttenwerke, de Wendel in Hayingen, and the Maximilianshütte in Bavaria. According to statistics just published, the total production of pig iron throughout the empire (including Luxembourg) during May amounted to 360,855 tons, of which 173,535 tons were forge pig and spiegel, 35,361 tons Bessemer pig, 108,248 tons Thomas iron, and 43,711 tons foundry pig. The production of crude iron during the corresponding period of 1887 amounted to 327,282 tons, thus showing a considerable increase. From the 1st January to the 31st May, 1888, there have been produced 1,756,310 tons of pig, as against 1,527,721 tons in the same period of the previous year. It is stated that the rolled iron syndicate in Upper Silesia have just sold a large quantity of rolled iron to a works outside of their usual sphere, and where they have to meet the competition of the rolled iron works of Western Germany. This transaction, which will be included in the third quarter of the year, has taken place at 135s. per ton, and shows an increase, as compared with the price ruling during the second quarter. The iron plate makers in Western Germany have collectively produced during May 10,333 tons of plates, against 9548 tons in April. The deliveries amounted in these months to 10,087 and 9111 tons respectively. New orders were received during May for 9035 tons, as compared with 7289 tons in April.

BRIQUETTES.—According to the annual report of the Society of Briquette Makers, which has just been published, the manufacture of briquettes is on the increase. At the end of 1887 the Society was composed of 59 works, having 171 presses, as compared with 52 works and 145 presses at the close of the previous year. The total quantity of briquettes produced during 1887 amounted to 1,059,020 tons, as against 953,177 tons in the previous year. The annual output of a single press was 6200 tons, or at the rate of about 25 tons daily, the number of working days being estimated at 250. The number of workpeople employed in this industry amounted to 1825.

DIRECT STEAMERS BETWEEN GERMANY AND THE EAST INDIES.—The President of the Association of German Jute Spinners, Privy Councillor Spiegelberg, has recently returned from a voyage to the East Indies, which was undertaken with the object of ascertaining whether direct steamship communication between the German ports and the East Indies could be established as a paying concern. In the report which he submitted to the Chancellor, he recommends the establishment of a direct line of steamers, mainly for the purpose of increasing the export trade in jute goods, the present method of shipping *viâ* London being too costly and cumbersome. But there are also other reasons. Herr Spiegelberg has found that in various parts of India there is a strong demand for German manufactures, and that German woollen goods are especially in request in Northern India, where they compete on favourable terms against English goods. The import of German salt into India would also appear to be a promising business. In addition to these advantages, which would result from a direct line of steamers, Herr Spiegelberg points out that there would be the advantage of increasing German prestige, and promoting the establishment of a German bank in India.

VIENNA, 25TH JUNE, 1888.

THE IRON MARKET.—No change of any importance has taken place in the iron market during the past week. Business in Vienna continues quiet, and but few transactions are taking place. The demand from retail dealers is at present very small, and wholesale dealers have considerable stocks on hand. No reductions in price, however, have been made, and this is mainly due to the firm attitude maintained by the various syndicates. In consequence of the dry weather prevailing during May, the harvest prospects in Southern Austria are somewhat unsatisfactory, and this is not without its effect on the market for agricultural implements. Building iron and sheets remain in moderate request. In Bohemia and the North generally the harvest is expected to be satisfactory, and to take place about the middle of July; business prospects for the latter half of the summer are consequently brighter. In Bohemia there has during the week been some activity in building iron, round and square bars, and castings, the latter more especially for gas and water mains and railways. Notwithstanding the slight spurt in business, prices have remained stationary. In sheets, business has become fairly brisk after a slight reduction in prices. The expected increase in the price of wire and wire nails resolved upon by the new syndicate has taken place, without, however, affecting the volume of business. Tin smiths, lock smiths, and other small iron industries are well employed. The characteristics of the Hungarian iron market are, on the whole, similar to those prevailing in Bohemia, with the exception that in Hungary there is momentarily a strong demand for crude iron.

THE VIENNA COMMERCIAL MUSEUM.—An important improvement has been introduced in the administration of this Institution, by the addition of a department in which information may be obtained regarding the Customs, tariffs, and other trade regulations in force in foreign countries. The general organisation of this department is similar to that of the Brussels Commercial Museum, with the exception that no information relating to railway tariffs can be obtained in the Vienna Museum; whereas this is one of the branches dealt with by the Brussels establishment. Information is given free of charge to merchants or their agents upon either verbal application or inquiry by letter. It is, however, preferred that inquiries should be in writing, giving exact particulars as to the country of destination, the character of the goods, the material employed in their manufacture, and where practicable accompanied by a sample. The department, in collecting information relating to foreign Customs tariffs, Excise duties, and other regulations affecting commerce, has been assisted by Austrian Consuls and Ambassadors abroad.

TRADE WITH ROUMANIA.—The protection policy of Austria and Roumania, which led to what is popularly known as the "Zoll-krieg," has, within the last two years, had the effect of almost completely killing trade between the two countries. The damage done does not only affect Austrian manufacturers, but also carrying companies. As an instance, I may mention that at the present moment the Danube Steam Navigation Company has hardly any Roumanian traffic; whilst a Russian company trading on the Danube do a fair amount of business with Roumania. The Russian Government, being eager to profit by the "Zoll-krieg," has established a sample warehouse at Bucharest, at an expenditure of 200,000 roubles, and this is stocked with samples of the production of Russian industry. As regards our Servian trade, the prospects are not much better than those of the Roumanian trade. Although Russian competition is not so strongly felt in Servia, the high tariffs on the Servian railways prove a great obstacle to our Eastern trade.

ELECTRIC LIGHTING.—Several leading manufacturers in Mariahilf and Neubau, Vienna, intend to erect a central electric light station for lighting both these districts. The estimated cost is £70,000, of which about one-third has already been subscribed, and it is not expected that there will be any difficulty in raising the balance among the commercial firms in the locality.

TELEPHONY.—The first telephone station under the direct control of the Government has been that established in the Rotunda, and steps have now been taken for the erection of six more stations in the town of Vienna itself. These will eventually be connected with the telephone exchanges in Baden, Vöslau, Wiener Neustadt, and Reichenau. A project is also under consideration for the establishment of a long distance telephone system between Prague and Vienna.

BRUSSELS, 26TH JUNE, 1888.

THE COAL MARKET.—Prices of industrial coal are well maintained, and rates for household coal are from 8s. 5d. to 10s. per ton. The *cahier de charges* (specification) for the new contracts for the supply of coal for the Belgian State railways contains some alterations as regards the test and performance of the coal. The lowest quality known as Type I. must evaporate in a locomotive boiler four and a half times its weight of water at a pressure of 90lb., and with a blast producing a reduction of pressure of 60mm. of water; the next better quality, known as Type II., must evaporate five and a half times its weight of water at the same pressure and draught; Type III. must evaporate seven and a half times its weight of water at 120lb. pressure, with a blast of 85mm.; and Type IV., the same efficiency, with a blast of 120mm. The Sambre Canal Company have made important reductions in their tariff for Belgian coal, and for products sent to collieries. Makers of briquettes in the centre and at Charleroi will be thereby enabled to obtain pitch from Paris under the most favourable conditions. In addition a rebate of 45 per cent., or about 1s. 3d. per ton, will be given on all shipments of briquettes.

THE METAL MARKET.—Prices on the whole are firm and the market is active, girders and angle iron being specially in demand. Merchant iron is quoted at 96s. per ton, girders at 96s., and No. 2 sheets at 120s. The price of Athus forge pig is 38s. 5d., and of the best Charleroi pig 43s. 2d. The rates for pig show some weakness, and the prices given above are only for urgent requirements. For future delivery reductions of 10d. to 1s. 8d. per ton are being made. Stocks are beginning to accumulate, and though they are small, the course of the market is nevertheless affected. A rise in the English market is the only thing which would have a counteracting influence. Some important orders for rolling stock for the Belgian State railways have been given out, the Dyle-Bacalan, Baume-Marpent, and Franco-Belge companies being the successful competitors. Old rails are quoted at 65s.

GLASS WORKS.—The convention for fixing the rates for the American market, which was concluded on the 1st of September last, was established for two years, but with power of bringing it to a conclusion on the 1st of July of this year. At a meeting of Charleroi glass makers, it has been decided to terminate the arrangement. This will cause fresh competition to our glass makers; but as manufacturers on the other side of the Atlantic had not been very strict in their observance of the convention, it will not make much difference.

TEXTILES.—The price of Russian hemp has risen about 1s. 8d. per cwt., and at Ghent there is far less being done than in the French markets. Home grown flax is quiet, but some important sales of Flanders yarn have been made. Owing to the bad prospects of this year's crop manufac-

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turers are anxious to contract for part of their requirements. Prices, in consequence, are firm, and a rise is anticipated.

ELECTRIC LIGHTING AT THE EXHIBITION.—So far the most successful installation is that of the Thomson-Houston Company, comprising seventy-eight arc lamps, the next best being that of the Société Bouckaert-Schuckert. The Pieper system has proved the worst, and the Brush Company's has not made a favourable impression. This has been due to the inferiority of the engines employed. M. Pieper has used a Van der Kerchove twin engine, which runs irregularly, and the Brush Corporation an engine by M. Van Acker, of Brussels, which has proved equally unsuitable. The Thomson-Houston Company employs an Armington-Sims engine of 84 h.p., driving two dynamos of 45 and 42 lamps capacity respectively. This engine works very well. M. Pieper is going to adopt an Armington-Sims engine instead of his present one. Some small installations will probably yet be put up in and around isolated buildings in the gardens, the motive power being supplied from some engines in the galleries of the machinery hall. The internal lighting at the Exhibition is throughout very good. Messrs. Ganz & Co. show their transformer system in practical operation; and M. Khotinsky has a nice exhibit of incandescent lamps supplied by batteries. There is a fair display of different types of direct driven dynamos, with high speed engines.

GUNPOWDER.—The Royal Powder Mills at Wetteren are making a new kind of gunpowder, which gives similar results to the Lebel powder; it is called *poudre papier*, and its ballistic value is much higher than that of the ordinary infantry powder. With a charge of 2½grm. of this powder, a bullet fired from a small calibre rifle attained a muzzle velocity of 1970ft. The new powder does not foul the barrel, and produces very little smoke.

DÜSSELDORF, 25TH JUNE, 1888.

THE IRON MARKET.—The iron market is quiet, but firm. A better tone has appeared within the last few days, arising from the improving aspect of affairs in England and more favourable reports from the United States. Business in pig iron is still very slack. Stocks increased 5500 tons in the month of May. Judging from the amount of business now being transacted, there should be a larger accumulation by the end of the current month. The weekly output of pig is now very large, and imports are heavy. The demand for spiegel has further decreased. The 10 to 12 per cent. quality is now offered at 57s. Forge is but little sought after. Lower prices are accepted from foreign buyers. For Luxemburg forge, however, there is a stronger demand, and prices have advanced to 41s. Thomas pig is also in better demand, and prices have become very firm again. For Bessemer, the market is somewhat dull. Foundry is still in brisk demand. The finished iron trade exhibits a little more life. Bars and wire constitute dull features, but there is considerable animation in most other classes of goods. Joists are in brisk and increasing demand. It is not unlikely that an advance in price will be declared at the next meeting of the syndicate. Orders for plates continue to come in freely. The make of plates by the firms which are members of the syndicate amounted in May to 10,333 tons, against 9548 tons in the same month of last year; and the orders booked in the same time amounted to 9036 tons, against 7289 tons. Sheets are still neglected, and some manufacturers have begun to restrict the make. Founders are very busy, and great activity prevails in machine shops. The exports of machines, other than sewing machines, in the first four months of the current year amounted to 19,263 tons, against 17,777 tons in the corresponding period of 1887. The make of pig iron in the month of May amounted to 360,855 tons, against 327,282 tons in May of last year. The total production in the first five months amounted to 1,756,310 tons, against 1,527,721 tons in the corresponding period of 1887.

ZINC PRODUCTION IN SILESIA.—The weakening tendency of the market for spelter has directed attention to the production of the Silesian mines. The output in the first quarter of the current year amounted to 20,999 tons, against 20,478 tons in the same period of 1887. The deliveries in the first quarter amounted to 19,727 tons, valued at £315,164, against 16,805 tons last year, valued at £219,033. As the number of workmen employed has increased only from 6047 to 6269, the augmented value represents a wider margin of profit. The exports from the whole of Germany have decreased compared with last year, the quantities for the first four months being, for spelter and scrap zinc, 14,911 tons, against 15,934 tons, and for rolled zinc 3483 tons, against 5425 tons.

LILLE, 26TH JUNE, 1888.

TEXTILE MANUFACTURES.—The trade in textile goods remains on the whole dull and lifeless. There are fluctuations from week to week, which serve only to raise and depress the hopes of manufacturers. Little or no progress is made towards recovery. In linen goods, in which this district is chiefly interested, business has decreased compared with last week. We are certainly in the dead season, but the turnover is below the average. Cotton goods move heavily in the market. The woollen trade, too, remains quiet, no further improvement having taken place. In silk goods a fair amount of business is being done; but the market lacks life and buoyancy. The foreign trade shows some expansion relatively to last year. The declared value of the imports of textile goods in the first five months of the current year amounted to £2,743,680, against £2,728,560 in the corresponding period of 1887. The value of the exports in the same time amounted to £11,671,080, against £11,616,000 last year. These totals were made up as follow, the figures within brackets being those for 1887:—Imports: Linen goods, £91,040 (£86,960); jute, £29,760 (£31,680); cotton, £812,520 (£950,120); woollen, £890,440 (£877,920); and silk, £919,920 (£781,880). Exports: Linen goods, £142,720 (£130,080); jute, £40,920 (£37,960); cotton, £1,715,760 (£1,855,000); woollen, £5,884,400 (£5,817,160); and silk, £3,887,280 (£3,775,800).

THE FLAX AND YARN MARKETS.—There is now but little business doing in flax, either home grown or Russian. The heavy rains which have fallen have put an end to the speculative buying that infused life into the market a fortnight ago, but prices remain firm. There is still considerable activity in yarns. Spinners have plenty of orders on hand, and refuse to commit themselves far into the future. Prices are firmly maintained. More business is being done in hemp. Tows are specially in demand.

THE IRON MARKET.—There is no lack of activity in the iron market of this locality. On the contrary, the orders which come to hand, though individually of little importance, are sufficiently numerous to maintain a fairly strong and steady course of business. Yet some anxiety is felt in respect to the immediate future of the trade. The merchants of Paris are able to supply the present needs for the few manufacturers who remain outside the syndicate, and consequently they persist in depressing the market. The latest accounts received from other districts are not encouraging, and the political outlook is clouded. For the present prices remain firm. At Valenciennes there is a brisk demand for steel billets, while at Denain there is great activity in the works making metal sleepers.

AMSTERDAM, 26TH JUNE, 1888.

THE PORT OF ROTTERDAM.—The yearly statistical review of the Port of Rotterdam has just been published, and is, as usual, full of varied information. In 1887, 4153 steam and sailing vessels, of a total of 2,488,264 tons, entered the port. Compared with 1886, this is an increase of fully 10 per cent. The figures show that Rotterdam is, in commercial importance, the eighth port of Europe, and its shipping is only a little under that of Hull and Antwerp. The report states that last year 7272 steam and 1547 sailing vessels of 14,528,943 tons, in addition to 3640 fishing boats, used the new waterway. These totals show a considerable increase compared with those of 1886. The framers of the report mention that the new waterway or ship canal from the sea to Rotterdam is being improved, and answers its purpose very well, for the time being; but they point out that the tendency everywhere is to increase the depth and width of ship canals and the accommodation of harbours for ocean-going craft. The minimum depth of the Rotterdam waterway at low water will only average 65 decimetres, whilst Havre will have, under similar circumstances, a depth of 80 decimetres, as soon as its Harbour Act is carried out. The Chamber of Commerce at Rotterdam urges that the minimum depth of the ship canal to the Hock of Holland ought to be increased to 80 decimetres, thus enabling the largest ocean steamers to proceed to Rotterdam.

NATIONAL INDUSTRIAL ART EXHIBITION.—An exhibition has been opened this month near the Hague. The exhibits comprise an extensive collection of industrial art products. The principal cities of Holland have contributed to this Exhibition. A congress of Dutch manufacturers, promoted by the Dutch Society for Industry, will be held at the Hague from the 9th to the 13th of July next, in which various questions relating to national and international manufactures are to be discussed.

WINTERTHUR, 25TH JUNE, 1888.

COAL.—The annual imports of coal into Switzerland average £720,000 in value. Attempts have been made from time to time to find coal here, but without result. The last large undertaking with this object, which sunk shafts in the canton of Aargau, lost thousands of pounds; but a new syndicate has now been formed in Zurich to bore for coal in the neighbourhood of Cornol, in the Bernese Jura. It is considered certain that a bed of coal extends from the Vosges, through the Jura mountains and the Swiss plateaus, to the Alps. For the most part the depth, viz., 5000ft., is too great to allow of its being worked profitably; but in certain portions of the Jura the depth is only 2000ft. It is intended to sink shafts to reach these latter strata, and if the experiment is successful it will bring about a revival of the iron industry in the Jura.

EXPORT TRADE.—The Geneva watch making industry has been very active for some months past, and large orders are received from America. The value of the textile goods exported to the United States in May from St. Gall, which is the centre of machine embroidery, shows an increase of 25 per cent. compared with the same month last year, the total value being in round numbers £63,000.

RAILWAY BRAKES.—The Gothard Railway, after experimenting for some time, have decided to adopt the Westinghouse automatic brake on their system. The same brakes are also being employed on the North-Eastern, Central, and Western railways of Switzerland.

BICYCLES FOR THE ARMY.—At the last military manœuvres the system of employing bicyclists for carrying dispatches was found to work so well, that cyclists will permanently form part of the army corps. This has given an impetus to the manufacture of bicycles in Switzerland, and the Government engineering shops at Thun have now taken up this branch of manufacture, and supply bicycles for military purposes.

NEW YORK, 16TH JUNE, 1888.

IRON AND STEEL.—The annual report of the American Iron and Steel Association states that the production of pig iron in the United States during 1887 was 6,417,148 tons, against 5,683,329 tons in 1886, an increase of 13 per cent. Of this 60 per cent. was made with bituminous coal and coke, 26 per cent. with coke and anthracite, 6 per cent. with anthracite, and 7 per cent. with charcoal. The production of Bessemer and Clapp-Griffiths steel amounted to 2,936,033 tons, an increase of 29 per cent. Eight new Bessemer and three new Clapp-Griffiths plants were completed in 1887, and at the close of the year there were altogether forty-three Bessemer plants with eighty-nine converters. The production of steel rails was 2,049,638 tons, against 1,526,410 tons in 1886, and 959,471 tons in 1885.

THE EDISON PATENT CASE.—The decision of Judge Wallace in the suit of the Edison Electric Light Company *versus* the United States Electric Lighting Company has attracted considerable interest amongst electricians here, and is important because affecting generally a point in the American Patent Law on which opinions have hitherto been divided. The United States Electric Lighting Company are antagonists of old standing of the plaintiffs, and have never shirked legal proceedings, but rather invited, or at least facilitated, the bringing of actions against them, so as to define their legal position with regard to certain patents. In the present case they were accused by the Edison Company of having infringed a certain patent for improvement in dynamos, which Edison applied for in America, in August, 1880, and in Austro-Hungary shortly after; but which, owing to the slow procedure of the United States Patent Office, was granted and published there a considerable time after the issue of the Austrian patent. The defendant company did not enter into the technical question whether they had or had not infringed, but relied solely on the fact that the Austrian patent had been allowed to drop in 1883, and that, therefore, the American patent was also no longer in force. The point at issue was whether the clause which makes the continuance of a United States patent depend upon that of any anterior foreign patent, should also apply to the present case, where the application for a United States patent had been made before any application for foreign patents. According to Judge Wallace, the clause also applies to such cases, so that in the future American patents, notwithstanding priority of application, will only remain valid as long as any foreign patent for the same invention remains in force. The practical effect of the verdict gained by the United States Electric Lighting Company in this suit is to throw open for public use not only the patent in question, but many others of Edison's patents, which have been taken out and then dropped in foreign countries.

NEW ELECTRIC RAILWAY.—Hitherto electric railroads started in this country were almost exclusively for passenger traffic; but a new line, the Ansonia, Birmingham, and Derby Electric Street Railroad, which was opened a fortnight ago, is mainly intended for goods traffic, although it does also carry passengers. The line is built on the Van Depoele system, and is in the form of the letter **Y**, the right arm of which runs to Ansonia, whilst the left crosses the Naugatuck river to Birmingham, and the stem leads to Derby dock, where the generating station is established. The river is not navigable above Derby, and the large factories of Ansonia, some three miles above the docks, could therefore not directly be reached by the Naugatuck Valley Steamboat Company running steamers from New York, and the goods traffic to New York went mostly by rail. The new electric road is intended to divert this traffic into Derby, and thus benefit the steamers. The line is operated from an overhead wire 380mils. diam. suspended about 16ft. above the street level from cross wires stretched between poles on either side of the track, a pair of poles occurring about every 100ft. The return current passes through the rails, which are of the ordinary tramway pattern, but joined by special copper fish plates. The current is taken off the wire by means of a grooved wheel pressing upwards against the wire, a swivel arm and spring attachment giving the required flexibility to the system. At the generating station within the Derby dock there is a 100 h.p. engine and boiler, and an 80 h.p. dynamo, and the motors used on the cars are of 15 h.p.

NEW RAILWAY.—A new system of railway has been invented by Mr. E. M. Boynton, who indulges in the very modest expectation of running trains on it at the rate of 100 miles an hour. The railway has one track laid on the ground and another directly over it, carried on a frame work. The locomotive and cars have wheels on the bottom and on the top, so as to make derailment impossible. The locomotive, which is now being built in the shop of Messrs. Russell & Sons, of Newburyport, Mass., has a single driving wheel 8ft. in diameter, and cylinders 12in. diam. and 14in. stroke. The boiler is 13ft. long and 42in. diam. All the wheels are of cast steel, with deeply flanged tyres shrunk on. The seating capacity of the train will be for one hundred passengers, and the first experiments are expected to take place in next August.

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THE EASTERN ARSENAL OF TIENTSIN.

By Allan C. Wylie.

II.

New Powder Mills.—These mills have been recently erected on the south and west sides of the Arsenal grounds, as far apart from the other buildings as possible, and comprise: (1) A brick building containing a charcoal breaking down machine and two pulverising drums; two nitre pulverising drums and two sulphur ditto. (2) Two buildings, each containing two mixing drums. (3) Two buildings, each containing two incorporating machines of the usual edge runner type. (4) One building containing one breaking down machine and one powerful hydraulic press and set of pumps. (5) One building containing one corning frame, the rolls being made of gun metal, with saw teeth, one roller being driven at double the speed of the other; from the corning rolls the powder is fed into two hexagon wire-covered reels, working on a slope, the wire cloth varying in the size of mesh to suit the various sizes of grains required. (6) One building containing two dusting reels, also of hexagon form, by which the superfluous dust is removed, and the grains again separated into their various sizes. (7) One building containing two glazing drums of cylindrical form made of oak. (8) One building containing two prismatic machines, which compress the powder into hexagon prisms about 3·4cm. in diameter by 2·4cm. in thickness, with a central hole about 93mm. in diameter. These machines are worked by eccentrics, with a movable feed plate, and are more complicated and consequently more liable to derangement than similar machines worked by hydraulic power. The whole of these machines are of German manufacture, as are also the engines, boilers, and gearing by which they are driven. The engines are a pair of coupled horizontal condensing engines with cylinders about 16in. diam. and 3ft. stroke, steam jacketed, with a peculiar expansion valve automatically actuated by a complicated arrangement of governor; but, in my opinion, a long way behind the best examples of the same class of engines made in England. The fly wheel is grooved to carry twelve ropes 6½in. in circumference, and the power is transmitted by rope gearing to the various buildings enumerated. The boilers supplying steam to these engines are three in number, placed in a building about 250ft. distant from the engines, and this distance must cause considerable loss by condensation. They are constructed on the principle of the Root's boiler, but have "Schwartzkopff's Patent" on the name plate. They are marked 10 atmospheres (150lb.), which, I presume, is the limit of their working pressure.

Drying Stove.—This is placed about the same distance from the boilers as the engines, but in the opposite direction, and the necessary heating power is conveyed to them by pipes and reducing valves.

Powder Proof Range.—This is situated in the eastern part of the grounds, and comprises an Armstrong 12lb. breech-loading gun, of the newest design, mounted on a beautiful flanged steel field carriage, the wheels of which are exceedingly well made and finished. It is fitted with a crusher gauge and the necessary apparatus for recording the muzzle velocity by one of Le Bulengé's chronoscopes, which is placed at a convenient distance from the firing range, and electrically connected with it. The strength of the powder manufactured is here carefully tested and tabulated by a very intelligent Chinese officer, who has been educated in the United States. I also noticed a densimeter, made by Elliott Brothers, London, consisting of a barometer tube with air pump attached, for ascertaining the density of the powder.

Drawing Office.—In this department there are about twenty young Chinese students, who all seem to be well educated. They are studying mechanical drawing and engineering, so as to qualify themselves for positions as foremen and managers of the various departments.

General Remarks.—The wages paid to the best workmen range per month from $15 to $20; ordinary workmen, $5 to $9; boys, $1½ to $3; coolies or labourers, 150 cash per day (about 7½d.). Work commences at 7 a.m. and finishes at 5 p.m., with an hour for dinner, and is carried on every alternate Sunday. The men seemed very industrious, quiet, and contented. Every department appeared to be carefully conducted, the machinery and shops were kept in first class order, and notwithstanding the dangerous nature of some of the processes enumerated, very few accidents have occurred since the works were commenced. The number of workmen at present employed is about 1500, all of whom, with their managers and foremen, are Chinese; the only European connected with the Arsenal being Mr. J. Stewart, the chief engineer, who has had the superintendence of erecting and starting the various departments I have named, with the assistance for short periods of Europeans sent out by the makers of the various plants, who also instructed the natives in the manufacture of ammunition, cartridges, &c. Mr. Stewart seems to have thoroughly and deservedly secured the confidence of the Chinese Government by the energetic and scientific manner in which his onerous and varied professional duties have been carried out. In the whole of this extensive establishment I did not see a single soldier or policeman; but attendants are stationed at the gate, as at Woolwich Arsenal, to see that nothing is taken away as the men leave work. Very little wood working machinery is used in the Arsenal, as the wages of coolies—who are excellent timber sawyers—are so low, viz., about 7½d. per day. Cannon, rifles, small arms, steel shells, or gun carriages are not made here; but it is evident from what I have seen that these departments will, one by one, be added at no distant period. An abundant supply of good coal is obtained from the Kaiping mines, about ninety miles distant; from which, as already mentioned, a branch from the new railway will be laid into the Arsenal.

Imperial Naval College.—On the eastern side of the Arsenal grounds, but kept totally distinct, are erected a series of buildings, called the Imperial Naval College, which is under the direction of the Taotai Lü, a member of the Hanlin College, which is the highest literary rank to which a Chinese can attain. The College is divided into two parts, the executive and the engineering. The former is under the control of Mr. Yen, a Chinese naval officer, who has graduated at the Royal Naval College, Greenwich, and has seen considerable service afloat. His staff has recently been reinforced by Mr. W. McLeish, B.A., formerly of Dulwich College, London. The studies in this department comprise mathematics, navigation, and nautical astronomy; and from the number of observations made during each twenty-four hours, I think that the latitude and longitude of this part of the world ought to be deeply impressed on every student's mind. Each student, before being admitted into this College, must pass a severe examination in Chinese classics, which also continues to form an important feature of his studies during the whole of his term. At the time of my visit, a batch of twenty-four students had just completed their course of instruction, and were about to take up their appointments in the steamers of the Imperial northern fleet, called the Pei-Yang squadron. The usual number of students in this department is about sixty, and the lessons are all given in English, the study of which begins as soon as they enter the College. I examined the engineering department with great interest, every facility for so doing being given me by Mr. H. W. Walker and Mr. G. H. Hearson, both of them engineers of the Royal Navy, who have been specially selected and lent by the British Government to fill their important positions. After being introduced to the courteous Chinese official in charge of this department, Mr. Kan, who welcomed me with true Chinese hospitality, I first paid a visit to the junior class of this department, and on the invitation of the Chinese instructor, I proceeded to question them on some elementary subjects. These students had been in the College about a year; their studies having been limited to acquiring a knowledge of the English language, elementary arithmetic, algebra, geometry, and geography. Considering the short time they had been engaged in these studies, and in a language totally dissimilar to their own, I was much impressed with the fluency displayed in reading English, and in solving problems in Euclid in the same language, asked at random. In describing on a black board the circles necessary to elucidate the problems, I was much amused by the ingenuity displayed in drawing these circles without the aid of compasses. Taking his long plaited queue in his left hand, and adjusting the radius with a small piece of chalk in his right hand, the student swept the circles with a rapidity and accuracy which seemed almost to foreshadow that the use of compasses in China would be found absolutely unnecessary.

At the time of my visit the senior class of students were engaged in the workshops connected with the College, and a brief description of these may not be uninteresting. These consist of a large and commodious fitting and turning shop 140ft. long by 40ft. wide, in which are erected a well selected plant of tools, consisting of turning and screw cutting lathes, planing, shaping, slotting, and drilling machines, &c., with benches and vices to correspond. The students are here instructed in the various uses of these tools during three days per week, the remainder of the time being devoted to theoretical studies. In this shop I was much pleased with the cleanliness and good order in which everything was kept, showing the care with which the early training of their English instructors had been impressed on their pupils. Adjoining this shop are the pattern, smithy, and moulding shops, in which all these branches are carefully and practically taught. These workshops have been in operation about three years, and were designed and carried out by the English instructors already named. In the interesting torpedo department, which is under the direction of Mr. Hearson, are two vertical engines and air compressors, made by the General Engine and Boiler Company, London, and a good supply of torpedoes. Those I saw are constructed on the Schwartzkopff principle, with phosphor bronze air chambers, and gun metal shells. The students are instructed to take these asunder, fit them together again even to the most minute and accurate details, and make the necessary adjustments. Close at hand is a wharf, from which dummy torpedoes are launched into an adjoining creek. Round the walls of this department are a series of well finished drawings and sections of all parts of the torpedoes, made by the students themselves. All the various working drawings have been made by the students under the supervision of their instructors, and reflect great credit on both masters and pupils. I looked over a set of marine engine drawings made by one of the students, and examined him as to the names of the various parts, their uses, and what materials they were made of, and I was certainly surprised at the rapidity and correctness of his replies—all given in English. The normal number of students in the torpedo department is about sixty. The whole of the students in the College are drilled daily for an hour, on the German military principle, and the senior students make excellent rifle practice. There is also a ship's mast and rigging on the grounds, on which they are exercised; but a good gymnasium, similar to those in use in all naval and military colleges, would still more improve their mental and physical capabilities. All the students are lodged, clothed, and fed at the Government expense, and receive pay varying from three to eight taels (15s. to 40s.) per month, according to their qualifications and seniority. The College and students are personally inspected at least once a year by His Excellency the Viceroy, Li Hung Chang, who takes a great interest in this institution, and to whose enlightened policy much of its success is due.

These students, as they finish their education and enter the Chinese navy, will no doubt exercise a great influence on their fellow countrymen, not only on board ship, but throughout every part of China; as what they have been taught in this College, and what they have learned personally of Europeans and their habits and customs, must form the theme of many an interesting discourse at their own homes, and from there permeate every class of Chinese society, down to the hardest working coolie. A great and ancient nation like the Chinese cannot be altered to new methods of thinking, teaching, and working in a short period, and it is only by such institutions as I have endeavoured to describe that it can be leavened and raised in the scale of nations. Baron von Richthoven, who has personally explored fourteen provinces of China, states that no province is wholly without coal; but the chief deposits are in the southern half of Chan-si, in the south of Human, and in the west of Chan-ting; and that the coal seams of Chan-si alone cover an area of not less than six hundred square miles, and contain 730,000,000,000 tons, the quality being an excellent anthracite; and that in the south-east of the same province there is another basin nearly as large, containing coal of a more bituminous character, which is already largely worked. The total annual consumption of coal of the world being taken at about 300,000,000 tons, there is therefore enough in the southern part of Chan-si alone to supply the demand of the whole world for probably 2000 years. Therefore, when similar arsenals and colleges to those I have described have been established in the various provinces of this immense empire, coupled with a complete system of railways—the one now in course of construction to this city being, without doubt, the forerunner of others in the near future—and with such a coal supply as I have indicated, China, with its great resources and cheap labour, will then begin to take its proper position among the nations of the world.

LIFE SAVING AND PRESERVATION CONGRESS.

The third meeting of the French Congress for the Preservation and Saving of Life will be held from the 25th to the 30th September next in the Palais de L'Industrie, Paris. The central portion of this large building will be converted into an immense lake, having a surface of about 5470 square yards. On this lake will be represented the various systems of lifeboats in use on the French coasts. In another basin, which will be erected with transparent walls so that it may be possible for visitors to see the interior of the basin, there will be shown at intervals divers engaged at work on an imaginary wreck. The questions which the Congress will consider are divided into the following ten sections: (1) Accidents which take place from natural causes, such as are due to the atmosphere, inundations, earthquakes, &c.; (2) the cause of epidemics and the means of their prevention; (3) the best means to be adopted for the prevention and extinction of fires; (4) the prevention of shipwrecks, the lighting of the coasts, and the erection of lighthouses; (5) the measures to be taken for the medical and surgical treatment and accommodation of wounded soldiers in time of war; (6) the means to be adopted for the prevention of accidents to persons engaged in dangerous occupations, such as those working in pits, in compressed

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air, water, &c.; (7) accidents occurring to persons travelling in railway trains, tramways, carriages, on board ship, &c.; (8) the best measures to be adopted for helping persons injured by accidents which render them incapable of providing for themselves and their families the necessaries of life; (9) the means to be taken for assisting persons wounded in the streets by falls, blows, bites of insects, &c.; (10) domestic accidents, their prevention and alleviation.

SHIPBUILDING NOTES.

Messrs. Jos. L. Thompson & Sons, North Sands shipbuilding yard, Sunderland, launched on the 23rd inst., the handsomely modelled steel screw steamer "Enterprise," built to the order of Messrs. Marwood & Co., of Whitby, and sister vessel to the "Discovery," launched on the 9th inst. by the same builders for the same owners. These vessels have a deadweight capacity of about 3000 tons on a light draught, and are of the "well deck" type. The engines, which have been constructed by Messrs. Thos. Richardson & Sons, West Hartlepool, are of the triple expansion type, and the working pressure is 150lb. per square inch.

The steamer "Dotterel," belonging to the Cork Steamship Company, went for her official trial trip last week after having her machinery converted to the triple expansion type by Messrs. David Rollo & Sons, of Liverpool. The cylinders are now 20in., 32in., and 52in. diam. respectively, with a stroke of 36in. There are two new steel boilers, 12ft. 6in. diam. by 9ft. 6in. long, each being fitted with three of Brown's patent ribbed furnaces, 3ft. 11in. diam. With a steam pressure of 150lb., at 74 revolutions per minute, 875 h.p. were indicated, the vessel running an average speed of 11 knots per hour. The improvements have resulted in an increase of speed with a reduction of fuel.

The steamer "Quito," just completed for the Pacific Steam Navigation Company by Messrs. Laird Brothers, of Birkenhead, made her official trial trip in Liverpool Bay last Saturday. With the engines running at 90 revolutions per minute, steam at 155lb. per square inch, upwards of 900 h.p. were indicated, and the vessel ran about 13 knots per hour on the measured mile. The vessel is 225ft. long, 35ft. broad, and 22ft. 6in. deep; and is the twelfth vessel Messrs. Laird Brothers have built for the Pacific Steam Navigation Company.

On the 19th inst., Mr. C. J. Biggar launched from his shipbuilding yard, Londonderry, the "Ivy," a handsome screw steamer for Messrs. A. A. Laird & Co., Glasgow, for their Londonderry and Glasgow cross channel trade. The dimensions of the vessel are: Length, 200ft.; breadth, 28ft.; depth, 13ft. 6in. She is built of steel, beyond Lloyd's requirements. There is poop accommodation for sixty first class passengers, and a handsome smoking room and companion on the poop deck. The forecastle is fitted for steerage passengers, and the holds between decks for cattle. Electric light will be fitted throughout.

On the 25th inst., the passenger steamer "Gulf of Corcovado" was launched from the yard of Messrs. R. and W. Hawthorn, Leslie, & Co., Hebburn. The vessel has been built for the Greenock Steamship Company. The length of the vessel is 320ft.; breadth, 40ft.; depth, 25ft.; having long poop, long bridge, and topgallant forecastle. She is built of Siemens-Martin steel, and will class 100 A1 at Lloyd's, and to gain the Board of Trade passenger certificate. She is the first of four vessels building by Messrs. Hawthorn, Leslie, & Co., for the Greenock Steamship Company, for their Gulf Line of steamers, and is intended for their South American trade.

The "Alexandra," built by Messrs. McKnight & Co., Ayr, for the Alexandra Towing Company, Liverpool, was launched on the 22nd inst. The "Alexandra" is an iron screw tug, 92ft. by 20ft. by 12ft. The engines, which are of 30 h.p., are by Messrs. Muir & Houston, Glasgow.

The "Oriole," paddle steamer, for the passenger service of the General Steam Navigation Company, London, was recently launched from the yard of Messrs. John Scott and Co., Kinghorn. The dimensions of the "Oriole" are as follow: Length, 236ft.; breadth, 27½ft.; and depth, 10ft.

The paddle steamer "Princesse Henriette," built to the order of the Belgian Government, and recently launched from the ship yard of Messrs. William Denny & Brothers, of Dumbarton, went on her official trial on Friday, the 15th inst., when most satisfactory results were obtained. The mean speed obtained during the trial was 21·1 knots, being six-tenths of a knot in excess of the requirements. The "Princesse Henriette" is a two-bowed vessel, 300ft. in length, 38ft. in breadth, and 13ft. 6in. moulded depth. She is fitted with a rudder forward as well as aft, to enable her to leave the harbour at Ostend without having to turn inside it. The stipulated draught of water was not to exceed 8ft. 8in.; but the builders have succeeded in keeping well within these limits, and the actual draught is much less. The engines are on the compound principle, having two cylinders of 59in. and 104in. respectively, with a stroke of 6ft.; the slide valves are worked by Brock's valve gear. On Thursday, the 21st inst., the "Princesse Henriette" made the quickest passage on record between Ostend and Dover, the time occupied being 2 hours and 50 min., which is less than the time taken by the steamers now on regular service by 1 hour and 50 min.

Notices of Meetings.

NEXT WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Monday, 2nd July, 5 p.m. General monthly meeting.

ROYAL UNITED SERVICE INSTITUTION.—Friday, 6th July, 3 p.m. Paper to be read on "The Machinery of Modern War Ships," by Mr. H. J. Oram, Engineer, R.N.

GEOLOGISTS' ASSOCIATION.—Friday, 6th July, 8 p.m. Papers to be read on "The Rhætics and Lias of Glamorganshire," by Mr. H. B. Woodward, F.G.S.; on "The Geology of the Forest of Dean," by Mr. E. Wethered, F.G.S., F.C.S.; and on "The Clays of Bedfordshire," by Mr. A. C. G. Cameron, of H.M. Geol. Survey.

PRICES CURRENT, 28TH JUNE.

Quotations at per ton, unless otherwise specified.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	25	10	0
" Ceylon	"	22	10	0
Cottonseed	"	20	15	0
Cod	"	18	10	0
Lard	"	43	10	0
Linseed	"	18	5	0
Palm, Lagos	"	20	0	0
Rapeseed: English	"	24	5	0
Seal: Pale	"	22	10	0
" Brown	"	16	0	0
Sperm	"	40	0	0
Whale	"	14	0	0
Turpentine	per cwt.	1	10	6
Coal	per gal.	0	0	5½
Petroleum (Refined)	"	0	0	5⅝
" Spirit	"	0	0	7¼

PIG IRON.

Middlesbro' Warrants, No. 3	31/6½	Cash	
Scotch Warrants, m/n	38/0½	"	
Hematite Warrants, m/n	42/1½	"	
Stocks in Stores. Scotch	998,762—Inc. for week,	2651	Tons
Middlesbro'	283,190—Dec. "	1093	"
Hematite	198,804—Dec. "	1165	"

Exclusive of stocks in makers' yards.

Market steady.

	No. 1.		No. 3.		
Coltness	47/3	.....	43/3	f.o.b.	Glasgow.
Gartsherrie	43/6	.....	41/3	"	"
Dalmellington	39/3	.....	37/9	"	Ardrossan
Eglinton	37/6	.....	36/6	"	"
Glengarnock	42/6	.....	38/3	"	"
*Derbyshire	—	.....	34/6	f.o.t.	Works.
*Lincolnshire	—	.....	31/6	"	"
*Lancashire	—	.....	36/6	"	"

*Forge Quality, about 1s. per ton less.

ANGLES, PLATES, BARS.

	Com. £	s.	d.		Best. £	s.	d.	
Middlesbro' Bars	4	15	0	.....	5	5	0	f.o.t. wks
" Angles	4	12	6	.....	5	0	0	"
" Plates	4	17	6	.....	5	7	6	"
Staffordshire Bars	4	17	6	.....	5	7	6	Manch'r.
" Angles	5	7	6	.....	5	17	6	"
Crown Sheets	6	10	0	.....	6	15	0	"
" Hoops	5	0	0	.....	5	10	0	"
"Siemens-Martin" Steel Boiler Plates					7	15	0	"
" Ship and Girder					7	10	0	"

METALS.

Spelter: Ordinary	£15	5	0	to	15	10	0
Copper: British Cakes and Ingots	81	0	0	"			
" Chili Bars	81	5	0	"	81	15	0
" Manufactured (strong)	88	0	0	"			
Lead: Common Pig	13	10	0	"	13	15	0
" English Sheet	14	5	0	"			
Tin: Straits	75	5	0	"	75	15	0
" Australian	75	7	6	"	75	17	6
" English Ingots	83	10	0	"	84	10	0

CARRON PIG IRON—BRAND "CARRON."

Present prices of "Carron" pig iron are as follow:—

	No. 1 Selected.	No. 3.	No. 4.
Prices, per ton	52/-	43/6	42/6

F.O.B. Grangemouth or F.O.R. Carron Works.

Terms: Cash on 10th of month following delivery.

	Per ton extra.
Delivery at Leith or Granton	2/-
Do. at Broomielaw, Glasgow	2/6
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	9/6
Do. at do. (traders' dock)	7/6
Do. at Hull (on quay)	5/-

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER.—Chili gobs continue firm at £81. 5s. to £81. 15s. per ton for sharp cash parcels; £78. 7s. 6d. to £78. 17s. 6d., three months. Manufactured, quotations are easier, without producing an increase in the demand.

TIN.—Quotations are fully £4 per ton lower. Straits spot parcels, £75. 5s. to £75. 15s. per ton; three months, £75. 15s. to £76. 5s. per ton, and tending downwards.

LEAD.—Slightly firmer; Spanish, £12. 2s. 6d. to £12. 5s. per ton.

SPELTER.—A little lower and weak.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	1	2	to	0	1	3
" " Liquid	gal.	0	1	2	—	0	1	9
" Citric	lb.	0	1	7½	—	0	1	7½
" Oxalic	"	0	0	3	—	0	0	3½
" Sulphuric	ton	1	5	0	—	1	10	0
" Tartaric	lb.	0	1	5½	—	0	1	6½
Alum: Lump (powder 10/- ex.)	ton	4	7	6	—	5	0	0
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	23	0	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	15	0	—	.....		
" Liquor	lb.	0	0	3½	—	.....		
Bleaching Powder	ton	7	5	0	—	7	10	0
Bisulphide of Carbon	"	12	0	0	—	12	10	0
Borax	"	30	10	0	—	32	0	0
Benzole (90%)	gal.	0	2	6	—	0	2	7
" (50/90%)	"	0	2	2	—	0	2	3
Copper Sulphate	ton	20	10	0	—	21	10	0
Copperas	"	1	10	0	—	2	0	0
Kieserit	"	1	10	0	—	.....		
Lead: Nitrate	"	23	0	0	—	.....		
" White Sugar	"	26	10	0	—	27	0	0
" Brown "	"	21	0	0	—	22	0	0
Potash: Bichromate	lb.	0	0	4½	—	.....		
" Caustic	ton	20	10	0	—	21	0	0
" Carbonate	"	17	10	0	—	17	15	0
" Chlorate	lb.	0	0	5½	—	0	0	5¾
" Prussiate (Yellow)	"	0	0	6¾	—	.....		
" Sulphate (Basis 90%)	ton	8	17	6	—	9	5	0
Precipitate: Red	lb.	0	3	1	—	0	3	2
" White	"	0	3	2	—	0	3	3
Salts: Epsom { Bags	ton	2	10	0	—	2	12	6
Epsom { Casks	"	3	5	0	—	3	10	0
" Glauber	"	1	5	0	—	1	10	0
Sulphur: Sublimed Flowers	"	8	10	0	—	9	0	0
" Recovered	"	4	10	0	—	4	12	6
Soda: Ash	deg.	0	0	1	—	0	0	1⅛
" Caustic (White, 70%)	ton	6	12	6	—	6	17	6
" " (" 60%)	"	5	12	6	—	5	17	6
" " (Cream, 60%)	"	5	12	6	—	.....		
" Crystals	"	2	10	0	—	.....		
" Bicarbonate	"	5	10	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	1	—	0	1	2
Tartar, Cream of	cwt.	6	3	6	—	6	5	0
Zinc Sulphate	ton	7	10	0	—	8	5	0

Messrs. S. W. Royse & Co., Manchester, report as follows:—

A better feeling exists in the chemical markets generally. Bleaching powder is pressed for sale at lower figures. The demand for soda ash is regular, and values practically unchanged. Caustic soda is also in fair demand at steady prices. Carbolic acid continues to weaken. In acetate of lime rather more has been doing, but prices tend downwards. In sulphate of ammonia a fair amount of business is being done at steady prices. Muriate of ammonia is in good demand, and acetate of soda is strongly inquired for.

MR. ROWLAND WILLIAMS, F.I.C., F.C.S., Manchester, has removed his chemical laboratory from Albert Square to larger premises at 28, Pall Mall, Manchester.

TRADE CATALOGUES.—We have received from Messrs. Lancaster & Tonge, Pendleton, near Manchester, a copy of their new catalogue, which contains illustrated particulars of steam engines, pumps, injectors, screwing machines, and other apparatus manufactured by the firm. They also issue a smaller price list of their leading specialties.—Messrs. Archibald Smith and Stevens, Queen's Road, Battersea, S.W., in a catalogue just sent out give a complete illustrated list of lifts of all kinds.—We have also received from Messrs. George Richards and Co., Limited, Broadheath, near Manchester, a complete and neatly illustrated catalogue referring to Richards' automatic cut-off engine. The illustrations show general views of the complete engine and all important details, while the description explains the advantages claimed by the makers. A number of indicator diagrams are given in order to illustrate the perfect regularity of the automatic cut-off under varying conditions of load. In perusing this catalogue, the reader will find some novel and interesting departures in the design of the engines.

NEW ENGINEERING WORKS AT BURY.—Messrs. John Downham and Co., Bury, are commencing the erection of an iron works, which is to be called the Barn Brook Iron Works. The main buildings will be 150ft. long and 50ft. wide, and will be constructed from the materials which formed the east nave of the Manchester Exhibition. Employment will be found for 150 hands, who are to be engaged in the making of all kinds of machinery used by dyers, bleachers, finishers, and calico printers. A large travelling crane, 35ft. span and 24ft. high, is to be used for facilitating the transit of work to a number of heavy lathes, planing, slotting, and radial drilling machines; and the part of the building which is not surmounted by the crane will be covered by a gallery, where the construction of light machinery will be carried on. The general arrangement comprises all the most modern advantages, and the tools, which are of the latest designs, are being made by Messrs. Kendal & Gent, Messrs. Hulse & Co., Messrs. W. Muir & Co., and Messrs. Vaughan & Sons. A steam boiler to work at 100lb. pressure is being supplied by Mr. W. Lord, of Bury, and a horizontal condensing engine by Messrs. John Musgrave & Co., of Bolton.

RAILWAYS.—A project is on foot to establish a circular railway for the town of Buda-Pesth. As the Hungarian Minister of Communications is taking very active steps to push this matter forward, it is probable that Buda-Pesth will be provided with a railway of this kind before a similar one is constructed in Vienna.

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HOME INDUSTRIES.

MANCHESTER, 28TH JUNE, 1888.

THE ENGINEERING TRADES.—There is no scarcity of work in the general engineering trade, and constant employment is found for all classes of mechanics. The reports of the various trade societies are unanimous in the assertion that work is plentiful, and that the number of unemployed is very few. Stationary engineers continue to be fully supplied with orders, and there appears to be no probability of any falling off. Many large orders are being executed on Indian, Russian, and Japanese account, and these, together with the constant run of home orders and repairs, are sufficient to keep the works in full operation. It is also stated that prices are gradually rising, although they are still much below the limits at which the engineers think they should be fixed. Millwrights and boiler makers continue to be well employed. The recent fall in steel boiler plates has not helped the makers to any great extent, on account of their having been covered with contracts. The fall will probably lead to a corresponding drop in the price of steel boilers. Bridge and girder makers are busy with a considerable number of orders which are now in course of execution. Machine tool makers continue to improve. There is a better demand for railway tools, especially on Indian and Colonial account. Machine makers are fully occupied, and from all parts of the world orders are coming in freely. Some firms in this branch of industry are paying special attention to the Eastern markets, notably China and Japan, and it is reported that their efforts have been very successful. In spite of the high tariff, large consignments of textile machinery are being shipped to the United States. The replacement of preparation machinery continues, so that whole departments are kept busy from this cause only. The new opener grid recently introduced by Messrs. Crighton and Sons, of Manchester, has an extensive sale, and is giving good results in practice. In carding engines a large number of the old type of roller and cleaner machine are being made, especially by Messrs. Platt Brothers & Co., Limited, Messrs. Asa Lees & Co., Limited, both of Oldham, and Mr. John Mason, of Rochdale. Mr. John Tatham has begun to make a patented arrangement for grinding the wire on the flats of revolving flat carding engines. This device grinds the flat while its working face is pressed against a plate, which is stepped to correspond with the heel, so that the points of the wire are kept parallel with the foundation, while at the same time its relation to the working face is kept unchanged. This is an important point in connection with these machines, and Messrs. Tatham & Knowles' invention meets it thoroughly. Loom makers are still busy, but new orders on home account are not coming in so fast as they were, although a good business is still being done with abroad.

THE SHIP CANAL.—The works in connection with this great undertaking are being pushed on, and are in many cases well forward. Railway communication is now established throughout the whole work, so that its progress is materially assisted. Near Manchester the waters of the Irwell have been diverted and conducted through a new cut, instead of through an old bend. The old bed of the river is being used as a spoil bed. An extensive landslip has occurred at Ince, but beyond a temporary disturbance of the works no damage was done. In connection with this work it may be pointed out that, as an indirect consequence of it, a good deal of engineering work will be required in carrying out the numerous sewage works which will become necessary to prevent the fouling of the river water. Several schemes are now on foot, including a large one of the Manchester Corporation, and several others will in a short time have to be commenced.

SMOKE PREVENTION.—Attention has been called in the report issued under the Alkali Works Act by Mr. Fletcher to an apparatus invented by Mr. Mond, of Northwich, for the production of gas from fuel which is quite smokeless when burned. The chief merit of Mr. Mond's process lies in the fact that the ammonia may be extracted before combustion in considerable quantity. It is stated that the experience of eighteen months' working is eminently satisfactory, and over 200 tons of fuel are daily treated in this manner at the works of Messrs. Brunner, Mond, & Co.

LONDON, 28TH JUNE, 1888.

THE MONEY MARKET.—The requirements of the Stock Exchange in connection with the settlement have made very little impression on the money market; the market continues dull and featureless, and rates remain at an almost unprecedentedly low ebb. The stock markets have more life and vigour in them, and at the close of last week the feeling was very strong, as there was a decided rise in foreign securities and in home railways. The strange thing about this was that the improvement was more marked in second and third rate than in first rate stocks. Russian, Turkish, Egyptian, and Greek Stocks gained perceptibly under the influence of Berlin buying. This to a large extent is due to the favourable view that is taken of the political outlook since the accession of the Emperor William. It is true that his speech to the Reichstag at the beginning of the week was followed by a decline in the markets; this, however, was due to a desire to realise the profit of the preceding rise before the beginning of the new account. The same occurred in the home railway market, the decline being entirely due to selling for realisation, and not to a want of backbone in the market, or to an unfavourable view of the prospects of the railways. Great Northern stock is considered to be the most promising purchase for the next week or two; and in the foreign market, which is generally healthy, Greek bonds are expected to mark a considerable gain in price. The American railway market is still hesitating, and will remain so until after the beginning of July, when the action of some of the prominent lines with regard to their dividends will decide the future tone. In the mining department diamond shares are unsteady, and copper shares tend downwards.

COMPANIES.—The following new companies have been registered since our last report: William Hunt & Sons, Ld., with a capital of £100,000, to carry on business as engineers and smelters at the Brades Works, Rowley Regis, at Oldbury, and at Birmingham; F. Joyce & Co., Ld., with a capital of £60,000, to carry on business as ammunition manufacturers; The Commercial Mill Company (Clayton-le-Moors), Ld., with a capital of £15,000, to carry on business as cotton and wool spinners; The Deanhead Water Company, Ld., with a capital of £10,000; The Langford Manganese Company, Ld., with a capital of £10,000; The Pottery Machine Company, Ld., with a capital of £27,000, to acquire patents for earthenware printing, &c.; H. Spicer & Co., Ld., with a capital of £150,000, to carry on business as paper manufacturers; The Honduras Company, Ld., with a capital of £25,000, to take over a concession for the Inter-Oceanic Railway of the Republic of Honduras; More & Co., Ld., with a capital of £70,000, to carry on business as brewers, &c.; The Martinstown (Dorchester) Brewery, Ld., with a capital of £15,000; The Condal Water Company, Ld., with a capital of £80,000; Suter, Hartmann, and Rahtjen's Composition Company, Ld., with a capital of £140,000, to carry on business as manufacturers of paints and compositions; The International Engineering Company, Ld., with a capital of £5,000, to acquire inventions relating to electric motors, &c.; The Algeciras (Gibraltar) Railway Company, Ld., with a capital of £750,000; J. & J. Charlesworth, Ld., with a capital of £500,000, to carry on business as colliery proprietors; The International Breweries Company, Ld., with a capital of £60,000, to carry on business as brewers in France; The Templeton and North Ottawa Mining Company, Ld., with a capital of £50,000; The Quebrada Copper and Silver Mines, Ld. (Nevada), with a capital of £4,000; and The Morgan Gold Mining Company, Ld., with a capital of £210,000.

TEXTILES.—The third series of Colonial wool sales opened on Tuesday last week. The attendance has been good, and the bidding brisk. Rates show a tendency to advance slightly. For Russian hemp higher prices are asked, but buyers hold back. A moderate amount of business has been done in Italian and in Manilla hemp.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 17th June, amounted to £1,259,082 on 15,861½ miles, as compared with £1,242,546 in the corresponding period of 1887, when the mileage was 15,746 miles. An increase is thus shown in the mileage of 115½ miles, or 0·7 per cent., and in the receipts of £16,536, or 1·3 per cent.

ROYAL AGRICULTURAL SOCIETY.—The Royal Agricultural Society's show will open at Nottingham on Monday, 9th July, and the implement yard can be viewed on the previous Saturday. The show ground is by the side of the Nottingham Canal, with the main entrance from Derby Road. The implements and machinery will be arranged as usual in three rows of sheds, the machinery in motion occupying the right and left boundary of the show ground.

LECTURES.—A course of lectures on the construction, testing, and use of electrical measuring instruments will be given by Professor Ayrton at the Central Institution of the City and Guilds of London Institute, commencing on the 16th of July next. The course will include experimental lectures and laboratory work, the latter being carried on in a laboratory specially fitted with accumulators, standard instruments, &c., for testing electrical apparatus.

THE PATENT OFFICE.—A fifth report of the Comptroller-General of Patents, Designs, and Trade Marks for the year 1887 has been published, from which we learn that the total number of applications last year was, for patents, 18,051; for designs, 26,043; and for trade marks, 10,586. These figures are considerably higher than the average of the previous three years. Of the applications made during the year, 53 per cent. were proceeded with. The total receipts were £124,279, of which £105,599 were for patent fees.

EXHIBITION.—An Ironmongers, Iron and Metal Trades' Exhibition is to be held in the Agricultural Hall, Islington, in November next. The exhibits are to include household ironmongery of all kinds, lighting, heating, and sanitary appliances, machinery, implements, and tools. The Exhibition is promoted by Mr. H. Hetherington, who has had considerable experience in the organisation of similar undertakings.

GLASGOW, 28TH JUNE, 1888.

ENGINEERING.—The *Evening Citizen* reports that Messrs. Hanna, Donald, & Wilson have contracted for a number of iron railway bridges in Manilla. There are about 3000 tons of malleable and cast iron in the contract, which is to be implemented by the end of the year.

SHIPBUILDING.—It is reported that Messrs. A. Macmillan and Sons, of the dockyard, Dumbarton, have secured an order to build a small screw steamer for foreign owners. It is also reported that a steel screw yacht of 200 tons is to be built for an English gentleman by Messrs. Russell and Co., Port Glasgow. There is a rumour, understood to be well founded, that the Peninsular and Oriental Company have placed a very large order with Messrs. Laird & Co., Greenock, viz., four vessels, each of 5000 tons.

NEW ORDERS.—Messrs. Wm. Simons & Co., of Renfrew, have received an order from the Natal Harbour Board, for one of their patent hopper dredgers. This vessel will be specially designed to meet the requirements of the Port of Durban, and will have a hopper capacity for 500 tons of dredgings. It is to be fitted with the builders' patent traversing bucket ladder.

PIG IRON.—In the presence of increased shipments, especially to Canada, the price of pig iron is considerably firmer. The shipments last week were 7810 tons, against only 3326 in the corresponding period last year. So far as the year has gone, the increase in shipments amounts to 11,479 tons.

SCOTCH BILLS IN PARLIAMENT.—Among the Bills now before Parliament, specially relating to Scotch affairs, is the Burgh Police and Health Bill (Scotland). This Bill is under consideration by a Committee of the House of Commons, and the measure is being discussed clause by clause. An important question, upon which there has been a considerable amount of discussion, relates to the powers of the Dean of Guild Court. In Scotland this Court, whose officers are elected by the Merchants' House or Merchants' Guild of former days, is understood to grant permission to erect buildings on the submission of plans. A clause dealing with the powers of this body has been altered so as to extend the powers of the Court, so as to provide for the surveying of buildings and their certification before occupation. This places in the hands of the Dean of Guild Court a weapon which may be used effectively for the prevention of occupation of insanitary houses. Some such provision as this has been loudly demanded for some time by the medical officers in the large cities.—Evidence has also been taken before the House of Lords' Committee on the Stirling and Western District Railway Bill. The object is, by constructing a short railway from the Kilsyth and Bonnybridge Railway direct to Stirling, to reduce the distance by North British Railway from Queen-street, Glasgow, to 26¼ miles. The present distance is 29½ miles. A considerable amount of opposition has been met with by proprietors whose lands the proposed railway passes through, and the amenity of whose mansions the railway is alleged to interfere with.

RAILWAY ACCIDENT.—An accident, attended with some injury to limb, but fortunately without loss of life, occurred on Thursday, the 14th inst., to the eleven o'clock forenoon express train from Queen-street Station, Glasgow, to Edinburgh. The accident was caused by some pit props stowed on a waggon in a mineral train becoming loose, and projecting over the six-foot way. The projecting props came into contact with the express coming in the opposite direction, and before the train could be brought to a standstill, smashed the side panels of a number of the carriages, wounding the passengers, and destroying the door furniture, &c.

GLASGOW INTERNATIONAL EXHIBITION.—The numbers still keep up, the extremely fine weather of the past few days having encouraged large excursion parties. The average attendance is now about 33,000, and the aggregate number of visits registered by the turnstiles is about 1,500,000. It is now announced that the Executive are about to add extensively to the lighting of the grounds both by arc lamps and glow lamps. It has been arranged that Her Majesty the Queen will visit the Exhibition during the month of August. The Executive will have during the next two months quite a number of guests. The British Medical Association and the British Archæological Association are both to hold their meetings in Glasgow. Besides these purely scientific associations, the Institution of Naval Architects and the Society of Chemical Industry have their annual meetings here, and the Iron and Steel Institute, which meets in Edinburgh during the last week in August, pays a visit to Glasgow on the 24th of that month for the purpose of visiting the Exhibition.

THE COLLISION ON THE MEASURED MILE.—It has been found impracticable to lift the "Princess of Wales," which now lies in deep water. The "Balmoral Castle" has had the damage done to her bow made good.

THE COMPASS ACTION.—Sir William Thomson's action taken against Messrs. McGregor & Co., nautical instrument makers, Glasgow, for infringement of his patent, is reported as having been settled out of court, the defenders agreeing to certain modifications in their compass, so as to avoid infringement.

(From our own Correspondents.)

LIVERPOOL, 27TH JUNE, 1888.

THE MERSEY RAILWAY AND BOLD-STREET STATION.—The Manchester, Sheffield, and Lincolnshire Railway Company are now seeking Parliamentary powers to authorise them to construct short railways to form junctions with the Mersey Railway Company in Liverpool. It is contended by the Mersey Railway Company that if such powers are granted, the Manchester, Sheffield, and Lincolnshire Railway Company will be able to use the Bold-street Station without paying any tolls, and will thus have a Liverpool terminus provided for them at the entire cost of the Mersey Railway Company. As this station, with its approaches, has cost an enormous amount of money, the Mersey Railway Company have decided to oppose the

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Bill now before Parliament, which is expected to come before Lord Jersey's Committee this week. The petition which was presented against the Bill in the Commons was withdrawn, to allow negotiations to be made between the two companies.

SHIPBUILDING. — Messrs. J. F. Waddington & Co., of Seacombe, Liverpool, have secured the contract for building a large stern wheel steamer about 170ft. long, having three decks, and passenger accommodation both for saloon and steerage. She will be fitted by the builders with compound engines, which will give a speed of 11 knots. This vessel will, we believe, be the first light draught stern wheel steamer from the Mersey to make an ocean voyage to her destination on her own bottom.

THE PRESERVED FRUIT INDUSTRY.—Mr. W. P. Hartley, of Liverpool, is building a village for the accommodation of his workpeople, and for this purpose has purchased an estate near his new works at Aintree, which he intends to lay out as a picturesque village of thoroughly useful dwellings, &c. Eighty-five competitive plans for this village have been received from architects all over the country, prizes of 50, 30, and 20 guineas having been offered for the three best plans.

LIVE AND DEAD MEAT IMPORTS.—There is a steady increase in the imports of dead meat, and a decrease in the imports of live stock from Canada and America; the total arrivals last week amounted to 1924 cattle and 8558 quarters of beef, being a decrease of 274 cattle, and an increase of 1350 quarters of beef over the previous week.

SHEFFIELD, 27TH JUNE, 1888.

IRON AND STEEL.—There has been a slight improvement in the demand for iron and steel. Scotch pig is securing a higher price, and English sorts are selling well at former, if not very much advanced, quotations. The South Yorkshire and North Derbyshire furnaces have a steady output, and there is every prospect of increasing trade. Operations are extensive at the forges and foundries, and the moulders in the latter shops are well employed. Work is fairly plentiful at the rolling mills. Armour plates are not yielding a great amount of work, nor are projectiles and ordnance being ordered in any quantity. The great activity in the shipbuilding trades is having a beneficial effect upon local industry. Ship plates are selling well at more satisfactory prices, and for marine machinery the demand is very encouraging. Screws, propeller bosses, and other important parts of ship gear are on better order, and a larger business is doing in chains. Material for bridges, and girders for building construction, are in better demand, and railway material is still in satisfactory request; tyres, axles, and springs are being sent out in large quantities. Bessemer rails are ordered freely, the prices being easy. For extensive contracts the quotations are very small. It is possible to buy at £3. 12s. 6d., and even £3. 10s., per ton, and coast makers are exporting rails at very low figures. Messrs. Craven are tolerably busy on railway vehicles, and are steadily improving their foreign business. In springs, Messrs. T. Turton & Sons are active. Messrs. Cammell and Co. are doing a good trade in rails. Agricultural machinery finds a rather quicker market. Wire for pit work, fencing, and other purposes is in brisk demand; and so are edge tools and better classes of cutlery.

LEEDS, 27TH JUNE, 1888.

THE HEAVY TRADES.—With the prospect of better prices and a brisker market, the condition of the manufactured iron trade is more satisfactory. The demand for bars, sheets, hoop iron, and some descriptions of plates is increasing; and the local call for both crucible and Bessemer steel is better. Railway plant of nearly all kinds keeps makers busy; and the well known engine builders of the town have orders on their books which will yield work for several weeks. Locomotives and traction engines are in course of construction for urgent use. Cranes and other apparatus for dock work, pumping machinery and boilers, are on more general order. Government orders are contributing, in some degree, to local industry. Engineers' tools and cut nails are selling well.

NEW SCHEMES.—There are rumours of several industrial developments in Leeds, chiefly with regard to steel making. At Denaby there is a project to erect an extensive factory for the manufacture of explosives, and the site, it is said, has already been secured.

NORTH STAFFORDSHIRE, 27TH JUNE, 1888.

THE IRON TRADE.—There is a stronger feeling amongst the iron masters of this district, and prices are somewhat firmer. Orders for export are more numerous, and for larger quantities than has recently been the case; but there is not much improvement in the home demand, and merchants' specifications are difficult to obtain. Some Belgian girders are being used in Hanley for constructive purposes, the contractor stating that having booked the work at a low figure, he has been obliged to buy the cheapest material. The pig iron market is firm, and stocks are being reduced. Contracts are being entered at prices somewhat less than those which prevailed at the close of last year. The number of furnaces in blast has not altered during the quarter.

THE COAL TRADE.—Those pits which produce only fuel suitable for domestic consumption are at a stand for orders, as owing to the hot weather the demand is very limited. The consumption of both forge and manufacturing fuel is fairly good and prices are firm, ranging from 6s. to 8s. at the pit, according to quality. Slack is hard to dispose of and prices low.

SOUTH WALES, 27TH JUNE, 1888.

TIN PLATES.—With the anticipation of a further fall in the price of block tin, plates have gone down to 12s. 6d. f.o.b. Swansea. The confident belief is expressed that tin will be sold as low as £60 within the next six months; at the same time, however, three months forward sales have been made at £80. A strike has taken place at the Gwendraeth Tin Plate Works, where, instead of 7s. per hundred boxes, the manager insisted on playing only 6s. to the employés of the wash house, these maintaining that the higher figure is paid at all other works. It is to be regretted that any difficulty should have arisen so soon after the resumption of operations following a long stoppage. It is rumoured that apart from those intended to be built by the owners of the Gwendraeth Works, another tin plate works will be erected at Llanelly at an early date. Mr. Richard Thomas, of London, purchased at a recent sale the Melin Griffith Iron and Tin Plate Works, with the buildings, plant, goodwill, &c.; the price paid being £12,000.

DISCOVERY OF A SILVER MINE.—Although nothing has been found in the South to rival Mr. Morgan's mine in North Wales, from which an ingot of gold weighing over 2000oz. has just been exhibited at the Ladies' Conversazione of the Royal Society, yet this district is not wholly without some of the precious metals. It is stated that at Llangadock, Carmarthenshire, a valuable silver mine has been discovered at a depth of about 20ft. from the surface.

WILLIAM HANCOCK & CO., LIMITED.—The directors of this Cardiff company recommend a dividend on the ordinary shares at the rate of 13 per cent. per annum, carrying £4,000 to reserve account and £2,363. 12s. 3d. forward.

BARROW-IN-FURNESS, 27TH JUNE, 1888.

THE "GREAT EASTERN."—It is probable that this ship will come to the Port of Barrow either for a complete demolition, or to be dismantled and re-fitted as a cattle or petroleum carrying steamer. The Naval Construction and Armaments Company have been interviewed by the representatives of the owners of the "Great Eastern," and have arranged with them to undertake the work. The only difficulty rests with the harbour authority as to whether the steamer can be safely docked in the Ramsden Dock.

LARGE SHIPBUILDING ORDERS.—The orders for two Pacific liners of 5000 tons each, placed at Barrow a fortnight ago, have now been supplemented with the order for two 2000-ton steamers for a British mercantile firm, and also with an important contract from a foreign government, probably the Spanish, for the construction and thorough equipment of three large and powerful high speed cruisers. These ships are to be built abroad, but the engines, machinery, torpedo fittings, Whitworth guns, Nordenfeldt quick-firing guns, and other necessary equipments for service, are to be supplied at Barrow.

IRON AND STEEL.—A steady tone continues to characterise the hematite iron and steel trade of this district; but although the demand is well maintained, and makers are well sold forward, considering the rate of the production of their works, prices do not advance; this fact may be accounted for by the heavy stocks which are held in the shape of hematite warrants, and in stocks on makers' works. 42s. 6d. is the quotation this week for mixed numbers of Bessemer iron net f.o.b., and 42s. for No. 3 forge and foundry qualities. There is a brisk and steady tone in the steel trade, and orders are offering plentifully, especially for steel rails and steel shipbuilding material. The former are quoted at £3. 17s. 6d. per ton for heavy sections, and £4 to £4. 5s. for light sections net.

MIDDLESBROUGH, 27TH JUNE, 1888.

PIG IRON.—The market continues to be steady. No. 3 G.M.B. is nominally 31s. 6d. per ton for prompt, and 31s. 9d. per ton for July-September delivery. There is very little business being done. Less Cleveland iron is being sent to Scotland on account of the decreased difference in price. The Teeside Iron Company are about to blow out two of their furnaces. It is difficult to see how a profit can be made at the present low prices, unless by those who are specially well placed as to their supplies of material. For warrants the demand is rather slack; sellers ask 31s. 7½d., but buyers will only give 31s. 6d. There are sellers of E.C. hematite pig iron, mixed numbers, at 42s. per ton f.o.b.

SHIPMENTS OF PIG IRON.—These have now fallen down to the average of former years. Up to the 23rd of June inclusive they amounted to 59,031 tons, as compared with 55,095 tons to a similar date of last year, and 87,975 tons to the 24th of May this year. The stock of iron in Connal's store is still on the decline, and stood at 283,641 tons on Saturday last.

MANUFACTURED IRON AND STEEL.—There is no change in the prices of manufactured iron and steel. Iron plates are at £4. 17s. 6d., angles £4. 10s. to £4. 12s. 6d., bars £4. 15s. per ton, less the usual discount, on trucks at manufacturers' works. Steel plates are being sold at £6. 2s. 6d., and rails (heavy sections) at £6. 2s. 6d. Iron founders are not very well off for work, but steel founders have as much as they can do. Engineers in general are fairly well off for orders.

SUNDERLAND, 27TH JUNE, 1888.

SHIPBUILDING.—During the last six months shipbuilders have had an increase of work as compared with last year; but the output does not show a very marked improvement, the increase in the number of vessels being only five. Thirty-one vessels, with a tonnage of 61,000 tons, have been launched this year, as compared with twenty-five of 48,367 tons in the first half of last year. It is, however, possible that the latter part of the present year will show a greater improvement now that the labour disputes are practically settled. The blacksmiths have this week accepted the offer of the employers of 1s. per week immediate advance and 6d. additional in August. The engineers' dispute has not yet, however, terminated. The present depression in Black Sea and other freights is not favourable to increased activity, and it is not surprising therefore that new orders are rare.

SHIPPING TRADE.—During the last week there was a slight increase in the coal shipments, the total quantity being 69,739 tons, as compared with 67,158 tons for the previous week, an increase of 2581 tons. 29,547 tons were shipped to foreign ports, and 40,192 tons coastwise, as compared with 28,570 tons and 38,588 tons respectively in the previous week. There were also exported 320,000 red bricks, 550 tons of patent fuel, 539 tons of coke, 97 tons of cement, 7000 dozen glass bottles, 63 tons of fire bricks, 20 tons of sanitary pipes, &c. The importation of mining timber was brisk, 196,132 pit props arriving, as against 127,102 in the previous week; besides 31,801 pieces of chocks, 54,194 sleepers, 5133 deals and battens, 148 bundles of iron nail rods, 347 bales of straw, 1000 tons of iron ore, &c.

NEWCASTLE, 27TH JUNE, 1888.

ROPE WORKS. — Business at the hemp and wire rope manufactories continues to be very active, the orders in hand from colliery owners being particularly numerous. There is also a fair amount of work in hand in connection with the rigging equipment of locally built steamers; and at some factories the execution of foreign contracts tends largely to maintain the present activity.

GLASS WORKS.—There is at present a large demand for the different descriptions of pressed glass ware, and the works are generally kept going to their full capacity. The bottle trade is also in a prosperous condition. The output from the Blaydon Glass Factory is large; the Gateshead Stained Glass Company have just secured several important orders to supply material for memorial windows and for general decorative purposes in churches and public buildings, and their establishment is now busier than at any former period.

CARRIAGE WORKS.—At this time of year carriage building usually receives a stimulus, and the works in this district are accordingly much busier than they were during the spring and winter months. Among other orders lately executed by Messrs. Atkinson & Phillipson were a number of broughams for the London Improved Cab Company, Limited. These vehicles were delivered to owners in May, and having been immediately put into use, are said to have given extreme satisfaction. The firm have recently forwarded a very handsomely finished phaeton to Kimberley, South Africa, and have also sent to the same destination one of their celebrated wagonette omnibuses for the use of the Bishop of Bathurst. They have besides sent a specially ordered vehicle to Bombay, and are likely to receive other contracts from the same quarter.

POTTERIES.—There is an improved demand for the different kinds of ware manufactured in the locality, with the result that the works are kept going steadily.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock, for the week ending 23rd June, amounted to 108,315 tons, being an increase, as compared with the corresponding week last year, of 31,143 tons.

BELFAST, 27TH JUNE, 1888.

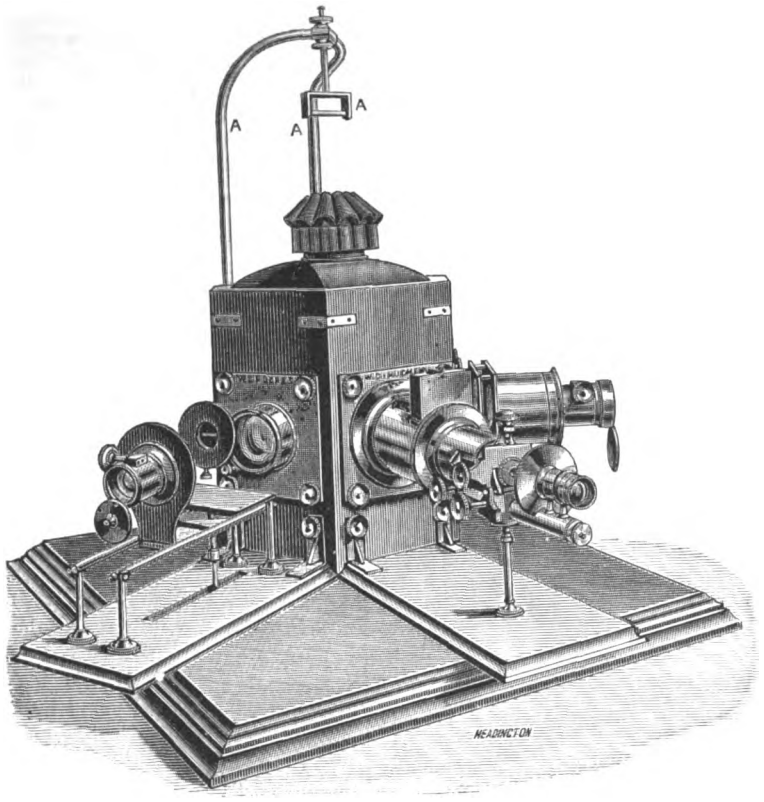
SHIPBUILDING.—All the yards continue to be fully supplied with work, and orders come in as rapidly as when the trade was at its brightest. The two principal yards in Belfast have received orders for vessels of large tonnage, which will at once replace those ready for launching. The strike among riveters for higher piece work rates has been arranged after five weeks' idleness, and all the trades are now fully employed.

COAL MINING.—The Congo Coal Pits, County Tyrone, have been closed, owing to a large influx of water rendering work impossible. Much inconvenience has been caused to factories in the neighbourhood, as all their firing was drawn from this source. New pits lately opened near Stewartstown are likely to prove a great success, and will probably supply the demand until the others are re-opened. Meanwhile, a large number of workers are out of employment.

LINEN TRADE.—The market for yarns continues to be steady, and prices in the various spinnings remain as before. There is no change in prices in the range of wefts, and trade is quiet. There is a better demand, however, for the lower numbers. Stocks are considerably smaller than they have been for some time. Tows are becoming scarce, and as there is a good demand, prices are hardening. Cloths remain unchanged. The sale of brown goods continues steady, and all the looms are fully employed. Finished linens are in good demand at late prices. Shirt and collar and cuff makers continue to be fully employed. There is a decidedly better feeling all round in the trade.

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HUGHES' LECTURE LANTERN.



HUGHES' LECTURE LANTERN.

At a recent meeting of the Physical Society, Mr. W. Lant Carpenter exhibited a new lantern for lecture purposes, which we illustrate above. The lantern was devised by Mr. W. C. Hughes, of Kingsland Road, London, with the special object of facilitating the change of image thrown on the screen. Thus, a lecturer can by means of this combination lantern rapidly bring before his audience first the general view of an object, next some detail, and thirdly an enlarged microscopic view of any part, simply by turning the lantern on its vertical axis; or different stages in a chemical or physical experiment can be shown in quick succession. The body of the lantern is a hexagonal prism, and each of the three adjacent front sides is fitted with projecting apparatus, the other three sides being provided with openings to give access to the interior. On the recommendation of Mr. Lant Carpenter, the Brockie-Pell focussing arc lamp has been chosen as the illuminant; but the ventilating arrangement and general construction admit also of the use of the oxy-hydrogen light, if electric energy be not available.

The first slide, that shown on the left in the illustration, is fitted with a "Gilchrist" demonstrating lantern, the prism and projecting lenses being movable along a pair of rails. The next, or middle slide, is fitted as a lantern microscope, with alum cell, mechanical stage for horizontal and vertical adjustment, and provided with various sets of lenses and objectives, whilst the third slide is arranged for spectroscopic work. To bring the beams of either one or the other of these slides on to the screen, all that the lecturer has to do is to turn the body of the lantern in the required direction, a spring catch fixing it in the exact position. To facilitate the turning, the lantern is mounted upon metal rollers.

HEAVY GUNS IN THE UNITED STATES.

According to the *Scientific American*, the South Boston Iron Works has just completed a 53-ton gun for the United States navy, which is about to be tried at Sandy Hook. It is a 12in. breech loader, and consists of a cast iron piece of 53 tons, when finished, turned, and bored, hooped and tubed with steel. The hooping consists of twenty-seven wrought steel rings, which are shrunk on and overlap so as to reinforce each other. The tube is 5in. thick, is inserted at the breech, and is 14ft. long, extending as far as the trunnions. The gun is 30ft. long. In the forthcoming trial the gun will be proved with five hundred rounds, the powder charge being 265lb., and the projectile 800lb. A Rodman gun, similarly tested, failed through erosion at the 137th round. The same firm have also in course of construction a 54-ton gun. This also is cast, and has a tube of steel 14ft. long and 5in. thick. Two "built up" steel rifled guns are also being made. They are 8in. in calibre, and to be all steel; their appearance is looked for with interest, as their success or failure will have much to do in determining the future of gun making in America. In addition, two naval carriages of the pneumatic type, for 8in. guns, are on the stocks, and four 10in. carriages of similar make for the monitor "Terror." The first 10in. rifled gun for the ironclad monitors has also been successfully tried at Annapolis. It is 27½ft. long, and weighs about 25¾ tons; its projectile is 500lb., and its charge 250lb. of cocoa powder.

THE HORSE POWER OF MARINE ENGINES.

Owing to the rapid developments which have taken place in marine engines during recent years, the ordinary methods of stating their horse power have become indefinite and unsatisfactory. Various attempts have been made to devise a method which would be generally accepted, but as yet without success. The latest has been by the Council of the North-East Coast Institution of Engineers and Shipbuilders, who have issued a report on the subject, and of which we propose to give a digest. The following is the notation adopted:—

D = diameter of low pressure cylinder in inches. If there be more than one low pressure cylinder, D^2 = sum of the squares of the diameters.
S = stroke of piston in inches.
P = working boiler pressure in lbs. per square inch above atmosphere.
H = heating surface of boilers in square feet.
P_m = mean pressure in lbs., reduced to low pressure cylinder.
R = revolutions per minute.

In order that any rule may be general in its application, all the engines to which it is applied must be assumed to conform to certain conditions, which conditions must be looked upon as normal, all other conditions being, of course, regarded as abnormal. The following six conditions are assumed: (1) That the steamer, whatever may be its boiler pressure between 50lb. and 250lb. per square inch, is expanded by the engines to the same terminal pressure. (2) That the expansion is effected by the engines with the same degree of efficiency for all pressures between 50lb. and 250lb. per square inch. From these two conditions it follows that the mean pressure reduced to the low pressure cylinder (P_m) may be assumed as proportional to the cube root of the boiler pressure ($\sqrt[3]{P}$), and further that its actual loaded trial trip value may be taken without sensible error as $5{\cdot}6\sqrt[3]{P}$. A table of calculated results shows that this assumption does not involve any material error. (3) That the piston speed of engines of different lengths of stroke are proportional to the cube root of their respective strokes; and further, that the actual loaded trial trip value of piston speed may be taken as $144\sqrt[3]{S}$. (4) That in all cases where the engines and boilers bear to each other such proportions as to prevent condition (1) from being fulfilled, without thereby violating condition (3), the coal consumption per i.h.p. will not be affected, but will be constant for the same boiler pressure. (5) That the boilers are constructed in accordance with what will be generally recognised as the fair average practice of the present day in respect of the allowance of steam room in relation to power, the diameter, area and pitch of the tubes, the relation of grate to heating surface, and the area of uptakes and funnel; that average natural chimney draught is used, or if forced draught be employed, that it does not exceed the average chimney draught; that the horse power is proportional to the heating surface (H), and to the cube root of the pressure ($\sqrt[3]{P}$); and further, that the actual loaded trial trip horse power may be taken as $\frac{H\sqrt[3]{P}}{16}$. (6) That the efficiency of the engine mechanism is constant, and that the propeller is such as to secure that the engines will utilise the boiler power referred to in condition (5) in the manner prescribed in conditions (3) and (4).

Then the proposed rule is deduced in the following manner:—

$$\text{I.H.P.} = \frac{\frac{\pi}{4}D^2 \times P_m \times 2SR}{33000}$$

substituting from conditions (1) and (2)

$$= \frac{\frac{\pi}{4}D^2 \times 5{\cdot}6\sqrt[3]{P} \times 144\sqrt[3]{S}}{33000}$$

By reduction

$$= \frac{D^2\sqrt[3]{PS}}{52} \quad \text{.....(A)}$$

$$\text{I.H.P. of boilers} = \frac{H\sqrt[3]{P}}{16} \text{ condition (5) ..... (B)}$$

If we suppose that (A) and (B) are equal, we obtain

$$H = \frac{D^2\sqrt[3]{S}}{3{\cdot}25} \quad \text{.....(C)}$$

This expression gives the normal relation between the engines and boilers.

Assuming that the power of the engines and boilers when taken together will be equal to the mean of their separate powers, we have:—

I.H.P. of combined engines and boilers

$$= \frac{\frac{D^2\sqrt[3]{PS}}{52} + \frac{H\sqrt[3]{P}}{16}}{2}$$

$$= \frac{(D^2\sqrt[3]{S} + 3{\cdot}25H)\sqrt[3]{P}}{104}$$

which, without sensible error and for convenience, may be written

$$= \frac{(D^2\sqrt[3]{S} + 3H)\sqrt[3]{P}}{100}$$

and it is proposed to call the result the normal indicated horse power (n.i.h.p.).

For paddle engines the same rule may be used, with its co-efficients modified to meet the altered condition of piston speed which usually obtains in these engines. Assuming that under condition (4) the piston speed of paddle engines may be taken at $90\sqrt[3]{S}$, the rule may, without sensible error, be written

$$\text{N.I.H.P. of paddle engines} = \frac{(D^2\sqrt[3]{S} + 5H)\sqrt[3]{P}}{160},$$

and equation (C) would become $H = \frac{D^2\sqrt[3]{S}}{5{\cdot}2}$.

The Council considers the term "nominal horse power" very indefinite and misleading as a measure of the power of marine machinery. If, however, instead of *indicated* power, a quantity be required which will compare more nearly with what is known as "nominal horse power," the above rule may be used thus:—

$$\text{Nominal horse power} = \frac{\text{N.I.H.P.}}{6}.$$

We understand that the Council of the North-East Coast Institution has sent the report to the various engineering Institutions for discussion, so that something like unanimity may be arrived at. We are therefore likely to hear a good deal on the subject at the beginning of the next sessions of these Institutions. In the meantime, however, we should be glad to have the opinions of some of our readers regarding it.

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All accounts are payable to the Publisher, GEO. CAWLEY, *70, Market-Street, Manchester. Cheques should be crossed Manchester and Liverpool District Bank, King-street Branch, Manchester. Post Office Orders to be made payable at Manchester.*

Offices for Publication:
22, *Wellington-street, Strand, London, W.C.*
70, *Market-street, Manchester.*
62, *St. Vincent-street, Glasgow.*

Advertisements:
London: 22, *Wellington-street, Strand, W.C.*
Manchester: 70, *Market-street.*
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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," either at the Manchester or the London Offices, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries, VOLS. I., II., & III.

From July, 1886, to December, 1887.

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Industries:

FRIDAY, 29TH JUNE, 1888.

THE NEW ELECTRIC LIGHTING ACT.

THE Bill amending Mr. Chamberlain's Electric Lighting Act of 1882 has now passed both Houses of Parliament, and only awaits the Royal assent to become law. Considering the great outcry which was raised by electric light engineers and contractors shortly after the passing of the original Bill, the present Bill—which was drafted with the distinct purpose of removing certain obstacles which hitherto were considered to hinder the development of the electric lighting industry—has attracted very little attention outside the circle of its parliamentary promoters and supporters. It is a short Bill of five clauses, and in general character does not materially differ from the Act of 1882, with which it will be incorporated. In one respect, however, it is a decided improvement over that Act. The great objection of electric light contractors to Mr. Chamberlain's Act was, that any successful electric light station was under it liable to be compulsorily purchased by the local authority after the lapse of twenty-one years, the price to be paid covering only the market value of the plant at the time of purchase. Where improvement is so rapid as in electric light machinery, the market value of the plant a few years after its erection is liable to be considerably below its first cost, and therefore the recompense represented by the purchase money would not have been equivalent to the outlay even after a few years. A glance at the price lists published by the leading dynamo makers five years ago and those published now will make this evident. The price of low tension dynamos, suitable for central station work, shortly after the passing of the Act averaged over £1 per lamp; now it is barely half that amount. It is evident that had a company started some five years ago, they would have had to purchase their machines at the high figure of £1 per lamp, and would have had to sell them, under the compulsory purchase clause, at the lapse of twenty-one years, to the local authority at less than 10s. a lamp. This would have represented a dead loss of one half their original outlay, to say nothing of the expenses of repairs and the effect of depreciation, which represent a further sacrifice. As it is with dynamos, so it is with all the other plant in the station, and capitalists were consequently hesitating to embark in a business which was practically untried as far as its earning powers were concerned, whilst the prospective and inevitable losses, resulting from the purchase clauses, were considerable. It has been the fashion with electric light engineers to lay all the blame for the want of progress in central station lighting in this country on the original Electric Lighting Act, but in this we think they were wrong. No doubt the Act has tended to retard progress, but there were other forces at work tending to the same result. The cheapness of gas, the conservatism of the public, the mistrust in which electric light investments were held by capitalists, owing to the over-speculation of 1881 and 1882, and last, but not least, the technical obstacles which formerly stood in the way of long distance distribution, were at least as really effective in checking the development of central station lighting as Mr. Chamberlain's much abused Act. With Lord Thurlow's Bill the obstacle of compulsory purchase, although not completely removed, has been greatly reduced. Under the new Act the local authority can only effect a compulsory purchase after a term of forty-two years, and this seems to be a sufficiently long time to enable the owners of a central station to reap all the benefits of further improvements in plant before they incur the loss of having to sell their plant at its bare market value. Clause 2 of Lord Thurlow's Bill is almost identical with the famous Clause 27 of Mr. Chamberlain's Act, except that the period after which compulsory purchase can be made is forty-two, and not twenty-one years, and that the subsequent periods for compulsory purchase have been increased from seven to ten years. Thus, if after the lapse of forty-two years the local authority do not elect to acquire the electric light undertaking, the original owners will have a further tenure of ten years at least. But in the present as in the previous clause the objectionable words that the purchase is to be made "without any addition in respect of compulsory purchase or of goodwill or of any profits which may or might have been or be made from the undertaking, or of any similar considerations," are left standing. Electric light companies must, therefore, not rely on payment for goodwill, and the main advantage the new Bill will confer upon them is that they will be left in undisturbed positions for a time long enough to enable them, if the business be fairly successful, to pay off the original capital before the evil day arrives when they will have to deal with the local authority.

Simultaneously with Lord Thurlow's Bill there was introduced another Electric Lighting Act Amendment Bill by the Earl of Crawford. This was allowed to drop, although in our opinion it was by far the better Bill of the two. In it there was no time fixed for compulsory purchase, but such purchase could take place if either through the insolvency of the undertaker or the unprofitable nature of the undertaking, or by mutual agreement between the undertakers and the Board of Trade, the latter should revoke the agreement under which the undertakers carried on the works. The price to be paid to the undertakers in such compulsory purchases was to be settled by the average market value of the shares or stock of the concern during the five years immediately preceding the sale. As the Bill expressly stated that no monopoly should be granted to any electric light undertaking, and as the conditions of supply and the maximum price to be charged were specified in the Bill, the security of tenure which the purchase clause conferred to the electric light undertakers could in nowise be disadvantageous to the consumers, and we would have much preferred to see the second clause of Lord Thurlow's Bill replaced by some such provision as was unfortunately lost with the Earl of Crawford's Bill.

We have, however, to deal with the Bill which has now passed, and must point out some other alterations embodied in it. One of these refers to the consent of the local authority. According to the Act of 1882 a license for seven years would only be granted by the Board of Trade with the consent of the local authority, but for a provisional order no such consent was required. According to the new Bill, "no provisional order authorising the supply of electricity by any undertakers within the district of any local authority shall be granted by the Board of Trade except with the consent of such local authority, unless the Board of Trade, in any case in which the

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consent of such local authority is refused, are of opinion that having regard to all the circumstances of the case such consent ought to be dispensed with, and in such case they shall make a special report stating the grounds upon which they have dispensed with such consent." The principle of free competition has found expression in an amendment introduced in the House of Commons, according to which "the grant of authority to any undertakers to supply electricity within any area, whether granted by license or by means of a Provisional Order, shall not in any way hinder or restrict the granting of a license or Provisional Order to the local authority, or to any other company or person within the same area." The Board of Trade is also given power to vary the terms upon which the local authority may require the undertakers to sell, if such terms have previously been agreed upon between the local board and the undertakers. The clause giving the Board of Trade power to control electric light lines or other work in public streets has been slightly enlarged, and the penalty to which undertakers are liable for interfering with the wires of the Postmaster-General has been increased from £10 to £20 for each day during which the contravention or wilful non-compliance with the orders of the Board for the protection of telegraph lines continues. We have given in the foregoing a brief sketch of the new Bill, which is in future to be cited and construed together with the original Act of 1882, under the title of the Electric Light Acts, 1882 and 1888.

On the whole electricians, and especially electric light contractors, will have reason to be satisfied with the new Act. If it does not give them all they asked for, it has certainly removed the greatest legal obstacle which has hitherto stood in the way of a public supply of electricity. It remains now to the profession to show that they are able to overcome the technical and financial obstacles to which we have alluded.

TEXTILE STATISTICS.

II.

The worsted industry, and the production of machines connected with it, are principally carried on in the Bradford district, which comprises Bradford as well as the towns of Shipley, Saltaire, Bingley, Keighley, Haworth, the Airedale up to Skipton, Burley, Otley, Thornton, Queensbury, Shelf, and part of Halifax. The value of the capital invested in the wool industry of the Bradford district was in 1884 estimated at 60·4 millions sterling. The Bradford district is still the principal producer of men's wear goods, and also for the lower qualities of women's wear goods; whereas the better qualities are imported from foreign countries, principally from France. Of the total productions of the Bradford district in 1884, there were exported 10 per cent. to the Colonies, and 35·4 per cent. to other countries, so that 56·6 per cent. remained in the country. In the Bradford district alone three-fourths of all the English and all the Irish wools are manipulated in so far as the raw material is combed and spun there; Huddersfield, Leeds, Leicester, and the West of England district being supplied with yarns from Bradford. It is remarkable that whilst the consumption of English wools is on the decline, that of merino wools, South American, Australian, and South African wool is increasing considerably. Particularly favourable periods for the Bradford district were the times of the American Civil War, and the years during and after the Franco-German War. Business was fairly remunerative up to the year 1874-75. Then over-production set in, followed by very heavy losses in some branches of the industry. Losses of this description were not experienced to the same extent in other countries. According to the official statement of the Board of Inland Revenue, the Bradford district shows the following fluctuations in the returns of commerce and industry during the last twenty-five years:—

	£
1860-64	1,414,049
1865-69	2,028,602
1870-74	2,943,783
1875-79	3,001,446
1880-84	2,405,346
1885	2,502,663

The losses referred to principally affected the so-called "staple" industries of Bradford, which even to-day are carried on with but scanty profits. These staple industries, that is to say, the production of worsted stuff goods, may be divided into three parts, viz., the manufacturing of those stuffs which are made of long lustrous wools mixed with cotton (*i.e.*, cotton warps); of those stuffs which are made of merino wools mixed with cotton; and of those stuffs which are made of all-wool. The Bradford district produced principally the stuffs of the first two descriptions. According to the report of the Royal Commission, the principal reasons of the considerable decline which these staple industries experienced in the years 1875-80 were: The protective duties of other countries; the change of fashion to all-wool goods, the so-called "merino dress fabrics," in which especially France has been excelling for years back; the competition of foreign countries; and the diminished demand of the Continental States. Whilst the staple industries of the Bradford district have experienced such a decided decline, some branches of industry (the so-called "new industries") have been greatly developed in that district. These industries, which have rapidly attained such importance, are principally the worsted coating industry, plush industry, the silk warp cashmere industry, and the machine industry.

The worsted coatings favoured by the change of fashion to combed yarn stuffs, took the place of the West of England cloth and of the Scotch cloth. Whilst the dress goods are made of cotton warp and worsted weft, these worsted coatings contain mostly worsted yarn, and differ materially from the former. They are at present chiefly manufactured in Bradford, Halifax, and Huddersfield, while in Leeds, Batley, and Dewsbury coatings are made of cotton warps with shoddy weft. Another branch of industry which has been thriving in Bradford for the last ten years is the spinning of silk waste, and the yarn thus obtained is used for sewing silk, children's dress goods, and plushes. The silk warp cashmeres are exported principally to the United States of America. Besides the above mentioned new industries of the Bradford district, the spinning and yarn trades have experienced a considerable development, caused by export as well as by home consumption of its products.

Referring now to the tweed trade, which derives its name from the manufacturing district traversed by the river Tweed, some of the principal towns in that district being Galashiels, Selkirk, Peebles, Innerleithen, Hawick, Langholm, Jedburgh, and Dumfries. The tweed manufacturers still find their principal market in London and Glasgow. During the last few years the direct export to Germany and France has increased, German and French buyers visiting the manufacturing districts twice a year. The export of the tweed trade to Germany is fairly considerable; next in importance come France and the United States of America. Italy imports only small quantities, and the export business to Russia is said to be annihilated by the imposition of protective duties. The Scotch wool industry has to compete with the English, as well as foreign markets, also with the affiliated industries of other British industrial districts, and lately German and French manufacturers are also entering into competition, after having learned to comply with English tastes. This is especially the case in dark coatings. In the Colonies, especially in Australia, the German competition in wool fabrics, chiefly in dark coatings and thin summer goods, has been very keen. The present position of the tweed trade is described as being depressed. The decrease of business began in the year 1877, a little improvement manifesting itself in 1880. Soon, however, a relapse set in, which has prevailed during the last five years. In 1885, 25 per cent. of the looms were idle. It was especially the change of fashion to worsted coating goods which during the last eight years proved fatal to the South Scotch industry, because the manufacturers would not entertain the idea of changing their machinery. At present principally worsted yarns are used which are bought in Yorkshire. Latterly the exports in Cheviots, especially to America, has risen considerably.

In no branch is the utilisation of apparently worthless material carried on with so much success as in the artificial wool industry. The most important product, the "shoddy," is produced from the "softs," viz., from worn out stockings, flannels, woollen fabrics, &c.; the "mungo" is produced from the "hards," *i.e.*, tailors' cuttings, worn out clothes, rags, &c. "Extract" is the name of the fabric which is produced by a mixture of cotton or linen with the wool extracted from rags. The waste from these processes, called "flocks," often seems to be little better than sweepings, but even this is turned to use. The shoddy industry originated in the year 1813 in Batley and Dewsbury, in Yorkshire, and the principal development took place in the period 1840-60. An important branch of this industry consists of the union cloth manufacture, so called on account of the cotton warp and woollen weft, and the cloth made by this process has the appearance of an all-wool fabric. Shoddy goods were for many years looked upon as base imitations; but are now considered a benefaction to mankind, because they bring warm clothing within the reach of the millions. The total weight of shoddy, mungo, &c., annually produced in England is estimated at 125,000,000lb. There are at present 108 shoddy factories in the United Kingdom, England and Wales having 107, and Scotland 1. This industry employs 93,766 spindles and 2222 doubling spindles, 1921 power looms, and 4709 hands.

The hosiery trade branch of the English textile industry has not suffered very much from the general depression. Lately, however, complaints have been heard that the profits are inadequate in proportion to the capital invested and the labour bestowed upon it. A few years ago English manufacturers thought that the competition of Saxony, especially Chemnitz, would have a material influence upon the hosiery trade. However, it seems at present that the Saxon competition is only confined to two or three articles. In 1885 the export of cotton hosiery goods amounted to £741,822, while the export of woollen goods only amounted to £555,448. The export of woollen hosiery to Germany amounted to £28,827, and cotton to £4,311. There are at present 227 hosiery factories in the United Kingdom. Of these 215 are in England and Wales, and 12 in Scotland. There are altogether 19,536 hands employed in this industry, as against 14,992 hands in 1878, which is an increase of 307.

NAVAL ORGANISATION.

The subject of our national defence continues to be vigorously discussed at various meetings and in the general Press, and the variety of opinions expressed must require cool judgment on the part of the members of the Government, who are directly responsible for the organisation of the necessary measures, to enable them to decide which of the numerous suggestions offered to them should be adopted. One of the most energetic of those who are endeavouring to rouse public opinion, and stimulate official action in the matter, is Lord Charles Beresford, and his position in Parliament, and an ex-Lord of the Admiralty, naturally cause considerable attention to be paid to his utterances. There is an impression, however, even among his warmest admirers, that his sayings and writings are very similar in their nature to his actions on board ship or in the field, that is, that there is more reckless bravery about them than cool, calculating common sense, such as is required in the guidance of any large government department. Some of his recent utterances are, however, worthy of attention, because if they are not useful for drawing out a constructive policy, they at least indicate the weak points in the present arrangements, as he has no hesitation in using the knowledge he gained in his official position to show the weakness of our present arrangements. We will, therefore, briefly notice a few of his criticisms and proposals. He insists very strongly on the difficulty or impossibility of fixing responsibility on those who are to blame for any defect in the arrangements or management, or for any insufficiency in the number of ships, or the amount of their armaments. On this latter subject, he says that if we were called upon to enter into hostilities with two great maritime Powers — as, for instance, France and Russia—that those who would work and take the command of the British fleets and squadrons are unanimous in their opinion that the fleet would not be sufficient in number or strength for such an eventuality. He says that the controversy between the experts and the party politicians or officials has arrived at a stage of simple contradiction, the Parliamentary officials maintaining that the tonnage and number of ships is in favour of Britain, while the others (the experts) maintain that such comparisons are useless, futile, and misleading, and that the only comparison worth viewing with interest is that which compares the work thrown on the respective fleets—viz., Britain against any two combined Powers—in case of war. This argument can only be determined by naming the fleets and ships, together with the localities where they must be employed, and the work they would have to do, and by pointing out those contingencies which are certain to occur in time of war. He indicates that probably a line of this character will be taken in the House of Commons on the shipbuilding vote, when the public will be able to see the facts of the case as they exist. We will therefore postpone the consideration of this part of the subject for the present; but it must be remembered that party politicians and those officials nominally responsible for the navy have, time after time, assured the country that the naval defence was complete, the finances administered in the most economical manner, and the navy itself thoroughly organised and ready for any emergency, but that, when occasion has arisen to substantiate these statements, they have without exception been falsified. He, however, is not inclined to blame the officials too heavily for the subsequent discovery of their inaccuracy; but he expresses the opinion that the system that allows such misconceptions must be ridiculously bad, and, in fact, rotten.

Lord Charles points out that with the present system it is quite impossible to fix the responsibility for anything that may go wrong upon any individual, or upon what is

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called the Board of Admiralty as a whole, and he justly remarks that unless responsibility can be clearly defined and firmly fixed, it is impossible that any system of administration can be sound or wisely and well conducted. He complains that while the seamen are held responsible for their own departments, and to the First Lord for their efficiency, it is within the power of the First Lord to ignore the advice or proposals which a Naval Lord may urge as being necessary to make his department as efficient as possible; but in the event of the First Lord not heeding this advice, he asks, who then can be said to be responsible. He further complains that the so-called Board of Admiralty is not worked as a Board, that the distribution of business is not suitable for modern requirements, some of the Lords having too much to do, others too little; that there is an immense gap between the executive of the Admiralty and the officers and men of the fleet; and, lastly, that the appointment of the seamen on the Board is not satisfactory, and is not regarded with confidence in the service. His Lordship, however, is not content with mere criticism, for in his latest utterance he puts forward a scheme for what he calls "A Workable Admiralty," which, however, he says is largely due to Mr. McHardy, an official at the Admiralty. He contends that the first essential is to abolish the fiction of a Board, and in its place to give the First Lord of the Admiralty three chief officers, each of whom would be individually and actually responsible to him and to the nation for his respective department. The First Lord should be able to call on these officers, or upon any others serving under them as heads of departments, to meet in consultation and settle matters in which their duties might be concerned, and by this means every matter connected with the fleet which required reform could be ventilated, but individual responsibility would be directly and entirely maintained, and the irresponsibility of the present system of governing by the fiction of a Board would disappear. Instead of the officials being called a Board, they might be denominated the Controller-General for the Personnel, the Controller-General for the Matériel, and the Parliamentary Secretary for the Finance. The Admiralty would, according to this scheme, be divided into three departments, each under a responsible head, who (with the exception of the Parliamentary Secretary) would not change with the Ministry, but should be appointed for a period of three or five years. Each of them should have a deputy, who would be a permanent official, and would be empowered to deal with certain questions, to act for his chief during his absence, and in the intervals of change of office to keep up the continuity of the business. Each of these three great departments would be further sub-divided into sections under a responsible head, who should make to his chief an annual report in regard to the state of the duties under his charge—the work done during the past and that proposed for the ensuing twelve months, accompanied by a financial report, showing the expenditure of the past year compared with the amount voted, and the estimated amount required for the ensuing twelve months. These reports and estimates from the several officers of the three great departments should be collected by the head of the department, and be forwarded with his remarks to the First Lord, who should then write his decision thereon as to the money that Parliament is to be asked to vote for the navy for the ensuing year; these reports, with the decision thereon, being laid before Parliament with the navy estimates.

A detailed scheme is given of the distribution of the duties and staff at the Admiralty if it were organised in the manner indicated. We cannot enter into details of that scheme, which seems to be very complete so long as the navy is not required for fighting purposes; but no provision seems to be made for a general staff, whose duties would be quite distinct for the administration of the navy, and the decision of the tactics or policy to be adopted in case of hostilities. The only addition proposed to the existing staff in the matériel department is that of a Director of Dockyard Accounts, the other chief officials being the Director of Naval Ordnance, the Director of Naval Construction, the Director of Engineering, the Director of Dockyards, and the Director of Stores. Each of these departments, however, seem to require strengthening on the professional side, as a great deal is done at present in a haphazard manner. Arrangements ought to be made for the First Lord having available the assistance of the highest authorities on any questions which may arise, not necessarily by multiplying the number of permanent officials to an unlimited degree, but rather by calling in competent advice on special occasions. If in addition a general staff were organised which would be responsible for the operations of war, in case that broke out, and in time of peace made arrangements and collected information which could at once be utilised in case of hostilities, then we might have a really "workable Admiralty," and not simply one which, while fully developed as a manufacturing and administrative concern, has overlooked the chief object of its existence, viz., its ability and readiness to fight.

CARBO-DYNAMITE.

Messrs. W. Borland & W. Reid have lately patented an explosive, in which the active agent, nitro-glycerine, is absorbed by carbon instead of kieselguhr. As carbon is an inflammable substance, complete combustion is claimed, and thus the noxious evolution of carbonic oxide from unconsumed particles is avoided, which often is due to the non-inflammability of the kieselguhr. The objections to ordinary dynamite are the fumes almost invariably met with in shafts and tunnels, the occurrence of "dynamite headache" from the mere handling of the charge, and the dangerous exudation of nitro-glycerine from the absorbent should the charge get wet. In addition, if a damaged cartridge is put into a bore hole, some of the nitro-glycerine may adhere to the sides, and the subsequent tamping of the hole may lead to fatal results. Many attempts have been made to use an absorbent which will minimise these dangers; but, in the majority of cases, the expense has thereby been greatly increased. For the present invention three important qualities are claimed, viz., a price not higher than ordinary dynamite, a greater explosive force, and the fact that water has no effect upon the material. The greater explosive force is said to be due to the fact that 90 per cent. of the charge is composed of nitro-glycerine, whilst the absorbent itself is highly combustible; whereas, the amount absorbed by kieselguhr is much lower, and the absorbent represents so much inert substance. A series of tests has lately been carried out at Treherbert, South Wales, which went far to substantiate these claims. The carbo-dynamite, in competition with No. 3 dynamite, appeared to have greater power when tried by blasting boulders in a bore hole in the heading of a tunnel under construction, and in similar lead cylinders. The absence of the usual fumes, when both were exploded in turn in an ordinary shaft, was only noticed in the case of the new compound, which also was the most successful in denting a steel disc and rending a steel tube. To show the relative solubilities of the explosives, equal quantities were placed in clear bottles, which were filled with water. After some time, the water in the bottles containing dynamite assumed the consistency of pea soup, while that in the other bottle remained unchanged, even when the bottle was violently shaken. It is stated that some carbo-dynamite placed in water eight months ago presents the same appearance now as when first immersed, and that its explosive quality is unaltered. It is also claimed for carbo-dynamite that it can be prepared with a large percentage of water, the steam from which, on explosion, at once extinguishes all flame, so that the explosive is eligible for use in coal mines and other dangerous places.

Letters to the Editor.

THE LEAMINGTON CENTRAL ELECTRIC LIGHT STATION.

To the Editor of "Industries."

Sir,—I shall be glad to correct two errors of detail in your otherwise accurate account of our Leamington installation. You speak of the device by which we keep a constant potential at the distributing centres as "a compound Shuckert voltmeter." The voltmeters are ordinary Shuckert voltmeters, and, so far as I am aware, the plan of compounding for this purpose does not in any way belong to Shuckert. The particular method of adjustment which you describe, and which we have found of great practical utility, is due to our electrician, Mr. R. H. Housman. A second rather important error occurs in your description of my current meter. You say, "in most cases only a small portion of the main current is passed through the meter." Now, although, as I explained at the time, we find the meters perfectly accurate when this is done, as a matter of fact our usual practice is to pass the whole current through the meter. Thus, at Leamington, the only exceptions to this rule are at the central station and at the Town Hall (360 lights), the reason being that the largest meters we have as yet made are for about 60 ampères; but we have now in hand a type that will carry 500, which we shall use at the central station.

Yours, &c.,
George Hookham.

Birmingham, 25th June, 1888.

REFLECTORS FOR DISTRIBUTING LIGHT.

To the Editor of "Industries."

Sir,—I am interested to learn from your account of the Leamington electric light station, that reflectors are being used for the purpose of uniformly distributing the light of glow lamps, although in this case, in my opinion, the illumination would be practically uniform without any such device. With lamps, or groups of lamps, placed at a distance apart equal to their height above the ground, the maximum illumination is 1 + the sum of cos ^{3} of the angles whose tangents are 1, 2, 3, 4, &c.=1·976. The minimum illumination is equal to 2 cos ^{3} of the angles whose tangents are 0·5, 1·5, 2·5, 3·5, &c.=1·91. The greatest variation is, therefore, about 3½ per cent. In a room 80ft. by 40ft. by 28ft. high, with five clusters of lights, the variation would be inappreciable to the most skilled photometrist, especially when the distribution would be assisted by the reflection from the walls. For street lighting, however, such reflectors should be of material service. The London gas lamps are generally 12ft. high and 66ft. apart, the distance being five and a half times the height. The variation under these circumstances is very considerable; the illumination at a point on the ground midway between the lamps is about one-thirteenth of the illumination which would be found below the lamp, if it cast no shadow. A few years ago—perhaps a few years too soon—I made a study of this subject, and with your permission I will send you some notes on the distribution of illumination, and the geometrical design of reflectors for street lighting, &c.

Yours, &c.,
2, Victoria Mansions, Westminster, 26th June, 1888. Alex. P. Trotter.

Books Received.

Mechanics' Workshop Handy Book. By Paul N. Hasluck, A.Inst.M.E. London: Crosby Lockwood & Co.

Manual of Steam Boilers; their Design, Construction, and Operation. By R. H. Thurston, M.A. New York: John Wiley & Sons. 1888.

A Short Text Book of Political Economy, with Problems for Solution. By J. E. Symes, M.A. London: Rivingtons. 1888.

The Phœnix Fire Office Rules for Electric Light Installations. Thirteenth edition. London: Phœnix Fire Office.

Calvert's Practical Notes on Screw Cutting. By Wm. Ward. Manchester: John Calvert.

The National Boiler Insurance Company, Limited: Chief Engineer's Report, 1887.

Geschichte der Transformatoren. Von F. Uppenborn. Munich and Leipsic: R. Oldenbourg.

Reviews.

A Manual of Steam Boilers: their Design, Construction, and Operation. By R. H. Thurston, M.A., Doc. Eng., Director of Sibley College, Cornell University, &c. New York: John Wiley & Sons. 1888.

We have had occasion to review recently several books which in our opinion are a good combination of theory and practice, and well suited to the wants of many of the rising generation of engineers. The mere pocket book crammed with empirical formulæ, or the results of experience in different classes of engines, or the treatise which solved problems conceived under all sorts of imaginary conditions, suited the merely practical man or the physicist; but the modern engineer who has combined with a fairly good training in theory a lengthened experience in the workshops, is not likely to be content with either the one or the other. He wants a book which will keep fresh in his memory the fundamental principles he has studied, and at the same time show how these are applied to the problems of everyday life. Professor Thurston's treatise has been designed for technical schools and engineers, and we believe that it will be found useful in both these capacities. It is chiefly nonsense to state, as a contemporary recently stated, that "the notion that a school text book is likely to prove useful to engineers making or designing boilers seems to us to be a complete mistake, for the methods of the schools are not the methods of the counting house or the drawing office. The boiler engineer does not necessarily know anything of thermodynamics; the practical construction of steam boilers and their management being either determined by hard and fast conditions perfectly understood, or modified by circumstances with which thermodynamics have about as much to do as Sanscrit. We do not say that thermodynamics should not be taught; on the contrary, we think that the whole science of heat should be taught with the utmost care, but not in connection with the construction of steam boilers." We would like to know, if thermodynamics is not to be taught to engineers who make steam engines and boilers, to whom should it be taught? If our contemporary be correct, the numerous chairs of engineering which are being founded, and the technical institutions which are being erected, are all useless, and the money expended would be more usefully employed in publishing cheap editions of all pocket books which have ever appeared. To say that the methods of the schools are not the methods of the counting house or the drawing office, is only to admit that hitherto neither schools, counting houses, nor drawing offices have been conducted as they ought to have been. We know several large engineering and manufacturing concerns which carry on immense businesses in which, if a stranger were suddenly placed, he would in some of the departments imagine he was in a technical school—everything he saw being in the way of investigation, measurement, calculation, or analysis. On the other hand, many of the best technical schools now carry on work which is of

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direct practical utility to the engineer, and the more their methods are perfected, the approximation of certain departments of the technical school, the drawing office, and the counting house will become closer. Sibley College, which is connected with Cornell University, and of which Professor Thurston is the director, and for the students of which the book we are considering has been chiefly written, with its laboratories, drawing offices, and workshops, is one of the best examples of the modern schools for engineers, and the students who leave it and similar institutions are not likely to be satisfied with simple empiricism.

Professor Thurston explains that his treatise is the outcome of an attempt to meet a demand which has been repeatedly made for a fairly complete, systematic, and scientific, yet "practical" manual, and it is intended to be sufficiently comprehensive to meet the wants of the engineer in his office, and yet so rigidly systematic as to be suitable for use as a text book in schools of engineering. It has been the endeavour of the author to incorporate the elements of the subject just so far as they are needed in preparing the way for the work of the designer, the builder, and the manager of steam boilers, while also amply complete and logical to permit the use of the book in the instruction of the student in applied science. He, however, explains that it was not to be expected that it would be found practicable to make a manual of this kind absolutely complete as a workshop treatise to be used by the boiler maker; but he hopes that within these limits it will be found fairly satisfactory to the engineer engaged in designing.

The plan of the work as explained by the author is as follows: Beginning with a historical and descriptive introduction, in which are traced the various developments of the apparatus used by the engineers of the time of Watt and earlier, and by his successors, and the progress made since his time to date, the existing standard forms of boilers are described and classified, and their special adaptations indicated. A chapter is devoted to the study of the characteristics of the materials used by the engineer in the construction of steam generators, and another to the strength of these metals in their several forms and compositions, the methods of adaptation to the purposes of construction, and to the statement of the precautions in their introduction into so important a structure. These two chapters form a very convenient *resumé* of the subject of the strength of materials as applied to steam boilers, and are largely adapted from the author's larger work, "Materials of Construction." Another chapter is appropriated to the examination of the composition and relative values of the various available fuels, and their economical use in the production of steam. Then follow chapters on heat and thermodynamics, which are as complete as the space will allow. Whether the statement which is given of the Second Law of Thermodynamics is the one which is most likely to convey the best idea of its meaning and consequences is, however, doubtful. The chapter on steam, vaporisation, superheating, condensation, pressure, and temperature is a useful synopsis of the physical properties of steam. Then follow chapters which are more directly connected with the designing of steam boilers. That on the conditions controlling boiler design is a clear statement of the different factors in the problem, while the next two explain the principles of boiler design, the accessories of boilers, and the design of chimneys, and should prove sufficient for their purpose, being fairly concise and very definite. The chapter on the construction of boilers, of course, is not a complete treatise on the subject, but still it gives a very good outline of the various processes; while the one which follows gives examples of the specifications of the chief types. The chapter on the operation and care of boilers and their management generally is founded chiefly on the experience of the author, and contains much useful information, and will be found interesting, especially to the class of young men to whom it is addressed.

In the chapter on trials of steam boilers, the methods reported favourably to the American Society of Mechanical Engineers are adopted as a standard, and the report of the committee is taken almost bodily into the text. As, however, the report was prepared by the author, this liberty is quite justifiable. The last chapter on boiler explosions is a reprint of a monograph by the author on the subject, and gives a *resumé* of the different theories of the causes of explosions, and a considerable amount of miscellaneous useful information bearing on the subject. One of the conclusions at which he arrives is that all explosions are due to simple and preventable causes, and nearly all to simple ignorance or carelessness on the part of either designer, constructor, proprietor, or attendants. That being so, the proper method to adopt for the prevention of explosions is to throw the responsibility for their results on the owners of the boilers, who would then be pretty certain to take very effective means to prevent them. Altogether the book is a most valuable one, and we have much pleasure in commending it to the attention of our readers.

ELECTRICITY AND MAGNETISM. By E. Mascart and J. Joubert. Vols. I., II. Translated by E. Atkinson, Ph.D. London: DE LA RUE & Co.

It is only a little more than half a century since Oersted made his celebrated discovery, and Ampère, the "Newton of electricity," gave his remarkable memoirs on electro-dynamics to the world. In the interval electrical science, as we now know it, has grown up. Faraday's researches, and the investigations of Green, Weber, Thomson, Helmholtz, Maxwell, Kirchhoff, and many others, have paved the way for the practical applications of electricity, which now concern the engineer quite as much as the pure scientist. The volumes before us may be said to contain a systematic and fairly complete outline of the work which has been done during the period we have mentioned. By the arrangement adopted, the treatise is divided into two parts. Vol. I. deals with general phenomena and theory, and Vol. II. contains methods of measurements and practical applications. This arrangement has its advantages and also its objections. For a student, no doubt, from one point of view, it is advantageous to have put before him, in the first place, a connected account of the main experimental parts, and the theory by which they are connected, and then to proceed to build a more practical and quantitative knowledge on this as a foundation. But, on the other hand, it often sheds light on a theoretical investigation to find its application ready at hand, to find, for example, a closer connection than is here the case of theoretical investigations of the properties of dielectrics, with measurements of specific inductive capacities, and of theory of flow of electricity, with the practical problems which present themselves in the measurement of currents and resistances. Apart from the arrangement, the work is on the whole admirable. It is marked by all the logical sequence and lucidity of exposition of the best French mathematical text books. It lacks, no doubt, the minuteness of detail and abundance of reference which are found in the cyclopædic work of Wiedemann, and we miss the power and grasp, and to some extent the charm, and it must be added also the difficulty of Maxwell's great treatise. But it is better fitted than either of these works to be put into the hands of a student whose mathematical equipment is fairly good, and who wishes to obtain a comprehensive view of the subject without attempting to grapple with its outstanding and peculiar difficulties. It is impossible within the space at our disposal to give an account of the contents of the work, or to attempt anything like a detailed criticism of the manner in which the authors and translator have performed their task. We shall content ourselves with stating a few points which we have noted in the course of a careful perusal of most of the original French edition, and a large portion of the English translation. In an interesting chapter on induction in dielectrics the authors deal with the problem of a dielectric sphere in a uniform field of electric force. An expression for the energy of the sphere in the field on page 167, Vol. I., is found by an erroneous process, which is the more extraordinary as the true value of the energy for the case supposed had just been obtained by an obvious and simple method. The further calculation in which this process is involved professes to consider the energy of a sphere in a variable field; but plainly, as the sphere is supposed so small that the electric force of the field may be taken as uniform over it, the energy must be the same as in the former case. Again, in the discussion of variable flow of electricity (page 225), the result is obtained that if the potential at the sending end of a long cable be kept of constant numerical amount, and made alternately positive and negative for an uneven number of equal short intervals, a maximum of potential at any distance x from the sending end will be obtained at an earlier and earlier epoch as the number of contacts increases. This result is not proved by the analysis given, for if the algebra be carefully gone over it is clear that the expression on the right hand of the equation at the foot of page 225, Vol. I., should have a negative sign prefixed. This connection, indeed, causes a modification of the final equation of the article, which involves the opposite conclusion to that stated. Both of these oversights are repeated in the English translation. The theoretical exposition of the great subjects of magnetism and electromagnetism leave little to be desired. Following Maxwell generally very closely, but with much in the way of commentary and elucidation, the authors give a very full synopsis of the ordinary mathematical theories. Still we miss the suggestiveness of Maxwell's work, and a student who can face successfully the inevitable mathematical difficulties of any thorough treatment of this subject, might after all do better by devoting himself at once to the study of that great masterpiece.

Vol. II. contains an account of various physical measurements involved in electrical processes, chapters on coils and their constants, the measurement of currents, electrometry, comparison of capacities and resistances, magnetic measurements, absolute measurement of resistances, and lastly, industrial applications. Here we think the authors have done more signal service to electrical workers than in their first volume. They have given what must be regarded as the fullest and best arranged account of the processes by which electrical constants are determined which has yet appeared. Generally speaking, the descriptions are clear, and the investigations marked by critical discrimination. Occasionally there is a tendency to too great fulness, and many matters of purely theoretical interest are treated, which might have more fittingly found a place in Vol. I. In this volume also we have noticed some mistakes which are not corrected in the English edition. The description of the bifilar given in chapter iii. is disfigured by two dynamical blunders. In the general case considered at page 64 of an unsymmetrical balance, it is stated that the vertical components of the tensions of the threads are inversely as the distances of their points of attachment above or below from the vertical through the centre of gravity of the body suspended. But this is not the case, for the horizontal components of the tensions, not being applied at the same level, give a couple in a vertical plane as well as one in a horizontal plane, and the former must be balanced by deviation of the vertical components from fulfilment of the condition stated. Again, it is assumed that the shorter thread has the greater tension; but a little consideration shows that this is not necessarily true. On the latter error is founded an erroneous discussion of the equation at the foot of page 65. The chapter on capacities and dielectrics is meagre generally, and markedly incomplete in its treatment of specific inductive capacity. Many of the latest and most important investigations, such as Quincke's and some of Hopkinson's, are not referred to, while those included receive little more than a passing notice. The results given by the latter author for oils are not stated in the English translation. In fact, no additions towards bringing the work down to date have been made in the translation, and this renders the chapter on industrial applications much below high water mark in what is the most rapidly advancing department of physical science. For example, nothing beyond the reports of Messrs. Allard, Joubert, Potier, and Tresca, made in 1882, is given in connection with the efficiency of secondary batteries, and almost all the later works on this subject are defective on this point. We think this chapter ought to be entirely rewritten, and much amplified, at the earliest opportunity. Regarding Dr. Atkinson's translation, we have only to remark that it is well done on the whole. In a few places he has missed the sense of his authors, as at the foot of page 332, where we find the following enigmatical rendering: "When the resistances to be compared are very small, they are put successively as shunts on the coils of the differential galvanometer." The sense of the original is: "When the resistances to be compared are very small, they are put as shunts on the coils of the differential galvanometer joined in series," which is quite clear and intelligible. Many words and terms of expression strike one as decidedly French, as "fictive" for fictitious, "electromotor" for electric generator or dynamo, and many others. These peculiarities excepted, the work of the translator is worthy of all commendation.

IMPROVED METHOD OF STORING WIRE BUNDLES.

WE are indebted to our American contemporary the *Iron Age* for the accompanying illustration showing a method of storing wire bundles, introduced by Mr. Wm. Q. Wales, Boston. The wire bundles are alternately



placed on opposite sides of an upright stick about 5ft. high, and capable of holding about twenty bundles. On the top of this stick the gauge number of the wire is marked. The stick need not be fastened in any manner, as a few bundles will be sufficient to steady it. The advantages claimed for this method are that it is easy to ascertain the number of bundles on the stick, and that it economises space.

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GLASGOW INTERNATIONAL EXHIBITION.

ENGLISH STEEL EXHIBITS *(continued from page 583).*—The exhibits of the English steel firms which remain to be noticed are distributed throughout Courts 1, 2, and 3, situated on the south side of the east corridor. Messrs. Cocker Brothers, Limited, of Sheffield, have a well arranged display of their manufactured steel specialties, at the south end of Court 1. As the bulk of the articles shown belong to Class VIII., devoted to cutlery, ironmongery, &c., it is only necessary to direct attention to the assortment of tool steel bars, and the fractures showing the different grades of steel arranged in a glass case at the rear of the stand.

Messrs. Jowitt & Sons, of Sheffield, have an open stand in the same court. They exhibit a large number of bars of various sections of their well known beam engine brands of cast and double shear tool steel, some fine blades for large plate shearing machines, and a splendid collection of files and rasps of all sizes, and of every possible variety of cut.

The West Cumberland Iron and Steel Company, Limited, of Workington, are represented by a glass case in Court 2, containing numerous samples illustrating the manufacture of hematite pig iron, Bessemer and Siemens steel, rails, sleepers, and plates. On the top of the case is a remarkable collapsed steel boiler tube. This is a length cut from the flue of a boiler which was allowed to run short of water while working at a colliery in the Midlands a few years ago; and the amount of buckling which the plate has undergone without fracture demonstrates the excellent quality and toughness of the steel. Beside the damaged flue is a ½in. steel plate, which has been exposed to the fire of Martini rifle bullets at ranges of 100 and 200 yards, and also bulged by the explosion of ½lb. of dynamite on its surface. The indentations produced by the impact of the bullets resemble marks which would be made by the use of a large and rather blunt centre punch. Of the objects inside the case a pressed steel gong suspended in a frame of twisted bar steel, and mounted on a steel railway sleeper, first attracts the eye. The gong and its supporting stand are turned and polished, and are interesting as examples of ingenious workmanship, but it is not clear what special characteristic of steel this portion of the exhibit is intended to illustrate. A large number of the different rail and tramway sections rolled by the company are shown, and also some good specimens of cold twisted and bent heavy rails, and a rail tested by a 10cwt. ball falling from heights of 12ft., 13ft., 14ft., and 16ft. A peculiarly shaped sleeper fitted up complete for the Southern Mahratta Railway Company of India; a section of the same before receiving the final pressing, and a section of a Midland Railway Company's steel sleeper, are also of interest to railway engineers. Broken tensile test pieces, with breaking stresses ranging from 28 tons to 31 tons per square inch, and elongations up to 26 per cent.; and a collection of small steel plates of different thicknesses twisted, drifted, and dished cold, prove the quality of the Bessemer and Siemens steel plates manufactured by the firm. Mr. Snelus, the general manager, has always been a strong advocate for the claims of Bessemer steel; and though the Siemens process is now also worked, the company have long enjoyed a high reputation for the production of reliable plates by the older method.

The Ebbw Vale Steel, Iron, and Coal Company, Limited, of Ebbw Vale, Mon., have a large and handsome stand in the same court, consisting of an oblong horizontal case, with a narrower vertical case rising from its centre. The whole is supported on a frame of heavy channel steel resting on short pillars formed of coiled bar steel. The lower case is partitioned off into a number of divisions, containing sections of Welsh bar iron, steel sleepers, tram rails, steel channel bars, tees, angles, and fish plates: tested fish plates, rail joints of all sizes, and specimens of puddled bar, forge and Bessemer pig iron. Below the stand are two of Rafarel's patent steel sleepers, one fitted up complete with chair and suspended rail, and the other with fastening chair and cushion; a steel sleeper for the East Argentine Railway; and one for the Indian State metre gauge railway. On the top of the lower case, resting on a shelf surrounding the base of the upper one, are some fine samples of twisted rails and heavy bars, and a piece of one of the first rails rolled at the Ebbw Vale Works in 1830. In the upper case there are numerous sections of double head, bull head, flanged, and tram rails, weighing from 9lb. to 80lb. per yard, which serve to illustrate the designs of both home and foreign engineers. A collection of steel channel sections is also shown, and one of these, measuring 10in. by 3¼in. by ⅜in., is the thinnest large channel bar yet rolled. All the steel exhibited is the product of the Bessemer converter, and it is interesting to recall that it was at the Ebbw Vale Works that the decarbonisation systems of Martien and George Parry, which in a sense were the precursors of the Bessemer process, were tried; and that steel produced by Parry's method was here rolled into rails before any—by the Bessemer process—were made in England. Mushet made several of his famous experiments to determine the influence of manganese on iron and steel at these works, and here also spiegeleisen was first made on a commercial scale in Britain. It may also be of interest to note that the Ebbw Vale Company started their first blast furnace so far back as 1780; and that in the year ending March, 1888, the output from the different departments amounted to 180,000 tons of pig iron, 120,000 tons of Bessemer steel, and almost 10,000 tons of iron bars, besides large quantities of iron castings, coke and bricks, and about 1,000,000 tons of coal.

Messrs. Seebohm & Dieckstahl's exhibit, in Court 3, takes us back to the old Huntsman crucible steel process, which for a century and a half has maintained its supremacy in the manufacture of the finest and most expensive qualities of steel. Mr. Seebohm, in a paper read a few years ago at the Chester meeting of the Iron and Steel Institute, somewhat ruffled the complacency of his audience by stating that, in spite of the advances made in metallurgic chemistry, there yet remained peculiar circumstances in connection with such an apparently simple matter as the making of crucible steel, upon which chemical analysis could throw no light. This view did not meet with much approval; but the fact remains that the best steel for cutting purposes can only be produced at the present day by closely following the methods which have been in use for more than a century. This firm, at the Dannemora Works, Sheffield, manufacture the best qualities of cast steel; and their neat show case contains a most interesting collection of bars and fractures of Swedish iron, cast steel ingot fractures, and an assortment of finished bars, to illustrate the different stages of manufacture. Fractures of tool steel bars with varying contents of carbon, and a variety of small tools made from various descriptions of steel, are also shown. We may note as specially worthy of examination the beautiful fractures of the Dannemora self hardening cast steel, the fractures of mild centred steel, and twelve small blocks of tempered steel, showing the gradations of colour produced by tempering.

The Consett Iron Company, Limited, of Blackhill, Durham, have in the same court a well arranged exhibit, which, though small as compared with some of the stands in the machinery section, is in several respects one of the most interesting metallurgical collections in the Exhibition. The various articles are arranged in tiers, and conspicuous on the top of all is a steel "cobble" plate—that is, a plate which has been crumpled by accidentally catching some fixed part of the plate mill when being passed through the rolls. Round the "cobble" are grouped some fine pieces of Durham coke, of which the company are able to produce 500,000 tons yearly; masses of raw and calcined Cleveland ironstone, Algerian ore, and furnace slags, with a row of chequer plates as a background. A step lower are ranged a number of small chequer plates of different pattern, numerous Siemens steel cold tests of various kinds, and several samples of pig iron, which the seven blast furnaces at Consett make when fully employed at the rate of 220,000 tons per annum. The next tier contains steel plates folded hot in a variety of ways; some excellent samples of thin bulged plates, both whole and cut in halves to show the reduction in thickness produced by the extension of the metal; hot folding tests of all kinds, twisted bars, and a number of broken tensile test pieces, showing the strength and ductility of the steel. A steel ingot, about 14in. square, broken through the middle, exhibits a sound and homogeneous texture. On the lowest ledge, and resting on the floor, are several plates bulged hot into the shape of Welsh hats, more than a foot deep; some excellent examples of flanged work; a steel bloom broken through, to show the grain; and a variety of tests showing the quality of the steel made by the firm. The manufacture of steel was only commenced at Consett a few years ago; but the company had for a long time previously been favourably known as iron plate makers, and until recently 175 puddling furnaces were at work. Before the use of steel became so general, from 85,000 to 90,000 tons of iron plates were made annually. This has declined to about 25,000 tons, while the output of steel plates is now about 100,000 tons. The steel plant consists of sixteen large Siemens furnaces, powerful cogging mills with bloom shears for converting ingots into slabs, and four splendid plate mills, with the necessary heating furnaces and gas-producing plant. The works are exceptionally well arranged, and are probably the finest of the kind in the world. Photographs of the Consett blast furnaces, and of the Orconera and Carmen mines, near Bilbao, placed at the sides of the stand, remind us that this company were among the first to adopt the Whitwell hot blast stove, and that the hematite ore used for conversion into steel comes from the firm's own property in Spain.

The only remaining exhibit which calls for any mention in this article is a small case forming part of Messrs. Palmer & Co.'s large marine stand, in the main avenue. This firm added the manufacture of steel to the other branches of their extensive business about two years ago, adopting what is now called the "Batho" open hearth furnace. They show a selection of cold tied steel bar knots, dished and double-dished plates, and numerous other specimens which, while not calling for special mention, afford sufficient indication of the excellent quality of the steel produced at the Jarrow works.

THE SCOTCH STEEL EXHIBITS.—Viewing the magnitude and importance of the Scotch steel industry at the present time, it is curious to note that even its immediate precursor, the iron industry, is of comparatively recent introduction into the country, and cannot in any sense be considered an anciently established business. About the middle of the 18th century, there existed smelting furnaces for charcoal iron near Goatfield and Bonawe, in Argyleshire, both, however, on a very minor scale. The establishment, in 1759, of the famous Carron Iron Works, near Falkirk, by Dr. Roebuck, was practically the first attempt to introduce the making of iron on anything like a large scale into Scotland. These works, in whose construction John Smeaton, the eminent engineer, took part, are still in existence, and to the fact that small cannon were amongst their earliest products is derived the origin of the term "carronade." In 1780, Wilsontown Iron Works, near Shotts, were erected, and there, in 1804, the first rolling mill in Scotland is stated to have commenced operations.

Turning now to the Scottish steel industry proper, we find that the manufacture of crucible steel—in which, according to Mr. James Riley, some six firms are at present engaged in Scotland, with a combined output of some 1500 tons per annum—was the earliest and, at one time, the only steel produced north of the Tweed. It was not till 1857 that an attempt was made, but unsuccessfully, at Coatbridge, to introduce the Bessemer process into Scotland; a similar experiment shortly after, at Govan, ended in no better results. Some four years later, Messrs. Rowan again grappled with the problem; but after a struggling existence, prolonged until 1875, their works were dismantled and closed. This brings us to the founding of the Steel Company of Scotland, Limited, who have been truly termed the pioneers of the Scotch steel industry. Commencing at Hallside in 1873, with four furnaces each of 6 tons capacity, the company produced steel rails only. In 1877 a plate rolling mill was laid down and brought into successful operation at Hallside. And now followed a marvellous development of the steel plate and bar industry. With increased demand followed an enormous expansion of productive power. The same year saw Messrs. Beardmore & Co., of Parkhead Forge, also Messrs. Williams & Co., of Wishaw, erect furnaces for steel making. In the following year large additions were made to the Steel Company of Scotland's Hallside Works, whilst their purchase of the works at Blochairn, which were forthwith converted for steel manufacture, increased to a very appreciable extent the productive power of the company.

In 1883, over seventy furnaces were in operation in the district, with an annual output computed to exceed 230,000 tons. The rapid development of the steel industry cannot be better illustrated than by quoting the following remarkable figures, viz., in 1873 an output of 1200 tons; in 1885 an output of 241,074 tons; in 1886 an output of 244,900 tons; whilst for the current year a considerable increase will doubtless be seen, for at the time we write, and for some months past, the whole of the works in Glasgow and its neighbourhood have been well supplied with orders, and working up to the fullest capacity. Several new works are in course of construction, and others are understood to be projected. The Scottish steel trade may generally be reported as enjoying a full measure of business and prosperity.

Coming now to the manufacture of open hearth steel, the furnaces in common use hold about 15 tons, but range up to 25 tons, with corresponding dimensions. A furnace will yield two charges per day of twenty-four hours. Before leaving the works of the manufacturers the steel generally is subjected to a series of specified tests by inspectors appointed by the Admiralty, the Board of Trade, Lloyd's Registry, and the Bureau Veritas, according to the ultimate destination of the material. Foreign Governments send their own officers when testing material, and in the case of bridge work, &c., the Engineer-in-Chief is represented by a member of his staff. The bend test pieces are from 1½in. to 2in. in breadth, and usually some 9in. long, and are divided into two classes—cold bends and temper bends. The former are bent without any further treatment; the latter, however, having been heated to a dull cherry red, are cooled in water having a temperature of about 82°F. previous to bending. The utmost method and order has to be observed in numbering the different test pieces, and so perfect are the systems adopted that the history of any particular plate or bar can be traced back to its original charge long after it has left the manufacturer's hands. The following are amongst the principal tests required:—

British Admiralty—Tensile test: Strips cut length-

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wise to have an ultimate tensile strength of not less than 26 tons and not exceeding 30 tons per square inch of section, with an elongation of 20 per cent. in a length of 8in. Bending test: Strips cut crosswise or lengthwise 1½in. wide, heated uniformly to a low cherry red, and cooled in water 82°F., must stand bending to a curve of which the inner radius is one and a half times the thickness of the steel tested. The ductility of every plate, is to be ascertained by the application of one or both of these tests to the shearings, or by bending them cold by the hammer. One plate to be taken for testing from every invoice, provided the number of plates does not exceed fifty. If above that number, one for every additional fifty or portion of fifty. Steel may be received or rejected without a trial of every thickness on the invoice. Foreign Governments as a rule adopt the test requirements of the British Admiralty.

Board of Trade.—For marine boilers: Tensile test for furnace plates and plates exposed to flame, 26 to 28 tons per square inch, with 20 per cent. elongation in 10 inches. Shell plates and plates not exposed to flame, 28 to 30 tons per square inch, with 20 per cent. elongation in 10in. The tensile strength and elongation are stamped on every plate. The bending tests are closely identical with those required by the British Admiralty.

Lloyd's Register.—Tensile test: Boiler plates, 26 to 30 tons per square inch and 20 per cent. elongation in 8in. Ship plates, 27 to 31 tons per square inch and 20 per cent. elongation in 8in. Ship angles and beams, 27 to 33 tons per square inch and 16 per cent. elongation in 8in. A tensile test from each charge is required. The bending tests are similar to those already set forth.

Bureau Veritas.—Tensile tests: Ship and boiler plates, angles, &c., 27 to 32 tons per square inch, with 20 per cent. elongation in 8in. Temper bend tests are made as already stated.

Civil engineers and others ordering steel are accustomed to issue their own specifications, dictated by the particular class of work for which the material is required. Thus, for example, the steel for the Forth Bridge is specified to have an ultimate tensile strength of 30 to 33 tons per square inch, and 20 per cent. elongation in 8in. for steel subject to tensile strains; and an ultimate tensile strength of 34 to 37 tons per square inch, and 17 per cent. elongation in 8in., for that portion of it which will be in compression. Temper and cold bend tests from each slab or bar are required to stand the British Admiralty specifications. The rivet sheet is specified to have an ultimate tensile strength of 26 to 30 tons per square inch, and 20 per cent. elongation in 8in., with bending tests as already given.

Having given a brief sketch of the iron and steel industry, we will now direct attention to the various steel exhibits. The Steel Company of Scotland have bestowed great pains on their exhibit, and the magnificent trophy they have reared forms in itself a monument of the Scotch steel manufacturing industry. The exhibit is square in plan, and has been tastefully designed as a canopied pavilion, every portion being formed of some plate, bar, or angle, made by the company. At one side is shown a steel marine engine column, weighing 6 tons, as supplied to the s.s. "City of New York," and near it is a collapsed steel boiler flue from the s.s. "County of Durham," exhibiting the marvellous tenacity of modern mild boiler steel. An exhibit which will, however, especially claim the attention of those interested in the steel industry, is a plate 18in. by 5in., no less than 130ft. long, curled up to facilitate transport. Specimens of dishing by means of explosives are also shown; the plates under which 8oz. of dynamite were fired exhibiting no failure or distress of any kind. A severer test could scarcely be imagined. The reeled bars for shafting, from the company's specially constructed reeling mill at Hallside Works, are remarkable for finish and tough skin.

Riley's patent welded steel pipe introduces a novelty which may some day revolutionise the whole pipe making industry. At present cast iron pipes are almost exclusively employed in this and other countries for gas, water, and sewage works; and only in localities to which the transport is particularly long and difficult have wrought iron and steel pipes been introduced, on account of the great saving in weight. So far the greater tendency to corrosion on the part of steel, as compared with wrought iron, has militated against the former when cast iron, though cheaper than both, was inadmissible; but this difficulty has, we understand, been met and successfully overcome.

Rolled blanks for eye bars are of particular interest, and a short description of their manufacture by a specially designed plant may be of value to the professional reader. Six rolls are employed, two main horizontal rolls and four side vertical ones; the former about 18in. diam., the latter about 9in. diam. The bar is first rolled down to a uniform thickness of 5in. throughout, the lower roll is then raised by means of a hydraulic cylinder beneath it (having a diameter of 11in., and a pressure of 1000lb. per square inch), the usual screw arrangement for tightening the rolls not being sufficiently powerful when the bar is between the rolls, and when rolling is continued until the requisite thickness is obtained. It is somewhat difficult to stop the engine at the right moment at the end of each pass, as the bar of course grows longer at each turn through the rolls. Another practical difficulty is to start with a billet of the right size, so that when the finished thickness, say 1¼in., is reached, the bar may be of the required length also. After rolling, the ends of the bar are re-heated, and the scrap ends are sheared off hot. The bars are then dispatched, and, after the eyes have been forged at the girder builder's, the bars are annealed. The Steel Company's foundry at Newton is well known for its excellent steel castings, the results of many years of patient labour on the part of Mr. Riley. A cast steel engine frame, as supplied to H.M.S. "Pheasant," shows to what perfection an intricate and difficult steel casting can be turned out. Specimens of spur and other tooth wheels, including bevelled gearing, exhibit the same high class finish. A cast steel piston is also shown amongst other exhibits of the same class of material. A variety of rail sections, tramway rail sections, angles, channels, T bars, and bulbs, are exhibited, which call for no special remark; and the numerous excellent specimens of bends, knots, &c., are also familiar to our readers. They abundantly maintain the high reputation built up by the Steel Company of Scotland.

The Hallside Works of the same company, started in 1872, are situated at Newton, a small village some six miles east of Glasgow, and cover the original seat of the company, who did not acquire their present Blochairn Works till some years later. Originally comprising but eight Siemens furnaces, these works now contain no less than twenty-two furnaces (capable of turning out 80,000 tons of ingots yearly). In addition to this, there are one 28in. cogging train, one 26in. train for rails and heavy sections, two 26in. plate mills, one 18in. mill for light sections, and one 14in. mill for bars. The foundry for steel castings has given them a world-wide reputation for stern frames, rudders, crank shafts, &c., and generally all those varied parts of ships and machinery for which cast steel has proved its suitability and superiority. The Blochairn Works, originally built for the manufacture of iron, were purchased in 1880 by the Steel Company of Scotland, and by them adapted for steel production. The system of working is identical with that pursued at the Hallside Works, differing only from it in unimportant details arising from local surroundings.

Messrs. David Colville & Sons, Dalzell Steel and Iron Works, Motherwell, have arranged an exhibit of great interest—a series of steps, laden with specimens and samples, which have been tested in every conceivable manner, and subjected to the severest trials; is surmounted by a 10ft. diam. steel boiler end plate, bearing the well known Dalzell brand. The raw materials shown will be examined with interest; and the steel in the earlier stages of ingots and billets, specimens of which are arranged in the trophy, form an instructive connecting link with the finished plates shown above. Messrs. David Colville & Sons' works, known under the name of the Dalzell Steel and Iron Works, are situated at Motherwell, a short distance from Glasgow. Originally established about the year 1871 for the manufacture of iron, that of steel was subsequently added, and now forms the principal output.

Messrs. Wm. Beardmore & Co., Parkhead Forge, Glasgow, exhibit steel forgings for marine purposes, which in quality of material, excellence of finish, and execution, fully maintain the reputation of this old established firm. A hollow steel propeller shaft for the Royal Italian warship "Re Umberto," 21⅓in. diam. by 37ft. 2½in. long, the hole being 13½in. diam., and weight 13 tons, is carried on two 6-ton ingots. A test piece is also exhibited from the shaft, which gave an ultimate tensile strength of 28·8 tons, and an elongation of 28 per cent. at fracture on a length of 8in. Messrs. Beardmore also exhibit a hollow steel built single crank shaft for the s.s. "Seamew" 14¼in. diam., 7ft. 10½in. long, with a 3in. hole through the centre. The weight of the ingots employed being 16 tons 6cwt., —that of the finished shaft 4 tons 17cwt. A sample tested for tensile strength giving 28·7 tons per square inch, and 27 per cent. elongation on 8in. at fracture. A model in wood is also shown of the hollow steel crank shaft for the before-mentioned Italian warship, having the following dimensions: 19⅓in. diam. by 9ft. 6in. long (with 9½in. hole through centre); weight, 7 tons; 28·5 tons strength per square inch of material; and 26 per cent. elongation on 8in. Another large exhibit by the same firm is a steel triple crank shaft, 15¼in. diam. by 21in. long, and weighing 17 tons, with 28·5 tons tensile strength, and 25 per cent. elongation on 8in. length. Messrs. Beardmore also exhibit a handsome model in wood of their slabbing hammer "Samson," with 48in. cylinder, 6ft. stroke, and capable of delivering a blow equivalent to 400 foot-tons. An interesting exhibit, and one well illustrating the remarkable ductility of rivet steel, are the words "Wm. Beardmore & Co." in bold round hand, the letters being formed by a continuous bar of ¾in. steel 70ft. in length. A long display of small articles of interest—knots, bends, paper weights, even a model of a high hat in steel, will be examined with interest; and all demonstrate the wonderful capabilities of mild steel, and the severe treatment to which it may be subjected without exhibiting distress of any kind. Some interesting photographs of mild ingot steel crank shafts are worthy of attention, also a railing formed by the torsion of a cold steel bar 1 5/16in. square by 19ft. 9in. long is an interesting and clever piece of work.

(To be continued.)

TREATMENT OF SEWAGE BY THE IRON PROCESS.

Mr. Conder's method of sewage treatment has now had some few years of trial, and he has summed up the advantages which are claimed for it in a paper which has recently been published in the collected professional papers of the corps of the Royal Engineers (No. XIII., page 1 *et seq*). The process consists simply in the local use of sulphate of iron to clarify and partially decompose the sewage. This property of sulphate of iron has been known for many years, but Mr. Conder deserves credit for showing how a solution of this substance can be easily used and applied locally. The instrument for effecting this purpose is called by the inventor a "ferrometer," and consists essentially of a box in which crystals of iron sulphate are stored, and which slowly dissolve in a current of running water which passes through the apparatus. In this way a solution of the deodoriser of tolerably uniform strength is obtained, and is added automatically to the water in urinals and sinks from time to time. If sufficient of the solution be added, a considerable amount of the organic matter is precipitated, and the effluent water will be correspondingly less foul. The sulphate of iron does not only act as a precipitant of the sewage matter, but, in addition, by being a carrier of the oxygen of the air, a certain amount of oxidation and destruction of the sewage matter is at the same time brought about. It must not be forgotten, however, that this oxidation of the ferrous sulphate causes a separation of a precipitate of the higher oxide of iron, which must be removed from time to time from the pipes and sewers in which this system of purification is employed. The system has been tried on a small scale at Chichester Barracks and at Windsor Castle, and the sanitary authorities at Guildford have also been induced to give a somewhat more extensive trial to the new process. Mr. Conder is of opinion that his method will be found both cheap and effectual, and we are inclined to admit that some such local treatment of foul and polluting liquids at the moment of formation will be the final solution of the much debated sewage problem. It has been recently proposed that a dilute disinfectant fluid, such as a solution of manganate or permanganate as is now used by the Metropolitan Board of Works at the sewage outfall, should be supplied to householders for flushing and cleansing purposes, and that, by thus rendering the sewage harmless as it is produced, the cost and trouble of dealing with large quantities of the material would be avoided. Both sulphate of iron and the manganate solutions just alluded to, although more costly than bleaching powder, have the advantage of being perfectly odourless, which commends the extension of their use locally, and until Mr. Dibdin and other advocates of the manganate treatment of sewage have found a suitable means of distributing and using their disinfectant in each house, we hope that Mr. Conder's ferrometers may be used.

SUGAR REFINING.

On Monday, the 4th inst., at a meeting of the Society of Chemical Industry, held at Burlington House, a paper, by Messrs. B. and J. Newlands, was read upon "The Mode of Using Char in Sugar Refining." The paper set forth that the charcoal used in experimenting was not new, but had been used for some time in sugar refining. New charcoal would not get rid of the colour in the sugar solution. Dried blood and horns give a charcoal of great decolourising power for oils and fats, but not suitable for sugar refining. For the latter, a charcoal is required which is both hard and porous, and one which adheres strongly to the tongue; when the charcoal is not sufficiently hard, it causes inconvenience by the production of dust. The following table shows the amount of dust produced after each sample of charcoal had been revolved 672,000 times, and then sifted:—

	Size of Sieve.	Dust produced Per cent.
English charcoal (No. 1)	10 to 20	2·560
" " "	20 to 30	2·560
" " "	40 to 50	3·220
" " (No. 2)	20 to 30	1·414
" " "	30 to 40	3·694
" " "	40 to 50	8·720
Russian charcoal	8 to 10	3·878

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Most refiners like a "small grist" char, since it is most efficacious in decolourising sugar, and the following table gives the results of experiments on that point. The amount of reduction of colour in each case was determined by means of a photometer:—

Size of Sieve.	Proportion of colour remaining.
Char 10 to 20	5
„ 20 to 30	4
„ 30 to 40	3·5

Original colour 23·0

The higher the temperature within certain limits the better are the decolourising results:—

Temperature, Fahr.	Proportion of colour remaining.
100	64
125	58
150	46
175	32
200	32

Original colour 420.

Time is a matter of importance, and six hours gives the best results in the case of cane sugar. Beet sugar is better with longer contact. The authors had obtained the following results in time experiments with three descriptions of sugar:—

	Jamaica.	Natal.	88 Nat. beet.
Original colour	660	420	23

Proportion of Colour Left.

Hours.	Jamaica.	Natal.	88 Nat. beet.
2	102	60	6
4	92	37	5½
6	60	28	5
8	64	29	4½
10	—	30	—

The colouring matter which char abstracts from sugar can be dissolved out of the char again by alkaline solutions, consequently the char does not act by destroying the colouring matter by peroxide of hydrogen or any other oxidising agent.

The absorption of air by freshly burnt bone charcoal goes on for a considerable time; for if some freshly burnt charcoal be put in a bottle, and turned out of it a few days afterwards, a thermometer then put in the mass will rise 20° or 30°F., showing that absorption is going on. In sugar refineries the char after use is washed with once or twice its weight of water, and then re-calcined in closed cylinders. At first steam is driven off from it, and this steam is utilised for the drying of wet charcoal. "Buchanan's Improved" kiln is one of the best forms of pipe kilns for revivifying charcoal.

Notes.

PHOTOGRAPHS OF LIGHTNING.

At the last meeting of the Royal Meteorological Society the first report of the Thunderstorm Committee was read. This deals with the photographs of lightning flashes, some sixty in number, which have been received by the Society. From the evidence now obtained, it appears that lightning assumes various typical forms under conditions which are at present unknown. The committee consider that the lightning flashes may be arranged under the following heads: 1, Stream; 2, sinuous; 3, ramified; 4, meandering; 5, beaded or chapletted; and 6, ribbon lightning. In one of the photographs there is a dark flash of the same character as the bright flashes; but the committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the committee propose to publish their report at once, along with some reproductions of the photographs by the autotype process, in order that observers may be prepared to notice the various forms of lightning.

THE SWEDISH IRON TRADE.

In a report to the Foreign Office on last year's trade at Gothenburg, Consul Duff states that there was a steady decline in the price of Swedish iron, which was partly due to the greater use of the Bessemer and Martin processes having lessened the demand for Swedish make. Swedish Bessemer, of which some years ago considerable quantities were shipped, has by degrees gone out of demand in the Sheffield market, and only small lots are now exported. Several works have now adopted the Martin process instead. Previous to 1887, the State railways were large importers of rails; but they are now buying most of what they want at home, so that the imports have fallen from 10,563 tons in 1886 to 5859 tons in 1887. The manufacture of machinery and implements in Sweden is making great progress, and the imports have been gradually declining during the last four years. The Consul says that the iron shipbuilding yards on the river at Gothenburg have turned out some excellent steamers.

MINING IN CUBA.

Vice-Consul Ramsden, of St. Jago de Cuba, states that an American company, with a capital of £400,000, is working some iron mines in Cuba at a large profit. A second company, also American, has just bought up another section of mines of the same ore, a third is at work on the manganese deposits, and a fourth has contracted for the well known copper mines at Cobre, renting them and the railway. Mr. Ramsden considers that there is every prospect of Cuba becoming a great mining centre, as the country and its enormous resources become better known.

ECCLESIASTICAL ART EXHIBITION.

Definite arrangements have now been made for holding the Tenth Annual Ecclesiastical Art Exhibition at Manchester, a suitable building having been secured. Many of the leading church furnishers, embroiderers, silversmiths, and glass painters will be represented, and educational works and appliances will also be included in the Exhibition. The loan collection will embrace goldsmiths' and silversmiths' work, ancient and modern, and ecclesiastical metal work in general; embroidery, needlework, tapestry, wood and ivory carving, ecclesiastical furniture paintings, drawings, architectural designs for churches and schools, photographs, books, and MSS., and other books of archæological interest belonging to the churches of the diocese.

MAGAZINE WEAPONS.

It appears from the last report by the Chief of the Ordnance to the United States Secretary of War, that the Americans are in no hurry to adopt a magazine rifle. General Benét says: "An effective and simple magazine gun has become a necessity, and we have been seeking for one that would be satisfactory to the army; but thus far without success. From the little that can be learned from the magazine systems said to have been adopted abroad, I am persuaded that nothing is to be gained by haste at this juncture; but that the Springfield arms will continue to admirably suit our purpose, and the best interests of the army, long enough to enable us to determine upon, finally, a magazine gun that will do credit to the inventive genius of our people."

ENGLISH GROWN TOBACCO.

We recently received from Messrs. Cope Brothers and Co., Limited, Liverpool, a sample box of tobacco which has been grown by Messrs. James Carter & Co., seedsmen, at a farm in Kent, and was cured by Messrs. Cope. It is stated that this crop is one of the first experimental crops brought to maturity and passed through the various stages of manufacture since the time of Charles II. Ever since tobacco growing was attempted in England its culture has not only not met with Government support, but has been actually prohibited, so that the few attempts formerly made had to be carried out in opposition to the law. Last year the Government were asked to allow the extensive experiments of which the present crop is the result. The rearing of the tobacco plant appears to be comparatively easy; but a much more serious difficulty seems to be the current Excise obligations. The other day the Chancellor of the Exchequer was questioned in the House of Commons on that subject, and he stated, after a few humorous remarks as to the quality of the tobacco, and to providing samples of it in the smoke room for trial, that any relaxation of the fiscal regulations which would injure the revenue was impossible.

NEW AMERICAN CRUISER.

The new cruiser "Texas," being built for the United States Government in the Navy Yard, Norfolk, Va., has her vital parts protected by a belt of armour and an underwater armour deck extending from the belt to the extremities of the vessel. She has twin screws. The principal dimensions are: Length between perpendiculars, 290ft.; extreme breadth, 64ft. 1in.; depth moulded to upper deck, 39ft. 8in.; mean draught, 22ft. 6in.; displacement, 6300 tons; displacement per inch at load line, 30 tons. Complement of officers and men, 300. Maximum speed, 17 knots. The main armament consists of two 12in. guns in turrets, and six 6in. guns protected by shields. The secondary battery consists of four 6-pounders, four 8-pounders, and four 47mm. revolving cannon, protected by 1½in. steel plating; two gatlings and two 37mm. revolving cannon. Two 1-pounders, two gatlings, and two 37mm. revolving cannon are placed in the military mast tops, to repel boarders and torpedo boats. Two 37mm. rapid-firing guns are fitted to the steam cutters. There are six torpedo tubes. The engines are triple expansion, placed in separate water tight compartments. The coal supply is 500 tons, and the endurance for a speed of 17 knots is 1110 knots. The ship has double bottom and transverse water tight bulkheads, and is built with vertical and flat keel plates, and there are longitudinal stiffeners for bottom and bilge.

SUGAR MACHINERY.

The British Vice-Consul at St. Iago de Cuba, in a Foreign Office report, states that the sugar estate machinery in use in Cuba is obtained from England, the United States, and France. He says the English sugar mills are found to be the strongest and best, but the French evaporating apparatus is preferred to and found to work better than the English. The general class of machinery made in the United States for export is, in his opinion, unreliable, being simply made to sell, though that used in the American refineries is unrivalled. Small machinery is often ordered from the United States instead of from Europe, on account of the greater promptness with which delivery can be obtained. At present there are two appliances for use on sugar estates for which there should be a good future, viz., cane shredders and furnaces for burning green bagasse. Though there are several in the market, none have so far given universal satisfaction, and the report states that there is a field for really good articles of this kind.

THE EFFECT OF RUSSIAN CUSTOMS DUTIES ON BRITISH TRADE.

The increases which are constantly being made in the Russian tariff are having, as is only to be expected, a serious influence in preventing imports into Russia, and German trade has suffered severely in consequence. Consul-General Grant, of Warsaw, in reporting on the trade of last year, points out that business with Great Britain has also decreased, there being a noticeable falling off in fancy cloths, Manchester cotton velvet, jute, felt carpets, cocoanut mattings, Nottingham curtains, leather and cotton beltings, Birmingham goods, Sheffield cutlery and tools, agricultural machinery and implements, leather for bookbinders, earthenware, and glass. There is also a decrease in cotton yarns and twist, knittings, Irish linen, chemicals, and aniline dyes. The only articles which seem to have held their own are power looms and spinning machinery. The Consul-General states that in consequence of the diminished importation of foreign manufactured goods, many small manufacturers in Warsaw have lately taken to producing articles which were formerly obtained from abroad, such as pins and needles, leather goods, umbrellas, cravattes, silk ribbons, stays, &c.; also silk, cotton, woollen, and kid gloves; felt and straw hats, small iron wares, tin goods, buttons, ready made clothes, knitted goods, musical instruments, toys and dolls, basket goods, and carpets. Warsaw is, in consequence, rapidly becoming an industrial centre.

THE FORESTS OF EUROPE.

The *Times* states that the French Ministry of Agriculture has just issued some interesting statistics respecting the distribution of forest in Europe. The total area of Europe laid out in forest—exclusive of Turkey, Bulgaria, Bosnia, and Herzegovina, omitted in the official statement—is set down at 286,989 million hectares, or about 708,862 million acres; that is, about 18·7 per cent. of the total area of Europe is forest land. In proportion to its total area Great Britain and Ireland has of all countries in Europe the least extent of forest, amounting to only 4 per cent. of its surface, and in proportion to the number of its inhabitants enjoys by far the least allotment of forest, amounting to only 0·036 hectare, or 0·089 acre—*i.e.*, considerably less than the tenth of an acre to each inhabitant. The country in Europe next lowest in the forest scale is Denmark, with 4·8 per cent. of forest land, or 0·09 hectare to each inhabitant. The third of the countries of Europe in the ascending forest scale is Portugal, with 5 per cent. of forest land and 0·11 hectare to each inhabitant—*i.e.*, an average of three times the amount of forest land to each inhabitant of Portugal that is allowed to each inhabitant of the United Kingdom. Holland has 7 per cent. of forest land and 0·05 hectare to each inhabitant, or about one and a half times as much as to each inhabitant of the United Kingdom. The country in Europe possessing most forest is Russia in Europe, with 200,000 million hectares—*i.e*, 37 per cent. of its whole area and 3·37 hectares to each inhabitant—that is, each inhabitant of Russia in Europe has an average of nearly ninety-four times the extent of forest land allotted to each inhabitant of the United Kingdom. In its percentage of forest land and the amount of forest to each inhabitant, Sweden, however, stands still higher. With 17,569 million hectares of forest, Sweden has 39 per cent. of its land in forest, and so 3·84 hectares of forest to each of its inhabitants. Norway, with 24 per cent. of its area in forest, allows each of its inhabitants an average of 4·32 hectares forest, or 120 times as much as is allowed to each inhabitant of the United Kingdom. Hungary has 29 per cent. of its area in forest, or 0·58 hectare of forest to each inhabitant. France possesses 9888 million hectares of forest, or 17·7 per cent. of its total area, and so allowing 0·25 hectare of forest to each of the inhabitants—nearly seven times as much as is allotted to each inhabitant of the United Kingdom.

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Patent Record.

Compiled from "The Official Journal of the Patent Office," by W. E. Heys, *70, Market-street, Manchester.*

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

15th June, 1888.

8756. Price, J. ..... Dredging apparatus.
8758. Forsyth & Coleman ... A power machine.
8763. Morris & Hatch ..... Sight feed lubricators.
8767. Crawford, T. ..... Apparatus for forming railway cuttings and quarrying.
8773. Hattersley & Hill ... Shuttle operating mechanisms for looms.
8774. Clegg, J. ..... Backing-off motion of mules.
8775. Kenyon, J. H. ..... Looms.
8776. Catlow, C. ..... Looms.
8778. Carey, W. ..... Underground engines.
8780. Rees, D. ..... Machine for moulding fire bars.
8781. Cross, E. ..... Prevention of accidents and breakdowns in mules.
8783. Evans, R. ..... Pressing scrap metal.
8785. Pittis, J. A. ..... Machines for cutting and arranging match splints.
8789. Burgess, G., & others... Automatic regulator for sectional warping and beaming machines.
8793. Dost, C. O. ..... Mills for grinding corn.
8800. Lorenz, W. ..... Circular revolving slide rest.
8811. Rosicky, J. ..... Scutching machines.
8814. Treeby, A. ..... Magazine small arm.

16th June, 1888.

8819. Sayer, R. C. ..... Aërial railways.
8820. Kay, J. ..... Combined slotting, shaping, milling, drilling, and boring machine.
8823. Storrar, J. M. ..... Candle making machines.
8826. Gallimore & Brooks... Apparatus for measuring yarn and thread in winding, reeling, balling, and similar machines.
8827. Smith, W. ..... Shuttle box motions of looms.
8831. Chatham, E. ..... Crushing and mixing mortar.
8832. Leane, G. H. ..... Constructing buildings in alluvial soils.
8841. Ferguson, F. O. ..... Propelling and steering boats.
8843. Norridge, F. ..... Raising water by pulsometer.
8844. Evans, P. ..... Manufacture of steel.
8845. Evans, P. ..... Screw propellers.
8851. Galloway & Beckwith Blowing engines.
8856. Kiddier, H. ..... Straight bar knitting machines.
8859. Lansell, G. ..... Pumps.

18th June, 1888.

8876. Welford, R. ..... Hydrocarbon engines.
8878. Tenner, A. ..... Cartridge loading machines.
8879. Fawcett & Castle..... Machinery for mixing cement.
8880. Russell, J. ..... Machines for treating fibrous plants.
8883. Vavasour, Sir W. ..... Steam traps.
8885. Carter & Cooper ..... Steam engines.
8886. Hughes & Lancaster.. Tram cars propelled by compressed air.
8890. Day, C. A. ..... Steam injectors (*Johnson*).
8892. Baddeley, C. ..... Joining the ends of rails on railroads (*Adams & Brannen*).
8906. Palmer, T. J. ..... Apparatus for embossing.
8908. Dowling, A. ..... Machines for washing & churning.
8909. Edwards, G. ..... Operating railway signals.
8911. Lake, H. H. ..... Reaping machines (*Cheney*).

19th June, 1888.

8924. Allison, H. J. ..... Picker motions for looms (*Sawyer and Douglass*).
8926. Twist, C. H. ..... Steam boilers.
8927-8. Craven, R. E. P. ..... Manufacture of metallic tubes.
8932. Bardwell, H. T. ..... Vertical mule.
8935. Clyne & Mitchell..... Stone polishing machines.
8942. Howden, J. ..... Feed water heater.
8943. Mollon & Mollon ..... Steam trap.
8963. Sayer, W. ..... Manufacturing bricks.
8964. Galloway & Beckwith Expansion valve gear.
8965. Remfuss, G., & others... Manufacture of barrel staves.
8968. Redfern, G. F... ..... Production of grooves in metal surfaces (*Société Industrielle pour la Schappe*).
8969. Edwards, E. ..... Roller bearings (*Schneider*).
8971. Fehrmann & Klug..... Machines for distributing fertilising agents.
8972. Cranston, W. McI..... Grain binding harvesters (*The Walter A. Wood Mowing and Reaping Machine Co.*).
8974. Lake, H. H. ..... Quick-firing guns and carriages (*Aktiebolaget Finsponys Styckebruk*).
8980. Lumley, P. A. ..... Manufacture of split rings.
8983. Pratt, R. J. ..... Chucks.
8984. Thompson, W. P. ..... Spinning silk (*Chapman*).
8985. Tucker, S. J. ..... Screw propellers.
8986. Wilson, J. ..... Propelling vessels.
8989. Thompson, W. P. ..... Looms (*Oldfield & Rush*).
8990. Thompson, W. P. ..... Motors (*Erwin*).
8994. Close, H. M. ..... Pumps.

20th June, 1888.

9001. Huelser, C. ..... Sewing machines (*Jansen*).
9009. Webster & Howorth.. Bending sheet metals.
9011. Woodhouse and Mitchell..... Friction clutches.
9015. Mills & May ..... Machinery for manufacturing paper.
9026. Carson, J. H. ..... Boats.
9028. Butler & Cammell ... Hydrocarbon motors.
9029. Wise, W. L. ..... Centrifugal machines for separating cream (*Jönsson*).
9031. Allen, V. I. ..... Machines for pressing hay.
9036. Carlsen, G. ..... Grinding machine for timber frame saws.
9037. Pierce, P. ..... Mowing machines.
9038. Plesner, T. ..... Grinding machines.
9039. Davidson, H. ..... Machine for reproducing articles to templet.

21st June, 1888.

9057. Bennis, A. W. ..... Boiler furnaces.
9062. Theermann, W. P. ..... Petroleum engines.
9063. Day, St. J. V. ..... Car axle lubricators (*Stever*).
9068. Brook & Taylor..... Drawing-off rollers for combing machines.
9070. Hetherington, J. M.... Detent brake for spinning and doubling spindles.
9077. Burnham, G. H. ..... Twist lace machines.
9084. Barfoot & Holmes..... Straight bar knitting frames.
9085. Cresswell, A. J..... Apparatus for stretching the wires of pianofortes.
9088. Bianchetti, B. ..... Piston for steam engines.
9090. White, L., & others ... Horizontal tubular boiler.
9094. Jones, A. S. ..... Hydrocarbon engines.

ELECTRICITY.

15th June, 1888.

8751. Wilmot, T. J. ..... Wheatstone automatic system of telegraphic transmission.
8765. Rowbotham & Fox..... Incandescent electric lamps.
8772. Rowbotham & Fox..... Electrical switches.
8784. Andersen & Tafe ..... Electrical supply.
8809. Lake, H. H. ..... Electric switches (*Berymann*).

16th June, 1888.

8836. Philpott & Alderton Safety electrical switch and fuse box.

18th June, 1888.

8871. Ryder, J. I. ..... Electrical switches.
8905. Lahousse, H., & others Electric batteries.
8912. Raison, H. ..... Electric meter.
8919. Lorrain, J. G. ..... Electric cable for high tension alternating currents (*La Société d'Exploitation des Câbles Electriques, système Berthoud-Borel et Compagnie*).
8920. Lorrain, J. G. ..... Electric cable applicable to long distance underground and submarine telephony (*La Société d'Exploitation des Câbles Electriques, système Berthoud-Borel et Compagnie*).

19th June, 1888.

8950. Burdon, C. B. ..... Electrical traction.

20th June, 1888.

9005. Wynne, F. ..... Dynamo-electric machines.
9032. Mortimer & Holloway Electric arc lamps.

21st June, 1888.

9046. Cox-Walker and Swinton ..... Magneto-electric bells.

CHEMISTRY.

15th June, 1888.

8766. Wass, A. G. ..... Utilising the residues from the manufacture of starch, glucose, starch sugar, dextrine, and alcohol.

16th June, 1888.

8840. Boake & Roberts..... Discharging excess of bleaching agent from paper pulp after bleaching.
8862. Gesner, G. W. ..... Treating metals.

18th June, 1888.

8916. Curtis & Brown..... Manufacture of compressed gunpowder.

19th June, 1888.

8922. Bang, A. ..... Dye stuffs (*Dahl & Co.*).
8925. Wilson, R. P., & others. Manufacture of metals.
8958. Wood, M. R. ..... Purification of bicarbonate of soda.
8961. Beck, W. H. ..... Depositing metals from their salts (*Levy*).

20th June, 1888.

9033. Swinborne & Swinborne ..... Treatment of hide to obtain gelatinous matters.

21st June, 1888.

9089. Wheen, F. ..... Soaps.
9091. Muller, J. A. ..... Prevention of fermentation.

MISCELLANEOUS.

15th June, 1888.

8750. Jorgensen, S. J. E..... Apparatus fixed on sextant for taking the horizon when the latter cannot be seen.
8752. Singleton, J. ..... Punching holes in straps.
8753. Macalester, J. C. ..... Castors.
8754. Corbett, J. L. ..... Clocks and watches.
8761. Wilson, J. ..... Automatic fog signalling.
8764. Lane, J. ..... Fire escape.
8779. Wilkinson and Fazackerly..... Fustian cutting knives.
8782. Fraser, W. ..... Consuming smoke.
8786. Wood, E. T. ..... Applying designs to celluloid.
8790. Darrah, C., & others... Tap unions.
8791. Brindley, C. F. ..... Pneumatic organs.
8796. Anthoni, G. C. ..... Deadening vibrations.
8798. Apps, R. T. ..... Sporting cartridges.
8799. The Electrical Combinations Company and Dingle..... Rotary brushes.
8802. Tucker, C. ..... Tricycles.
8805. Harkins, W. ..... Copying machines.
8806. Jeffery, T. B. ..... Velocipede saddles.
8807. Edwards, E. ..... Couplings for pipes (*Feyrer and Thirion*).
8808. Lake, H. H. ..... Metallic roofing plates (*Thorn*).
8812. Neu, G. S. ..... Controlling the supply of liquids to tanks.
8813. Lake, H. H. ..... Metallic roofing plates (*Thorn*).

16th June, 1888.

8818. Burrough & Verney... Carts and waggons.
8821. Neuhaus & Ascher ... Fire escapes.
8825. Sandbrook, T. ..... Valve seatings for cisterns.
8828. Taylor, R. ..... Spindle bolsters.
8834. Corden, H. ..... Ratchet braces.
8837. Smith, W. W. ..... Extinction of fires.
8846. Coutts, C., & others ... Fire escapes.
8849. Bennett, S. ..... Gas lamps.
8852. Hall, J. E. ..... Consuming smoke.
8853. Boothroyd, I. W., and others..... Velocipedes.
8855. Edwards, W. J. ..... Fire escapes.
8858. Willis, W., & others ... Measuring liquids.
8861. Wright, J. ..... Hinge.
8863. Doig, A. ..... Wheels of carriages.

18th June, 1888.

8882. Penn & Penn ..... Lamp.
8884. Vavasour, Sir W. ..... Universal wheel springs.
8888. Joyce, S. C. ..... Wheels for bicycles.
8894. Bennett, J. ..... Gas pipes or burners.
8897. Flint & Fade ..... Velocipede saddles.
8898. Grindle & Vinning ... Extinguishing fire.
8902. Boult, A. J. ..... Securing the hatches of vessels (*Bond*).
8904. Boult, A. J. ..... Printing on celluloid (*Gleason*).
8910. Lake, H. H. ..... Sewing needles (*Kempshall*).
8918. Clark, A. M. ..... Valve nut lock (*Vanwort & Devau*).

19th June, 1888.

8934. Tolson, G. ..... Preparing rags for carbonising.
8937. Knowles & Mercer..... Tappets for actuating healds in looms.
8940. Finney & Sheldon..... Decorating earthenware.
8948. Turner, W. B. ..... Finishing cartridges.
8959. Lux, F. ..... Gas burner regulators.
8966. Hopkinson & Appleton Baths or vessels containing liquids used in electro-plating or dyeing.
8967. Rhodes & Crowe ..... Hank dyeing mechanism.
8970. Lynam, J. D. ..... Range finders.
8973. Elliott, S. ..... Treatment of smoke.
8975. Stollwerck & Stollwerck ..... Stoppering bottles.
8977. Lake, H. H. ..... Stoppering of bottles (*Caswell*).
8981. Aria, C. D. ..... Treatment of fabrics and metals to render the same impervious to the action of acids, water, air, mineral oils, &c.
8982. Key, W. ..... Liquid meter.
8987. Wilson, J. ..... Preserving timber.
8995. Zalinski, E. L. ..... Dynamite shells.
8999. Clark, A. M. ..... Machine belting (*Phelps*).

20th June, 1888.

9003. Willett, S. ..... Attaching carded articles.
9006. Berkeley, H. ..... Cement.
9008. Skidmore & Jones ..... Rolling clips for springs.
9021. Macandrew, A. ..... Mounting of sails for vessels.
9023. Bannister, M. C. ..... Agitating apparatus for ice making tanks.
9027. Powell, W. ..... Propulsion of vehicles on common roads.
9040. Ellmore, W. P. ..... Locks.
9044. Dratz & Dratz ..... Dyeing materials and apparatus.

21st June, 1888.

9048. Rushton, E. ..... Brace for swifts.
9049. Phillips, F. G. ..... Aneroid barometers.
9054. Peyton, W. ..... Chimney pot.
9055. Turner, F. ..... Picks for mining.
9056. Scotson, W. ..... Prevention of corrosion of propeller blades.
9060. Thompson & Hailwood Valves of india-rubber.
9064-5. Aston, W. H. ..... Bottle stoppers.
9069. Dobbie, J. C. ..... Mariner's compass.
9073. Farini, G. A. ..... Cartridges.
9080. Robb, T. ..... Parquetry flooring.
9086. Neale, M. T. ..... Fire escapes.
9092. Lawson, J. ..... Signal lantern (*Banks & Storey*).
9093. Bollemont, E. C. de... Manufacture of vegetable fibre from wood.

COMPLETE SPECIFICATIONS ACCEPTED.

Persons interested in opposing the grant of the following patents may give notice of opposition at any time within two months after the dates given.

ENGINEERING.

23rd June, 1888.

4245. Bennis, E., & others..... Boiler furnaces.
9125-9217-9686. Christie, R. C., & others ..... Gun carriages (*Canet*).
9364. Baruelle fils, G. ..... Machines for working hides.

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9375. Christie, R. C., & others Apparatus for loading guns (*Canet*).
10016. Fidkin, A. Creel frames used in carpet looms.
10029. Detweiler, D. B. Cutter bar and knives for harvesting machines.
10386. Bailey, W. H. Wool combing machines.
10573. Harrison, A. Testing the force with which different projectiles strike an object.
10660. Wiske, F. Steam engine cylinders.
10797. Cope & Hollings Cutting tubes or bars of metal into lengths.
11162. Halliwell, J. Spooling machines.
11183. Goodall, E. F. Apparatus for grinding.
11184. Redfern, G. F. Metal sleepers (*De la Gressière*).
11211. Wise, W. L. Brakes (*Argo*).
11254. Hooker, J. J., & others. Stopping and starting vehicles.
11257. Caron, E. L. T. Ironing machines.
11275. Seed, J. Spinning and doubling cotton.
11301. Ransom & Garrard ... Ploughs.
11332. Morton, G. Looms for weaving chenille weft or fur.
11335. Worrall, T. D. Printing in colours.
11346. Pottage, R. Sewing machines.
11347. Roche, E. Weighing machines.
11403. Nordenfelt, T. Machine guns.
11430. Clifford & Clifford.. Railway waggon or truck.
11441. Archer, W. S. Machines for opening and cleaning cotton.
11442. Auspitz, F. Machines for washing, wringing, and calendering.
11446. Darracq, P. A. Sewing machine.
11516. Cope & Hollings. Hollow steel shafting.
11615. Elliott, I. Twist lace fabrics.
11622. Petersen, N. Furnaces.
11895. Greenwell, G. C. Screening coal.
12124. Schönheyder, W. A. G. Fluid pressure engine.
12133. Robinson, T. N. Cross-cut saw benches.
13589. Wilkins, S. B. Hand pumps.
14671. Weston, T. R. Safety firing mechanism for small arms.
16750. Thomlinson, J. Printing machines.
17581. Lewis & Stirckler. Machines for lasting the uppers of boots.
1424. Taylor, H. Ring spinning machines.
2627. Hubert, P. Lubricators.
2788. Sergeant & Cook Mitreing machines.
2833. Illsley, W. Manufacture of bricks.
4637. Tellier, C. Apparatus for utilising waste heat for producing motive power.
4817. Jordan, T. N. Machine for dressing lace.
4961. Boult, A. J. Steam boilers (*Rushton*).
5276. Leavitt, F. McD. Drop hammers.
5309. Nichols, M. L. Grain binding harvesters.
6976. Farini, G. A. Magazine attachment to the Martini rifle.
7210. Lake, H. H. Preventing the oscillation of railway vehicles (*Pullman*).
7248. McGregor, A. Reaping and mowing machines.
7249. McGregor, A. Machinery for pulping roots.
7272. Lumley, M. Machine for making wire loops for wiring the corks of bottles.
7277. Larsen, H. S. Automatic cork cutting machines.
7299. King, J. T. Apparatus for rolling metal rods (*Day*).
7305. Fawcett & Fawcett ... Arrangement of toggle jointed levers for imparting a double pressing motion for use in moulding and pressing bricks.
7336. Smith & Paget. Roller bearings.
7410. Maxfield, W. B. Taking-up apparatus for circular knitting machines (*Heidelmann*).
7453. Jungbluth, W. Weaving bars for looms.
7555. Passburg, E. Vacuum drying apparatus.

ELECTRICITY.

23rd June, 1888.

7185. Akester, W. H. Electric motors.
11390. Stevenson, J. S. Elements for secondary batteries.
11417. Garrett, T. A. Electrical connections with moving bodies.
11502. Lauckert, E. F. H. H... Dynamo-electric and electro-dynamic machines.
7536. Willcox, B. Galvanic batteries (*Whittier*).

CHEMISTRY.

23rd June, 1888.

10135. Bennett, J. A. B. Recovering tin from tin scrap.
10199A. Bull, H. C., & others.. Aluminium alloys. (Received 10th November, 1887. This Application having been originally included in No. 10199, 1887, takes, under Patents Rule 23, that date.)
10206. Bull, H. C., & others ... Extracting metals from their ores.
10955. Mond, L. Obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride.
7497. Allison, H. J. Explosive compounds (*Fitch*).

MISCELLANEOUS.

23rd June, 1888.

5653. Stephan & Southerton Velocipedes.
8830. Morgan, W. Driving chain.
8966. Smith, G. Safety lamps.
9960. Dewies, A. C. Packing for stuffing boxes.
10098. Thompson, W. P. Nut locks (*Rolls*).
10177. Mayer & Liepmann ... Manufacture of porous pots, plates, or partitions for electric batteries.
10203. Bull, H. C., & others ... Calcining oven.
10204. Bull, H. C., & others ... Air heating stove applicable for metallurgical purposes.
10205. Bull, H. C., & others ... Gas producers.
10494. Fisher & Harrison ... Drive chain.
10542. Breeden & Bateman ... Taps.
10798. Ray, R. A. Consuming smoke.
11155. Sonnenthal, E. Cans for lubricating purposes.
11218. Dronsfield, J. S. Equalising the thickness of roller skins.
11265. Bangert, H. F. Flush bolts.
11285. Hannan, R. Manufacture of rubber composition strips used in the manufacture of insulated wires and cables (*Smith*).
11299. Vero, C. Manufacture of silk hats.
11302. Vero, C. Finishing felt hats.
11314. Hassel, W. Manufacture of forks.
11355. Grawitz, W. J. S. Preparation of cotton fibres for dyeing.
11377. Rylands & Stoner Stoppers for bottles.
11394. Gartside & Barnes ... Dyeing cotton.
11399. Waele, A. de Fire escapes.
11432. Trench, G. Blasting in coal mines.
11587. Holt, J. Latches and bolts.
12524. Snelus, G. J., & others Cements.
12911. McLea & Punshon. Waterproofing composition.
14092. Rosskothen, F. Method of, and apparatus for, dyeing and bleaching yarn in bobbins and cops.
14394. Snelus, G. J., & others.. Cements.
14430. Jerram, F. O. Sewing machines.
16275. Foster & Foster Manufacture of twine.
16675. Batchelor & Latch... Joining wire ropes.
17929. Carter & Carter. Apparatus for ventilating.
18042. Pirnie, G. Manufacture of whips. (Received 3rd May, 1887; ante-dated 17th October, 1887, under International Convention.)
433. Taylor, R. Facing nuts and bolt heads.
1316. Nightscales & Illingworth Door bolts.
4544. Bouverie & Balch Life buoys.
5312. Thompson, W. P. Recording thermometers (*Draper*).
6757. Graetz & Kiesow Lamp burners.
7174. Walker, F. Packing for pistons (*Jaeger*).
7322. Marsh, R. C. Watches.
7386. Körber & Steuth Regenerating gas lamps.
7447. Minors, J., & others ... Padlocks.
7533. Newton, H. E. Purification of water and sewage (*Ripley*).
7540. Boult, A. J. Freight cars (*Brown*).
8020. Turner, S. Roof tile.

PATENTS VOID THROUGH NON-PAYMENT OF RENEWAL FEES.

(To the 16th March, 1888, inclusive.)

Year 1884.

4614, 4615, 4616, 4622, 4628, 4632, 4633, 4637, 4639, 4641, 4648, 4651, 4652, 4654, 4655, 4656, 4658, 4659, 4662, 4663, 4664, 4665, 4667, 4671, 4675, 4678, 4679, 4680, 4681, 4682, 4684, 4685, 4686, 4691, 4692, 4693, 4694, 4698, 4699, 4704, 4705, 4707, 4710, 4713, 4715, 4719, 4720, 4721, 4724, 4725, 4726, 4734, 4736, 4739, 4742, 4744, 4746, 4747, 4748, 4756, 4758, 4763, 4764, 4766, 4769, 4771, 4772, 4776, 4777, 4778, 4781, 4782, 4783, 4784, 4786, 4789, 4790, 4791, 4792, 4796, 4799, 4800, 4803, 4804, 4805, 4812, 4818, 4819, 4821, 4822, 4823, 4824, 4827, 4837, 4838, 4839, 4840, 4845, 4846, 4851, 4853, 4855, 4856, 4859, 4860, 4862, 4865, 4866, 4867, 4877, 4879, 4880, 4887, 4888, 4890, 4891, 4892, 4893, 4898, 4902, 4903, 4904, 4908, 4911, 4913, 4914, 4917, 4923, 4925, 4926, 4929, 4931, 4932, 4935, 4936, 4937, 4945, 4946, 4947, 4949, 4950, 4951, 4952, 4968, 4969, 4971, 4973, 4975, 7722, 8942, 13235, 14781.

Year 1883.

1286, 1293, 1295, 1331, 1332, 1379, 1380, 1395, 1403.

Year 1882.

1162, 1163, 1166, 1240.

Year 1881.

1107, 1134, 1136.

Year 1880.

1058, 1060.

Year 1879.

1010, 1030.

Year 1878.

995, 1016.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

Compiled from the Published Specifications by W. E. Heys, 70, *Market-street, Manchester.*

ENGINEERING.

Newspaper Printing Machines.—*J. H. Burton, D. Braithwaite, and M. Smith, Manchester.*—This invention relates to an improved method and means for enabling a greater amount of late news to be printed by the auxiliary cylinder than has hitherto been possible. The auxiliary cylinder is provided with one or more longitudinal dovetail recesses, and a type box fits into the recess by means of a dovetail on its under side. In order to hold the box in its position, one end of the recess is closed by an annular plate which turns round the axis of the auxiliary cylinder. This plate is provided with dovetail recesses which are coincident with those in the cylinder; and after the type box has been allowed to pass through the recess in the plate into its position in the cylinder, the plate is turned in order to throw the recesses out of register. The interior sides of the type box are radial to the centre of the cylinder, so that the type and the spacing rules must be wedge-shaped. Curved slots are formed at both ends of the recess, in order to receive the projections on the spacing rules for the purpose of preventing the type dropping out, and each type is formed with a notch which fits a corresponding ridge on the spacing rules. Six claims are made for the use of this form of type box, for the details of its construction, and special form of type and brass rules.—No. 5989. April 23rd, 1888. 8*d.*

Boiler Furnaces.—*H. H. Lake, London. (O. B. Peck, Chicago, U.S.A.)*—This furnace is designed for the purpose of utilising the waste heat of slag by employing it in the generation of steam. A plan and vertical section of the furnace and boiler are shown in the accompanying figures. The table B, which carries the slag, is provided on its under surface with a circular rack M, and the shaft L carries a gear wheel Q, which meshes with the rack M. The circular walls of the furnace A surround the table B, and are separated by a water space. The slag is discharged through the spout D upon the floor B. A blast pipe C enters the walls of

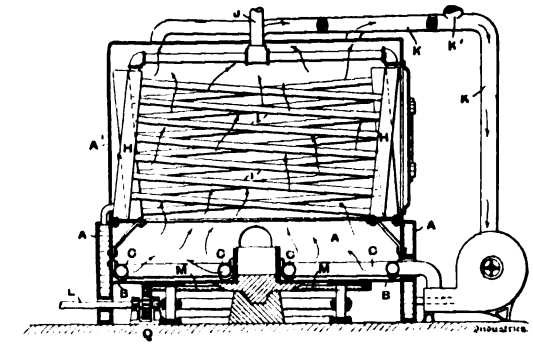


Fig. 1.

the furnace above the table and passes round its circumference, and the air issuing from it causes the slag to give up its heat more rapidly. The parts are so arranged that after the slag has been rotated with the table through one revolution all the available heat shall have been abstracted from it. The carrier E, consisting of a series of scrapers on an endless chain, serves to remove the spent slag. The chain passes through the walls of the furnace, and is rotated by two drums N N¹. As this scraper travels over the surface of the table B it removes the slag and throws it into

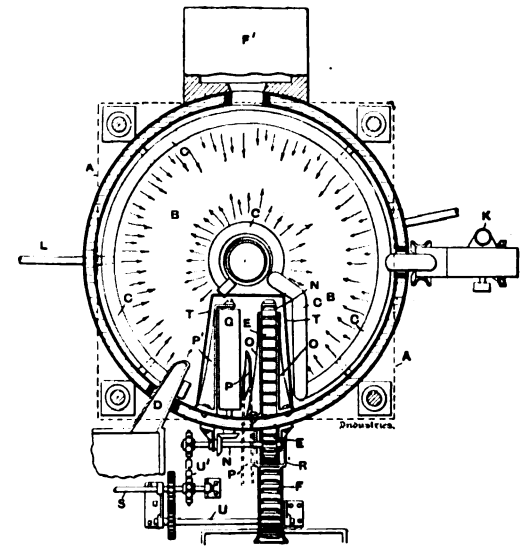


Fig. 2.

the receptacle R, from whence it is elevated by the band F and deposited upon a refuse heap. Above the walls of the furnace is the tubular boiler, in which are arranged the hollow heads H and the water tubes I. The heat from the slag passes between the tubes. At the top of the tubes there is a pipe J which carries off the live steam, and from the top of the cover a pipe K leads back to the fan which forced the air into the pipe C. The additional fire box F¹ is placed outside the furnace, so that if there should be an insufficient supply of slag an auxiliary fire may be lighted for the purpose of heating the boiler. A small spout P is placed in front of the chain E, and it allows a preparation of mud to fall upon the table before the charge of slag enters. A wheel G spreads it out and so forms a coating of fire proof material, which prevents the table from being attacked by the great heat of the slag. Six claims are made for this furnace.—No. 4708. March 27th, 1888. 8*d.*

Joining Metal Plates.—*F. C. Bellinger, Fulda, Germany.*—A joint for metal plates is here introduced, which has a greater resistive power than a soldered joint and a more advantageous exterior than a riveted joint or a fold. The joint is produced by punching elongated slits at right angles to the edge of one plate, and by bending up corresponding laps at the edge of the other plate. These laps are inserted in the slits, and then turned round, and are afterwards pressed into the plate by rolling. A narrow, flat pad, of a thickness equal to two plates, is produced, which is free from any kind of projections or depressions in its surface. On one side only the joint is raised above the level of the plates. One claim is made for this joint.—No. 8930. June 22nd, 1887. 8*d.*

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CABLE TRAMWAYS.—*W. N. Colam, London.*—This invention relates to the pulleys which guide and support the cable, and its object is to reduce the size of the hatchways in the road, to lubricate the bearings more perfectly, and to simplify their general construction. Two views of a supporting pulley are given in the accompanying figures. The pulley A is preferably made in two pieces, the rim forming one piece, and the arms and the boss forming the other; and the axle D is made in one

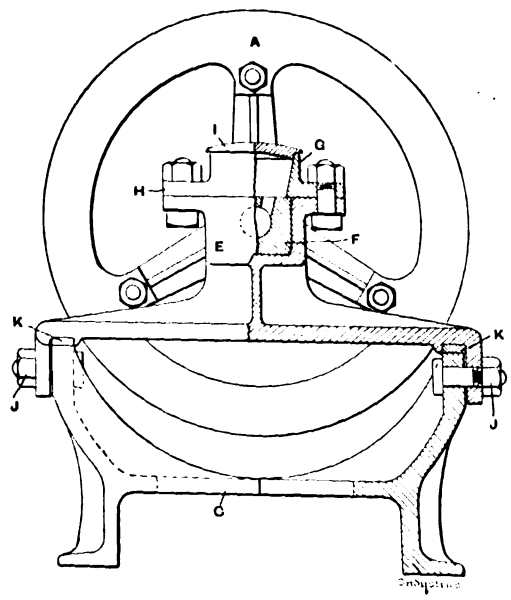


FIG. 1.

piece with the boss and arms. The pulley is mounted in a compound plummer block E B, which is self contained. The bearing blocks F are made of lignum vitæ when a cast iron axle is used. The block B is adapted to fit and slide laterally on the pedestal C, and suitable locking bolts J are provided to fix the one to the other after adjustment. Strips of wood K are interposed between the block B and the pedestal, in order to deaden the noise of the travelling cable. To insure perfect lubrication, the large grease pots G are formed in the bearing caps H, and are provided with the covers I, so that the lubricant can be introduced without removing the bearing caps. The boss of the pulley for guiding the cable round curves is made of a good length, so as to give a steady bearing, and it is preferably

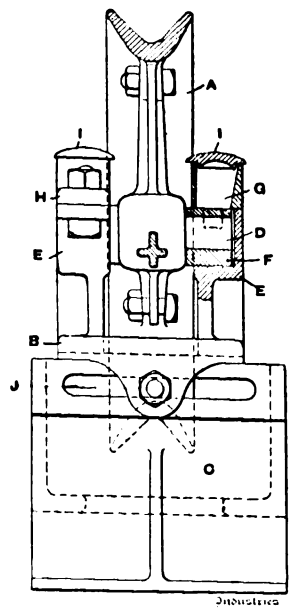


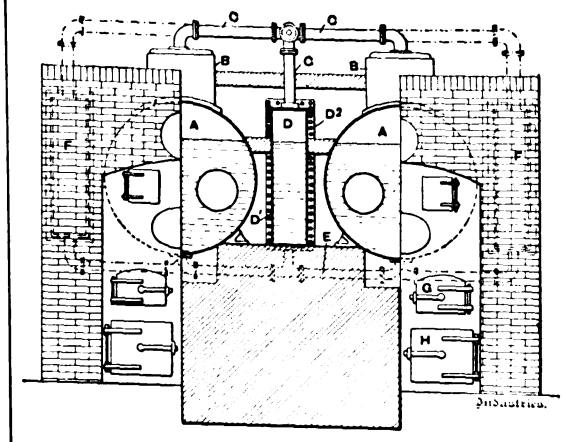
FIG. 2.

lined with white metal. The pulley runs on a steel pin fixed vertically in a shoe which is laterally adjustable. The pin has a round head at one end, and is tapered at the other to fit in a conical hole in the shoe; between the head of the pin and the top of the boss is interposed a leather washer to keep out the dirt; the top of the shoe is recessed to form an oil cup, and two steel washers are interposed between the top of the shoe and the bottom face of the boss. In order to lubricate the pulley a hole is drilled down the centre of the steel pin, and on the circumference of the pin are cut one or more oilways which are connected to the hole in the pin by suitable passages. The end of the central hole at the taper end is coned to fit the end of a tubular elbow, to which is fixed a pipe leading to the outside of the shoe, terminating in a piston lubricator. Five claims are made for the combination in the supporting pulley of the parts A B C J K, and for the construction of the guiding pulley as described.—No. 8686. June 16th, 1888. 8*d.*

STEAM ENGINES.—*J. Bureau & H. Hendlé, Paris.*—The principal feature of this invention is the method of guiding the piston of the direct acting steam engine described in the specification of Patent No. 9753 of 1886. Grooves are cut in the thickness of the cylinder for the reception of bronze rings, which also hold india-rubber rings in grooves round their circumference. The bronze rings are pressed against the slide on the cylinder cover by springs, and the lubricant is thus retained between them. Bronze wearing plates are fixed to the sides of the slide to reduce the friction, and they can easily be removed when worn. Another improvement is here introduced into the construction of the ball and socket joint of the piston rod and the stuffing box. Instead of allowing the socket to work directly against the ball, the inventors now use a lining of bronze. In order to be able to free the slide from the piston rod without having to take the piston out, the head of the piston rod is made detachable, so that the stuffing box may be simply slid off the piston rod. The reversing link is attached to a rod guided in slides on the valve box, and is connected to the valve rod by an arm, in order to gain room and at the same time to allow the eccentric rods sufficient length. Two claims are made.—No. 6485. May 3rd, 1887. 8*d.*

GIG MILLS.—*E. Michaelis, A. Smethurst, & C. Wood, Manchester.*—This invention relates to the machine described in Patent No. 11640 of 1885, granted to C. E. Moser, and consists in the application of frictional gearing for driving the raising cylinder from the countershaft, with the object of increasing the accuracy of adjustment of the range of variable speeds. Each of the raising rollers receives an independent rotary motion by pulleys from the countershaft, which in its turn is driven from an upright shaft; a friction roller, whose boss is supported by a friction clip, is mounted upon a feather key on the latter shaft, and upon a feather key on the main shaft is mounted a friction plate, which can be moved along the shaft into and out of gear with the friction clip on the upright shaft by means of a clutch lever. The friction clip which supports the friction roller is arranged to be adjusted by screws for the purpose of moving the friction roller nearer to or farther from the centre of the friction plate, and so to impart a quicker or a slower rotary motion to the countershaft and raising rollers. Two claims are made for these improvements.—No. 7844. May 31st, 1887. 8*d.*

STEAM BOILERS.—*J. W. Oldroyd, London.*—The object of this invention is to utilise the heat which is otherwise absorbed by the brick work. Instead of making the walls of the flues of brick work, the inventor replaces them by long thin steam generators, which are connected with the main steam pipe, or

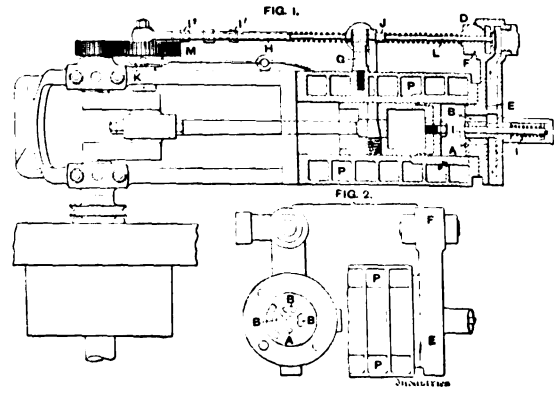


with the steam chest of the boiler. The accompanying figure illustrates an application of this method. A A are the steam boilers proper, and B their steam chests; D is the auxiliary boiler or economiser, which is constructed of boiler plates D^1, and strengthened by angle iron D^2. This economiser is connected to the boilers by the tubes E; and the steam pipes C connect the steam chests, economiser, and main steam pipe. Two claims are made for the combination of the boilers A, steam chests B, steam tubes C, and water pipes E, with the auxiliary boiler D, which is constructed as described.—No. 3216. March 2nd, 1888. 6*d.*

CONVERTERS.—*J. W. Bookwalter, Springfield, Ohio, U.S.A.*—The inventor places a cylindrical core of fire clay from one side to the other of the interior of the converter; this core is in a horizontal position, and its upper side is on a level with the tuyeres. The core occupies the position which is ordinarily assumed by a certain quantity of inert metal, because of the current generated by the air blast being a circular one. By the use of this core all the metal is equally acted on by the air blast, and there is no stationary mass of metal in the centre. Two claims are made for the use of this core.—No. 6951. May 9th, 1888. 6*d.*

DOUBLING AND TWISTING MACHINES.—*H. B. Arundel, Manchester.*—The object of the invention is to slightly raise the top roller from the bottom roller, so that the threads shall cease to be pinched between them when the thread breaks. For each top roller there is provided a thin plate or frame, through a hole in which the roller can work; this thin plate rests with two of its edges upon projections from the cap bars, and its under side is, in all positions, clear of the surface of the bottom roller. The plate is arranged to be slided to and fro, in a direction at right angles to the axes of the rollers, and when slided sufficiently forward, it comes under, and lifts the top roller clear from the bottom roller. As the top roller passes over a slight elevation on the thin plate, the latter is held from moving back too easily, except when released after the threads have been pieced together again. Instead of having a slight elevation on it, the plate may be provided with a projection to catch against one of the projections on the cap bar supporting the plate. There are bearings on each side of the plate to receive the pivots of a forked lever, whose arms are on either side of the top roller. Between the two bent ends of the arms of this lever is carried a bar of glass or earthenware; the threads after passing the delivery rollers go over the bar, and the tension of the threads in passing to the bobbin pulls down that end of the forked lever and lifts a projection at its other end, clear of a constantly oscillating bar or other mechanism. When the threads break the inner end of the forked lever comes in the way of this oscillating mechanism; the forked lever and thin plate are consequently forced forward, and the delivery of thread is stopped. When the machine is at rest the threads between the rollers and spindles may become slack, and the heavy ends of the forked levers will raise the top rollers, with the result that the threads will be broken when the machine starts again. In order to prevent this, the inventor arranges the mechanism so that the oscillations of the bar shall be stopped just before the machine comes to rest, and started a little time after the machine resumes operations; the same object will be gained by using a thin plate, which comes under and holds up the heavy ends of the forked levers just before the machine stops, and is withdrawn just after the machine has started. Four claims are made for this improved mechanism.—No. 13820. October 12th, 1887. 8*d.*

GAS ENGINES.—*J. Y. Johnson, London.* (*La Société Salomon Frères & Tenting, Paris.*)—These improvements relate to the arrangement of the admission and the exhaust valves, and to the disposition of the cooling chambers which surround the cylinder. The application of this invention to an engine working with compression and making four strokes to each explosion is illustrated in the accompanying figures; Fig. 1 shows a horizontal section of the cylinder, and Fig. 2 shows



enlarged views of the valve box. The gas and air are admitted through the valve I in the interior of the chest E, which is in one piece with the chamber F containing the exhaust valve D. The air enters the cylinder through the orifices B, and the gas enters through A; the relative area of A and B is capable of regulation. The rod H, attached to the toothed wheel M, actuates the valve rod L, and thus controls the discharge valve D. The cylinder is cast with hollow sides, and includes the vertical passages P; by this arrangement a draught of air is caused to circulate rapidly through the channels for the purpose of absorbing the waste heat from the cylinder. During the first outstroke of the piston a vacuum is produced on one side of the admission valve I, which is accordingly opened, while the spring which holds it to its seat is compressed; when the piston makes its return stroke, the valve yields to the action of the spring and returns to its seat. After reaching the end of the instroke, an electric spark explodes the mixture; during the next instroke the rod H presses against the valve rod L, and holds it open during the whole of the time occupied by this instroke. Two claims are made for the construction of the cooling passages, and for the arrangements of the ports.—No. 2804. February 24th, 1888. 8*d.*

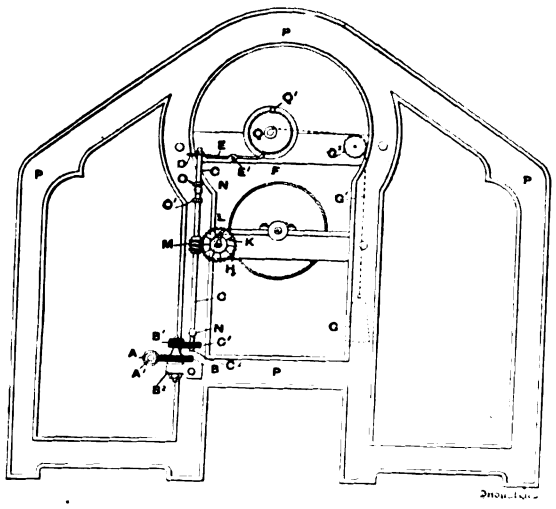
HARVESTERS.—*J. Howard & G. Gibbs, Bedford.*—The driver's seat is so arranged in connection with the driving gear that, when the driver dismounts, the working parts of the machine are automatically thrown out of gear. In applying this improvement to a grass mowing machine, in which the seat is attached to the rear end of the pole between the two main driving wheels, the inventors connect the seat by a hinge or joint to the rear part of the pole, so that the seat is free to move a short distance in such a manner as to disengage the driving clutch the moment the driver dismounts. Another improvement relates to the method of connecting the draught appliances to the machine; the horses are made to draw from the drag bar, in addition to drawing from the pole. The whipple trees, to which the horses are attached, are connected to a long staple fixed on the under side of the pole, and are free to slide upon it within a certain limit; one end of a draught rod is attached to the hinder whipple tree, and the other end to a drag bar, in such a manner as to prevent the lifting of the driving wheels from the ground, and to carry the cutter bar lightly over the surface. It is also found that the ordinary ball and socket joint between the pitman rod and the knives is the cause of loss of time when changing the knives. By this invention the ball and socket joint is so formed that, upon raising the cutter bar to a certain angle, the pitman may be disconnected from the knife by the ball being drawn through an orifice in the socket. Three claims are made—one for each improvement.—No. 10010. July 16th, 1887. 11*d.*

BOLTING MACHINES FOR FLOUR.—*H. Coubrough, London.* (*G. Summerton, San Francisco.*)—This invention relates to an improved construction in bolting machines, by means of which the bolting cylinder, while revolving on a horizontal axis, has a constant end and side shake imparted to it, so as to give it a sifting action. For this purpose the drum, which may be of hexagonal or other shape, has its axis supported in bearings that are suspended by links from fixed brackets; the bearings are also connected to other horizontal links that are pivoted to the framing of the machine. The points of attachment of the links to the bracket and framing are by preference made adjustable in slots, so as to vary the angle of suspension of the axis. The rotary motion is imparted to the axis and bolting cylinder from a vertical driving shaft by means of a horizontal way shaft and a pitch wheel and chain; upon the vertical axis there is a cam, against which a rounded surface or anti-friction roller on the one end bearing of the axis is pressed by a spring; this spring presses against the other end bearing, so that as the driving shaft rotates, its cam,

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in conjunction with the spring, imparts a to and fro end motion to the axis and cylinder, the bearings of which will swing on the suspended links, while at the same time they receive a lateral oscillating movement owing to their connection with the side links. The pressure exerted by the spring is made adjustable by means of a regulating screw. The longitudinal reciprocating motion imparted to the cylinder causes the coarser material that is retained to travel towards the discharge end, and this may be made to take place faster or slower according to the position of the links in the slots in the brackets. Two claims are made for this method of oscillating the bolting cylinder.—No. 12532. September 15th, 1887. 8*d*.

Spinning Machinery.—*H. H. Tankard & H. W. Broadbent, Bradford.*—The apparatus here introduced is intended for regulating the production of yarn or "doffings" of worsted, &c., by means of a self acting device, which stops the machine at the proper time for each doffing, and indicates the number of doffings. P represents the frame and Q the throwing off wheel. The worm wheel A is mounted on the shaft A^1 and drives the pinion B; motion is transmitted through B^1 C^1 to the rod C, on whose upper end is mounted a slotted disc D. The swing lever E is retained underneath the cam plate D, and its other end F is acted on periodically by the projection Q^1 on Q. The toothed indicating wheel H gears with the worm M, and on its surface is a series of marked divisions which correspond to the number of doffings that may be completed before the machine is stopped. K is a stop on H, which comes in contact with the pointer L, and



stops the rotation of the wheel; when this happens the worm climbs and lifts the axis C and disc D. The weight G is hung over the pulley G^2 and wheel Q. At the completion of each doffing the throwing off wheel Q is caused to rotate by the action of the weight G until the notch in the cam plate D comes over the arm E; the other end F is then disengaged from the wheel Q. At the same time this revolution is noted on the dial H by the worm M having moved it to the extent of one peripheral tooth past the pointer L. When the requisite number of doffings have been indicated the wheel H becomes fixed, and the axis and cam plate rise; the arm F is released from its hold on the wheel Q, which is caused at once to rotate by the action of the weight Q. The stoppage of the frame takes place until the attendant re-sets the regulating device. One claim is made for this apparatus for regulating and indicating the production of yarn.—No. 11472. August 23rd, 1887. 8*d*.

Gas Engines.—*C. D. Abel, London.* (*Gas Motoren Fabrik Deutz, Cologne.*)—This invention relates to that description of apparatus for igniting the charges of gas engines in which a portion of the charge is brought in contact with the interior of a tube whose exterior is heated by a gas flame. The tube, according to this invention, is arranged centrally within an annular Bunsen burner, and the outer end of this tube is closed by a removable cap. At the centre of the burner, and at about the middle of this passage, is formed a branch passage, which extends vertically upwards, and the vertical igniting tube is placed upon it. The upper end of the chamber of the burner, in which part of the horizontal passage and the lower part of the igniting tube is situated, narrows towards the tube, so as to leave only a limited annular opening, through which the mixture of gas and air entering at the lower end of the burner issues. Surrounding the part of the tube above the annular orifice is a chimney which is lined with fire clay, and perforated with a number of small openings at the level of the burner's orifice, for the purpose of permitting the air to enter. The mixture of air and gas burns in the form of an annular flame surrounding the tube within the chimney, and the supply of air being so regulated as to render the flame of a reducing character, no oxidation will take place on the tube. Four claims are made for this gas igniting device.—No. 11444. August 22nd, 1887. 8*d*.

Shaping Metals.—*T. R. Bayliss, Northfield, Worcestershire.*—The machinery constituting this invention is particularly applicable for stamping, drawing, shaping, and cutting metallic articles of a tubular form, such as cartridge cases. The machinery is double acting, so that a disc or blank can be punched out at one end of the machine, while a cupping or drawing operation is carried on at the other end. Of two sliding bolts, one carries a drawing tool, a crank shaft, and driving gear, and the other a stamping or heading tool. In place of the ordinary cast iron frame for supporting the working parts, the inventor substitutes a series of steel or wrought iron columns mounted on a strong bed plate. Two sets of the columns are used. One short set supports the lower bearings carrying the pinion shaft, the pinions, and the punch guides; and a longer set of columns supports the crank shaft, and is surmounted by a cap, to which the mechanism for working one of the sliding bolts of the punches is jointed. The sliding bolt of the machine carrying the heading punch is actuated by a knuckle motion worked from the crank shaft; the bottom of one of the links of the toggle motion is jointed to the sliding bolt, and the top of the other link is jointed to the strong cap on the top of the columns. A connecting rod is jointed at one end to the middle of the toggle motion, and at the other to the crank shaft. The crank shaft not only gives motion to the toggle joint for the purpose of working the sliding bolt of the heading punch, but also operates the sliding bolt which carries the drawing-through punch, the latter sliding bolt being connected directly to the crank shaft. The heavy work of the machine is done by the sliding bolt which is operated by the toggle joint, for by the straightening of the toggle joint great pressure is exerted on the bolt; the lighter work is effected by means of the sliding bolt worked directly from the crank. The mechanism is so arranged that as the sliding bolt at one end descends the bolt at the other end ascends, and *vice versa*. Two claims are made for this double acting machinery.—No. 12061. September 6th, 1887. 11*d*.

Pulverisers.—*H. H. Eames, Baltimore, U.S.A.*—The accompanying figures show two sections taken at right angles to each other through the apparatus. The cylinder A is made in two parts, B and C, which are held together by the hinges D and the bolts E. The material to be disintegrated is fed through the

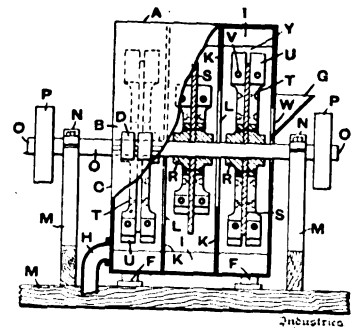


Fig. 1.

hopper G, and the resulting pulverulent material is discharged through the opening H. The shaft O carries the three flanged hubs R, on which are fixed the beater arms T and the discs S. These discs are of steel, and are provided with perforations for the purpose of allowing the finer particles to pass through from one chamber to another. In order that the material shall be

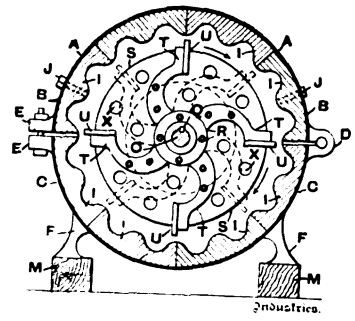


Fig. 2.

thrown against the outer casing at different angles, the cylinder is lined with the corrugated segments I. The division plates K have circular openings in their central part to allow for the passage of the material from one chamber to the next. The rotation of the hammers U and the arms T causes a current of air to be induced through the chambers, which carries the pulverised material away. Four claims are made for this apparatus.—No. 4681. March 27th, 1888. 8*d*.

ELECTRICITY.

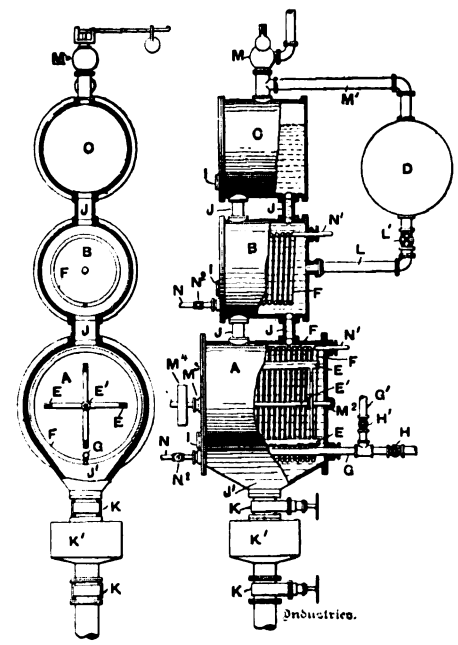
Electrical Switches.—*J. H. Holmes, Newcastle-on-Tyne.*—The object of this invention is to insure the making and breaking of the electrical circuit being effected rapidly, although the handle be operated slowly. The movable conducting contact piece is urged from one position to another solely by the force of a spring, and is not moved directly by the handle. The force of the spring is exerted between the handle and the contact piece, and the direction of the force is altered by moving the handle to either side. The handle and the contact piece are both pivoted, and they constitute a pair of pivoted levers with a spring pressure tending to draw them in either of two directions, so that when one of them is moved by the operator through a sufficient distance, the direction of the force which the spring exerts will be changed so as to draw the other lever over to the same side. The spring is always exerting a certain amount of force on the contact piece, in order to prevent it from remaining stationary in an intermediate position. One claim is made for the form of levers and springs used for this object.—No. 5648. April 18th, 1887. 8*d*.

Secondary Batteries.—*E. E. Vaughton, Birmingham.*—The aim of most constructions of secondary batteries has been to keep the active substance of the electrodes as porous as possible. The method pursued by the present inventor, however, is the reverse, for by the continued exertion of evenly distributed pressure upon the surfaces of the electrodes, the active material is rendered as compact as possible, and is kept in perfect electrical contact with its supporter. The light plates of lead forming the electrodes may be either in the form of plain sheets or with single or double flanges, and may be perforated or not. The active material is red lead, which is applied to the supporting plate in a plastic state in a layer of a thickness equal to the depth of the flanges. When this active matter has been subjected to a uniform pressure for some time, it is found to assume the hardness of terra cotta, and it can then only be removed by chipping; and the longer the accumulator is used the tougher becomes the active material. Each active surface of the electrode is covered with canvas, and between each two pieces of canvas is placed a layer of non-conducting porous material, such as asbestos. Between such partitions are driven several pairs of wedges, so as to exert the necessary pressure. Seven claims are made for this battery.—No. 14622. October 27th, 1887. 8*d*.

Dynamos.—*L. Hanson, Halifax.*—An improvement is here introduced into the construction of the field magnets of the dynamos, which were described in Patent No. 15230 of 1886, granted to the same inventor, with the object of obtaining a more complete magnetic circuit. Molten iron is run amongst the iron wires at the pole pieces; this iron forms a solid mass with the wires, and the electric circuit is made without break or joint. One claim is made for this improvement.—No. 10240. July 22nd, 1887. 6*d*.

CHEMISTRY.

Carbonate of Soda.—*M. R. Wood, Brooklyn, U.S.A.*—The present invention relates to an improved form of apparatus for use in the manufacture of the monocarbonate and bicarbonate of soda by the ammonia process, and the object is to carry out the process with a large quantity of liquid, and at the same time to maintain substantially a specific and smaller body of solution into which the carbonic acid gas is first introduced. The lower primary vessel is shown at A, and the two secondary vessels at B C; the vessels are connected with one another by the pipes J, and the primary vessel is provided with a discharging apparatus formed of two valves K and a chamber K^1. The brine supply tank D communicates through L with the vessels B and C, and the upper vessel C is surmounted by a safety valve M. An equilibrium of pressure is thus maintained



between the vessels A B C D. An agitator E in the vessel A is formed of blades which radiate from the central shaft E^1, driven by the pulley M^4. A coil F in the vessel A communicates at one end with a supply pipe N, and at the other with a delivery pipe N^1. The flow of refrigerating material, such as cold brine, through the coil F is controlled by a valve N^2, and this refrigerant conducts away the heat of the chemical combination. A similar coil is arranged in the first secondary vessel B. The gas pipe G extends into A, and it is perforated for the purpose of distributing the carbonic acid through the liquid in A. A branch pipe G^1 communicates with the ammonia reservoir. The solution of brine in A is first impregnated with ammonia, and then a current of carbonic acid gas is sent through it; carbonate of soda thus formed is drawn off, together with the chloride of ammonia formed in the process. One claim is made for this apparatus.—No. 4284. March 20th, 1888. 8*d*.

Sulphate of Manganese.—*W. N. Hartley, Dublin, and W. E. B. Blenkinsop, London.*—In preparing the sulphate of manganese the inventors make use of the chemical reaction of the dioxide of manganese on iron pyrites. The proportions are: 91½ of pyrites "smalls" containing 47 per cent. of sulphur, and 116 of manganese ore containing from 59 per cent. to 70 per cent. of black oxide of manganese. After having been ground together under edge runners and thoroughly mixed, the materials are sifted and thrown upon the hearth of a reverberatory furnace. The charge, which at first is black, soon assumes a greenish-brown tinge, due to the formation of the sulphide and oxysulphide of manganese. After having been raised to a dull red heat, the charge is shovelled out, and thrown at once into water. Copper is commonly contained in iron pyrites, and nickel and cobalt not unfrequently occur in manganese ores; and the sulphates of these metals are formed together with that of manganese. From a solution of the salts the sulphates of the three other metals may be separated by throwing into the solution some anhydrous sulphide of manganese, and then raising the liquid to its boiling point. The sulphates of copper, nickel, and cobalt are converted into sulphides, while the manganese sulphide goes into solution as sulphate. The insoluble black sulphides of copper, nickel, and cobalt are allowed to settle, and are afterwards converted into sulphates by roasting. The sulphide of manganese used in this precipitating process may be specially prepared by heating in a crucible a mixture of sulphate of manganese and powdered coal or charcoal; or a portion of

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the maganese ore may be withdrawn from the furnace when in the greenish-brown condition mentioned above. Two claims are made, for the manner of making the sulphate of manganese, and for the separation of nickel, copper, and cobalt.—No. 6029. April 25th, 1887. 6*d*.

Condensing Lead Fume.—*J. B. Clark, Bristol, and The Panther Lead Company, London.*—In smelting lead ores it is customary to employ flues of considerable length between the furnace and the chimney shaft, with the object of collecting the lead which would otherwise be lost. According to the present invention the fume is led from the flue to a series of condensing chambers, each of which consists of a pipe of earthenware. The pipes are arranged in a vertical position with the lower extremities in a tank of water and their upper ends closed. Near the lower end of the pipe a branch is formed which communicates with the flue and serves as an inlet for the fume, and near the upper end of the pipe there is a branch outlet. The pipe is charged with coke or other material, which is adapted when saturated with water for condensing and arresting the fume during its upward passage through the pipe. The water is introduced in a spray or in a stream at the upper extremity of the pipe, and after percolating through the material escapes at the lower extremity. The condensed fume is carried down with the water and settles at the bottom of the tank. The uncondensed fume which may escape at the upper end of the vertical pipe is led into a chamber, which is of such a size in relation to the furnace that the velocity at which the fume traverses it shall be very moderate: the subsidence of the fume is thus facilitated. The inlet from the flue to each condensing apparatus is provided with a damper. Several vertical pipes may be grouped together with a common inlet and outlet. When using a reverberatory furnace the inventors employ an exhaust fan between the furnace and the condensing apparatus, or between the latter and the subsiding chamber. By this means the draught may be more efficiently controlled. Four claims are made for this apparatus for condensing the lead fume.—No. 9706. July 11th, 1887. 8*d*.

MISCELLANEOUS.

Preparing Flax.—*J. R. Garratt, Holywood, County Down, and W. Scott, Belfast.*—The object of this invention is to prevent any dust or other extraneous matter from combining with the sliver or from settling upon the drawing-off rollers. A current of air has hitherto been employed for the purpose; it has been found, however, that the dusty material is apt not to settle, but to continue circulating in the currents of air. In order to overcome this difficulty, the present inventors place a pan underneath the gills; the pan is closely fitted to the apparatus, so that no draught is induced through the flax. The dust settles down quietly without being blown about, and its subsequent disturbance is prevented by a small quantity of water in the bottom of the pan. In order to prevent any dust or other impurity from attaching itself to the drawing-off rollers, and thus impairing the efficiency of their grip, the inventors substitute metal scrapers in the place of the ordinary rubbers. The scrapers are pressed against the rollers by means of springs, and are so held that their original knife edges shall be preserved by the scraping action. If the rollers are made of wood the scrapers serve a double purpose, for not only do they remove the dust and other impurities, but they also conduct away any frictional electricity which may have been generated on their surface. Eight claims are made.—No. 17652. December 22nd, 1887. 8*d*.

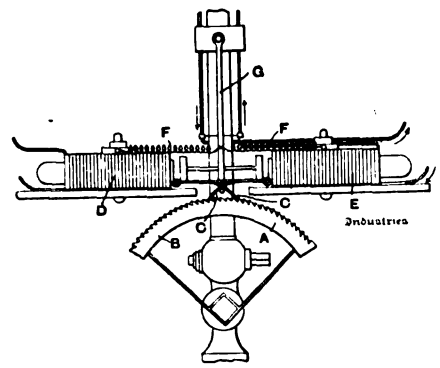
Annealing Kilns for Slag Blocks.—*C. J. Dobbs, Middlesbrough.*—In the specification of Patent No. 3870 of 1883, the inventor described a kiln for use in annealing paving blocks made of furnace slag, in which the blocks were annealed by their own heat exclusively. It has been found advantageous, however, to employ a certain amount of extraneous heating to the floor of the kiln, in order to prevent any chilling of the lowest layer. According to the present invention, therefore, a pit or recess is formed below the floor of the kiln, which is made loose for the purpose; the pit is filled with a layer of suitable fuel, preferably coal, and is afterwards covered over by a floor of bricks whose joints are grouted in. Upon introducing a charge of slag blocks, the heat conducted from them passes through the floor and sets up a very slow combustion in the layer of fuel beneath. Sufficient heat is thus generated to prevent any chilling of the blocks, and the combustion will continue for so long a time that it will be only necessary to renew the layer of fuel after a number of charges of blocks have been acted upon in this manner. The floor being loose at the sides, will gradually sink down as the fuel is consumed, and thus keeps the fuel always enclosed and protected against the entrance of any more air than is necessary. One claim is made.—No. 2607. February 21st, 1888. 8*d*.

Spindles.—*P. Eadie, Paisley, R. Eadie, Manchester, and J. Eadie, Paisley.*—This invention relates to an arrangement by which the rotation of the spindles may be retarded or arrested when required. A circular cam is mounted upon a pin between each pair of spindles; the pin is fixed eccentrically upon a stud which is secured by means of a set screw to the spindle rail. A lever or handle is attached to the cam for the purpose of manipulating it when required, and the cam is surrounded by a plate whose opposite ends are concave. By turning the cam in one direction or the other, either end of this plate is caused to arrive against a collar on one of the spindles, and so to retard or stop its rotation. One claim is made for the combination of the stud, pin, cam, handle, and plate, as described.—No. 10277. July 22nd, 1887. 8*d*.

Firing Pottery.—*J. Aynsley, J. Chew, F. J. Ridgway, J. A. Chew, & J. Aynsley, Longton, Staffordshire.*—According to the method hitherto adopted, the bags for distributing the heat in potters' ovens are built close against the outer wall, the regulating flues being simply apertures left in the wall of the oven opposite the bags. It has been found that by this arrangement the ovens are not of an even temperature throughout, and that a great portion of the heat issuing from the bags is absorbed by the wall. According to the present invention, the bags are isolated, and are built at convenient distances from the oven wall, and the fire flues underneath the oven bottom are so constructed that the heat passing through them may be distributed. By this means a more even temperature is obtained, and also the bags may be surrounded by "saggars" containing the articles to be fired, and thus a greater proportion of the heat is utilised. The "saggars" may be placed uninterruptedly round the outer or largest portion of the oven, and consequently a greater number of them can be received into the oven at once. In order to regulate the heat of the ovens, the inventors build air flues from the outside to connect with the bags; the flues are fitted with suitable appliances for governing the amount of air passing through them. Two claims are made for the method of arranging the bags and flues.—No. 2206. February 14th, 1888. 8*d*.

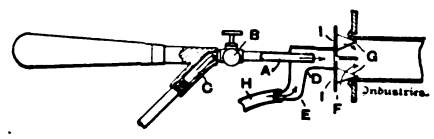
GERMAN PATENT ABSTRACTS.

Gas Tap.—*J. R. Schiller & C. Meyer, Zürich.*—This invention relates to a gas tap to which is connected an electric apparatus for lighting or extinguishing gas flames from a central station. From the gas pipe an armature G is suspended between two electromagnets D and E, and is always held in position equally distant from these electromagnets by springs F F. To the gas tap are secured two segments A and B of ratchet wheels, the teeth of which stand in opposite directions, so that when one of the



pawls C attached to G engages with the corresponding ratchet wheel it moves the tap in one direction, while the other one on engaging turns it in the opposite direction. By sending a current through one of the magnets, the armature G is attracted and one of the pawls turns the ratchet wheel, and, for instance, opens the tap. By sending the current through the other magnet, G is attracted in the opposite direction, the other pawl engages, and shuts the tap again. Wires are connected to small pieces of platinum placed just over the burner, and are heated by the current passing through them, thereby igniting the gas.—No. 43008. April 3rd, 1887.

Cleaning of Tubes.—*H. L. Currier, Lynn, Massachusetts, U.S.A.*—This method of cleaning tubes consists in directing a steam or air jet loaded with sand against the sides of the tubes. The apparatus used for this purpose consists of a tube A fitted



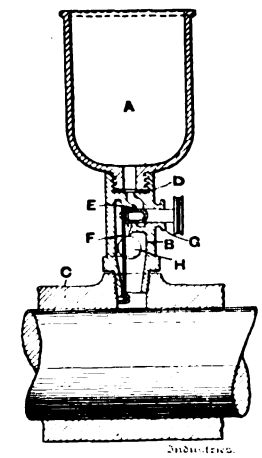
with a valve B and a steam tube C. A is connected to a short tube D provided with a sand tube H secured to a branch tube E. The tube D carries a flange I fitted with guides G, and connected to a ring F in such a manner that perforations remain between the flange I and the ring F.—No. 43033. September 10th, 1887.

UNITED STATES PATENT ABSTRACTS.

Loom Temple.—*W. H. Taylor, Hampton, Ontario.*—The T shaped frame of the temple is provided with slots for the purpose of allowing its adjustment on the breast beam of the loom. A vibrating arm is pivoted to the central arm of the frame, one end of it carrying an adjustable striking piece for contact with the lay beam, and the other being connected by means of cord to a weight which retracts the bar after it has been set by its contact with the lay. To the end of the bar is riveted a spring piece which is provided with teeth, projecting through slots in the frame, to engage the cloth, and an inclined plane in connection with the spring piece serves the purpose of lifting the teeth out of the cloth, when it meets the long arm of the frame, on the vibrating bar being struck by the lay. Two claims are made for these improvements.—No. 383501, dated 29th May, 1888.

Looms.—*H. Wyman, Worcester, Massachusetts.*—The inventor introduces an improved arrangement of the stopping mechanism for looms. The lay is provided with feelers which feel for the binders at the backward movement of the lay. The presence of a shuttle causes an arm of the feeler to act on a lever pivoted below the breast beam, and to free it from a pin on an arm of a rock shaft extending across the loom. There is a similar set of devices at each side of the loom. One of the arms of the rock shaft is extended, and is connected with a sliding rod which is normally forced by a spring towards a cam on the crank shaft. The presence of the shuttles in opposite boxes at the level of the race way entirely frees the rock shaft arms from engagement with the levers, and permits the spring to force the sliding rod into a depression in the cam as the latter is rotated; the shipper handle is thus forced out of its notch by means of a lever pivoted below the breast beam, which is hit by the arm on the rock shaft. The continued rotation of the cam re-sets the mechanism. Four claims are made.—No. 383163, dated 22nd May, 1888.

Axle Lubricator.—*G. W. Brown, West Newbury, Massachusetts.*—The flow of oil from this lubricator is regulated according to the temperature of the bearing. The cup A holds the oil, and the stem B is screwed into the bearing. The screw G is provided for the purpose of cutting off and opening the supply of oil; the oil passes through perforations in the hollow end of the screw,

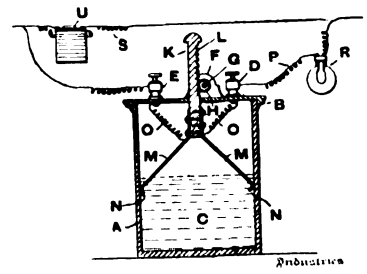


and out through the valve E. A sight hole is provided at H. A double strip of metal F is screwed at one end to the bearing, and the other end carries the valve E. It follows that the degree of heating of the bearing will control the opening and closing of E, as the heat will have the effect of bending the double strip of metal F. Six claims are made for the operation of this valve by the variation of temperature.—No. 382752, dated 15th May, 1888.

Cotton Gin.—*J. R. Montague, Auburn, New York.*—According to this invention the cotton is taken from the hopper by a toothed roller, over which vibrates a cleaning card, for the purpose of opening and straightening the fibre. The cleaning card is moved concentrically with the toothed roller by means of special mechanism. A wiper roll knocks the cotton down upon a vibrating screen, which allows the dirt to fall through; from thence the cotton passes under a feed roll to the gin rolls, and is acted upon by a reciprocating rake when near to the latter rolls. The ribs upon the feed roll are arranged so as to be protruded and withdrawn by a cam. Nine claims are made.—No. 383754, dated 29th May, 1888.

Shuttles for Looms.—*J. C. Sergeson, Philadelphia.*—The spindle holding head has pivoted on it the bobbin retaining catch, which is normally forced by a spring to engage the bobbin. The head is also provided with a cavity for the reception of a knuckle, which is actuated by a spring. This knuckle serves the purpose of holding the spindle, and is formed with a lip, which engages the end of the bobbin retaining catch when the spindle is in its outer position, and so frees the bobbin from the catch. Four claims are made.—No. 383774, dated 29th May, 1888.

Rheostat.—*F. J. Crouch, Eugene City, Oregon.*—The accompanying illustration represents a vertical section of the improved form of rheostat as applied to an electric light system. The circuit includes the lamp R and the resistance coil U. The rheostat consists of a vessel A which is partly filled with a



saline solution. The vertical rod K, which is mounted in suitable slides, carries a rack L and the two conducting arms M. These arms are insulated from one another, and extend more or less into the saline solution. The rack gears with a pinion G whose revolution regulates the amount of current passing through the instrument. The wires of the circuit are attached to the arms M by means of the clamps D E and the wires O. Four claims are made for this instrument.—No. 383345, dated 22nd May, 1888.

The full specifications of the British and United States patents, and the Official Journals of the German Patent Office, from which the above abstracts have been compiled, and the Official Journal of the United States Patent Office, may be seen by subscribers and clients at the Reading Room, Manchester Office of Industries, *where also Patent Indexes from* A.D. 1617 *may be consulted. Copies of the British specifications may be obtained on application to* H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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